DEVELOPMENT AND PRELIMINARY EVALUATION OF A MULTI-COMPONENT WORKPLACE WELLNESS PROGRAMME TARGETING OVERWEIGHT AND OBESE WORKERS

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THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PUBLIC HEALTH

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ORIGINAL LITERARY WORK DECLARATION

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ABSTRACT

Sedentary lifestyle and unhealthy diets contribute towards obesity and increase risks for the early development of non-communicable diseases in Malaysia. The workplace has been targeted for lifestyle intervention. In this quasi-experimental study, a 6-month 'Healthy Worker Programme' was carried out at a worksite and compared to a control worksite. Both worksites were located in Federal Territories. The programme, a multicomponent intervention, based on the Socio-Ecological Model, promoted improvement in diets and physical activity (PA) of overweight and obese government office workers. The programme included workplace environment modification (eg. displays of health posters, top management support, healthier alternatives at the cafeteria), co-worker and individual motivation through monthly health information packs/newsletters. At mid-programme, a telephone call was made to respondents for feedback and advice. The primary outcomes were weight and body mass index. Secondary outcomes were physical activity, dietary intake and quality of working life. For assessment of quality of working life (QOWL), the Work-Related Quality of Life-2 Scale was translated into Malay and validated.Data collection was conducted at baseline, mid-programme (3rd month), programme end (6th month) and post-programmme (9th month). Repeated measures analysis of covariates (ANCOVA) was carried out using modified intention to treat approach. A total of 283 workers enrolled into the study. At the intervention site, there were 51 males (39%) and 81 females (61%). At the control site, there were 69 males (46%) and 82 females (54%). Data from 183 office workers were analysed, that is 93 respondents from the intervention group and 90 controls. At programme end, the proportion who lost at least five percent of their original weight was 14% among the intervention group and 4% among controls (p=0.03). Those in the programme were 1.6 times more likely to lose this amount compared to controls (RR = 1.6; 95% CI: 1.2, 2.2). There was a significant mean

difference of -0.6 kg/m^2 in body mass index (BMI) change between the intervention and control groups (95% CI: -0.9, -0.3). The proportion who lost five percent of their original weight were 12% among the intervention group and 8% among controls at post-programme. At programme end, respondents at intervention site were 1.3 times more likely to achieve 10,000 steps (95% CI: 0.8, 2.1). PA continued to improve and at post-programme, they were 1.8 times more likely to reach 10,000 steps a day (95% CI: 1.2; 2.5). There was significant overall mean reduction of 3% carbohydrate daily intake between baseline and at programme end. An increase of mean QOWL score(especially through better 'General Well-Being' and reduction of 'Stress At Work' factors) was seen in the intervention group at programme end which continued modestly post-programme. The preliminary results show that the 'Healthy Worker Programme' can reduce weight and BMI among overweight and obese workers, with sustainable changes in the short term. It may also improve workers' physical activity and QOWL. However, the programme would benefit from further improvement and evaluation before implementation widely.

ABSTRAK

Gaya hidup sedentari serta pemakanan yang kurang sihat adalah faktor penyumbang terhadap obesiti yang meningkatkan risiko untuk penyakit tidak berjangkit di Malaysia.Tempat kerja adalah lokasi yang baik untuk intervensi gaya hidup. Dalam kajian kuasi-eksperimental ini, program enam bulan 'Pekerja Sihat' telah dijalankan di sebuah tempat kerja dan dibandingkan dengan tempat kerja lain sebagai kawalan. Kedua-dua tempat kerja ini berada di Wilayah Persekutuan. Program ini adalah sebuah intervensi pelbagai komponen, berpandukan Model Sosio-Ekologi, yang menggalakkan penambahbaikan tahap aktiviti fizikal dan pemakanan bagi pekerja-pekerja pejabat kerajaan yang berlebihan berat badan dan obes. Program ini melibatkan modifikasi persekitaran tempat kerja (seperti pameran poster kesihatan, sokongan pihak pengurusan, makanan yang lebih sihat di kafeteria), motivasi individu serta motivasi daripada rakan-rakan sekerja melalui pakej maklumat kesihatan bulanan. Pada pertengahan program, panggilan telefon dibuat untuk memberi maklumbalas serta nasihat kepada peserta program. Skala Kualiti Kehidupan Berkaitan Tempat Kerja-2 telah diterjemah dan divalidasi dalam Bahasa Malaysia untuk menilai kualiti kehidupan berkaitan pekerjaan. Hasil kajian yang utama adalah berat badan dan indeks jisim tubuh, manakala aktiviti fizikal, pemakanan dan kualiti kehidupan berkaitan pekerjaan adalah hasil kajian sekunder. Data dikumpul pada awal kajian, pertengahan program (bulan ke-3), semasa program tamat (bulan ke-6) dan pasca-intervensi (bulan ke-9). Data dianalisa dengan 'repeated measures analysis of covariates (ANCOVA)' mengguna kaedah 'modified intention to treat'. Seramai 283 pekerja telah mendaftar ke dalam kajian. Di tempat kerja intervensi, terdapat 50 lelaki (39%) dan 81 perempuan (61%). Di tempat kerja kawalan, terdapat 69 lelaki (46%) dan 82 perempuan (54%). Data daripada 183 pekerja pejabat telah dianalisa (93 di tempat kerja intervensi, 90 di tempat kerja

kawalan). Pada akhir program, sebanyak 14% di tempat intervensi dan 4% di tempat kawalan berjaya menurunkan sekurang-kurangnya 5% daripada berat badan asal. Mereka yang mengikuti program mempunyai kebarangkalian sebanyak 1.6 kali untuk menurunkan berat badan sebanyak ini. Terdapat purata perbezaan berat badan sebanyak -0.6 kg/m^2 (95% CI: -0.9, -0.3) pada indeks jisim tubuh antara kumpulan intervensi dan kawalan.Pasca-intervensi (tiga bulan selepas program tamat), mereka yang berjaya menurunkan berat badan sebanyak lima peratus berat asal adalah 12% di kalangan intervensi dan 8% di kalangan kawalan. Pada akhir program, kebarangkalian pekerja di tempat intervensi untuk mencapai 10,000 langkah sehari adalah 1.3 kali lebih daripada pekerja kawalan (95% CI: 0.8, 2.1). Tahap aktiviti fizikal terus meningkat di kalangan kumpulan intervensi dan kebarangkalian ini meningkat kepada 1.8 kali, tiga bulan selepas program tamat (95% CI: 1.2, 2.5). Terdapat penurunan pengambilan karbohidrat secara keseluruhan dalam sehari sebanyak 3% di antara awal dan akhir program. Dalam kumpulan intervensi, terdapat peningkatan purata kualiti kehidupan berkaitan pekerjaan (terutamanya melalui penambahbaikan faktor ‘Kesejahteraan Diri’ dan pengurangan “Tekanan di Tempat Kerja”) yang terus meningkat pasca-intervensi. Keputusan awal ‘Program Pekerja Sihat’ menunjukkan ia boleh mengurangkan berat badan dan indeks jisim tubuh di kalangan pekerja berlebihan berat badan serta obes. Perubahan ini berkekalan dalam jangka masa pendek pasca-intervensi. Ia juga mungkin dapat mempertingkat aktiviti fizikal dan kualiti kehidupan berkaitan pekerjaan. Namun, program ini boleh diperbaiki lagi serta dinilai semula sebelum diimplimentasi dengan meluas.

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LIST OF SYMBOLS AND ABBREVIATIONS

BMI	:	Body Mass Index
CAW	:	Control At Work
EEN	:	Employee Engagement
GWB	:	General Well-Being
HWI	:	Home-Work Interface
JCS	:	Job and Career Satisfaction
PA	:	Physical Activity
QOWL	:	Quality of Working Life
RR	:	Relative Risk
SAW	:	Stress at Work
WCS	:	Working Conditions
WRQOL	:	Work-Related Quality Of Life
WRQLS-2	:	Work-Related Quality of Life Scale-2

LIST OF APPENDICES

CHAPTER 1: INTRODUCTION

Malaysia is a South-East Asian country, consisting of Peninsular Malaysia at the southern-most tip of the Asian Peninsula and two states, Sabah and Sarawak, located on the Borneo Island. South-East Asia (SEA) is made up of Malaysia, Thailand, Singapore, Brunei, Indonesia, Vietnam, Myanmar, Laos, Philippines, Cambodia and Timor-Leste (Asia Society, 2015) (See Figure 1.1). Located near the equator, it is hot and humid all year round.It is well-known for its rainforests, beaches, colonial heritage and bustling city, Kuala Lumpur which boasts a skyscraper skyline. Its population, consisting of multi-ethnic groups, was 28.6 million in 2010 and is estimated to have approached 30 million in 2014 (Department of Statistics Malaysia, 2014). The majority ethnic groups in the peninsular are the Malays, Chinese and Indians. The indigenous groups in peninsular Malaysia are the 'Orang Asli'. In Sabah and Sarawak states, the population consists of many indigenous groups, such as the Kadazan Dusun, Dayaks and Bajau (Malaysia Tourism & Travel Guide, n.d.). While agriculture is still important in the country, there has been a shift towards industrialization and rapid urbanization (Leete, 2007). Malaysia is a rapidly developing nation, aspiring to reach a developed status by the year 2020 (Lee, 2014).

Figure 1.1 Malaysia and Other South East Asian Countries (University of Texas Libraries, 2016)

1.1 The epidemic of obesity and chronic diseases in Malaysia and globally

Obesity is a public health problem that has affected many countries worldwide. Malaysia faces the same dilemma with an increasing trend of overweight and obesity prevalence (Bhurosy & Jeewon, 2014; Popkin, Adair & Ng, 2012, WHO, 2015d, WHO, 2015e).It is estimated that one billion adults are overweight worldwide and this number may grow if no effective health measures are taken (WHO, 2015a).It was reported that Malaysia had the highest prevalence of overweight and obese adults in South East Asia (BBC News, 2014; Ng et al., 2014). According to the Malaysian National Health Morbidity Survey in 2011, it was found that approximately 60 per cent of adult Malaysians were overweight or obese (Institute for Public Health, 2011). It was also reported that a recent free health screening provided by a social insurance company (SOCSO) for workers found that out of 308,039 workers examined, 36.94% were overweight and 17.63% obese. Also, 13.14% had hypertension, 8.45% had diabetes and

61.76% had high cholesterol (Sivanandam, 2015). The National Health and Morbidity Survey 2011 reported that 35.7% of Malaysian adults aged 16 years and above were not physically active (Institute for Public Health, 2011). The combination of reduced physical activity levels, unhealthy diets and tobacco use, contributes to chronic diseases (non-communicable diseases) such as coronary artery disease, stroke, type-2 diabetes and some forms of cancers (WHO, 2015a).

It is unknown to many that 80% of non-communicable diseases (NCDs) occur in low and middle income countries, thus threatening economic development.Non-communicable diseases, mainly cardiovascular diseases, chronic respiratory diseases, diabetes and cancer, cause most fatalities in the South-East Asia Region. NCDs claim approximately 8.5 million lives yearly and a third of these deaths occur in individuals below 70 years of age. Four modifiable behaviour risk factors which largely contribute to the development of these NCDs are an unhealthy diet, insufficient physical activity, tobacco use and harmful alcohol consumption.Such NCD is more prevalent among the poor (WHO, 2015g). A multi-sectoral strategy which involves coordinated efforts between the government, private sectors, academia and international organisations, is required to tackle the growing NCD problem which puts considerable strain on health care systems. With this in mind, the Ministry of Health (MOH) of Malaysia launched a non-communicable diseasesplan and programme, that is “The National Strategic Plan for Non-Communicable Disease (NSP-NCD) 2010-2014” and the “NCD Prevention 1Malaysia” (NCDP-1M) programme with a multi-sectoral approach that encourage involvement of the community to engage in NCD screening and promoting healthy lifestyle changes among the population, including at workplaces (Mustapha et al., 2014).

1.2 Sedentary lifestyle and health promotion at the workplace

According to the World Health Organization (WHO), the main cause of overweight and obesity is an energy imbalance where there has been a rise in intakes of energy-rich foods that are high in fat (WHO, 2015e). There also has been more physical inactivity due to more sedentary lifestyles at work and at home. Many tasks at home and the workplace can be accomplished with devices to reduce our physical effort. With the advent of the television and computerized games, many spend hours in front of a screen for entertainment. New modes of transportation such as using cars and public transport, as opposed to walking and cycling to work, contribute to less physical activity to travel to work. Rapid urbanisation also may reduce opportunities to be physically active through leisure activity such as jogging, gardening, hill climbing, trekking or playing sports. Environmental and societal changes associated with development and the lack of supportive policies in the areas of agriculture, health, environment, urban planning, transport, food processing, distribution, marketing and education affects dietary and physical activity of individuals (WHO, 2015f).

Most adults in the United States were reported to be sedentary and such physical inactivity during work, coupled with increased calorie intake was found to result in many workers becoming overweight (Troiano & Richard, 2008; Engbers et al., 2005). Sitting for a long duration to complete tasks and access to unhealthy foods at work contribute to overweight and obesity in the population, increasing risks for non-communicable diseases (Engbers et al., 2005; U.S. Surgeon General, 1996). In a study by Luckhaupt and colleagues (2012), as many as 27.7% of workers in the United States were obese. Physical inactivity at work and unhealthy diets with high calories may result in many workers becoming overweight (Engbers et al., 2005).

Energy imbalance can occur at the worksite due to the sedentary nature of the job such as many hours of sitting. Calorie-dense foods, such as those high in fats and sugar, at work may contribute to overweight and obesity among workers (Engbers et al., 2005). However, different jobs expose workers to varying work conditions, with some more sedentary than others.Having the correct energy balance plays a role in health maintenance and prevention of obesity, cardiovascular diseases and some cancers (U.S. Surgeon General, 2005). The increase in the sedentary nature of work needs to be countered with promotion of physical activity (Pronk & Kottke, 2009). Those who are active at work, or had a sedentary job but met the recommended physical activity outside work are associated with less abdominal adiposity (Steeves et al., 2012). A study by Luckhaupt and colleagues (2014) reported that occupational factors such as working for more than forty hours per week was significantly associated with an increased risk of obesity among workers. In their study, it was found that those in the public administration had the highest prevalence of obesity,as much as 36%. The study recommended improving workers diet and physical activity levels (Luckhaupt et al., 2014).

The workplace has been targeted for health promotion as many adults spend about half of their waking hours at work (Engbers et al., 2005; Pronk& Kottke, 2009). There appeared to be limited published literature on comprehensive multicomponent health promotional studies conducted at workplaces in Malaysia. Literature on workplace health promotion programmes had focused on either physical activity and/or dietary intake interventions among overweight and obese government employees (Appukuty et al., 2014; Moy et al., 2006, Ramli et al., 2013). They showed slight to moderate improvement in various outcomes. For example, Appukutty and colleagues (2014) reported weight reduction while a pilot study by Ramli and colleagues (2013) reduced body fat percentage, increased cardio-respiratory fitness, improved lower body

flexibility and abdominal strength and endurance. The study by Moy and colleagues (2006) among security guards showed significant reduction in serum cholesterol levels. The sustainability of these programmes beyond the study period, and its long term impact on work related outcomes remains to be investigated.

A meta-analysis showed that workplace health promotions could improve workers' physical activity levels, lower job stress and absenteeism rates, while increasing job satisfaction (Conn et al., 2009). With a workplace health promotion, a company could save from unnecessary medical bills, reduce employee turnover and enhance its productivity while encouraging a better working environment committed to employees' health (Quintiliani, Sattelmair & Sorensen, 2008).

1.3 Health and work-related outcomes of physical activity and/or dietary worksite interventions

Many health and work-related outcomes have been reported in studies which included a physical activity and dietary intake intervention at worksites. A systematic review of studies published from 1995 to 2009 found that dietary intervention improved the consumption of fruits, vegetables and fat intake in workers (Mhurchu et al., 2010). Other diet and physical activity workplace interventions found that positive effects also included a lower resting heart rate (Aldana et al., 2005) and blood pressure (Aldana et al., 2005; Arao et al., 2007; Maruyama et al., 2010; Muto et al., 2006). A meta-analysis of workplace health promotion to increase physical activity among workers, from 1969 to 2007, found that there was an increased level of fitness with improved lipid and anthropometric measurements (Conn et al., 2009). A recent review of workplace physical activity and yoga interventions have been associated with reduced depressive and anxiety symptoms, respectively (Chu et al., 2014).

Quality of life (QOL) has been assessed as an outcome of workplace interventions. A meta-analysis reported significant improvement in quality of life in ten studies. Workers' moods improved significantly in 28 studies. Job satisfaction improved in five studies, lower job stress was reported in three studies and less absenteeism seen in twelve studies (Conn et al., 2009). While QOL and some work-related outcomes were seen to have improved in studies, there appeared to be a lack of studies assessing changes to quality of working life (QOWL) among workers with a workplace physical activity and dietary intervention. Quality of working life (QOWL) is that part of Quality of Life (QOL) that is influenced by work and important for retaining and attracting employees to a workplace (Van Laar, Edwards & Easton, 2007). According to Van Laar and colleagues who created the initial 'Work-Related Quality of Life Scale' (Van Laar et al., 2007) which was later improved to become the Work-Related Quality of Life Scale-2 (WRQLS-2) with better reliability, factors for QOWL include Job & Career Satisfaction (JCS), Control At Work (CAW), Working Conditions (WCS), Stress At Work, Home-Work Interface (HWI), General Well-Being (GWB) and Employee Engagement (EEN) (Lin et al., 2013; Sirisawasd et al., 2014).

The quality of working life would be an important aspect to determine as an organisational outcome of a workplace health promotion. Organisations may decide to fund workplace health interventions to protect the health of their workers, to reduce risks of early progression of diseases which may affect worker productivity and contribute to medical costs. It would be beneficial if such workplace health programmes improve QOWL among its workers too which may retain and attract workers. This study included the outcome of quality of working life, using the Malay translation of the WRQLS-2 which served as a novel contribution to this area of research.

1.4 Rationale for this study

The Malaysian working population is an important group of persons who contributes towards the economy and development of the nation. More Malaysians are becoming overweight and obese, leading to higher risks of developing chronic illnesses such as high blood pressure, cardiovascular diseases, Type-2 diabetes and cancer. This incurs high healthcare costs and reduces their healthy lifespan. There needs to be more public health campaigns and awareness programs targeted at various groups of people to inculcate a healthy lifestyle for weight management among overweight and obese adults.

An office is a place where many adults work, but mostly in a sedentary manner. A recent study among government servants also found that 14.8% had low physical activity levels (Suriani et al., 2014). Inactivity contributes to increased weight and obesity especially when accompanied by an unhealthy, high calorie diet. Workplace health promotions at Malaysian offices would be useful to encourage Malaysian workers to adopt a healthier lifestyle, thus affecting a positive change in an important group in the community.

The 'Healthy Worker Programme' was a six-month workplace health intervention, which utilised the Socio-Ecological Model, to set strategies to improve dietary intake and physical activity among overweight and obese workers to reduce their weight. Intervention was targeted at multiple levels, from the individual, interpersonal and organisational aspects. The study observed health and work-related outcomes of the programme. Health-related outcomes included weight, body mass index (BMI) and changes in physical activity and dietary intake. The intervention included dietary advice such as to reduce sugar and fat consumption and to increase fruit and vegetable intake. For dietary intake, energy intake, macro- and micro-nutrient

intake was carried out to observe any changes to the respondents' dietary patterns. Energy intake showed respondent's overall calorie consumption. Macronutrient analysis showed the breakdown of how much of their intake came from carbohydrates, protein and fat. This reflected whether respondents have managed to reduce their fat intake compared to baseline as advised in the intervention (and not just their overall energy intake). Micronutrients reflected the consumption of vitamins and minerals in respondents' diets. This included Vitamin C in their dietary intake, from fruits and vegetables. By studying the macro- and micronutrient intake (besides energy intake) one could determine if respondents were eating balanced meals which were healthy (with less fats and had sufficient vitamins and minerals), as recommended by the intervention. If only energy intake was analysed (and not macro- and micronutrients), one would only be able to see the total calorie consumption and be unable to observe how healthy their diets were. This included observation if fat intake was within the recommended percentage of total daily intake. Also it was observed if respondents achieved daily recommended micronutrient intake such as iron, calcium and vitamins.

For work-related outcome, quality of working life (QOWL) was measured. The Work-Related Quality of Life Scale-2 (WRQLS-2) was initially translated into the Malay language and validated (Phase I). The newly translated scale was used in the next phase of the study where the 'Healthy Worker Programme' was implemented and evaluated (Phase II).

The samples were workers working in public services. Two government worksites with similar work environment and public facilities were selected, of which one was at intervention site while the other site as control.Both sites were government offices located in Malaysia's Federal Territory and had a cafeteria and a gym. Both had corridors, staircases and were surrounded by walking paths and parks which provided

an environment to walk about. The two worksites had workers who worked mostly in offices. This was to try to achieve as similar an environment as possible for both worksites, to compare outcomes with and without the 'Healthy Worker Programme'. The worksites were located about an hour's drive apart so as to reduce contamination of controls. The intervention group received the 'Healthy Worker Programme'. The control group of workers at the separate worksite received minimal health information which was given to both worksites.

This study provided preliminary information on the usefulness of the 'Healthy Worker Programme' for weight reduction and improvement of quality of working life among overweight and obese workers. The programme involved the top management in promoting physical activity and healthy dietary intake. The study determined sustainable change among workers three months after the programme ended.

1.5 Research question

The research question was:

Will the 'Healthy Worker Programme' be effective in reducing weight and improving physical activity, dietary intake and quality of working life among overweight and obese workers?

The primary outcomes of the study were weight and body mass index (BMI). The secondary outcomes were physical activity, dietary intake and quality of working life (QOWL).

1.6 Null Hypothesis

There is no significant difference between the changes in weight, physical activity, dietary intake and quality of working life among overweight and obese workers at a worksite with the 'Healthy Worker Programme' compared to one without the programme.

1.7 Alternative Hypothesis

There is a significant difference between the changes in weight, physical activity, dietary intake and quality of working life among overweight and obese workers at a worksite with the 'Healthy Worker Programme' compared to one without the programme.

1.8 Study objectives

General objective

The general objective of this study was to develop, pilot-test and preliminarily evaluate a multi-component workplace wellness programme; the 'Healthy Worker Programme', targeting overweight and obese workers.

Specific objectives

i) To validate the Malay version of the Work-Related Quality of Life Scale-2 to assess quality of working life (QOWL).
ii) To develop and pilot test the multicomponent workplace wellness programme, i.e. the Healthy Worker Programme.

iii) To determine the preliminary effectiveness of the 'Healthy Worker Programme' in reducing weight, increasing physical activity and improving dietary intake and quality of working life.

1.9 Conceptual framework of the 'Healthy Worker Programme'

A conceptual framework of the 'Healthy Worker Programme' represents the concept of how the 'Healthy Worker Programme' which includes multiple levels of intervention may affect the health and work-related outcomes assessed (Figure 1.2). The intervention targeted to improve physical activity and dietary intake of overweight and obese workers. With higher activity levels and dietary intake which includes healthy foods and drinks which are lower in calories, workers can reduce their weight and body mass index (Appukutty et al., 2014; Morgan et al., 2011).

Physical activity interventions at work have been shown to improve job satisfaction and well-being and reduce job stress (Conn et al., 2009; Quintiliani et al., 2007). These positive changes at work could improve the Quality of Working Life (QOWL) such as through the factors of Job & Career Satisfaction (JCS), General Well-Being (GWB) and Stress At Work (SAW). As the intervention includes promoting physical activity and healthy dietary intake at work and at home, the study also observed any changes in quality of working life in terms of 'Home-Work Interface' (HWI) and 'Employee Engagement' (EEN). Other factors of QOWL such as 'Control At Work' (CAW) and 'Working Conditions' were also observed for any changes. There appears to be a research gap in observing QOWL change with workplace physical activity and dietary intake interventions. This study is among the first few to observe if such intervention can affect QOWL using the Work-Related Quality of Life Scale-2. A

conceptual framework is provided (Figure 1.2). A logic model for the programme is included in the methodology section (Chapter 3).

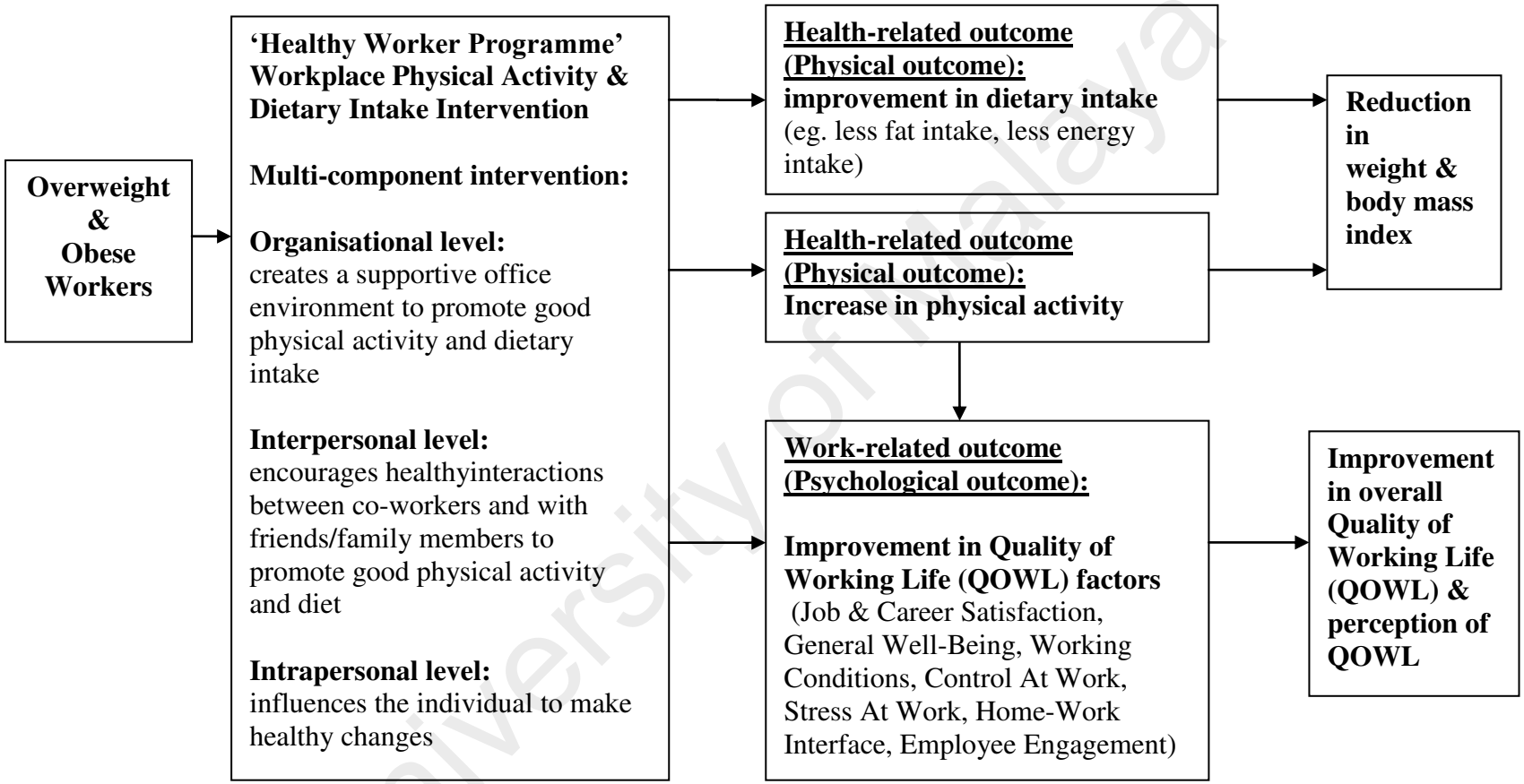

Figure 1.2 Conceptual framework for the 'Healthy Worker Programme'

CHAPTER 2: LITERATURE REVIEW

The trend of increase in obesity globally has proven to be a major public health problem (Ng et al, 2014). Obesity is associated with increased risks for non-communicable diseases (WHO, 2015g). This chapter reviewed the global obesity trends, body mass index categories and the association of obesity with non-communicable diseases.The review includes assessing the obesity problem in the population, so as to understand the social and environmental interactions that may occur outside the workplace which can also affect workers. The sedentary versus active lifestyle, factors associated with obesity, obesity among workers and workplace physical activity and dietary intake interventions were discussed. An overview of global initiatives to incorporate workplace health promotion to tackle the obesity problem among the population of workers is provided. Common strategies and/or models and the use of the complex intervention for workplace health promotion are discussed. The effects of duration, intensity and follow-up of workplace dietary intake and/or physical activity interventions are presented. This is followed by a review of barriers and incentives which affect workers' participation in such interventions. Health and work-related outcomes of workplace physical activity and dietary intake interventions are also reviewed. While quality of life and work-related outcomes such as job satisfaction and job stress have been observed as workplace health promotion programmes, there has been a lack of studies observing quality of working life (QOWL). In addition, the description of various QOWL definitions and its factors was presented in this section as QOWL was an organisational outcome observed in this study. A summary of the effectiveness of physical activity activity and dietary intake workplace interventions were presented in the final section.

2.1 Global overweight and obesity trends

Overweight and obesity is a state of the body where there is excess accumulation of fat tissue which may impair health (WHO, 2015d).The trend of increasing obesity among the population is global (Ng et al., 2014). An overweight and obesity epidemic is occurring in both developed and developing nations (Bhurosy &Jeewon, 2014; Ng et al., 2014). Obesity worldwide has more than doubled since the year 1980. In 2014, more than 1.9 billion adults who were 18 years and older, were overweight. This totals to 39% of the adult world population. Out of these overweight adults, 600 million (13%) were categorised as obese, that is 11% of men and 15% of women (WHO, 2015e).

A systematic analysis for the Global Burden of Disease Study in 2013, which studies global, regional and national trends of overweight and obesity among adults and children from 1980 until 2013, reported that the prevalence of overweight and obesity combined, increased by 27.5% in adults and 47.1% in children worldwide. Overweight and obese individuals rose globally from 857 million in the year 1980, to 2.1 billion in 2013 (Ng et al., 2014). The proportion of adults with a body mass index of 25 kg/m^2 or greater (International WHO 1998 classification for overweight or obese) increased from 28.8% to 36.9% while for women, it increased from 29.8% to 38.0%. The prevalence of overweight and obese children and adolescents increased from 8.1% to 12.9% in boys and 8.4% to 13.4% in girls. While the trend of increase in adult obesity reduced among developed countries since 2006, its prevalence has exceeded 50% among both men and women in Tonga and among women in Libya, Qatar, Kuwait, Kiribati, the Federated States of Micronesia and Samoa.In developed countries, more men than women were overweight and obese, while in developing countries, more women were overweight and obese. However, looking at obesity rates alone (without overweight cases), prevalence of obesity was found to be higher in women from both developed

and developing countries (Ng et al., 2014). In the coming years, mean body mass index may increase more in less developed countries (Bhurosy & Jeewon, 2014).

According to the World Health Organization (WHO), in the year 2008, there were 1.5 billion adults aged 20 years or older who were overweight. In 2010, there were a total of 43 million children under the age of five years who were overweight (WHO, 2015a). Now, most of the world's populations live in nations where overweight and obesity kills more individuals than being underweight. Obesity is preventable and reducing its prevalence should be prioritised as a public health agenda to reduce risks for non-communicable diseases (WHO, 2015g). In Malaysia, obesity is associated with being female (5.3%), lower socio-economic status (0.9%), family history of illness such as high blood pressure, coronary heart disease, diabetes and strokes (4.8%) and a non-smoking status (6.4%) (Tan et al., 2011). In the Malaysian Health and Morbidity Survey 2011, it was found that Indians had the highest prevalence of obesity, followed by the Malays, other Bumiputras, Chinese and other ethnicities. The rise in obesity could lead to a reduction in future life expectancy (Ng et al., 2014). Obesity prevention programmes should target multiple levels of intervention, including socio-economic contexts and include all levels of the population (Bhurose & Jeewon, 2014).

2.2 Body Mass Index

One of the most common and widely used index to measure obesity in literature is the body mass index. Body mass index (BMI) is calculated by dividing a person's weight in kilogrammes by the square of their height in metres (kg/m^2). The body mass index can be used to categorise persons into 'underweight, normal weight, overweight and obese' categories (CDC, 2015). The BMI is an easy calculation for mass screening to determine an individual's weight category and their risk for developing health

problems. The body mass index does not measure body fat directly, however, it can be an indicator for body fatness (CDC, 2015). The correlation between body fat and the body mass index is fairly strong as reported by Flegal and others (2009). The BMI cut-off points are meant to identify, in each population, the proportion of persons at risk for adverse health outcomes (such as non-communicable diseases). This is to inform public health policy-makers, to trigger action such as preventive programmes or to gauge outcomes of health programmes (WHO expert consultation, 2004).

The WHO Expert Consultation (2004) recommended that the international WHO 1998 Classification be retained as the following cut-off points: <18.5 kg/m^2 (underweight), 18-5-24.9 kg/m^2 (normal range), ≥25 kg/m^2 (overweight), 25-29.9 kg/m^2(pre-obese), ≥30 kg/m^2(obesity), 30-34.9 kg/m^2 (obese class I), 35-39.9 kg/m^2 (obese class II), ≥40 kg/m^2 (Obese class III). However, Asians in general have an increased percentage of body fat compared to Caucasians of the same age, gender and body mass index. Compared to Caucasians, the risk for Asians developing Type 2 diabetes was also higher in Asians below the BMI of 25 kg/m^2. Asian trigger points for public health action were recommended at lower BMI levels. The recommended classifications were a BMI of less than 18.5 kg/m^2 as underweight, 18.5-23 kg/m^2 as increasing but acceptable risk, 23-27.5 kg/m^2 increased risk and 27.5 kg/m^2 or higher as high risk.With this in view, the Ministry of Health of Malaysia has adopted in its Clinical Practice Guidelines for Obesity (2004), that the classification for underweight remain the same, the BMI for normal range is between 18.5 kg/m^2 to 22.9 kg/m^2, Asians with a BMI of 23 kg/m^2 to 27.5 kg/m^2 are considered overweight and those above 27.5 kg/m^2 are obese (MOH, 2004).

In Malaysia, the National Health Morbidity Survey 2011 found that using the new cut-off point of a body mass index of 23 kg/m^2 as being overweight, there were

approximately 60 per cent of adult Malaysians who were overweight or obese, that is 33% were overweight and 27% were obese (Institute for Public Health, 2011). However, using the international BMI classification (WHO 1998 classification), there were less who were overweight and obese, that is approximately 44%. There were a total of 29% overweight and 15% obese using this classification.

Other body mass indices for other South East Asian countries as reported by Ng and colleagues (2014) using the WHO 1998 classification for BMI are seen in Table 2.1. Malaysia appears to have on average, the highest proportion of overweight and obese individuals, followed by Singapore and Thailand. This is a major concern for the government of Malaysia, especially in the Ministry of Health (Mustapha et al., 2014). Malaysia, as a developing country, has surpassed Singapore and Brunei which are high-income countries in the region, in its prevalence of overweight and obesity.

Table 2.1 Prevalence of Overweight and Obese Adults in South East Asia (SEA) (Ng et al., 2014)

SEA country	Males (%)		Females (%)	
	Overweight	Obese	Overweight	Obese
Malaysia	43.8	11.4	48.6	16.7
Singapore	44.3	12.0	32.5	10.8
Thailand	32.1	6.5	39.7	11.2
Indonesia	21.4	5.4	30.6	8.3
Laos	22.1	5.4	27.0	5.9
Brunei	23.3	3.6	17.9	3.5
Cambodia	11.9	1.3	18.3	2.9
Vietnam	13.6	1.5	12.3	1.7
Timor-Leste	3.2	3.2	6.6	1.5

2.3 Obesity and Non-Communicable Diseases

The fundamental cause of increased weight in individuals leading to obesity is an energy imbalance between the amount of calories consumed and energy used by the body for daily activities. Globally there has been more energy intake through foods that are high in fat and calories. There is also more physical inactivity due to a more sedentary lifestyle as a result of changes in the way we work, in transportation and urbanisation. Such changes that affect physical activity and dietary patterns are due to societal and environmental factors associated with development around us (WHO, 2015f).

Throughout the world, at least 2.8 million people die annually as a result of being overweight and obese. An estimated 2.3% or 35.8 million global disability-adjusted life years (DALYs) are caused by this health problem (CDC, 2015). One DALY can be considered as lost of one year of a 'healthy life' (WHO, 2015c). Being overweight or obese can lead to adverse metabolic effects on a person's blood pressure, lipid levels and insulin resistance. Increase in body mass index is associated with higher risks of diabetes, strokes and coronary heart disease (WHO, 2015e).A study of 4,428 Malaysian adults reported that those who had a BMI of over 30 kg/m^2(obese subjects), had a three-fold and two-fold increase for prevalence of newly diagnosed diabetes and impaired glucose tolerance test respectively, among those who stated not having diabetes initially (Wan Mohamud et al., 2011). Cancers of the breast, colon, kidney, prostate, endometrium and gall bladder are also linked to higher body mass index (WHO, 2015e). Other conditions associated with being overweight and obese includes sleep apnoea, breathing problems, osteoarthritis, gallbladder diseaseand low quality of life (CDC, 2015).

Mortality rates increase steadily as the degree of overweight increases. A median BMI between 21 to 23 kg/m^2 is best for optimum health in the adult population. It is recommended for individuals to maintain a BMI between 18.5 to 24.9 kg/m^2. Co-morbidities risk increase for BMI between 25.0 to 29.9 kg/m^2. Moderate to severe co-morbidities exist for BMI more than 30 (WHO, 2015b). Abdominal obesity has been found to be strongly correlated with cardiovascular risk (Su et al., 2015). The prevalence of cardiovascular risk factors is high among Malaysian adults and preventive steps should be taken to prevent a rise in cardiovascular disease (Ghazali et al., 2015). An unhealthy diet, physical inactivity and tobacco consumption are major risk factors for non-communicable diseases (NCDs) such as cardiovascular disease, respiratory disease, diabetes and cancers. If these risk factors were eliminated, about 75% of heart disease, type 2 diabetes and strokes and 40% of cancer would be prevented. The World Health Organization (WHO) states that it is unknown to many that 80% of non-communicable diseases occur in low and middle income countries. This invisible epidemic is a threat to the economic development. NCDs are the leading cause of death globally and cause more than 36 million lives lost annually. Non-communicable diseases affect both women and men equally. More than 9 million deaths due to NCDs occur before the age of 60 years. NCDs are also a threat to economic development of countries as they contribute to health care burdens and loss of productivity. Obesity and non-communicable diseases are preventable require preventive strategies to reduce its prevalence (WHO, 2015a).

2.4 Sedentary lifestyle and physical activity

'Sedentary' originated from the Latin word 'sedere' which means 'sit'. 'Sedentary' can be defined as a way of life which involves much sitting and little physical exercise (Oxford Dictionaries, 2015). Physical activity means any body movement that works the muscles and uses more energy than at rest (U.S. Department of Health & Human Services, 2000). Examples include walking, gardening, playing, running or cleaning the house. Physical activity encompasses four domains in our everyday life, leisure/recreation or exercise, occupation (school for youths), transportation and homes (Sallis et al., 2012). A lot of physical activity was required to play games, to learn new skills, to get work done, to get from place to place and to do household chores in the past. However, with changes in the society such as mechanization and computerization, there has been a reduced need to be physically active (Sallis et al., 2012). According to the World Health Organization (WHO), globally in the year 2008, as many as 28% of men and 34% of women were insufficiently active, based on self-reported questionnaires.

In the home, new technology and inventions have made it easier to cook and clean without much effort. Robot vacuums, bread-makers, washing machines, dryers, dish washers, mixers and blenders all make housework a less strenuous task. Services such as food delivery and drive through fast food restaurants and laundry service can further lessen energy expenditure for busy workers.In the United States, it was found that most adults had inadequate physical activity for optimum healthaccording to Bassett and colleagues (2010) and Troiano & Richard (2008) who conducted a pedometer- and accelerometer-based studies, respectively. A total of 35.7% of Malaysian adults were found to be physically inactive, based on self-reported physical activity (Institute for Public Health, 2011).

The World Health Organization (WHO) strives to promote a healthy lifestyle. WHO recommends for adults aged 18 to 64 years old, as much as 150 minutes of moderate-intensity, aerobic physical activity per week or 75 minutes of vigorous-intensity, aerobic physical activity per week, or a combination of both moderate- and vigorous-intensity physical activity.Aerobics activity should last for at least ten minutes. These recommendations apply to individuals who do not have any mobility problems, such as those with non-communicable diseases (such as high blood pressure and diabetes (WHO, 2010). However, medical advice is required for those with illnesses before increasing their physical activity.

Devices can be used to measure physical activity. Pedometers have been used to count the number of steps taken by an individual a day. With the availability of the pedometer, there have been many studies on its use to promote an active lifestyle (Aldana, 2005; DeCocker, Bourdeaudhuij & Cardon, 2010; Dishman, 2009; Freak-Poli, 2011; Mummery et al., 2006; Tudor-Locke et al., 2011).Tudor-Locke and Bassett (2004) have proposed preliminary pedometer-determined physical activity cut-off points for health adults, that is less than 5000 steps/day (sedentary), 5000 to 7499 steps/day (low active), 7500 to 9999 steps/day (somewhat active), 10,000 to 12,499 steps/day (active) and 12,500 steps/day or more (highly active). There have been studies which promoted a goal-setting of 10,000 steps a day (DeCocker, Bourdeaudhuij & Cardon, 2010; Miller et al., 2015; Mummery et al., 2006; Tudor-Locke et al., 2011). Tudor-Locke and colleagues (2011),determined how many steps taken a day for adults would be recommended to achieve the amount of moderate to vigorous physical activity (MVPA) levels required. They reported that 7,000 to 8,000 steps per day was a reasonable threshold for free-living individuals. The study also recommended that the 10,000 steps per day is a reasonable target for healthy adults.

However, a limitation with the pedometer is that it can only measure ambulatory movements such as walking or running. Non-ambulatory movements such as cycling, skating or lifting objects cannot be measured. An accelerometer is superior to a pedometer because it can also detect non-ambulatory movement, such as movement in the trunk in lower extremities. It also records the intensity and the duration of physical activity a person undergoes, which a pedometer cannot do. Accelerometers can determine the activity pattern of a person, such as at what time or how frequent a person moves in an hour and can determine if a person moves frequently (Berlin, Storti & Brachl, 2006). However, accelerometers are more expensive than pedometers and require more technical knowledge to use (Berlin et al., 2006; Tudor-Locke et al., 2011).The pedometer and accelerometer are well-correlated in terms of assessing physical activity (Tudor-Locke et al., 2005).

Benefits of physical activity include having better body mass composition and body mass index. Those who are more active tend to have better cardio-respiratory and muscular fitness, lower all causes of mortality, and less risk of hip and vertebral fractures (WHO, 2010). The World Health Organization member states have decided to strive to reduce physical inactivity by 10% in the year 2025 as a global non-communicable disease target (WHO, 2015f).

2.5 Changes in global dietary patterns

Dietary patterns have changed throughout the years and some factors have been reported to have played a role in this. Urbanisation appeared to be a major driving force in global obesity and availability of cheap vegetable oils allowed low and middle income countries to increase their energy intake with minimal expenditure. In the past several decades, with the change in dietary patterns and physical activity, there was a

change in body composition globally which led to a problem of global obesity. The increasing use of caloric sweeteners for food and drinks contributes to more calorie intake of individuals, in both children and adults. Improved food distribution systems such as the penetration of hyper-markets and the ease of availability of processed foods, high-fat, sugar-added, high-calorie, salt-laden foods may contribute to unhealthy eating patterns leading to obesity (Bhurosy & Jeewon, 2014; Popkin, Adair & Ng, 2012). High-calorie foods are also easily available such as at fast-food restaurants or supplied by vending machines strategically placed at common areas (Wright & Aronne, 2012). There has also been a decrease of intake of legumes, coarse grains and vegetables and an increase in the intake of animal products, leading to more consumption of saturated fats (Popkin et al., 2012). In the United States, there is ecological evidence that an increase in portion sizes of pre-packed and restaurant foods throughout the years have possibly contributed to the overweight and obesity prevalence in the country. It is possible that such trends promote over-eating in the population (Swinburn, 2004). Improved access to foods due to more fat, more meat, added sugars and bigger portion sizes, or the 'Nutrition Transition' and the reduction of physical activity levels has been identified as prime risk factors for the increase in obesity rates worldwide (Bhurosy & Jeewon, 2014).

2.6 Overweight and obese workers

Physical inactivity at work and unhealthy diets with high calories may result in many workers becoming overweight. Energy imbalance can occur at the worksite due to the sedentary nature of the job. There may be many hours of sitting only. Access to unhealthy foods at work may worsen the condition for workers (Engbers et al., 2005). However, different jobs may expose the worker to varying work conditions, with some

more sedentary than others. Having the correct energy balance plays a role in health maintenance and prevention of obesity, cardiovascular diseases and some cancers (U.S. Surgeon General, 2005).

The increase in the sedentary nature of work needs to be countered with promotion of physical activity (Pronk & Kottke, 2009). High occupational activity for workers with a sedentary lifestyle outside of their work, was associated with reduced abdominal adiposity. For workers who had sedentary work, those who met physical activity recommendations outside of work (during their leisure time, domestic activity or transportation) were associated with less odds ratio for abdominal adiposity (Steeves et al., 2012). Also, a study by Luckhaupt (2014) reported that occupational factors such as working for more than forty hours per week and exposure to a hostile work environment were significantly associated with an increased risk of obesity among workers. Those in the public administration had the highest prevalence of obesity that is as many as 36%. The study recommended prevention of workplace hostility and changing the behaviour of workers to improve their diet and physical activity levels (Luckhaupt et al., 2014).

It was found in a recent free health screening provided by a social insurance company (SOCSO) for Malaysian workers, out of a total of 308,039 workers assessed, 36.94% were overweight and 17.63% obese. Of these workers, 13.14% had high blood pressure, 8.45% had diabetes and 61.76% had high cholesterol (Sivanandam, 2015). A study by Suriani and colleagues (2014) reported that 14.8% of Malaysian government servants had low physical activity levels.

Obesity can affect the development of a society and nation as it can incur societal costs such as reduced well-being and human lives lost. This can lead to an increase in medical costs for workers which may include chronic long term medication

and care for obesity-related diseases. Workers may also need support services and disability management. Worker productivity can also be affected (Borak, 2011). A study in the United States by Van Nuys and colleagues (2014) reported that the employer costs and probability of disability, workers' claims and number of days missed increases with BMI above 25 kg/m^2. Morbidly obese workers cost more than twice of normal weight workers, that is an average of $8067 a year for medical, sick day, short term disability and workers' claims (Van Nuys et al., 2014). A cohort study in the United States, by Kleinman and colleagues (2014), found that higher worker BMI had increased medical, pharmacy and worker compensation costs and also sick leave. Annual costs were $4285, $4873 and $6316 for those with body mass indices of less than 27, from 27 to less than 30 and those 30 and above, respectively. Workers with higher BMI levels were associated with significantly more costs and absences and lower productivity (Kleinman et al., 2014).

2.7 Global initiatives to incorporate workplace health promotion

Adults spend about half of their waking hours at work and the worksite is deemed a good place to promote healthy behaviour (Engbers et al., 2005). The workplace may contribute to an unhealthy lifestyle by providing a sedentary lifestyle for workers with much exposure to calorie-dense food. However, it may also be an environment which provides opportunities to address the overweight and obesity problem (Borak, 2011). The workplace as a vital setting for health promotional activities is well recognised by the World Health Organization (WHO). The WHO 2004 Global Strategy on Diet, Physical Activity and Health endorsed during the 57th World Health Assembly emphasised the importance of providing healthy food choices, support and encourage physical activity at the workplace to reduce workers' risk for non-communicable diseases. The subsequent WHO Global Plan of Action on Workers'

Health 2008-2017 further reinforced the need in advocating healthy diet and physical activity among workers and the promotion of good mental health at work (Quintiliani et al., 2008).

Workplace health promotions have been incorporated as a work culture in some organisations. In the United States of America (USA), the "Healthy People 2010" initiative targetted to achieve 75% participation of worksites in offering a comprehensive employee health promotion program to their employees and a 75% participation rate of employees in these employer-sponsored health promotion programs (U.S. Department of Health and Human Service, 2000). Workplaces should consider incorporating a culture which includes an environment conducive for health promotional activities such as maintaining good physical activity and appropriate nutrition for workers (Pronk & Kottke, 2009).

A Political Declaration of the High Level Meeting of the United Nations General Assembly on the Prevention and Control of Non-communicable Disease in September 2011 committed to advance the implementation of the WHO Global Strategy on Diet, Physical Activity and Health. This promoted policies and actions which would improve diets and increase physical activity of populations. This was followed by a "Global Action Plan for the Prevention and Control of Non-communicable Diseases 2013-2020" which aims to achieve the commitments of the previous political declaration. This plan included targets such as a 25% relative reduction in premature mortality due to NCDs by the year 2025 and reducing global obesity rates to that of the year 2010 (WHO, 2015e).

Workplace health promotions have tried to improve workers' health through many methods. Environmental modifications are an important factor in workplace health promotions (Engbers et al., 2005). The corporate setting provides many

opportunities for health promotion, from policies allowing paid time-off to exercise and sponsorship of fitness centre memberships, to availability of on-site gyms or venues for exercise and nutrition classes. The workplace also usually offers communication channels through meetings, bulletin boards and emails to promote health messages. Corporations can promote a healthy lifestyle of workers as part of their strategic corporate health and business agenda. Health policy initiatives give the much needed support to influence corporate-based health promotional activities (Pronk & Kottke, 2009).

A meta-analysis found that workplace health promotion increased the physical activity of workers. Absenteeism and job stress were reduced and job satisfaction increased significantly (Conn et al., 2009). Many businesses have begun to recognize that workplace health promotion is a way to protect their human and financial resources. By reducing employee disease risk factors, a company may save unnecessary health costs, enhance productivity, reduce the turnover and absenteeism rate and create an encouraging working environment by showing a commitment to the employee's well-being (Quintiliani, Sattelmair & Sorensen, 2008).

Many interventional studies have been carried out to promote a healthier lifestyle at the workplace (Aldana et al., 2005; Anderson et al. 2009; Arao et al., 2007; Engbers et al., 2005; Conn et al., 2009; De Cocker, De Bourdeaudhuij & Cardon, 2010; Dishman et al., 2009; Lemon et al., 2010; Maruyama et al., 2010; Mhurchu, Aston & Jebb, 2010; Moy, Salam & Wong, 2008; Muto et al., 2006). Such health promotion activities are strategies designed to improve health-related behaviour patterns and health outcomes of workers. Worksite health promotion may target different objectives. Health promotion to improve dietary intake and physical activity levels may be addressed together or separately from other objectives such as reducing stress at work (stress

management) and smoking cessation (Anderson et al., 2009). The outcomes observed from each intervention may vary between studies.

In Malaysia, there has been some initiative to promote health at the worksite, however these efforts are still minimal, not well-sustained or comprehensive and can be further improved. The Malaysian Ministry of Health had also launched 'The National Strategic Plan for Non-Communicable Disease (NCD) 2010-2014' and the 'NCD Prevention 1Malaysia Programme' where a multi-sectoral, integrative approach was used. While government primary care clinics offered screening for NCDs to patients and long-term management, funding was provided under the Malaysian Health Promotion Board for volunteers from the community to promote healthy lifestyle through interventions within the community. The NCD prevention programme focuses on schools, workplaces and the community (Mustapha et al., 2014).

In line with the Malaysian government's initiative to promote a healthy lifestyle at the workplace, this study determined the effectiveness of the six month long 'Healthy Worker Programme'. The programme was a physical activity and dietary intervention for overweight and obese individuals at the workplace to reduce weight and improve physical activity, dietary intake and quality of working life. The study also observed if any of these changes were sustainable in the short term, that is three months after the programme ended.

While designing a workplace health physical activity and dietary intake intervention, its strategies and components need to be considered. The workplace intervention should be able to be adopted well into an organisation. There are many strategies and models for health behavioural change. Here we discuss some of them.

2.8 Strategies to promote health at the workplace

Many strategies are used to promote health at the workplace. These include use of informational and learning experiences, behavioural and social strategies, environmental modification and changes in policy. Here we discuss some of the common strategies used.

Informational and learning experiences at the workplace target to educate the workers on health and what is required to achieve optimum health. Informed workers may make more effort to adopt healthier lifestyles. Health-related information may be given through talks, individual or group counselling, pamphlets, website, intranet, electronic mail, posters and health education software (Anderson et al., 2009; Cox, 2003).

Interventions may include environmental modification and policy strategies. This type of intervention facilitates workers to make healthier choices at work. They target the whole work place and not just individual workers. Environmental modification includes provision of gym, healthy food options at the cafeteria or vending machine, displays of health information such as behavioural changes for disease prevention and an exercise path for walking. Policy strategies include change in procedures or rules, such as allowing workers to exercise during office hours, provision of gym memberships, provision of free or subsidised healthy meals and incentives for workers who maintain healthy behaviours (Anderson et al., 2009; Cox, 2003). Most studies combined the use of informational and behavioural strategies to promote dietary intake and physical activity.Less studies use environmental modification at the workplace (Anderson et al., 2009).

Behavioural and social strategies aim to change individual cognition which can mediate behavioural changes. These include increasing awareness, self-efficacy and

perception of support. Such strategies target the intentions of individuals. Counselling and goal-setting sessions are sometimes used. Sometimes the employees are involved in identifying workplace health promotional activities, target and goal setting for participants. The social environment of the workplace is changed to improve workers' support to achieve healthier behavioural patterns. Group or individual counselling, skill-building activities or the use of rewards or reinforcement at work may be used. Co-worker and family support has also been used to influence behavioural change (Anderson et al., 2009; Cox, 2003).

A complex intervention can also be used to promote healthy behavioural change. Such an intervention includes many components which may interact with each other. In the Healthy Worker Programme, a complex intervention was used to deliver multiple components based on the socio-ecological model, to affect changes in respondents for weight reduction and improve their quality of working life.

2.9 Complex intervention for health promotion

Complex interventions are commonly used in public health practice. They are conventionally defined as interventions with several interacting components. Its dimensions of complexity include number of groups or organisational levels targeted by the intervention, interacting components in the experimental and control groups and degree of flexibility or tailoring of the intervention that is permitted. It can also include the number or difficulty of behaviours required by those receiving or delivering the intervention and the variability of outcomes (Craig et al, 2008).

According to the United Kingdom Medical Research Council (UKMRC), the key elements of the development, implementation and evaluation of complex interventions may take different forms. The following figure (Figure 2.1) summarises the main stages, with arrows showing the main interaction between stages. Each stage has key functions and activities and the flow between stages may not necessarily be linear or cyclical, as shown by the arrows (Craig et al, 2008).

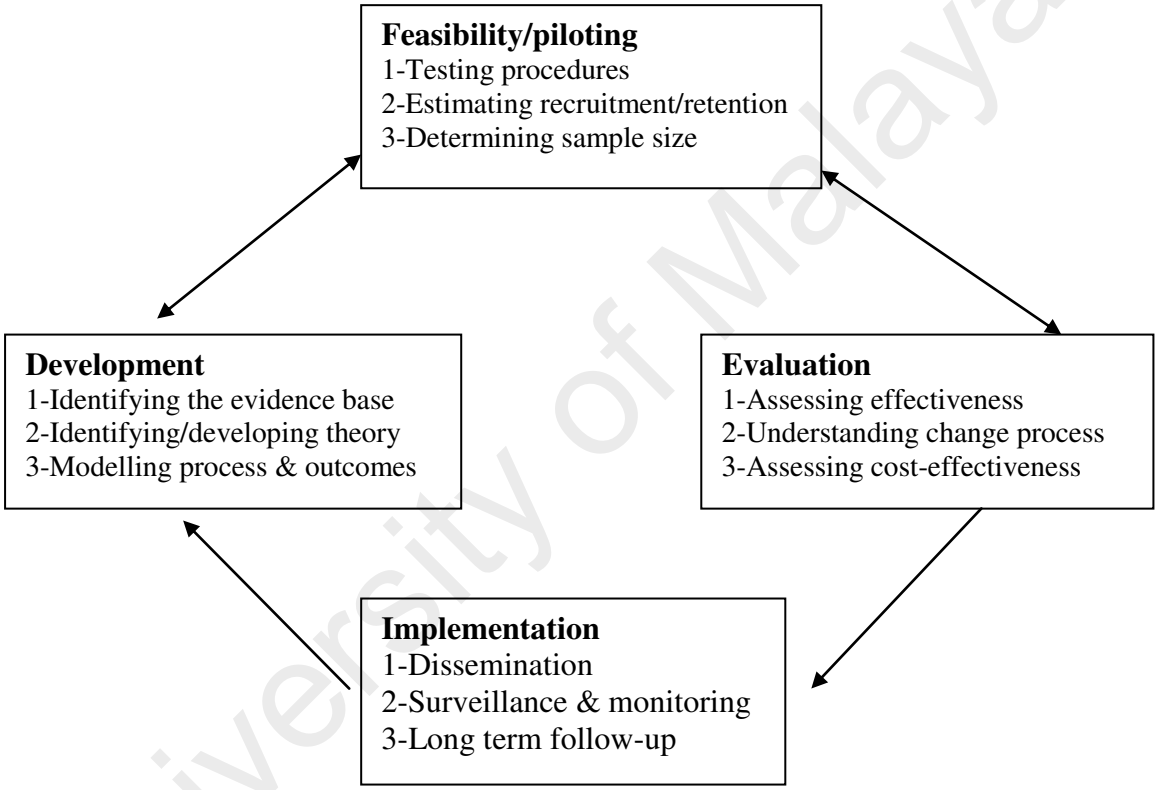

Figure 2.1. Key elements of the development and evaluation process of a complex intervention (Craig et al, 2008)

In developing the complex intervention, a good theoretical understanding of the health problem is required as to how the intervention leads to change. Background information on previous interventions which have led to the desired outcome should be obtained. A theory should be developed for the intervention leading to change. The

context of the intervention is important. A good understanding of the study context will aid in defining the problem and optimizing the intervention and evaluation (Cambell et al., 2007; Craig et al. 2008). (See Figure 2.2)

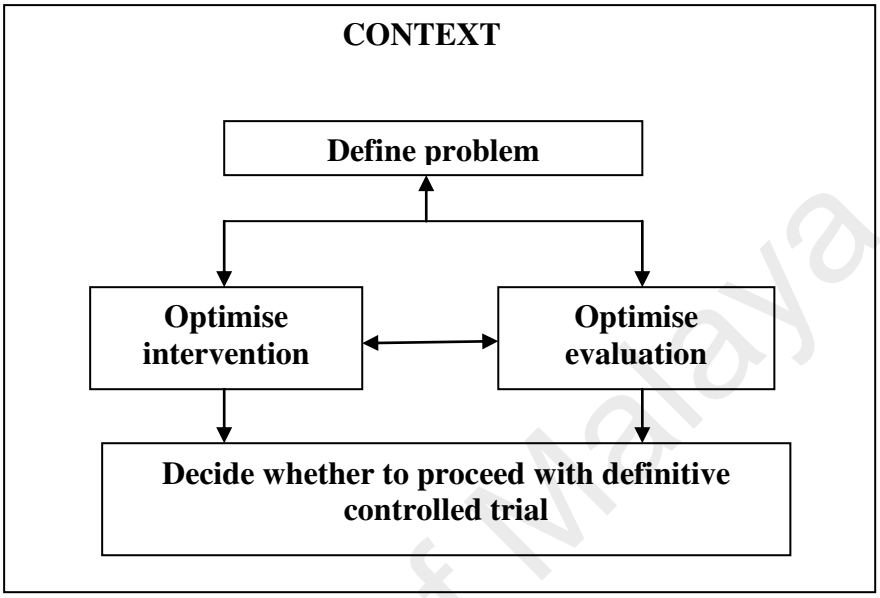

Figure 2.2 Relation between the context, problem definition, intervention and evaluation for the complex intervention (Campell et al., 2007)

Conducting a smaller version of the intervention and evaluation (i.e. modeling) can provide important information regarding whether the full scale intervention will be successful or cost-effective. A pilot study could determine problems such as delivery and acceptability of the intervention components. It could also show possible recruitment and retention rates and effect sizes. In a complex intervention, strict accordance to the protocol is not a necessity, as the intervention would be better by allowing adaptation to local settings (Craig et al., 2008).

In evaluating a complex intervention, an experimental design is most robust. However, if it is not practical or not feasible, a quasi-experimental or observational design can be used. While the intervention can be evaluated based on a primary and a few secondary outcomes, a range of measures would be best to evaluate its outcome.

Follow-up assessments would be helpful to determine if changes in the short term are persistent. However, this range of measures can make the evaluation of such intervention, time-consuming. A process evaluation, which explores how a study was implemented can also be conducted. It can be nested within the trial to examine the fidelity and quality of implementation. This can provide information regarding why an intervention succeeds, fails or results in unexpected outcomes. A cost-effective analysis can also be undertaken to determine if such an intervention would be worthwhile to achieve the desired health outcome. Complex interventions should be reported with detailed descriptions of the intervention to facilitate replication, synthesis of evidence and implementation in a wider circle (Craig et al., 2008).

In developing this complex intervention, main factors which contributed to overweight and obesity, that is unhealthy diets and a sedentary lifestyle, were identified (WHO, 2015e). The context of the intervention, that is among workers at the workplace, was also considered. Systematic reviews of workplace physical activity and/or dietary interventions showed significant improvement in the mean weight of workers (Anderson et al., 2009; Verweij et al., 2010). A systematic review by Chu and colleagues (2014) reported that worksite physical activity interventions reduced anxiety and depression among workers. Workplace health promotion can affect workers to work positively and reduce job stress (Conn et al., 2009; Kuopolla et al., 2008).

In this study, the 'Healthy Worker Programme', was developed. The intervention was targeted at the organisational, inter- and intrapersonal levels. Strategies were directed at different levels to improve physical activity and dietary intake to reduce workers' weight and body mass index as explained in the Methodology section (See Figure 3.2 Logic Model of the 'Healthy Worker Programme'). At the organisational level, intervention included creating a healthier work environment

through encouraging healthier foods at the cafeteria, exhibiting health posters and displays of calories in common foods at office pantries and on cafeteria tables. At the interpersonal level, intervention included co-worker motivation through sharing of experience and encouraging words in the newsletters. Health information was given in the monthly motivation to improve workers' physical activity and dietary intake at the intrapersonal level. Interaction could have occurred between the different components of intervention. The healthier office environment could affect staff's perception on health behaviour and this could in turn, motivate co-workers to influence each other to gravitate towards health-seeking behaviour. The co-worker motivation was also delivered in newsletters which were part of the monthly motivation given to workers which contained health information. The monthly motivation which was delivered at the intrapersonal level to change the individual's behaviour, could in turn affect the individual to motivate others around them to also adopt a healthier lifestyle (at work and at home).

Process and outcome evaluations were undertaken during this study. Many measures were used to evaluate the outcome of such an intervention. The primary outcomes were weight and body mass index, while the secondary outcomes were physical activity, dietary intake and quality of working life. Assessments were made for physical activity using a pedometer and a questionnaire, dietary intake (including energy intake and macro- and micronutrients), weight and body mass index. Quality of working life and its components (general well-being, employee engagement, stress at work, home-work interface and job and career satisfaction) were also assessed as an organisational outcome of having a 'Healthy Worker Programme' for workers. Process evaluation included participation rates in different types of intervention such as response rates, retention rate, and feedback on the usefulness of the intervention components. The cafeteria was also evaluated on healthy changes during the

environmental modification of the workplace. Sustainability of changes were assessed three months after the programme ended. The preliminary findings were reported to determine the feasibility of the programme. This will facilitate further improvements to the programme before it can be implemented on a wider scale.

2.10 Models for workplace health promotion

Theories for behavior change can be used in planning workplace interventions for changing health behaviour.Among the many models which can be used for health promotion are the Health Belief Model, The Theory of Planned Behaviour, The Transtheoretical Theory, Diffusion of Innovation Theory and the Socio-Ecological Model (Boston University School of Public Health, 2013; Cox, 2003; Glanz, Rimer & Viswanath, 2008). The Health Belief Model derived from the psychological and behavioural theory that a person's health-related behaviour are dependent on their desire to avoid illness (or to get well if they are already ill) and that a certain action will prevent or cure an illness. This depends on perception of susceptibility to an illness, severity of the illness, benefits from healthy behaviour and barriers which stop them from carrying out the healthy behaviour. Other factors also include cues to take action or triggers such as symptoms of having a disease or advice from others. Feelings of self-efficacy also play a role in this model, where the person has confidence to be able to successfully carry out healthy behaviour. Limitations of the Health Belief Model are that it does not account for a person's behaviour that may occur due to their attitudes, habits, social acceptability and environmental (or economic) factors which may promote or prevent such health behavior (Boston University School of Public Health, 2013).

The Theory of Planned Behaviour (TPB) Model distinguishes between three types of beliefs, that is behavioural, normative and control. This model comprises of

attitudes, behavioural intention, subjective and social norms, perceived power to change behaviour and the control a person has over this. The Theory of Planned Behaviour takes into account of social and subjective norms where the person relates to whether they should change their behaviour depending on what they think or what already is accepted to be a cultural norm. This theory assumes a person has enough opportunities and resources to be successful in carrying out healthy behaviour and does not take into account environmental or economic pressures. It also does not take into account that a person's behaviour can change over time (Boston University School of Public Health, 2013).

The Diffusion of Innovation Theory explains that a certain idea could diffuse into a population over time until a product or acertain behaviour is adopted. This takes into account that there will be proportions of the population who will want to be the first to try an innovation (new behaviour), followed by the early adopters, early majority, late majority and lastly the laggards who are very conservative and will be most resistant to change. Limitations of this theory include that it works better to explain the adoption of behaviours rather than cessation of an unhealthy one. It also does not take into account social support or a person's resources to take up a new behavior (Boston University School of Public Health, 2013).

The Transtheoretical Theory (which is also called the Stages of Change) focuses on stage-appropriate intervention to guide through six stages of change: pre-contemplation, contemplation, preparation, action, maintenance and termination (relapse) (Cox, 2003; Prochaska & Velicer, 1997). In the pre-contemplation stage, individuals are not intending to make any health behaviour changes in the next six months. In this stage, they may not be aware that their behaviour is problematic. In the contemplation stage, unhealthy behaviour is recognized and individuals are intending to

change their behaviour in the next six months. During the preparation stage, individuals are ready to take action in the next 30 days and have begun to take steps toward behaviour change. In the Action Stage, individuals have recently changed their behaviour (within the last six months) towards a healthier one and intend to continue. In the Maintenance Stage, individuals have sustained their new healthy behaviour for more than six months. At this stage, there is a tendency to relapse into their earlier stages. In the Termination Stage, individuals are sure that they will not return to their unhealthy behaviour. Limitations of this model include not taking into account social pressures (Boston University School of Public Health, 2013).

Ecological perspectives to change health behaviour include four principles which are: multiple levels of factors, interaction of factors across levels, multi-level interactions should be more effective in changing behaviour and ecological models work best when they are behaviour-specific. The levels of factors include intrapersonal, interpersonal, organisational, community, public policies and environment. Intervention at the intrapersonal level may include individual education and counselling. Interpersonal influence would include support and influence from family members, friends and co-workers. At the organisational level, intervention could include health programs or services to promote healthy behaviour. Within communities, there could be health campaigns. In the environmental level, there could be built environments which would be supportive for a healthy behaviour. Public policies could exist in an organisation (such as in a workplace), in a community or within a nation to promote healthy behaviour or curb unhealthy ones. This distinguishes ecological models from previous models which focused on one or two levels (Glanz et al., 2008). Influences can interact between levels, such as health education to increase physical activity and an organisational policy at work to support exercise would increase chances of an individual to improve their activity levels.

However, in a health intervention which uses this model, it will be difficult to discern which level of intervention would have caused a behavioural change in an individual (Glanz et al., 2008). Different individuals would react differently to each level of influence. A more motivated individual may improve their behaviour after one session of health education, compared to another less motivated individual who may require more levels of influence such as social pressure to improve from family and from the environment through public policies. Targeting a change in the environment only, without any health education or counselling for individuals may not promote the healthy behaviour (Linde et al., 2012). For example, having a gym at a worksite may not influence workers to start exercising.

An advantage of using an ecological model, is that it is most likely to have population-wide effects. Influences through public policies may reach many in the community, such as banning smoking in enclosed public areas or tax-reduction in buying exercise equipment. Intervention targeting individuals may have short-term effects and are not sustainable in the long term (Glanz et al., 2008). Based on the Socio-Ecological Model, there is exposure to organisational, interpersonal and individual factors, with possible interaction between the levels of intervention (McLeroy, 1988; Socio-Ecological Model, n.d.). Health programmes should include multiple levels of intervention to improve outcomes (Mhurchu, Aston & Jebb, 2010).

Horodyska and colleagues (2015) reported that physical activity and dietary intake interventions may address individuals' skills, beliefs, or social, physical or built environments, or focus on practicing recommended behaviour. Multi-level or multi-component interventions may include these actions, targeting individual, social and physical environment levels (Horodyska et al., 2015). Also, according to Sparling (2010), successful workplace health promotion programmes have multiple components,

is comprehensive and integrated. The five elements in a comprehensive programme are health education, supportive social and physical environments, integration, linkage to related programs (such as occupational medicine and worker safety) and screening programmes (Sparling, 2010). Goldgruber and colleagues (2010) in their review of effectiveness of workplace health promotion, reported the greatest effects from combined interventions which aimed at helping individuals and the whole workforce, too. Heath and colleagues (2012), in their reviews of physical activity intervention from around the world, found behavioural and social approaches effective and recommended environmental and policy approaches. The socio-ecological model has multiple components, targeting multiple levels, including the individual, their immediate social circles (such as colleagues) and the organisation, and appears superior to other models to improve health behaviour. However, high complexity of interventions using a socio-ecological model can hinder identification of which factors which contributed most towards its success (Horodyska et al., 2015).

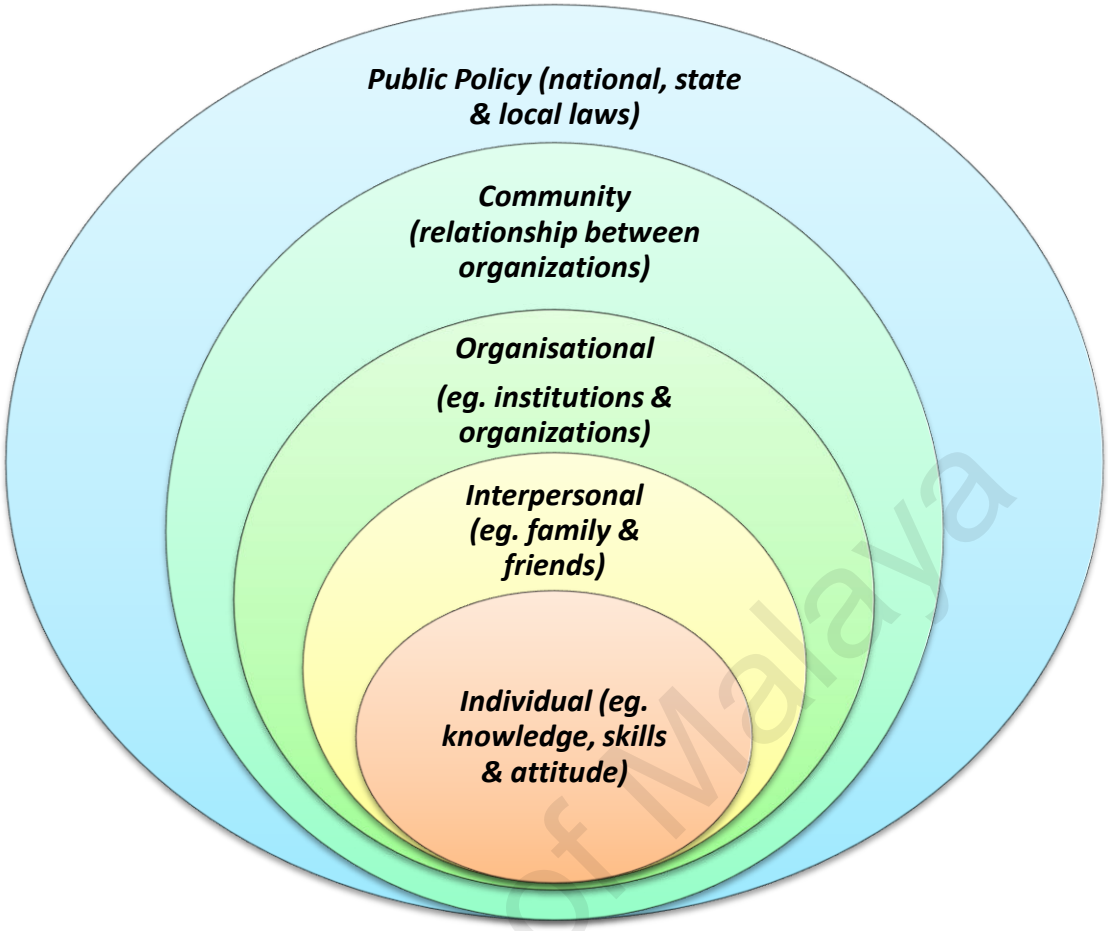

Figure 2.3 The 'Socio-Ecological Model' to explain factors that may influence the individual (Socio-ecological Model, n.d)

2.11 Intervention duration, intensity and follow-up

Studies of workplace dietary intake and physical activity interventions had varying intervention durations, intensity and follow-up periods (Anderson et al. 2009; Aldana et al., 2005; Arao et al., 2007; Bort-Roig et al., 2014; Carter et al., 2014; Conn et al., 2009; De Cocker et al., 2010; Dishman et al., 2009; Engbers et al., 2005; Freak-Poli et al., 2011; French et al., 2010; Lassen et al., 2003; Lassen et al., 2013; Lemon et al., 2010; Linde et al., 2012; Maruyama et al., 2010; McEachan et al., 2011; Mhurchu, Aston & Jebb, 2010; Miller et al., 2015; Morgan et al., 2011; Muto et al., 2006; Moy, Salam & Wong, 2008; Nurminen et al., 2002; Tamers et al., 2011) (See Table 2.2). In a systematic review of workplace interventions for physical activity and dietary intake by

Anderson and colleagues (2009), duration of interventions were less than six months in 19 studies (40%), six to nine months in 14 studies (30%), 12 to 18 months in 8 studies (17%) and more than 18 months in 6 studies (13%). Intensity of studies, which was defined as the number of contacts with participants was found to be between two to five contacts in 20 studies (43%), more than five contacts in 26 studies (55%) and unreported in a study (Anderson et al., 2009).

Studies were carried out to examine changes from six weeks to five years (Engbers et al., 2005; Conn et al., 2009; Maruyama et al., 2010; Dishman et al., 2009; Arao et al., 2007; Muto et al., 2006; Moy, Salam & Wong, 2008; Anderson et al. 2009; Aldana et al., 2005; Lemon et al., 2010; Mhurchu, Aston & Jebb, 2010). A study found improved workers' understanding of good nutrition and physical activity, nutritional intake and physical activity levels and had significantly lower body fat, blood pressure and cholesterol at six weeks and at six months (Aldana et al., 2005). A workplace randomized controlled trial with four months of intervention with individual counselling sessions and monthly website-based advice among middle-aged, male white-collar workers showed significant improvements in anthropometric and biochemical measurements (Maruyama et al., 2010). A meta-analysis for worksite nutrition and physical activity interventions found modest improvements in workers' weight from six to twelve months of follow-up (Anderson et al., 2009). Retention rates for workplace interventions to improve dietary intake were found in a systematic review by Mhurchu and colleagues (2010) to be from 21% to 100%. For physical activity interventions at the workplace, retention rates were found to be from 40% to 80% as reported by Marshall and colleagues (2004).

There was variability in the study durations, intensity of interventions and follow-up periods between studies. From the review of follow-up duration of physical

activity and dietary intake workplace interventions, it appeared that most studies observed outcomes at baseline and at follow-up. There was a lack of studies observing sustainability of health outcome change after the intervention ended. This appears to be a research gap for such worksite interventions. This study aims to observe sustainability of changes of such a workplace health promotion.

2.12 Barriers and incentives to participation in workplace health programmes

Barriers and incentives (or enablers) for participation in workplace health programmes which promote physical activity and dietary intake are important to consider when designing and implementing a workplace health programme. Such factors are important to understand what type of components that would attract them to change and maintain healthy behaviour and what challenges they may face in making these changes. In a study of 2337 employees by Kruger et al. (2007), of potential barriers and incentives for use of on-site health promotional services, barriers identified were not having time during the work day, before or after work (Kruger et al., 2007). A similar study by Person and colleagues (2010) among 481 employees' participation in a wellness program, reported that barriers to participation were (from most to least) poor incentives, inconvenient locations, time limitation, lack of interest in topics, undefined reasons, inappropriate scheduling, poor marketing causing poor awareness of the program, health beliefs that they had sufficient health knowledge and were healthy, and a general poor interest in the program (Person et al., 2010). Those who have illnesses may also be participate less in physical activities (Casey, De Civita & Dasgupta, 2010). According to Blackford and colleagues (2013), barriers to participation in office-based physical activity and dietary interventions include feeling too tired or have work and/or family commitments.

Important incentives included a change of policy to one which offered time to exercise at work and healthy food provision through vending machines or cafeteria food. There was also a high preference among employees for services such as fitness centres, weight-loss programs and on-site exercise classes. Other incentives included convenient timing and location of health promotional activities (Kruger et al., 2007). A study among male workers by Morgan and colleagues (2011) used financial incentives in their workplace health programme. A 50 Australian dollar gift voucher (which could be spent at a sports equipment shop) was given to participants who had the highest mean percentage of weight loss after a month and at the conclusion of the programme (Morgan et al., 2011). Creative and appealing incentives can make a workplace health promotion more successful (Sparling, 2010). According to a study of workers by Blackford and colleagues (2013), factors which encourage or enable workers to undertake regular physical activity during a work day include colleagues to exercise with, activities at lunch time, work recreation teams, enjoyment of physical activity, showers and change rooms at work. Other enablers for improving total fruit and vegetable consumption were nutrition knowledge and food prepared at home (Blackford et al., 2013).

Findings from studies on barriers and incentives for participants of workplace health programmes are important as they give insight into what would be workers'preference and factors that may facilitate change in their behavior towards a healthier one. Such factors could be included in the intervention to increase the effectiveness of a programme.

2.13 The impact of workplace physical activity (PA) and dietary interventions

A review was undertaken to understand the impact of physical activity and/or dietary interventions in the workplace. A database search was undertaken for literature published from the year 2000 to 2015, was conducted on PubMed, ScienceDirect and Google Scholar using the key words "work", "workplace", "worksite", "physical activity", "dietary intake" and "obesity".All types of workplace studies which included physical activity and/or dietary intake interventions and had health and/or work-related outcomes were included in the literature review. A total of 27 workplace studies with health and/or work outcomes were discussed as a narrative review here.

2.13.1 Health-related outcomes of workplace PA and dietary intake interventions

The "health and well-being outcome estimates" were categorized into the following groups: physical activity, fitness, diabetes risk (fasting glucose and insulin levels), lipids (total cholesterol, high density lipoprotein or HDL, ratio of total cholesterol to HDL), anthropometric measures (body mass index or BMI, weight, waist circumference, waist-hip ratio and percent body fat), quality of life and mood. Small to medium positive effects were found for physical activity behaviour (effect size of 0.21), fitness (effect size of 0.57), lipids (effect size of 0.13) and anthropometric measures (effect size of 0.08) (Conn et al., 2009). A systematic review and meta-analysisof workplace physical activity and/or dietary intake intervention from 1980 to 2009, reportedsignificant weight reduction among the intervention group compared to controls,that is an average mean difference of -1.19 kg. There was also a significant mean difference of BMI reduction, -0.34 kg/m^2 (Verweij et al., 2011).

Overweight and obese healthcare workers can also benefit from workplace health programmes. A recent review of published literature up to the year 2012, of

dietary and/or physical activity interventions for weight management targeting healthcare workers reported that from their meta-analysis, those allocated to the intervention lost significantly more weight, that is an average of 3.95 kg (95% CI: -4.96, -2.95) than controls after up to 12 months of follow up (Power et al., 2014).Gudzune and colleagues (2013) carried out a systematic review of studies to prevent weight gain in workplace and college settings which reported that there was moderate strength of evidence that interventions which had combinations of different strategiesprevented weight gain of at least 0.5 kg over a year compared to controls. However, these studies did not prevent body mass index gain or waist circumference increase (Gudzune et al., 2013).

Results from workplace interventions vary from study to study, depending on the intervention design as can be seen in Table 2.2 and from systematic reviews of workplace dietary and/or physical activity interventions (Anderson et al., 2009; Conn et al., 2009; Geaney et al., 2013; Gudzune et al., 2013; Maes et al., 2011; Mhurchu et al., 2010; Steyn et al., 2009; Verweij et al., 2011). For example, environmental interventions only, without any inter- or intrapersonal level interventions, such as counselling or involvement of colleagues or family members respectively, may not affect significant changes in weight (Linde et al., 2012). A recent, seven months workplace physical activity and dietary intervention by Miller and colleagues (2015) among university employees with pre-diabetes reporteda significant 5.5% mean weight loss in the intervention group compared to controls who lost a mean of 0.35% of their weight.A study by Appukutty and colleagues (2014) reported that a six month intervention among government servants resulted in 14% who lost five to ten percent of their initial body weight and a total of 7% who lost more than 10% of their body weight.

Carter and colleagues (2013) reported that they conducted a randomised controlled trial which compared three groups, that is one group which used a smartphone with a "My Meal Mate" application, another group who referred to an online, website dietary advice and the last group which had a paper food diary and a book with calorie counts of common foods. After six months, the intervention group which used the smartphone application lost the most weight, that is a mean weight loss of 4.6 kg. The mean weight loss for the paper diary group was 2.9 kg and 1.3 kg for the website group. Mean body fat percentage reduction in the smartphone, paper diary and website groups were 1.3%, 0.9% and 0.5% respectively. Kim and colleagues (2015) carried out a workplace intervention among obese, male employees. While the intervention group received tailored, phone text messages on exercise and diet delivered every other day, both intervention and control groups received four offline behavioural sessions and brief counselling over six months. Both groups were found to have lost an average of over a kilogramme of body weight after the study ended, with no significant difference in weight loss. It is possible that any form of health promotion is better than none at all at a worksite, as control groups with minimal health education (such as brief counselling) and regular monitoring of weights may also result in some weight loss.

Pedometers were used in physical activity interventions to determine the number of steps taken per day by workers (Aldana et al., 2005; Dishman et al., 2009; Maruyama et al., 2010). A meta-analysis of walking interventions since 1995 using pedometers found that participants lost about 0.05kg per week and an average of -1.27kg weight change was seen among nine studies (Richardson et al., 2008). Physical activity (PA) levels have been shown to increase with workplace health promotions. PA levels were measured by pedometers, accelerometers or questionnaires such as the International Physical Activity Questionnaire (IPAQ) (Aldana et al., 2005; Arao et al., 2007; Bort-

Roig et al., 2014; Dishman et al., 2009; Freak-Poli et al., 2011; Miller et al., 2015; Morgan et al., 2011; Parry et al., 2013; Tamers et al., 2011).

Many studies of workplace dietary interventions made positive changes in workers' diets such as an increase in fruit and vegetable consumption (Freak-Poli et al., 2011; French et al., 2010; Mhurchu et al., 2010; Miller et al., 2015; Tamers et al., 2011).Some interventions reported a reduction in total fat intake. Interventions included worksite environmental modification with and without health education (Mhurchu et al., 2010).Workplace canteen interventions where healthy food options were made available showed a reduction in calories consumed by employees (Lassen et al., 2003; Lassen et al., 2013).A systematic review by Mhurchu and colleages (2010) which reviewed studies from 1995 until April 2009 reported that worksite promotions for healthy eating are associated with a moderate improvement in dietary intake of employees. The review also recommended that interventions should include multiple components, instead of focusing on individual education only (Mhurchu et al., 2010). A similar review by Maes and colleagues (2011) of European workplace dietary interventions with or without a physical activity component, between January 1990 to October 2010, found limited to moderate evidence of positive effects on employees. Such positive effects reported by both systematic reviews included increased consumption of fruits and vegetables, weight loss and improved dietary behaviour.

Geaney and colleagues (2013) reviewed workplace interventions which included dietary modifications with or without nutritional advice from 1951 to November 2011. Dietary modifications had to have at least one of the following changes at the workplace, workplace canteen, on-site food establishment or vending machine: changes in dietary content of food or meals available as a result of food preparation modification, changes in portion size, or changes in food choices by increasing the

availability of healthier options or reducing unhealthy ones. The systematic review found six studies with these criteria and reported that four of these studies showed modest increase (less than half a serving a day) in fruit and vegetable consumption in workers (Geaney et al., 2013).However, not all studies found improvements in dietary intake, Morgan and colleagues (2011) reported that in their weight loss programme among male shift workers, no significant changes were seen in fruit, vegetable, diet soda and alcohol intake. While there appeared to be many studies which observedchanges in types of food consumed, such as whether there is an increase in healthy food consumption (eg. fruits and vegetables) and decrease in less healthy alternatives (sugary and calorie-dense foods), there appeared to be few published studies which determined any changes in energy, macro- and micronutrient intake.

Other health-related outcomes of dietary and physical intervention studies included a lowerresting heart rate (Aldana et al., 2005; McEachen et al., 2011) and systolic and diastolic blood pressure (Aldana et al., 2005; Arao et al., 2007; Maruyama et al., 2010; McEachan et al., 2011; Muto et al., 2006).Increased strength in hand grips, lumbar and scapular regions were found in a study by Queiroga and colleagues (2014) among employees who followed exercise sessions provided at their workplace, compared to those who did not.

Significant improvement was seen in quality of life in a meta-analysis of ten pre- and post-treatment groups, which showed an effect size of 0.24. Workers' moods were seen to have improved significantly in a meta-analysis of 28 studies, with an effect size of 0.21 for seven, two-group comparison studies with pre- and post-testing and 0.31 for 21 studies of pre- and post-treatment within a group (Conn et al., 2009). A recent review of workplace physical activity and yoga interventions have been associated with reduced depressive and anxiety symptoms, respectively (Chu et al., 2014).A study by

Johar and colleagues (2015) found that both a low intensity, dance exercise ("Aero Mass") and conventional aerobics exercise will reduce anger, hostility and depression among staff. However, the effects among the dance exercise sessions were significantly better.

Another outcome observed by Conn and colleagues (2009) in their systematic review was healthcare utilization. Healthcare utilization was found to be increased in a meta-analysis of five studies (effect size= - 0.17). The reason for this may be due to screening for health risks during the studies which could have prompted follow up referrals for some respondents (Conn et al., 2009).

Workplace physical and dietary intake interventions have been shown to have health-related benefits, both physically and mentally (Aldana et al., 2005; Conn et al., 2009; Geaney et al., 2013; Mhurchu et al. 2010). There appears to be a lack of studies with multiple assessments throughout such workplace intervention and observation of sustainability of changes post-intervention. Most studies also report mean weight changes. Few studies report clinically significant weight loss (i.e 5% weight loss). For dietary workplace interventions, not many studies report changes in energy, macro- and micronutrient intake. This study aimed to observe changes in these areas where there is a lack of information.

2.13.2 Work-related outcomes of workplace PA and dietary intake interventions

There is a lack of literature to examine the evidence of work-related outcomes of workplace physical activity and diet interventions and presents a knowledge gap to be researched (Conn et al., 2009; Pronk & Kottke, 2009; Proper et al., 2006; Proper & Van Mechelen, 2007). Meta-analysis of workplace physical activity interventions found

improvements in work-related outcomes such as job satisfaction, lower absenteeism and job stress, which are related to QOWL (Conn et al., 2009). It was found that in a meta-analysis of five studies, job satisfaction was found to be improved in the intervention group with an effect size of 0.33 or Common Language Effect Size (CLES) of 0.59. For work attendance, twelve studies were analysed and found that there was a lower mean absenteeism of an effect size of 0.19 (CLES= 0.55). Job stress was found significantly lower among a meta-analysis of three studies (effect size=0.33, $p<0.1$). Components of successful workplace interventions included physical activity and exercise at work, motivational sessions and some also included counseling on healthy diets.

Workplace studies used different approaches in their physical activity and/or dietary interventions in observing work-related outcomes. An 8-month intervention by Nurminen and colleagues (2002) which included weekly 60-minute weekly and two additional physical reinforcement sessions for workers reportedimproved work ability. A study by Lemon and colleagues (2010) which carried out a two year "Step Ahead Program" carried out a socio-ecological intervention at the workplace. The intervention included a supportive environment, individual intervention, weekly newsletters, website information, stairway signs, "walks with the President"activity, health posters and workplace events such as a farmer's market. This progam reported improved worksite commitment to employee health (Lemon et al., 2010). In a recent published study by Morgan and colleagues (2012), a 3-month workplace 'POWER' dietary and physical activity intervention among male workers found that there was less presenteeism, absenteeism and workplace injuries compared to controls. Their intervention included an information session, programme booklets, group-based financial incentives, pedometer for self-monitoring and motivation and also an online component (Morgan et al., 2012).

Some work-related outcomes such as job satisfaction, job stress and worksite commitment observed in these studies are related to QOWL. However, there appears to be a lack of published literature looking at the impact onoverall quality of working life (QOWL) with workplace physical activity and dietary interventions.This study aimed to contribute more information towards changes in QOWL from a workplace physical activity and dietary intervention.

2.14 Quality of working life

As quality of working life is also seen as that part of overall quality of life which is influenced by work (Van Laar et al., 2007), it is an important aspect of occupational health, a branch of public health. Many adults work and with increasing work demands and long hours spent working, it is an important aspect of life for many individuals. Quality of working life is important for attracting and retaining individuals in an organisation (Van Laar et al., 2007). A systematic review and meta-analysis by Conn and colleagues (2009) reported many workplace physical activity interventions which improved job satisfaction and reduced job stress, both of which are components of QOWL. Perceived workability (Nurminen et al., 2002) and worksite commitment to employee health (Lemon et al., 2010) were also found to have improved with a workplace physical activity intervention. However, there appears to be a lack of published studies focusing on changes in QOWL with a physical activity and dietary intake intervention in the community or at the workplace. There is also a lack of published studies to determine changes in QOWL with health promotions and due to temporal changes at worksites throughout the year.

There has been much literature written about the concept of “Quality of Working Life” (QOWL) and its importance since the late 1960s (Nanjundeswaraswamy &

Swamy, 2012; Sheel, Sindhwani, Goel, & Pathak, 2012; Sinha, 2012). There are many ways to define "Quality of working life" (Nanjundeswaraswamy & Swamy, 2013; Saklani, 2004; Sheel et al., 2012; Van Laar, Edwards, & Easton, 2007). In 1975, Walton stated that components of QOWL included adequate and fair compensation, opportunity for continued growth and security, safe and healthy working conditions, development of human capacities, social integrative constitutionalism and the total life space and social relevance (Walton, 1975). In 1989, Baba and Jamal, stated that components included job satisfaction, job involvement, job stress, role ambiguity, organisational commitment, work-role conflict and work-role overload (Baba & Jamal, 1989). Job satisfaction and quality of working life among nurses, according to Ellis and Pompli (2002) were dependent on factors such as poor working environments, shiftwork, balance of work and family, resident aggression, unable to deliver the quality of care preferred and workload. Other factors observed were lack of involvement in decision-making, professional isolation, role-conflict, poor relationship with peers and supervisors, lack of recognition and poor opportunities to learn new skills.

Quality of working life has also been defined as the existence of a "work environment", which is a matter of certain humanistic and life-enhancing work experience characteristics as perceived by peoples of the organisation. It encompasses financial and non-financial issues relating to work context, work content and work relations (Saklani, 2004). QOWL researchers in Malaysia either developed their own scales or used modified versions of the 1975 Walton study (Walton, 1975) . However, these studies looked at occupations such as executives, factory workers, accountants, academic staff and librarians. (Aziz et al., 2011; Daud, 2010; Hanefah, Md Zain, & Mat Zain, 2003; Noor & Abdullah, 2012; Raduan, 2006). A Malaysian study by Raduan and colleagues (2006) identified career satisfaction, career achievement and career balance as components of QOWL. In this study, it was observed that career achievement was the

most important determinant, followed by career satisfaction and career balance (Raduan et al., 2006).

In 2007, Van Laar and colleagues stated that QOWL may be seen as the way in which work is good for individuals. It can also be seen as the way an employee would evaluate their job (Van Laar et al., 2007).There has not been a clear consensus among researchers if QOWL is one-dimensional or multidimensional (Van Laar et al., 2007). However, researchers have identified many components that may make up QOWL (Daud, 2010a;Nanjundeswaraswamy & Swamy, 2012; Saklani, 2004; Sheel et al., 2012; Sinha, 2012). Different quality of working life scales are being used by researchers and many appear weak. Van Laar and colleagues (2007) stated that there appeared to be a lack of psychometric analysis of quality of working life scales, inconsistencies in factor structures and weaknesses in psychometric properties of scales. There is also a lack of psychometrically strong QOWL scale for health care workers (Van Laar et al., 2007). Previous scales also was deficient as it did not take into account the broader aspect of quality of working life such as home-work interface, stress, general life satisfaction, the role of more women in the workforce and the emergence of flexible work arrangements. Van Laar and colleagues (2007) sought to develop the Work-Related Quality of Life Scale (WRQLS) which built on previous QOWL research and included this broader range of factors. An improved scale was needed to take into account of modern-day changes in work practice.

The Work-Related Quality of Life Scale developed by Van Laar and colleagues has 24 items and six components which were found to contribute to QOWL. The six factors are Job and Career Satisfaction (JCS), Working Conditions (WCS), Stress At Work (SAW), Control At Work (CAW), General Well-Being (GWB) and Home-Work Interface (HWI).In the scale, the last item determines the respondent's perception of

overall work-related quality of life (Van Laar et al., 2007). The following table (Table 2.2) shows the definition of each QOWL factor.

Table 2.2 Factors of QOWL (Quality of Working Life, 2015).

QOWL Factor	Definition
Job and Career Satisfaction (JCS)	General satisfaction with job and career development
Working Conditions (WCS)	The physical working environment and conditions and having the right tools and equipment to do the job
Control At Work (CAW)	Involvement of workers in decision-making
General Well-Being (GWB)	Psychological and physical well-being, wellness and happiness of workers
Home-Work Interface (HWI)	Organisation understands and tries to help workers with pressures outside work (includes organisational flexibility).
Stress At Work (SAW)	Work-related stress
Employee Engagement (EEN)*	Positive attitude held by the employee towards the organisation and its values

**First 6 factors were originally in the Work-Related Quality of Life Scale. EEN added to the current Work-Related Quality of Life Scale-2.*

In the United Kingdom (UK), the Work-Related Quality of Life Scale was tested among health care workers, higher education employees, the police force and other job categories (Easton et al., 2013; Edwards J.A. et al., 2009; Van Laar et al., 2007). It was found to be psychometrically valid and reliable. Van Laar stated that with his model, QOWL can be viewed as one or multi-dimensional. QOWL can be broken down to its components for analysis, or seen as a global measure of total QOWL (Van Laar et al., 2007).

The Work-Related Quality Of Life Scale has been used by many researchers from over 30 countries. It has been translated into many languages, including French,

Chinese, Spanish, Portuguese, Turkish, Welsh and Farsi (Quality of Working Life, 2015). In translating and validating the Turkish version of the initial scale, three items were removed to improve its reliability (Duyan, Akyildiz & Van Laar, 2013). The scale was also used in a study among English-speaking nurses in Singapore. Exploratory factor analysis found that after removing two items, a five-factor model, without the CAW construct, was more appropriate for determining QOWL among the nurses there (Zeng et al., 2011). In a recent study by Chen and colleagues (2014), the scale was also validated in the Malay language. In this scale, there were five factors instead of six, where HWI was integrated with WCS to become HWI-WCS (Chen et al., 2014). It appears that QOWL may be perceived differently in populations due to varying work policy or ethos. Differences in cultures may also influence the relevance of certain items in a translated scale (Weeks, Swerissen, & Belfrage, 2007).

In 2011, an updated Work-Related Quality of Life Scale-2 (WRQLS-2) was created by Van Laar and colleagues in the UK. The new scale included a seventh component of QOWL that is Employee Engagement (EEN) which further improved the reliability of the scale. The EEN factor was to reflect the "positive attitude held by the employee towards the organisation and its values". This new scale was translated into the Thai and Chinese languages and validated among nurses (Lin et al., 2013; Sirisawad et al., 2014). Both scales included all seven factors as in the original English version. However, the validation of the Thai and Chinese Work-Related Quality of Life Scale-2 (WRQLS-2) and the previous Malay Work-Related Quality Of Life Scale (earlier version) used principle component analysis only and lacked confirmatory factor analysis (CFA) to examine the factors of their models (Chen et al., 2014; Sirisawad et al., 2014). The Thai and Chinese WRQLS-2 were also only validated among nurses. The WRQLS-2 had not been validated before in the Malay Language.

The Work-Related Quality of Life Scales 1 and 2 are relatively new and not many published studies are found on its use to date. There is a lack of studies using this new scale for longitudinal or experimental studies. In published studies, the scales were used for determining quality of working life such as among higher education employees (Edwards et al., 2009) and healthcare workers (Van Laar et al., 2007). The studies did not observe changes in QOWL with an intervention at the workplace. This study attempts to provide more information on changes in QOWL with a health promotion and the usefulness of this scale in the Malaysian workplace setting. While there are a few published QOWL studies in Malaysia using different scales, these scales were developed and tested among a limited group of occupations (Aziz et al., 2011; Daud, 2010; Hanefah, Md Zain, & Mat Zain, 2003; Noor & Abdullah, 2012; Raduan, 2006). The Work-Related Quality of Life Scale was created based on data from among 15,000 workers in the United Kingdom, used in over thirty countries by researchers and translated into many languages (QOWL, 2015). The scale is psychometrically strong and incorporated factors such as general life satisfaction and stress (Van Laar et al., 2007). The Work-Related Quality of Life Scale has been validated in Malaysia, Turkey and Singapore, while its updated version, the Work-Related Quality of Life Scale-2 (which includes the Employee Engagement component), has been validated in Thai and Chinese languages. In this study, it was decided to translate and validate the Work-Related Quality of Life Scale-2 to assess QOWL as an outcome.From an occupational health point of view, it would be interesting to determine if an organisational change in QOWL would occur if there were a health programme at the workplace. If there were such changes, it would be beneficial for an organisation to instill such programmes to continue to attract and retain workers, while promoting healthy behaviour and reducing risks for non-communicable disease in the working population.

2.15 Summary of effectiveness of physical activity and dietary intake workplace interventions in weight reduction

Workplace interventions for physical activity and/or dietary intake have variable outcomes. In this review, some interventions resulted in more weight loss than others as summarised in Table 2.3. Interventions with different components and strategies, such as environmental modification, supportive environment for healthy choices, health education, counseling or motivation for behavioural modification appear to be more successful for weight reduction.

Interventions which used multiple strategies observed more weight loss among workers. Miller and colleagues (2015) in their 7-month study, included weekly exercise sessions, physical activity, diet and weight self-monitoring records, goal-setting and calorie in food booklets. Their intervention resulted in an average 5.5% weight loss inthe intervention group (Miller et al., 2015). A total of at least 5% weight loss is recommended for overweight and obese persons for health benefits (MOH, 2013; NCCFN, 2010). Appukutty and colleagues (2014) carried out a 6-month intervention which included five exercise sessions weekly, dietary advice and behavioural counseling. They observed a total of 14% of respondents who lost 5 to 10% and another 7% of workers who lost more than 10% of their body weight (Appukutty et al., 2014). In a study by Salinardi and colleagues (2013), a mean average of 8 kgs was lost in the intervention group. Their intervention had two phases, a 6-month weight-loss phase followed by a 6-month weight maintenance phase. Its intervention included recommendations for reduced energy, low glycaemic load and high-fibre diet and behavioural change education. There was no significant weight increase also seen in their weight maintenance phase. In a study by Morgan and colleagues (2011), their 3-month intervention which included an information session, programme booklets, group-

based financial incentives and an online componentresulted in a mean reduction of 4 kgs in the intervention group.

However, there were also some studies which had multiple components and strategies, but showed less, significant mean weight reduction. These included studies by Maruyama and colleagues (2010) withfour months of physical and dietary intake intervention, individualized assessments, goal-setting, counseling with a dietitian and physical trainer, monthly website advice and a self- monitoring website for diet and exercise. They reported a mean weight reduction of 1.3 kgs and body mass index (BMI) reduction of 0.5 kg/m^2 (Maruyama et al., 2010). A study by Arao and colleagues (2007), carried out an intervention consisting of counseling, social and environmental support and observed a BMI reduction of 0.6 kg/m^2.

Interventions which concentrated on only one or two components (very few components) appear to be less successful in reducing workers' weight. No significant weight changes were seen in studies by Johar and colleagues (2015) and Quieroga and colleagues (2014) which used exercise sessions, Kim and colleagues (2015) who used tailored text messages or Linde and colleagues (2012) who used environmental modifications.A six-month intervention by Ramli and colleagues (2013) which used two components, that is a monthly health/dietary education and two weekly unsupervised exercise sessions also observed no significant weight reduction among workers.

In this review, studies with a longer follow up duration, that is more than a year, reported little or no significant weight or BMI change (French et al., 2010; Lemon et al., 2010; Linde et al., 2010; Tamers et al., 2011). A intervention by French and colleagues, with a duration of 18 months, which included monthly advisory group meetings, healthy alternatives in vending machines, weighing competitions, upgraded gyms, food and physical activity programmes, farmer's markets and a peer-mentoring programme,

showed modest reduction in BMI, that is as much 0.14 kg/m^2. Studies by Lemon and colleagues (2010) and Tamers and colleagues (2011) had which had a worksite interventions lasting for 2 years and 18 months repectively, including multiple components and strategies, but did not show any significant changes in weight or BMI. A study by Linde and colleagues (2012) only had an environmental intervention for two years also did not show any significant changes in mean weight or BMI. While the study by Linde and colleagues (2012), had only an environmental component, the other studies had multiple strategies and components. Sustainability of motivation through a longer period may have also been a challenging issue (French et al., 2010; Lemon et al., 2010; Linde et al., 2010; Tamers et al., 2011).

There appears to be lack of studies reporting clinically significant weight loss (at least 5% initial weight loss) and a reporting of sustainability of changes post-intervention of workplace physical activity and dietary intake interventions. More studies should report clinically significant weight loss to promote the public health significance of such interventions. Sustainability of changes are important to determine its long term impact on workers.

In this study, the 'Healthy Worker Programme' was developed using the Socio-ecological Model to deliver a multi-components physical activity and dietary intake intervention targeting at different levels for overweight and obese workers. The study was pilot-tested to assess weight (including clinically significant weight loss), body mass index, physical activity, dietary intake and quality of working life changes at multiple time points during the study. Health and work-related changes were observed and compared to a control worksite. It was preliminarily evaluated on its process and effectiveness. This study also aimed to provide preliminary information on

sustainability of changes post-programme and quality of working life changes in such a workplace health programme.

Table 2.3 Summary of Workplace Physical Activity and Dietary Interventions andOutcomes

Study	Respondents	Duration and type of intervention & control (PA=Physical Activity)	Outcomes *(PA=Physical Activity)*
Miller et al. (2015)	78 university employees with pre-diabetes	**Duration:**7 months (PA and dietary intake intervention) Randomised controlled trial **Intervention:**16 weeks of 'Group Lifestyle Balance' intervention: weekly 60 minutes sessions, PA, diet and weight self-monitoring records, booklet of calories contained in common foods, goal setting for PA (10,000 steps/day). **Controls:**usual care (information booklet regarding lifestyle changes and standard medical care). **PA measurement:**Accelerometer (step counts) **Dietary assessment:** food frequency questionnaire	**Weight**: Intervention group significantly loss more percentage of weight (5.5%) compared to controls (0.35%) **PA:** increased steps in intervention group after intervention and at 3 months' follow up (not significant). **Diet:**greater intake of fruits, decrease intake of meat, fish, poultry, seeds and nuts in the intervention group.
Johar et al. (2015)	40 overweight, female employees	**Duration:**12 weeks (PA intervention) Randomised controlled trial **Intervention**: low intensitydance exercise "Aero Mass", 50 minutes, 3 times a week **Controls:**conventional aerobics exercise, 50 minutes, 3 times a week	Reduction in anxiety, hostility and depression in both groups, but significantly more in intervention group.
Kim et al. (2015)	205 obese, male employees	**Duration:** 6 months (PA and dietary intake intervention) Randomised controlled trial **Intervention:**tailored text messages every other day **Controls:**both groups received 4 offline education sessions with brief counselling, monthly weight checks by nurse.	Mean weight reduction of 1.71 kg in intervention group and 1.56 kg in control group (no significant difference).

Table 2.3 continued

Study	Respondents	Duration and type of intervention & control (PA=Physical Activity)	Outcomes *(PA=Physical Activity)*
Bort-Roig et al. (2014)	129 office employees	**Duration:** 5 months (PA intervention) Mixed method **Intervention:** W@WS Programme- sit less, move more programme. Encourage incidental movement at office and increase duration of walks. W@WS website. **Controls:** No controls. **PA measurement:** IPAQ short form	**PA:** 67% increased step counts and 60% decreased occupational sitting.
Queiroga et al. (2014)	354 employees	Cross-sectional PA study. Workers who participated in the last 30 days in on-going exercise sessions at work were compared to those who did not. **Intervention:** Exercise sessions at work. (Provided for the last 5 years) **Controls:** workers who did not exercise at work for last 30 days	Increased in muscle strength (hand grips, lumbar and scapular strength). No significant changes in BMI, waist circumference and blood pressure.
Appukutty et al. (2014)	30 overweight & obese government servants	**Duration:**6 months (PA and dietary intake intervention) Cohort study. **Intervention:** 5 exercise sessions per week, dietary advice and behavioural counselling.**Controls:** none.	Significant reduction in waist circumference and body mass index in women. A total of 14% of respondents lost between 5 to 10% of their body weight. 7% lost more than 10% of their body weight.
Lassen et al. (2013)	270 employees	**Duration:** 6 months (Dietary intake intervention) Quasi-experimental **Intervention:** Half of foods served labeled as 'healthy'. **'**Keyhole certification' of canteen.**Controls:** No 'Keyhole certification' of canteen.**Dietary intake assessment:** photography & food-weighing.	**Diet:** Significant mean decrease in energy density in consumed meals at canteen from 561kJ/100g to 368 kJ/and 407kJ/100g at end-point and follow-up.

Table 2.3 continued

Study	Respondents	Duration and type of intervention & control (PA=Physical Activity)	Outcomes *(PA=Physical Activity)*
Carter et al. (2013)	128 overweight employees	**Duration:** 6 months (Dietary intake intervention) Pilot randomised controlled trial **Intervention:** Three groups- 1) Smartphone application ('My Meal Mate' self-monitoring of diet & PA), 2) slimming website and 3) food paper diary with calorie count.	**Weight & Body fat changes:** **Smartphone:** - 4.6 kg; -1.3% **Website:** -1.3 kg; - 0.5% **Paper diary:** - 2.9 kg; - 0.9%
Parry et al. (2013)	62 clerical workers	**Duration:**12 weeks (PA intervention) Randomised controlled trial **Intervention:** Participatory approach. Three groups- 'Active office'; 'Active Workstation'; Traditional physical activity'. **PA measurement:** accelerometer	**PA:** significantreduction in sedentary time on work days (-1.6%), increased number of breaks on work days (0.64), during work hours (0.72), increase light activity during work hours (1.5%) and moderate to vigorous activity on work days (0.6%).
Ramli et al. (2013)	28 overweight & obese civil servants (pilot study)	**Duration:** 6 months (PA and dietary intake intervention) Cohort study. **Intervention:** monthly health/dietary education, two weekly unsupervised exercised sessions. **PA assessment:** IPAQ (International Physical Activity Questionnaire) **Controls:** none	No significant difference in body weight. Increase physical activity level from 1853 to 4638 MET-mins/week (not significant). Significant reduction in body fat percentage (from 40.2% to 39.2%) and sit and reach distance.
Salinardi et al. (2013)	133 overweight & obese employees	**Duration:** 6 months weight loss phase, followed by 6 months weight maintenance phase. (Dietary intake intervention) Worksite-randomised controlled trial (2 intervention worksites, 2 control worksites); office-based. **Intervention:** recommendation for reduced energy, low glycaemic load, high-fibre diet & behavioural change education. **Controls:** wait-listed control	Significant weight loss of 8 kgs in the intervention group, while the controls gained 0.9 kg. No significant weight gain for participants in the weight maintenance phase. Significant reduction in systolic and diastolic blood pressures in intervention group compared to controls.

Table 2.3 continued

Study	Respondents	Duration and type of intervention & control (PA=Physical Activity)	Outcomes *(PA=Physical Activity)*
Linde et al. (2012)	1672 employees	**Duration:** 2 years (PA and dietary intake intervention) Group randomised trial of six worksites **Intervention:** 4 environmental components intervention (food availability and price, physical activity promotion, scale access and media enhancement). **Controls:** No contact	No significant weight change between groups.
McEachan et al. (2011)	1260 employees	**Duration:** 3 months (PA and dietary intake intervention) Cluster randomised controlled trial (44 worksites randomised) **Intervention:** tool-kit for physical activity promotion, newsletters, health posters, team challenges. **Controls:** Leaflets for good dietary intake and physical activity	Reduced **systolic blood pressure** (effect size=-1.79 mmHg) and **resting heart rate** (effect size=-2.08 beats)
Tamers et al. (2011)	2,878 employees	**Duration:** 18 months (PA and dietary intake intervention) Group randomisation from 34 worksites **Intervention:** "Physical Activity & Changes in Eating" Eg.posters, motivation, social activities, self-help manual, employee pot luck, walk/run events. **Controls:** No controls. **PA measurement:** computed metabolic-equivalent score and questionnaire **Dietary intake measurement:** food frequency questionnaire	Respondents with higher social worksite support had: **PA:** 14.3% higher PA scores **Diet:** 4% higher fruits and vegetables consumption.
Freak-Poli et al. (2011)	762 employees	**Duration:** 4 months (PA and dietary intake intervention) Cohort study (non-randomised). **Intervention:** the 'Global Corporate Challenge', emails, website to monitor progress, health information. **Controls:** No controls. **PA measurement:** pedometer **Dietary intake measurement:** fruit and vegetable intake questionnaire	Reduction in **waist circumference** (-1.6cm) and **blood pressure** (systolic -1.8mmHg and diastolic -1.8mmHg). **PA:** increase in physical activity (by 6.5%), reduction in sitting time (-0.6 hours/day), **Diet:** increase in fruits (by 4%) and vegetables intake (by 2%)

Table 2.3 continued

Study	Respondents	Duration and type of intervention & control (PA=Physical Activity)	Outcomes *(PA=Physical Activity)*
Morgan et al. (2011)	110 overweight/ obese, male shift workers	**Duration:** 3 months (PA and dietary intake intervention) Randomised controlled trial **Intervention: '**Workplace POWER' programme, 1 information session, programme booklets, group-based financial incentives and an online component.**Controls:** wait-list control group **PA measurement:** Godin Leisure-Time Exercise Questionnaire **Dietary intake measurement:** Victorian Cancer Council food frequency questionnaire	**Weight :** -4kg (intervention); +0.3kg (controls) **Waist circumference:** -4.4cm (intervention) +1.5 cm (controls) **BMI (kg/m^2):** -1.3 (intervention); +0.1 (controls) **Systolic BP (mmHg):** -7.3(intervention); -1.3 (controls) **PA:**significant increase in intervention group (d=0.77) **Diet:** significant increase in cola intake in intervention group. **Work-related:** improved presenteeism, absenteeism and injuries.
French et al. (2010)	160 employees of bus garages	**Duration:** 18 months (PA and dietary intake) Randomisation of 4 garages within pairs of intervention & control **Intervention:** Garage Advisory Group- met monthly; healthy alternatives in vending machines, upgraded gym conditions, weighing competitions, food and physical activity programs, Farmer's markets, peer-mentoring program. **Control:** Garage Advisory Group- met quarterly **PA measurement:** accelerometry **Dietary intake measurement:**24-hour dietary recall	In intervention group, **BMI** reduced by 0.14 kg/m^2. **Diet:** In intervention group, energy intake decreased and fruits and vegetable intakes increased significantly.

Table 2.3 continued

Study	Respondents	Duration and type of intervention & control (PA=Physical Activity)	Outcomes *(PA=Physical Activity)*
Maruyama et al. (2010)	101 middle-aged, white-collar male workers with metabolic syndrome risk factor(s)	**Duration:** 4 months (PA and dietary intake). Randomised controlled trial **Intervention:** Individualised assessment, goal setting, counselling with dietitian& physical trainer, monthly website advice, self-monitoring website for diet & exercise. **Control:** no treatment **PA measurement:** pedometer **Dietary measurement:** food frequency questionnaire	Significantly mean difference between groups: **Weight**: -1.29kg; **BMI:** -0.47 **Glucose:** -5.2 mg/dl; **Insulin:** -2.09 (microunits/l) **PA:** No significant difference in steps/day. **Diet:** Increased consumption of recommended foods, decreased of consumption of foods to reduce eating.
Lemon et al. (2010)	806 hospital employees	**Duration:** 2 years (PA intervention) Randomized controlled trial (Randomisation of 6 hospitals) **Intervention:** Step Ahead Program. Socio-ecological intervention. (supportive environment, individual intervention-weekly newsletter, website, stairway signs, "walks with the President" activity, health posters, hospital events-farmer's market) **Control:** no treatment	No significant change in **BMI.** Intervention group reported improvements of **worksite commitment** to employee health.
De Cocker et al. (2010)	298 employees (social services company)	**Duration:** 20 weeks (PA intervention) Quasi-experimental **Intervention:** based on '10,000 Steps Ghent and social ecological model. Education through emails, posters, staircase use, goal setting (10,000 steps/day), pedometer use, worksite competition and walking circuit at office. **Control:** no treatment **PA:** pedometer	Downward trend of steps taken per day from baseline (end of summer) to follow up (winter). Among those already active, there was a significantly smaller decrease of steps taken in intervention group compared to controls. **31%** reported to have changed PA behaviour due to intervention.

Table 2.3 continued

Study	Respondents	Duration and type of intervention & control (PA=Physical Activity)	Outcomes *(PA=Physical Activity)*
Dishman et al. (2009)	1442 employees (Home Depot staff)	**Duration:** 12 weeks (PA intervention) Group randomised intervention **Intervention**: "Move to improve" (social-ecological intervention) pedometer use, support from management, team and personal goal setting **Control:** health risk appraisal & monthly newsletters on health benefits of physical activity. **PA:** International Physical Activity Questionnaire (IPAQ) short form &pedometer	**PA:** Increase in moderate & vigorous exercise, **51%** at intervention site **25%** at control site.
Moy et al. (2008)	150 security guards	**Duration:** 2 years (PA and dietary intake intervention) Quasi-experimental **Intervention:** Intensive individual & group counselling for diet and physical activity **Control:** minimal information by mail and group counselling **Dietary intake measurement:** 24-hour dietary recall and food frequency questionnaire	**Diet:** Reduced fat intake, increased fruits & vegetable intake in intervention group. Reduced total cholesterol (mean intervention effect of -0.38)
Arao T et al. (2007)	177 male employees with cardiovascular risk factor(s)	**Duration:** 6 months (PA and dietary intake intervention) Non-randomised cluster allocation. **Intervention:**"Life style modification Program for Physical Activity and Diet" (counselling, social & environmental support) **Control:** feedback physical activity & diet by nurse, printed materials on healthy diet & cooking and exercise. **PA measurement:** Maximum oxygen uptake (VO_2 max) and leisure time exercise energy expenditure **Dietary intake measurement:** food frequency questionnaire	Significantly greater decreases in **BMI** (-0.6 kg/m^2), **systolic pressure** (-4.5 mmHg), **LDL cholesterol** (-17.7 mg/dl) in intervention group. **Diet:** No difference in dietary habits. **PA:** Greater leisure time exercise energy expenditure. Mean inter-group difference: 400.6 kcal/week

Table 2.3 continued

Study	Respondents	Duration and type of intervention & control (PA=Physical Activity)	Outcomes *(PA=Physical Activity)*
Muto et al. (2006)	75 male sales representatives	**Duration:** 3 months (PA and dietary intake intervention) Quasi-experimental **Intervention:** Main program: 30 min individual counselling-Education on nutrition, physical activity, cardiovascular risk factors.Follow up: telephone call 3 months after main program. **Controls:** no treatment	Total **cholesterol** reduced significantly in intervention group: -25.7 mg/dl in the intervention group, -8.7 mg/dl in controls.
Aldana et al. (2005)	145 employees	**Duration:** 4 weeks (PA and dietary intake intervention) Randomised controlled trial **Intervention:** Coronary Health Improvement Project (CHIP), (4 times a week- 2 hour educational lectures, specialist advice, assignments, goal setting, pedometer use). **Control:** no treatment **PA measurement:** pedometer **Dietary intake measurement:** Block 98 full-length dietary questionnaire	Significantly **lower body fat, cholesterol**and **blood pressure** in intervention group. **PA:** 25% increase in steps at 6 weeks, 16% increase in steps at 6 months (compared to baseline). **Diet:** increase in fruits and vegetable intakes(at 6 weeks and 6 months compared to baseline)
Lassen et al. (2003)	5 worksite canteens	**Duration:** 8 months (dietary intake intervention) Prospective study (no randomisation) **Intervention:** '6 a day Worksite Canteen'. Training of canteen staff, canteen support visits. No controls.	**Diet:** Significant increase in total consumption of fruits and vegetables, an average of 70g per customer at end-point and 95g per customer at follow-up.
Nurminen et al. (2002)	260 women laundry workers	**Duration:** 8 months (PA intervention) Randomised controlled trial **Intervention:** weekly 60-minute sessions and two additional physical activity reinforcement sessions. **Control:** All respondents received counselling and prescription for exercise and feedback on exercise capacity from a physiotherapist.	Slight increasein perceived **work ability** among intervention group.

CHAPTER 3: METHOD

The study was conducted in two phases. The first phase was conducted with the aim to translate into Malay, normalize and validate the Work Related Quality Of Life Scale-2 (WRQLS-2) for use among Malaysian workers. The WRQLS-2 was utilised to assess any changes in quality of working life,which was one of the measured outcomes of the 'Healthy Worker Programme'. The second phase was the development and pilot-testing of the 'Healthy Worker Programme' physical activity and dietary intake intervention.

3.1 Translation, normalisation and validation of the Work Related Quality of Life Scale-2 (WRQLS-2) for use in the Malay language

3.1.1 Study instrument

The Work-related Quality of Life Scale has been used worldwide and is available in five different languages (English, Chinese, Turkish, Farsi and Welsh). It was developed by psychologists from "Quality of Working Life Ltd.", a spinout company of University of Portsmouth, United Kingdom, which collaborates with researchers to continue its benchmarking work.Van Laar and colleagues (2007) created the 'Work-Related Quality of Life Scale'. The scale was found to be psychometrically reliable and valid among healthcare workers and higher education workers (Van Laar et al., 2007). It was later improved to become the Work-Related Quality of Life Scale-2 (WRQLS-2) with better reliability. The WRQLS-2 consists of 34 items, of which 33 items measure the components of quality of working life, while the last question measures the perception of overall quality of working life. Respondents answer on a

Likert Scale of 1 to 5 regarding how much they agree on each item in the questionnaire. A neutral answer is provided on the scale (See Appendix A).

The WRQLS-2 measures overall QOWL and its factors. The factors are job satisfaction, control at work, working conditions, stress at work, home-work interface, general well-being and employee engagement.The "Job and Career Satisfaction" factor measures general satisfaction with job and career development. "Working Conditions" reflects the physical working environment and conditions and having the right tools and equipment to do the job. "Control At Work" measures involvement of workers in decision-making. "General Well-Being" means the psychological and physical well-being, wellness and happiness of workers. The "Home-Work Interface" measures how much the organisation understands and tries to help workers with pressures outside work and includes organisational flexibility. "Stress At Work" determines the level of work-related stress. This encompasses the extent to which work pressures and demands were deemed acceptable and not excessive or stressful. The employee engagement factor was to reflect the "positive attitude held by the employee towards the organisation and its values" (Lin et al., 2013; Sirisawasd, 2014; Van Laar et al., 2007).

The seven constructs of the scale and examples of its items are:

-Job and career satisfaction (JCS): *"I am satisfied with the career opportunities available for me here".*

-Working conditions (WCS): *"I am happy with the physical environment where I usually work".*

-Control At Work (CAW): *"I feel able to voice opinions and influence changes in my area of work".*

-Stress At Work (SAW): *"I often feel under pressure at work".*

-Home-Work Interface (HWI): *"I am able to achieve a healthy balance between my work and home life".*

-General Well-Being (GWB): *"Recently I have been feeling reasonably happy all things considered".*

-Employee Engagement (EEN): *"I am proud to tell others that I am part of this organisation"*(Quality Of Working Life, 2015).

3.1.2 Translation, pre-testing & pilot testing

The WRQLS-2 Scale was translated using the forward and back translation technique (Brislin, 1970). Translation of the scale was carried out by acertified translator at the Linguistics Department at the University of Malaya, who was not familiar with the WRQLS-2 scale. Back translation of the scale into English was done by another lecturer from a separate faculty, who was also blinded to the scale.

The new scale was then pre-tested among ten working individuals from different occupational groups, genders, age groups, marital status, racial and educational backgrounds. Each individual read the questions and explained what they understood. This was to test the readability of the questions and if respondents could comprehend the items. This was followed by pilot-testing among two groups of individuals (6 persons in one group and 7 in another group). The groups were made up of healthcare workers, research officers, medical laboratory technicians, bio-medical officers and office workers. The group members looked at the scale items one at a time to discuss further changes to improve the scale. After pre-testing and pilot-testing, discussions

were carried out in person with the translator and via email with the scale developer to make improvements. The language of the scale was normalized and edited to become a culturally acceptable translation, while trying to keep as closely as possible to its original content.

3.1.3 Study participants

The questionnaires were distributed to office workers and health care workers (HCWs) as there is a lack of study on this subject among the latter group (Van Laar et al., 2007). Having two groups of workers would also widen the applicability of the Malay validated scale. Minimum sample size was calculated using suggestions by Hair and colleagues (2010) for structural equation modelling. As there were seven constructs and each construct had three or more items, it was suggested that a minimum of 150 samples was required. However, a sample size of 300 was targeted, consisting of 150 office and 150 HCWs. Questionnaires were distributed to 170 office workers and 170 HCWs, in case of data loss due to poor response or incomplete questionnaires.

Respondents for the validation process were purposively selected among healthcare and office workers from both government and private sectors in the Federal Territory of Kuala Lumpur and the Selangor state. The HCWs included doctors, nurses, physiotherapists and hospital attendants. Office workers included administrators, managers, lawyers, bank officers, secretaries, clerks and drivers. Drivers were included as they were support staff at offices and provided variation to the study sample.

3.1.4 Data analysis

The instrument validation process was conducted in three stages using both confirmatory (stages 1 and 3) and exploratory (stage 2) factor analyses to test, modify and confirm the underlying factor structure of the Malay version of the Work-Related Quality of Life Scale-2 (WRQLS-2). Data were analysed using the IBM-Statistical Package of Social Sciences (IBM-SPSS) Version 16.0 (SPSS Inc., 2006) and SPSS Analysis of Moment Structures (AMOS) (Arbuckle, 2006). Reversed scores were calculated for negative statements, namely one 'General Well-Being' (GWB) item and all 'Stress at Work' (SAW) items. Descriptive analyses were undertaken to obtain frequency, proportions, means and standard deviations. Confirmatory factor analysis (CFA) was carried out using the AMOS 21 software (Awang, 2013).

First, a confirmatory factor analysis (CFA) procedure was used to test the fit of the Malay data to the original seven factor work-related quality of life model. A combination of several fit indices was used to assess the model, as there is no agreed single standard (Hair et al., 2010). Fit indices used were Root Mean Square Error of Approximation (RMSEA), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Comparative Fit Index (CFI) and Chi-Square test. (Awang, 2013; Hair, Black, Babin, & Anderson, 2010; Holmes-Smith, Coote, & Cunningham, 2006). It is generally accepted that Chi-square/df index ratio value less than 3; CFI, GFI and AGFI values greater than .90; RMSEA $\leq$.07 indicate adequate model fit (Hair et al., 2010).

Due to an unsatisfactory fit of the model initially, the separate measurement models for each construct were examined for uni-dimensional fit by determining the relevance of its items within their own construct (Awang, 2013). Items with low loading factors were removed from the measurement model to improve fit. Model fit indices (RMSEA, GFI, AGFI, CFI, Relative Chi-sq) were referred to for each construct

measurement model. The constructs JCS, GWB, WCS, SAW and EEN were examined using this approach. There were only three items for HWI and CAW and could not be further analysed with AMOS. The items of these two constructs were pooled with other constructs for analysis (Awang, 2013). The constructs were also examined for discriminant validity at this stage, by examining the correlation between two constructs. Each construct was checked for discriminant validity by checking its correlation with another construct. A correlation of more than 0.85 indicated multi-collinearity and a redundancy of both constructs in the final model.

An exploratory factor analysis (EFA) was then carried out. The Kaiser-Meyer-Olkin (KMO) and Bartlett's Test was conducted to determine possibility of reduction into dimensions.Principal axis factoring extraction method was used, due to the reflective nature of the items in the questionnaire. This was conducted with iterated oblique rotation (Promax) as there was possibility of inter-dependency of the factors (constructs) of quality of working life (QOWL). Items which were relevant in the unidimensional models earlier and the items from the CAW and HWI constructs were included in the EFA. Criteria for consideration in the new model were items with Eigenvalues of more than 1 and loading values greater than 0.3.

A new model was created with the factors extracted from the EFA, including items of good factor loadings. For multicollinearity between constructs, one redundant construct would be deleted from the final model. The selection for which construct would be deleted was based on the EFA, as to which factor was extracted, had a clear cut dimension, better loading and fewer cross-loading of its items.

The validity of the final scale was determined by determining its convergent, construct and discriminant validity. Its reliability was determined by examining its internal reliability, composite reliability (CR) and average variance extracted (AVE).

The Cronbach's Alpha value of 0.7 or higher was used for internal reliability. A value of 0.6 or more for the CR indicated good internal consistency and reliability. In a good structure the individual factor loadings must be at least 0.5 and average variance extracted (AVE) must be higher than 0.5 (Hair et al., 2010), that is as much variance is explained as unexplained.

For discriminant validity, the square root of the AVE for a construct is compared to its correlation with other constructs. There is good discriminant validity when the square root of its AVE is more than its correlation with other constructs (Awang, 2013).The correlation between each construct in the final model was determined again using AMOS. Any constructs with very high correlations (r>0.85) with another construct, indicated multi-collinearity, a redundancy of having both constructs in the model.Cross-validity of the final model for other groups was tested with Bollenstein bootstrap re-sampling of 1000 samples.

The overall QOWL was determined by calculating the average scores of factors. 'Perceived QOWL' by respondents were determined by the last item in the scale, "I am satisfied with the overall quality of my working life". The correlation between the overall calculated QOWL and the last item of the scale was analysed.

3.1.5 Use of the Work-Related Quality of Life Scale-2 (WRQLS-2) in the study

In the second phase of the study, a quasi-experimental study was carried out among overweight and obese workers. A workplace physical activity and dietary intervention, the 'Healthy Worker Programme' was carried outat a workplace and compared to a control workplace which did not have such a programme. The validated Malay Work-Related Quality of Life Scale-2 (WRQLS-2) was used to determine if

there were any changes to the average quality of working life or its factors (such as general well-being, job and career satisfaction, home-work interface and employee engagement) among workers.

3.2 Phase II: The 'Healthy Worker Programme'

3.2.1 Study design

This was a quasi-experimental study with an intervention and a control worksite. The quasi-experimental study design was used as there was no randomisation carried out (Harris et al., 2006). This type of study design is commonly used for worksite intervention studies (Berry & Mirabito, 2011; De Cocker et al., 2010; Lassen et al., 2013; Moy et al., 2008; Muto et al., 2006).The 'Healthy Worker Programme' was a complex intervention, conducted over six months, where respondents were exposed to multiple levels of intervention.A complex intervention may contain interacting components and a range of possible outcomes. Such an intervention allows a degree of flexibility or tailoring of the intervention. In complex interventions such as the 'Healthy Worker Programme', a single primary outcome may not be the best way to use data collected. A range of measures is recommended to evaluate the programme. Complex interventions do not require strict fidelity towards a certain protocol and adaptations can be undertaken in different settings (Craig et al., 2008). Thus, the complex intervention design was used for this programme, allowing it to be an adaptable method to induce behaviour change at any workplace setting.

Based on the Socio-Ecological Model (McLeroy, 1988; Socio-Ecological Model, n.d.), respondents were exposed to organisational, interpersonal and individual factors, with possible interaction between the levels of intervention. At the organisational level, health posters were displayed at various sites of the workplace,

displays of table-top information on fat and calories in common foods at the cafeteria and office pantries, encouragement of healthy foods at the cafeteria and giving out of prizes by top management for weight loss and increase in physical activity. At the interpersonal level, motivation was given by co-workers through newsletters to maintain a healthy lifestyle. At the individual (intrapersonal) level, workers were given monthly health information leaflets and a motivational phone call at the third month. Repeated assessments were carried out at baseline, mid-programme and at programme end. The programme was also assessed for sustainability of changes at three months after it ended. Possible changes due to maturity effects or secular trends were determined by examining the control group. A flowchart of the study is shown in Figure 3.3 and further details on the intervention are mentioned in sections 3.2.10.1 to 3.2.10.3.

3.2.2 Study population

Participants were government office workers in the Federal Territory (Kuala Lumpur and Putrajaya). Government office workers were targeted as previous studies suggested that physical inactivity and adoption of unhealthy dietary habits are common in this group. It was found that every 3 out of 20 public servants had very low physical activity (Suriani et al., 2014). Another study suggested even higher prevalence of physical inactivity and unhealthy diet, 50% and 87% respectively (Mat Hasan et al, 2016). In addition, worksite health promotion efforts require the involvement and support from the top management. The selected government organisations were supportive of the research programme and gave permission to entry.

3.2.3 Study location

Malaysia has thirteen states and three federal territories. The three federal territories are Kuala Lumpur, Putrajaya and Labuan (myGovernment, n.d.). Kuala Lumpur and Putrajaya are at Peninsular Malaysia, while Labuanis at the Borneo Island. The Federal Territories of Kuala Lumpur and Putrajaya,which are about 40 kilometres apart (Google Map Data, 2015) or about an hour's drive from each other,were chosen as study locations. They are not too close to each other which may cause cross-contamination. They were also not too far apart as to facilitate research activities to deliver intervention and assess outcomes.

Kuala Lumpur is the capital of Malaysia where previously, many government buildings were found. Putrajaya is the new Federal Government Administrative Centre for many government ministries and some offices have relocated there (Official Portal of Perbadanan Putrajaya, 2015). There are also residential and commercial buildings in Putrajaya. However, Kuala Lumpur remains the premier financial and business centrefor the country. Kuala Lumpur has a population of 1.45 million while Putrajaya has approximately 72,000 (Putrajaya Facts, 2015; World Population Review, 2015).

The intervention worksite was located at Bukit Kiara, Kuala Lumpur and was an administrative training centre. The control worksite was a registration centre for births, deaths and marriages at Precinct 2, Putrajaya (See Figure 3.1). The profile of the selected worksites are described further in the following section (Section 3.2.5)

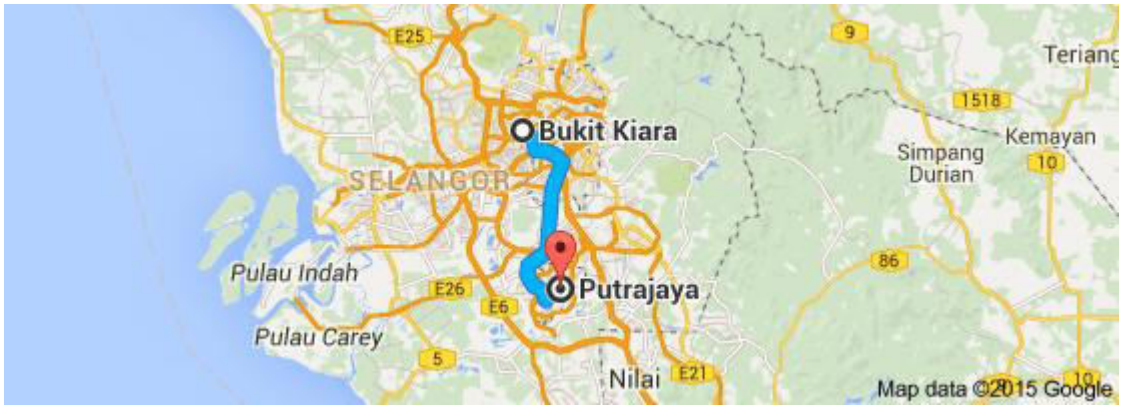

Figure 3.1 Location of Bukit Kiara (in Kuala Lumpur) and Putrajaya (Google Map Data, 2016)

3.2.4 Study setting

One government worksite in the Federal Territory of Kuala Lumpur was the intervention site while another in the Federal Territory of Putrajaya was the control. Worksites selected had similar work environments and public facilities. For example, both have a cafeteria and an on-site gym. Both worksites have staircases, parks and paths surrounding the office buildings which allow opportunities for staff to exercise or to be physically active. The intervention site was a training centre for administrative staff, while the control site was a registration centre for births, deaths and marriages. There was approximately 500 staff at the intervention site and 1000 staff at the control site. At both sites, the main nature of work was office-based, however support staff who did general work were also included in the study. There were no health programmes except for sports activities, such as friendly football matches, intermittently throughout the year. The worksites were located at least about an hour's drive away from each other, to reduce contamination of the control environment.

3.2.5 Sample size and its justification

Sample size was calculated using the "PS–Power and Size Calculation" software based on the primary outcome of reducing body mass index as an effect of physical activity and dietary intake workplace intervention. A difference in body mass index as much as -0.5 kg/m^2 between intervention and control groups was referred to based on a worksite-based study among a group of Asian (Japanese) white collar workers (Maruyamaet al., 2010). The significant level was set at 0.05 (95%) and the power of the study at 0.8 (80%) (McCrum-Gardner et al., 2010). The ratio of intervention to control respondents was set at 1:1. The sample size was calculated to be 64 respondents for the intervention group and 64 for controls. A systematic review on workplace interventions on improving diets of employees showed retention rates of 21% to 100% among interventions that lasted 4 months to two and a half years (Mhurchu et al., 2010). Retention rates of most pedometer interventions ranged from 40% to 80% (Marshall et al., 2004). Based on this information, it was decided to anticipate a retention rate within the range of 21 to 80 per cent, that is 50 per cent. The sample size was further inflated in case of a drop-out rate of 50%, giving rise to a new sample size of 128 intervention respondents and 128 controls.

3.2.6 Sampling technique

A health screening was conducted by nurses (who were blinded to the intervention) and employees who fulfilled the inclusion factors were invited to participate in the 'Healthy Worker Programme'. This method of recruitment and voluntary participation is commonly adopted in workplace interventions (Carter et al., 2013; De Cocker et al., 2010; Marshall, 2004; Queiroga et al., 2014). Voluntary participation was chosen to minimise disruptions to workers and their work schedules at

the time of the study.Workers could also opt out of the study at any time. The Physical Activity Readiness (PAR-Q) questionnaire from the Canadian Society of Exercise Physiology was used to screen whether respondents can take part in physical activity intervention such as walking (Canadian Society of Exercise Physiology, 2002) (See Appendix B).

Respondents were also screened for any illnesses. Blood pressure was recorded using the Omron automatic blood pressure monitor (Sem-1 Model, Omron Healthcare Co., Ltd., Kyoto, Japan) as recommended by the WHO STEPS Manual for chronic disease risk factor surveillance (WHO, 2008). Respondents were assessed at rest while sitting upright. The blood pressure cuff width was of appropriate size, that is at least 40% of the circumference of the respondent's arm (MSH/MOH/AMA, 2013). A large-sized blood pressure cuff was used as required. Three blood pressure measurements were taken. The two latter readings were averaged to determine if blood pressure was high (WHO, 2008). Those who had a systolic blood pressure of 140 mmHg or more or a diastolic pressure of 90 or more was considered hypertensive (MSH/MOH/AMA, 2013).

For fasting blood glucose and cholesterol levels, patients were informed to fast from midnight and blood samples taken in the fasting state in the morning by finger prick (capillary blood sample). The Cardiochek PA lipid and glucose analyser (Polymer Technology Systems, Inc, Indianapolis, U.S.) is a reliable screening tool and was used for this purpose (Noor Ani et al., 2012). Blood pressure, fasting glucose and cholesterol levels were assessed by registered nurses trained to use these devices. A fasting cholesterol level of 5.2 mmol/L and above was classified as abnormally high following the criteria used by the Malaysian National Health Morbidity Survey 2011 (Institute for Public Health, 2011). Respondents with a fasting glucose level 5.6 mmol/L and above were referred to a physician at a government clinic or hospital for further tests to

investigate for diabetes (MEMS/MOH/AMA/PDM, 2009). Any abnormality was referred to a physician for follow-up management. A physician screened respondents for any illnesses and assessed if the respondent may be included in the study from the health screening. The results of fasting blood glucose, cholesterol and blood pressure from the health screening of staff were used for assessing participants' health status for inclusion into the study (See Appendix C). Such a screening was required to reduce risks of adverse events during the study. While physical activity is beneficial for healthy individuals, some diseases such as severely uncontrolled hypertension, diabetes or severe arthritis may require treatment before engaging in increasing physical activity. Persons with controlled diabetes, hypertension or moderate arthritis benefit from regular exercise and a healthy diet, may be included into the study, but require proper follow-up with a physician.

3.2.7 Inclusion factors

The World Health Organization (WHO) recommends for Asians, a BMI of 23kg/m^2 to be considered as the cut-off point for overweight (WHO, 2004). Employees who were overweight and obese, with a body mass index of ≥23.0kg/m^2 were invited to participate in the study.

3.2.8 Exclusion factors

Exclusion factors were pregnancy, medical conditions which precludedmoderate exercise and affected walking (eg. severe osteoarthritis of the knee, unstable angina, acute injury to lower limbs), cease to work at study site or unwilling to participate.

3.2.9 Intervention

The 'Healthy Worker Programme'was carried out for six months, as detailed by its components below. As stated by a meta-analysis of workplace nutrition and physical activity intervention by Anderson and colleagues (2009), improvement in workers' weight were seen between six to twelve months of follow-up. Recruitment for the study occurred in early 2012. Intervention began in March 2012 and ended in August 2012. Assessments for anthropometric measures (weight and body mass index), physical activity levels, dietary intake and quality of working life were carried out at baseline, 3rd and 6th months of intervention. A final assessment at three months after the programme ended (ninth month of study) was held to determine sustainable change, that is in November 2012. The 'Healthy Worker Programme' was a complex intervention which targeted multiple levels of intervention (Craig, 2008), based on the Socio-Ecological Model (McLeroy, 1988; Socio-Ecological Model, n.d.). The Socio-Ecological Model has also been used in other workplace health interventions (De Cocker et al., 2010; Dishman et al., 2009; Pronk et al., 2009).

The Socio-Ecological Model states that there exists an interactive relationship between the individual and the environment. The individual is responsible for making changes to improve health, through acquiring knowledge, skills and their attitude. However, the social environment which includes interpersonal relationships (such as friends, colleagues and family), organisation (workplace and social institutions), community and public policy help influence the individual's choices and behavior (McLeroy, 1988; Socio-Ecological Model, n.d.) (See Figure 3.2).

Based on the Socio-Ecological Model, the 'Healthy Worker Programme' delivered intervention at the organisational level (the workplace), the interpersonal (through relationships with colleagues and family members) and individual factors

(exposure to knowledge and skills) and allowed interaction between these different levels (Craig, 2008). A logic model which includes the intervention components are detailed as follows (Figure 3.2). A flowchart of the study is also provided (Figure 3.3).

A logic model of the 'Healthy Worker Programme' defines the programme components, that is the levels of intervention, activities and participation, the health and behaviour and organisational outcome assessed. The multi-component intervention to improve physical activity level and dietary intake, occurred at different levels, involving different categories of staff and social circles. The intervention targets to improve physical activity and dietary intake, to reduce weight of overweight and obese workers.

Physical activity interventions at work have been shown to improve job satisfaction, well-being and reduced job stress (Conn et al., 2009; Quintiliani et al., 2007). These changes could improve the Quality of Working Life (QOWL) such as through the factors of Job & Career Satisfaction (JCS), General Well-Being (GWB) and Stress At Work (SAW). As the intervention includes promoting physical activity and healthy dietary intake at work and at home, the study also observed any changes in QOWL in terms of Home-Work Interface (HWI) and Employee Engagement (EEN). There appears to be a research gap in observing QOWL change with workplace physical activity and dietary intake interventions. This study is the first few to observe if such intervention can affect QOWL using the Work-Related Quality of Life Scale-2. (See Figure 3.2).

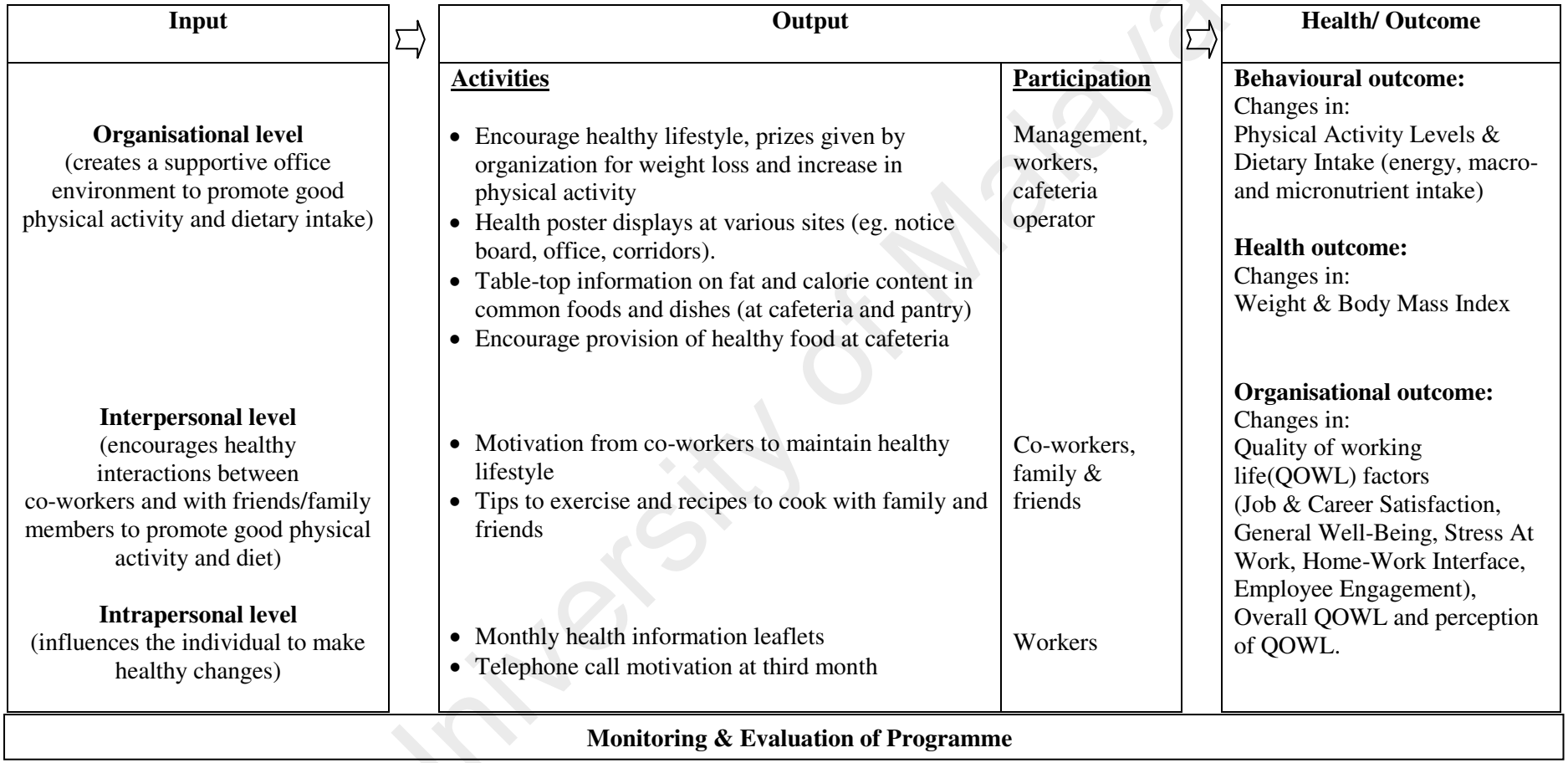

Figure 3.2 'Healthy Worker Programme' Logic Model

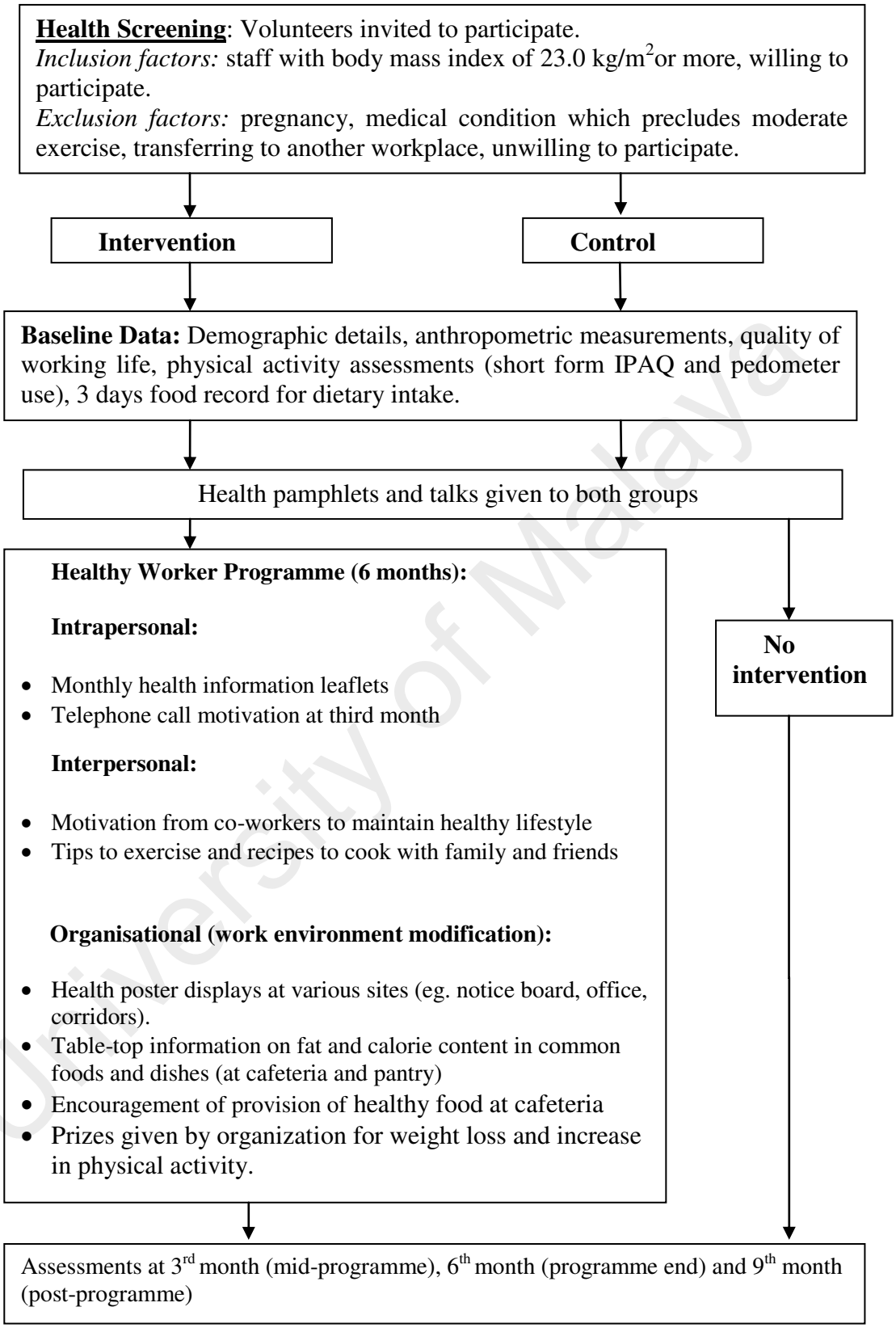

Figure 3.3 Flowchart of the study

3.2.10 Different levels of intervention

Different levels of intervention were carried out, that is at the organisational level, inter- and intrapersonal levels. Intervention was to create a supportive atmosphere to encourage improvement of physical activity and dietary intake among workers. This included interactions between staff which promoted healthy behaviour.

3.2.10.1 Organisational level

At the organisational level, there was environmental modification to create a supportive atmosphere for workers to adopt a healthier lifestyle through a more active lifestyle and eating healthily to lose weight. This is one of the strategies used to promote health (Anderson et al., 2009; Cox, 2003; Linde et al., 2012). Interventions from the management level and at the cafeteria are explained as follows.

(a) ***Top management***

Top management, that is the Director and the Heads of Departments, gave support to the programme. The Human Resource Department was delegated the task of facilitating study activities. Management support was also used in other workplace health promotions (Dishman et al., 2009; Lemon et al., 2010). The top management personnel wereinvolved in giving prizes to respondents as a show of organisational support for those who managed to reduce their weight and recorded high levels of activity using their pedometers (the 'Pedometer Challenge') at the third and sixth months. Those who recorded the most steps were given gifts such as water bottles, face and hand towels. Workers who lost much weight were given gift hampers which contained items such as fruits and healthy foods during organisational gatherings. Competitions related to weight reduction and physical activity have also been used in other workplace interventions (De Cocker et al., 2010; French at al., 2010; Morgan et

al., 2011). To encourage workers to come for three monthly assessments, small gifts such as specially designed pens, bags, document holders, decorative air fresheners, keychains with flashlights and mugs were given during the assessments. Top management was also encouraged to hold activities to improve workers' health, such as exercise classes and sporting activities.

(b) ***Cafeteria***

A meeting between the researcher and the cafeteria operatorwas arranged to seek support for the 'Healthy Worker Programme'. The cafeteria operator was given information provided by the Ministry of Health for the preparation and selection of healthy recipes. The operator was encouraged to provide healthy foods (such as more vegetable dishes, fresh fruits, dishes cooked with less oil and fats). He was informed of the health promotion that was planned and asked for support in providing healthier alternatives. Information such as a criteria and checklist of what would constitute a healthy cafeteria was also given (See Appendices D and E). The cafeteria operator was also invited to listen to an hour-long lecture on eating healthily and healthy food preparation by nutritionists from the Nutrition Division of the Ministry of Health which was held at the beginning of the study for both intervention and control groups.The talks were part of the minimal health education given to the control group for ethical reasons. However, the cafeteria operator was unable to attend the lecture as he was busy. Training of cafeteria staff and cafeteria support visits are part of a workplace cafeteria intervention to promote healthy eating among staff in a study by Lassen and colleagues (2003).

A corner of the cafeteria was designated as a health information centre, where posters on how to care for one's health through a good diet and physical activity were

exhibited. A tabletop calendar-style display of calories and fat content in common Malaysian foods and dishes was placed on cafeteria tables (See Appendix F). Health posters are used as a strategy to promote healthy behaviour in many studies (Anderson et al., 2009; Cox, 2003; Freak-Poli et al. 2011; McEachen et al., 2011) and information on calorie content in common foods also given to respondents in a similar study by Miller and colleagues (2015).

(c) ***Display of Health Posters***

Besides the dedicated corner at the cafeteria, as mentioned above, health posters were also placed at common areas. Health posters were to distribute knowledge on healthy behaviour (Anderson et al., 2009; Cox, 2003; Freak-Poli et al. 2011; McEachen et al., 2011). These included office bulletin boards, on notice boards along corridors and staircases. Information on calories in common foods was also given to workers, such as in a workplace intervention by Miller and colleagues (2015). Posters have been pre-tested and printed by the Ministry of Health of Malaysia. Their topics were healthy dietary intake, maintaining optimal physical activity and its benefits, exercising safely and prevention of disease through a healthy lifestyle. Also, posters were placed by staircases, encouraging physical activity through stair-climbing, instead of the elevator use. Encouragement of staircase use and stairway signs for this has also been used in other studies (DeCocker et al., 2010; Lemon et al., 2010). Posters on kilocalories burned from different physical activity were also placed at the gym.

Posters at the cafeteria were changed monthly and included:

- **1st month:** 'Food Pyramid for Balanced Diet' & 'Examples of Recommended Dietary Intake for a Day' (with calorie display).
- **2nd month:** 'Tips to Reduce Calorie Intake' (eg. reduce sugary drinks & drink plenty of water), 'Tips to Eat Healthily'.

- **3rd month:** 'Motivation to Achieve Ideal Body Mass Index' & 'Exercising Safely'.
- **4th month:** 'Ways to Achieve 10,000 Steps a Day' & 'Love Your Heart, Live Healthily'.
- **5th month:** 'Calories in Common Foods' & 'Walking is Good Exercise'.
- **6th month:** 'Exercising Properly to Reduce Injury'

3.2.10.2 Interpersonal level

Activities to be carried out at home with family and friends

Printed information on tips for increasing physical activity and exercising with family and friends were given together with the monthly motivational packs. Healthy recipes were also included so that respondents could try cooking healthily at home. A study by Arao and colleagues (2007) also promoted healthy eating by providing respondents with healthy recipes. While workers were not required to document whether they carried out suggested activities, during the evaluation process, workers were asked whether they tried out any tips with friends or family.

Co-worker support

Monthly motivational packs also included newsletters with congratulatory messages to those who achieved weight loss or increased their physical activity(Contents of monthly motivational packs are further explained in the next section3.2.10.3). Those who recorded good progress (such as those who increased their physical activity or showed weight loss) were invited to write words of encouragement to other colleagues to be included in the motivational packs. These words of encouragement provided co-worker support by sharing of experiences on how to be physically active or to improve their diets at home or at work. Co-workers also

motivated each other to continue to strive towards a healthier lifestyle by sharing what inspired them, advising others to stay motivated, the gains from leading a healthy lifestyle and to show to colleagues that it is possible to be active, eat well and lose weight. This intervention component was similar to a worksite intervention by French and colleagues (2010) who involved peers to mentor. However, in our study, as to reduce any disruptions to differing work commitments and schedules, we used the monthly motivational packs to deliver motivation from co-workers to fellow respondents. Monthly health education has also been used by Ramli and colleagues (2013) in an intervention among civil servants.

3.2.10.3 Intrapersonal level

At the intrapersonal level, workers were given monthly health information through leaflets and a telephone call to motivate them at mid-programme. This is a type of informational experience to promote healthy behaviour (Anderson et al., 2009; Cox, 2003). Other studies also used this method of information distribution (Arao et al., 2007; Dishman et al., 2009; Eakin et al., 2007;Freak-Poli et al., 2011; Goode et al., 2012; McEachen et al., 2012). While the health information was dispatched to workers on a monthly basis, a single telephone call at mid-programme, was made to advise and motivate workers to take care of their health. This was similar to an intervention among workers by Muto and colleagues (2006). Such a telephone call was delivered three months after the beginning of a worksite health programme (Muto et al., 2006). Systematic reviews of telephone call interventions to initiate and maintain physical activity and dietary intake has shown positive results for promoting such behavioural change. Such telephone call interventions were also used with other forms of interventions such as printed health materials to enhance workers' motivation levels

(Eakin et al., 2007; Goode et al, 2012; Pronk, 2012). The method for the telephone call is explained further in section (b) below.

(a) ***Monthly motivational flyers & health tips***

A health promotional information pack was sent to respondents every month through the office mail despatch. Monthly information distribution was also used in workplace health promotions by other studies (Maruyama et al., 2010; Ramli et al., 2013). Information was given with newsletters and included how to improve physical activity at work, home, alone or with family members. Newsletters have been used to promote health at other worksites (Lemon et al., 2010; McEachen et al., 2011). Tips to promote more physical activity at the office (incidental movement) were also provided, similar to a workplace intervention by Bort-Roig and colleagues (2014). Healthy recipes were provided from the Ministry of Health and Nutrition Society of Malaysia selection of healthy recipes book "Resipi Sihat, Pilihan Bijak" (Siong, 2002). Information on stress management was also given to respondents to improve the general well-being and reduce stress of workers. Information packs included pre-tested printed material by the Ministry of Health and were freely available to the public (See Appendix F). Topics covered every month included:

- **1st month:** Welcome newsletter to participants, 'Healthy Weight', 'Diabetes Prevention', 'Love Your Heart'& 'Motivation to Quit Smoking' pamphlets.
- **2nd month:** Motivation to reduce risks of non-communicable diseases through a healthy lifestyle. 'Reduce Sugar Intake', 'Eat More Fruits & Vegetables'& 'Reduce Fat Intake' pamphlets.

- **3rd month:** Motivation in newsletter to continue to improve physical activity and dietary intake. 'Stretching at Work', 'Healthy Lifestyle, Prevent Diabetes'& 'First Aid for Sports Injury' information.
- **4th month:** Results in newsletter regarding respondents who managed to lose weight and had good PA levels as seen in third month assessment. 'Tips for meeting 10,000 Steps Guideline', 'Reducing Weight Safely through PA and a Healthy Diet' & bookmarks with healthy PA and balanced diet information. Tips to include family members such as 'Tips to Reduce Sugar in Diet' (health pamphlets for housewives) & 'Exercise for the Elderly'.
- **5th month:** Motivation to take care of health to reduce risk of non-communicable diseases was provided. These included 'Healthy Recipes', 'Stress Management' & 'Relaxation Technique' pamphlets & 'Guide to Increase PA' booklet.
- **6th month:** Final newsletter which included results of those who managed to reduce at least 5% of body weight ("Top Weight Losers" winners) and had good PA levels ("Pedometer Challenge" winners). It also included motivational words from those who successfully lost weight or managed to achieve an active lifestyle. There was also sharing of successful experience of winners. Certificates of appreciation were given to all respondents of the programme. Congratulatory messages from the researcher were given to all who participated in the study till the end. Encouragmenet was also given to all to continue with efforts to maintain healthy lifestyle and achieve ideal body weight.

(b) ***Telephone calls***

After the 3rd month (mid-programme) assessments of outcomes, respondents received a telephone call from a nutritionist, to inform them if they had any improvements in physical activity levels or weight changes. Muto and colleagues (2006) used a similar phone call, at the third month, during their workplace health promotion to educate on nutrition and physical activity. Upon calling a respondent, they were asked if it were a suitable time to discuss about their progress in the programme or if they wanted to be called back at a more convenient time. During the call of about 15 minutes' duration, respondents were given motivation to continue to take steps to further improve or to maintain their activity levels for health. The nutritionist reminded workers of what foods to reduce in their diets such as fried foods, coconut milk and foods high in sugar, fat and salt. Workers were reminded to increase consumption of fruits and vegetables. They were also encouraged to consume foods prepared in a healthy manner, such as raw fruits and vegetables in salads, or foods that were steamed, stewed or boiled.Calls were made during office hours and in the evenings up till 6pm, to contact numbers provided by respondents (either an office number and/or mobile phone).Respondents were also contacted with the help of the organisation's operator, in case of a previously failed attempt to reach a respondent. Calls were repeated up to twice if they were unanswered. Respondents who were not contactable were considered as not participating in the mid-programme telephone calls for motivation.

3.2.10.4 Control Group

The control group was given minimum health promotion for ethical purposes.Health talks and pamphlets are commonly given to the public by health care workers in efforts to promote health. Both groups received similar health pamphlets and

talks throughout the study. The talks were a 2-hour talk on"Healthy Eating", given by a dietitian, a 2-hour talk on "Active Lifestyle" by a Sports Medicine Specialist and a 1-hour talk on "Obesity and Non-Communicable Diseases"by a physician. These health talks were given once at the beginning of the study. Pamphlets on healthy lifestyle and communicable diseases were made available for all respondents during the talks and assessments at baseline, 3rd, 6th and 9th months. The pamphlets were pre-tested and printed by the Ministry of Health of Malaysia and were available to the public for free. Health talks and pamphlets on health education are also given to controls in workplace health intervention studies (McEachen et al., 2011; Miller et al., 2015).

3.2.11 Programme Evaluation

The 'Healthy Worker Programme' was evaluated on its process, behavioural, health and organisational outcomes (CDC, 2015; Craig et al., 2008). :

a) Process (eg. retention rate in the programme, participation in different programme components and participation in different data collections). Changes towards a "healthy cafeteria' was carried out every three months at baseline, mid-programme (3rd month), programme end (6th month) and post-programme (9th month), using the 'Healthy Cafeteria Evaluation Checklist'. (Appendix E). A post-intervention feedback was used to collect data on the usefulness of programme components to respondents (See Appendix H). A qualitative inquiry was undertaken after the programme ended to determine barriers to to improving dietary intake and physical activity while participating in the programme.

b) Behavioural and health outcomes (dietary intake, physical activity, weight and BMI changes).

c) Organisational outcome (effects on the organisation in terms of quality of working life).

3.2.11.1 Process evaluation

Process evaluation was conducted throughout the intervention. Self-administered questionnaires were used to collect demographic details such as: age, gender, race, job designation, marital status, income level (See Appendix G). A respondent's feedback form was distributed to facilitate in evaluating the programme (See Appendix H). Process evaluation included participation rates in different types of intervention (eg. reading of monthly motivation, phone call motivation, involvement of family members, use of healthy recipes), response rates and feedback on how useful an intervention was for respondents. The cafeteria was also evaluated on healthy changes during the intervention. A surprise check on the cafeteria was carried out at baseline and at the third month (mid-programme), sixth month (programme end) and ninth month (post-programme). A "Healthy Cafeteria Evaluation Checklist" was used for this evaluation (Ministry of Health, 2011) (See Appendix E). Feedback was given to the cafeteria operator to continually encourage provision of healthy food options for employees. The outcome of the programme at the workplace was assessed in terms of its effects on the quality of working life.

The qualitative interview was a small component of the evaluation, to determine barriers to improving physical activity and dietary intake, even with a workplace programme.The in-depth interviews were carried out at the end of the programme. Bort-Roig and colleagues (2014) also used a qualitative method to explore barriers to uptake of their strategy to sit less and move more at the workplace in their process evaluation.

It was important to know these barriers as it may show weaknesses of the programme and steps to improve the programme can be taken by tackling these barriers.

Face-to-face, brief, in-depth interviews were held at the intervention site, in a meeting room, to understand barriers to improve physical activity and energy intake among respondents at the intervention site, despite having a workplace health programme in place. In-depth interviews were preferred instead of focus group discussions as the respondents had varying work schedules and commitments. Interviews were carried out by the researcher, who is a female physician with a Masters in Public Health degree and has undergone training for use of qualitative inquiries for public health research. The researcher is also the overall coordinator for the workplace health programme and is known to the interviewees. The researcher has also met with the respondents during the program activities.

Interviewed subjects were selected purposively, including both genders and of different backgrounds, categories of staff, and levels of achievement in the programme. The interviews lasted about forty-five minutes. Interviews with respondents were held until no new information was gathered from them, that is until saturation point. Ten persons were interviewed and there were no refusals to be interviewed. No other person was present except the interviewer and interviewee. Interviews were audio-recorded and transcribed verbatim. Questions asked were:

What would you say were barriers for you to:

i) Take care of your dietary intake?

ii) Maintain good physical activity level?

The researcher coded the data. Data was analysed thematically from the content, using the cutting and sorting method (Gantley et al., 1999; Tong et al., 2007). Data was

reported with reference to the "Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines (Tong, Sainsbury & Craig, 2007).

3.2.11.2 Health and behaviour outcomes

For impact on health and behaviour, anthropometric measurements and physical activity were assessed at baseline, third (mid-programme), sixth (programme end) and ninth months (post-programme). Dietary intake was carried out at baseline, sixth and ninth months. It was not conducted at the third month (mid-programme) as to reduce the number of records that respondents had to fill at this time period to reduce respondent fatigue.

(a) ***Anthropometric measurements***

Anthropometric measurements of weight, height and body mass index were conducted as prescribed in the Ministry of Health manual for assessments of non-communicable disease risks (Ministry Of Health Malaysia, 2007). Weight and height was measured using a digital scale and stadiometer (Seca, Model 7802321008, Hamburg, Germany). The scale was calibrated and checked prior to each use with a weight stone (1 kg weight). The scale was placed on a flat and firm surface of the floor. Before weighing, respondents were asked to remove their shoes, jackets and heavy items in their pockets such as wallets, hand phones and keys. Weight was recorded to one decimal point in kilograms (kgs).Weight loss will also be calculated by subtracting the weight at the assessment period from the baseline weight. As much as five to ten percent reduction of initial weight is recommended for overweight and obese individuals (MOH, 2013; NCCFN, 2010). For height measurement, respondents were asked to remove their shoes, and stand on the stadiometer with their heels, back of their

shoulders and head touching the height rod. Height was recorded to the nearest half centimeter using the SECA stadiometer.

Body mass index (BMI) is an index of weight-for-height and is a useful population measure that is used to classify whether an adult is overweight or obese. It is used for both genders and for all ages of adults. It is however, considered as a rough guide as it may not correspond to the same degree of fatness in different persons (WHO, 2015). Body mass index was calculated using the following formula and classified following the Ministry of Health Clinical Practice Guidelines for Obesity (2004) as in Table 3.1 (MOH, 2004).

$$\textbf{BMI} = \frac{\text{Weight (in kg)}}{\text{Height (in metres)}^2}$$

Table 3.1 BMI classification following Clinical Practice Guidelines 2004 (MOH, 2004)

Classification	BMI (kg/m^2)	Risk of co-morbidities
Underweight	<18.5	Low (but increased risk of other clinical problems)
Normal	18.5-22.9	Average
Overweight:	≥23.0	
At Risk	23.0-27.4	Increased
Obese I	27.5-34.9	High
Obese II	35.0-39.9	Very high
Obese III	≥40	Extremely high

(b) ***Physical activity (PA) levels***

To determine the impact of the programme on physical activity levels, any improvement of mean steps per day and overall physical activity level was determined as follows.

i Mean steps taken per day (objective measurement)

The YAMAX CW-700 pedometer (Yamax Cooperation, Tokyo, Japan) was used for the recording of respondents' steps per day. The model resets itself to '0' steps at mid-night and does not require respondents to 'start' or 'stop' its step-counting function. It also has a memory recall for the records of each of the last seven days (Oliver et al., 2011). The Yamax CW-700 is one of the brands reported suitable for measurement of physical activity (Schneider, Crouter & Bassett, 2004). Respondents used the pedometer for seven days consecutively, from the moment they woke up until they slept at night. The pedometers were worn at the hip, on a belt or at the waist of their skirts. They were only allowed to remove their pedometers when bathing, sleeping, swimming, during contact sports or when there was excessive shaking, such as when they were riding motorbikes. They recorded the number of steps they took for the day before going to bed at night (before midnight). An average of the seven days' record was calculated. (See Appendix I). It was found that at least three days of record was needed to estimate a person's PA (with a correlation of 80%). Records with at least three days were included in the analysis (Tudor-Locke, 2005).Step data was cleaned by removing records of steps less than 100 or more than 50,000 steps per day (Basset et al., 2010). Besides observing average daily step counts, respondents were also categorised into those who achieved 10,000 steps per day as recommended by Tudor and colleagues (2004). Respondents were informed to call the researcher in case of problems with their pedometers. Faulty pedometers were replaced as soon as possible, usually the following day.

ii Overall PA level (subjective measurement)

In assessing overall physical activity using a questionnaire, van Poppel and colleagues (2010) reported that no questionnaire appeared to be superior to another. However, the International Physical Activity Questionnaire (IPAQ) is one of the most widely validated and used physical activity questionnaires (van Poppel et al., 2010). It was originally validated in 12 countries and showed acceptable reliability and validity comparable to other questionnaires for physical activity among 18 to 65 year old individuals in diverse settings (Craig et al., 2003). It has a long (31-item) and short (9-item) version (van Poppel et al., 2010). The short IPAQ form was recommended for national monitoring (Craig et al., 2003). It has been translated into many languages such as Arabic, Greek, French, German, Korean, Malay and Spanish (IPAQ, 2011). The validated Malay version of the IPAQ short form was chosen for this study as it is less time consuming so as to reduce respondent fatigue. The short form of the IPAQ was also used in other workplace interventions (Bort-Roig et al., 2014; Dishman et al., 2009).

For overall PA levels, the IPAQ asks respondents to recall how many days and the duration spent on walking, moderate and vigorous activity in the last seven days. PA will be calculated as 'MET-minutes per week' which can be categorized as low, moderate or high PA levels. As in the IPAQ guideline, only completed forms will be analysed. Incomplete forms or those where respondents tick "unsure" for the number of days or duration for a type of physical activity were not analysed (IPAQ, 2010). (See Appendix J and K).

(c) ***Dietary intake (energy intake, micro- and macronutrients)***

To examine the impact of the program on dietary intake, respondents were asked to record everything they ate or drank for three days, that is two working days and one day at the weekend. The diet record method was a relatively easy method to be implemented at the workplace and has been shown to reduce errors in food reporting and quantification, compared to the 24-hour recall and food frequency method (Crawford et al., 1994). Respondents were given a booklet with pictures of examples of portions of common food and drinks, based on the "Atlas of Food Exchanges & Portion Sizes" (Suzana et al., 2009). This included the different sizes of plates, bowls, cups, mugs, spoons and ladles. It also contained pictures of the types of food such as types of apples, oranges or fish. Small, medium and large sizes of food or servings were shown, such as for seafood, fruits and rice. They were taught how to usethe booklet for reference to record the amount and type of foods consumed. (See Appendices L and M).

Diet records were analysed for average energy, macro- and micro-nutrients daily intake by a nutritionist trained to use the Nutritionist Pro computer software (Version 3.0, Axxya Systems, USA, 2007). The Nutritionist Pro database includes several international food databases including typical Malaysian foods and the Malaysian Food Composition Tables. For any processed or packaged foods, information from their nutrition labels were entered into the software directly (Mirnalini et al., 2008). For local dishes that were not available on the database, the recipes were obtained from local recipe books and energy and nutrient content analysed using the Malaysian Food Composition Tables (Tee et al., 1997). The nutrients analysed were protein, carbohydrate, fat, sodium, sugar, fiber, iron, vitamin C and calcium. Only completed 3-day records were analysed. The nutritionist involved in nutrient analysis and keying in of data was blinded to which group the respondents were assigned to and the

intervention, to ensure both groups were treated equally and coded numbers were used during data entry to reduce bias. The data entered was checked by the researcher.

3.2.11.3 Quality of working life outcome among workers in the organisation

The changes in quality of working life (QOWL) among respondents were assessed at baseline, third (mid-programme), sixth (programme end) and the ninth months (post-programme). The validated Malay Work-related Quality of Life Scale-2was used to assess the quality of working life of respondents (See Appendix N and O). The average quality of working life score was used to detect any changes. Changes to factors of QOWL, such as job and career satisfaction, general well-being and stress at work, were also assessed.

Respondents who had incomplete forms or ambiguous answers were contacted and asked to complete their forms either verbally, giving the answers through a telephone call or through a meeting to complete them. The respondents were contacted up to two times to ask to complete or clarify their answers.

3.2.12 Operational definitions

Physical activity (PA): Physical activity is any body movement that works the muscles and uses more energy than at rest. Examples include swimming, walking, gardening and running (U.S. Department of Health & Human Services, 2000).

Quality of Working Life (QOWL): 'Quality of Working Life' is that part of overallquality of life that is influenced by work. It is more than just job satisfaction or work happiness, but the wider context in which an employee would evaluate their work environment (Van Laar et al., 2007).

3.2.13 Study variables

Independent variables: gender, height in metres (m), job designation, age, race, marital status, workplace, education level, number of dependents, household income, presence of chronic illness, participation in an exercise programme and participation in a weight loss programme.

Dependent variables:

Anthropometric measurements: Weight in kilogrammes (kg) and body mass index (BMI) (kg/m^2)

Physical activity (PA) level: Average steps taken per day, metabolic equivalent minutes per week (MET-mins/week) andphysical activity level category (low, medium, high).

Dietary intake: Average daily energy intake (kcal), average daily intake of protein, carbohydrate, fat, iron, sodium, vitamin C, sugar, sodium, calcium and fibre (in grams or milligrams).

Workplace outcome: Quality of working life scores (using the Work-Related Quality of Life Scale-2).

Process evaluation: Response rates and percentage of participation in intervention. Observation of changes at cafeteria, barriers to improvement of physical activity and dietary intake.

3.2.14 Data entry and analysis

Data coding, entry and analysis was carried out using the IBM-SPSS statistical software version 16.0 (SPSS Inc., Chicago, IL, USA). Data was entered by a trained research assistant who was blinded to the intervention. The database was later checked for errors, missing data and outliers by the researcher. Data analysis was carried out

using ‘modified intention to treat’. Modified intention to treat is being used in the analysis of some randomised controlled trials. Intention to treat analysis have been reported to be used in a modified manner such as analysing respondents who have baseline assessments or respondents who have at least one measurement post-baseline. This type of method has been used to due to missing data problems (Abraha et al., 2010). In this study there were four assessments, that is at baseline, mid-programme (third month), programme end (sixth month) and post-programme (ninth month). Respondents at the workplace may have had other commitments and could not come on some of the assessment dates.

Respondents with baseline data and at least two out of three follow-up data for weight, BMI, physical activity and QOWL outcomes, were included in the analysis. For dietary intake (where there was no mid-program assessment), respondents with baseline and at least one more follow-up data was included. Missing data was managed with ‘Last Observation Carried Forward’ (LOCF), with the assumption that there has been no change since the last observation. LOCF is a commonly used method of data imputation which is potentially useful in longitudinal studies, especially with multiple assessments (Yeatts & Martin, 2015). This method of missing data management was also used in other weight loss studies (Astrup et al., 2009; Greenway et al., 2010).

Data was analysed for frequencies and demographic details. For continuous variables, data was tested for normal distribution. Categorical variables were analysed using Chi-square test.Outcomes were compared to baseline for any change, in both groups (Linde et al., 2012; Miller et al., 2015; Morgan et al., 2011). Analysis of variance (ANOVA) for repeated measures was carried out to determine differences within and between groups for the follow-up assessments (Miller et al., 2015; Murray et al., 2004). Repeated measures analysis of covariates (ANCOVA) was used to determine

differences in outcomes within and between groups while controlling for characteristics between worksites which differed significantly at baseline (Statistics Solution, 2015). Drop-out analyses were carried out using the independent samples t-test and chi-square tests to determine if there was any difference between the characteristics of those who participated throughout and those who dropped out of the study (De Cocker et al., 2010). Results were presented using 0.05 as the level of significance and 95% confidence intervals.

For estimating effect size, relative risk (RR) ratios were used as the study was a prospective one and relative risk is useful to determine magnitude, direction and relevance of effects. Relative risks are easily interpreted and consistent with how clinicians usually assess treatment efficacy (McGough & Faraone, 2009). The relative risk is the ratio of the probability of participants who had improved (such as lost at least 5% of weight or reached a target of 10,000 steps a day) in the program divided by the probability of participants who improved in the control group.

$$\textbf{RR} = \frac{\text{Probability of participants improving in the 'Healthy Worker Programme'}}{\text{Probability of participants improving in the control group}}$$

The 'partial eta squared' was used to determine effect size in ANOVA repeated measures analysis (Laerd Statistics, 2013). 'As per protocol' analysis was also carried out after analysis by 'modified intention to treat'. This was planned a priori to determine if significance of results occurred with a different approach to analysis.

In-depth interviews were transcribed verbatim. Data was coded by the researcher. Thematic analysis was conducted from the transcribed conversation, to

determine barriers to workers to improve their physical activity and dietary intake using the cutting and sorting method (Gantley et al., 1999).

3.2.15 Ethical considerations

Ethical approval was granted by the Medical Ethics Committee of University Malaya Medical Centre, Kuala Lumpur (Reference Number: 860.4). This study was funded by the Postgraduate Research Fund of University of Malaya (Grant Number: PV095 2011A). An information sheet regarding the study was given to all respondents with contact details of the researcher if they had any queries. An informed consent was required from respondents to participate in the study (See Appendices P&Q). Respondents were screened for fitness to exercise using the PAR-Q questionnaire (See Appendix B). Questionnaires were self-administered and labelled by identification numbers only to protect the confidentiality of the respondents' information. Respondents could exit the study at anytime they wanted to. Both intervention and controls were given healthy lifestyle pamphlets and talks during the study.

CHAPTER 4: RESULTS

Results are presented according to the phases of the study. Phase I was the validation of the Work-Related Quality of Life Scale-2. Phase II of the study was the 'Healthy Worker Programme', where the scale was used to determine if there were any changes in quality of working life among workers in the weight-reduction programme. Phase II results consist of the evaluation of the 'Healthy Worker Programme', its process evaluation, behaviour and health effects and impacts on the organisation in terms of quality of working life (QOWL) changes.

4.1 Phase I: Validation of the Malay Work-Related Quality of Life Scale-2

A total of 305 workers returned their questionnaire forms (90% response rate), consisting of 150 health care workers and 155 office workers. A total of 11% of cases had at least one randomly missing value in their WRQLS-2 responses and were removed, leaving a total of 272 cases for analysis (142 healthcare workers and 130 office workers). The data for quality of working life was normally distributed. The socio-demographic details and working characteristics of respondents are shown in Table 4.1 and 4.2, respectively. The respondents were mostly females, Malay and worked in the public sector. The majority did not suffer from any chronic illnesses or have any disability. Most did not have any dependents at home. Their health and number of dependents can affect their QOWL through the'General Well-Being' (GWB) and Home-Work Interface' (HWI) factors respectively.

Table 4.1 Socio-demographic details of respondents (Phase I)

Characteristics		N (%)
Mean Age, **s.d.**(years)		31.9 , s.d.=9.1
Sex:	Male	88 (32 %)
	Female	187 (68 %)
Ethnicity:	Malay	239 (87%)
	Indian	17 (6%)
	Chinese	13(5%)
	Others	5 (2%)
Education Level:	High school	74 (27%)
	Pre-university	106 (39%)
	University degree	82 (30%)
	Post-graduate	10 (4%)
Marital status:	Single	111 (41%)
	Married	154 (57%)
	Widowed/Separated	7(2%)
Dependents:	None	98 (36%)
	Infants	45 (17%)
	Pre-school & School-going children	24 (9%)
	Elderly	39 (14%)
	Disabled & Other types	17 (6%)
	More than one type of dependent	50 (18%)
Disability:	No	271 (99.6%)
	Yes	1 (0.4%)
Has chronic disease (eg. high blood pressure, asthma, diabetes, heart disease):	No	228 (84%)
	Yes	44 (16%)

Table 4.2 Working characteristics of respondents in Phase I

Characteristic		N (%)
Background:	Healthcare worker	142 (52%)
	Office worker	130 (48%)
Sector:	Public	178 (66%)
	Private	94 (34%)
Mean duration of work at current worksite,s.d.(years)		6.75, s.d.= 8.03
Monthly income (Ringgit Malaysia, RM)*:	1500 or less	65 (24%)
	1501-3000	137 (50%)
	3001-4500	45 (16%)
	4500-6000	13 (5%)
	>6000	14 (5%)
Working Conditions:	Full time	263 (98%)
	Part time	5 (2%)
Permanent/Contract:	Permanent	207(76%)
	Contract	65 (24%)
Shift Work:	Yes	91 (34%)
	No	181 (66%)
Weekly working hours:	<20	7 (3%)
	20-40	78(29%)
	41-50	138(50%)
	51-60	27(10%)
	>60	22(8%)

** Note: RM 4.4 is equivalent to 1 U.S. Dollar (January 2016 currency exchange)*

Measurement model

In the first phase, the confirmatory factor analysis (CFA) showed poor fit of the data to the original 7-factor model. (See Figure 4.1). Of the fit indices, only RMSEA showed a fit, RMSEA= 0.075 (≤0.08). The results of other model fit indices were Relative Chi-square =2.5, GFI=0.78, AGFI=0.74 and CFI=0.82.

The relevance of its items within their own construct was determined by exploring each measurement models for uni-dimensional fit of items in a construct. Three items (items 1,3 and 8) were low loading (<0.6) and removed from the 'Job & Career Satisfaction' (JCS) construct. One item "I have unachievable deadlines", was

removed from the 'Stress at Work' (SAW) construct due to low loading. This item may be irrelevant among some categories of staff which do not have deadlines, such as in the case of most healthcare workers where patient care is continuous with passing over of responsibilities to the next shift. Two low-loading items (items 4 and a negatively-phrased item 9) were removed from the 'General-Well-Being' (GWB) construct to improve model fit. Two items (item 25 and 29) were removed from the 'Employee Engagement' (EEN) construct. Constructs with more than three items were tested for unidimensionality. The AMOS software can only test unidimensionality if there are more than four items in a construct (Awang, 2013). Fitness indices showed good unidimensionality in JCS, WCS, GWB, EEN and SAW.

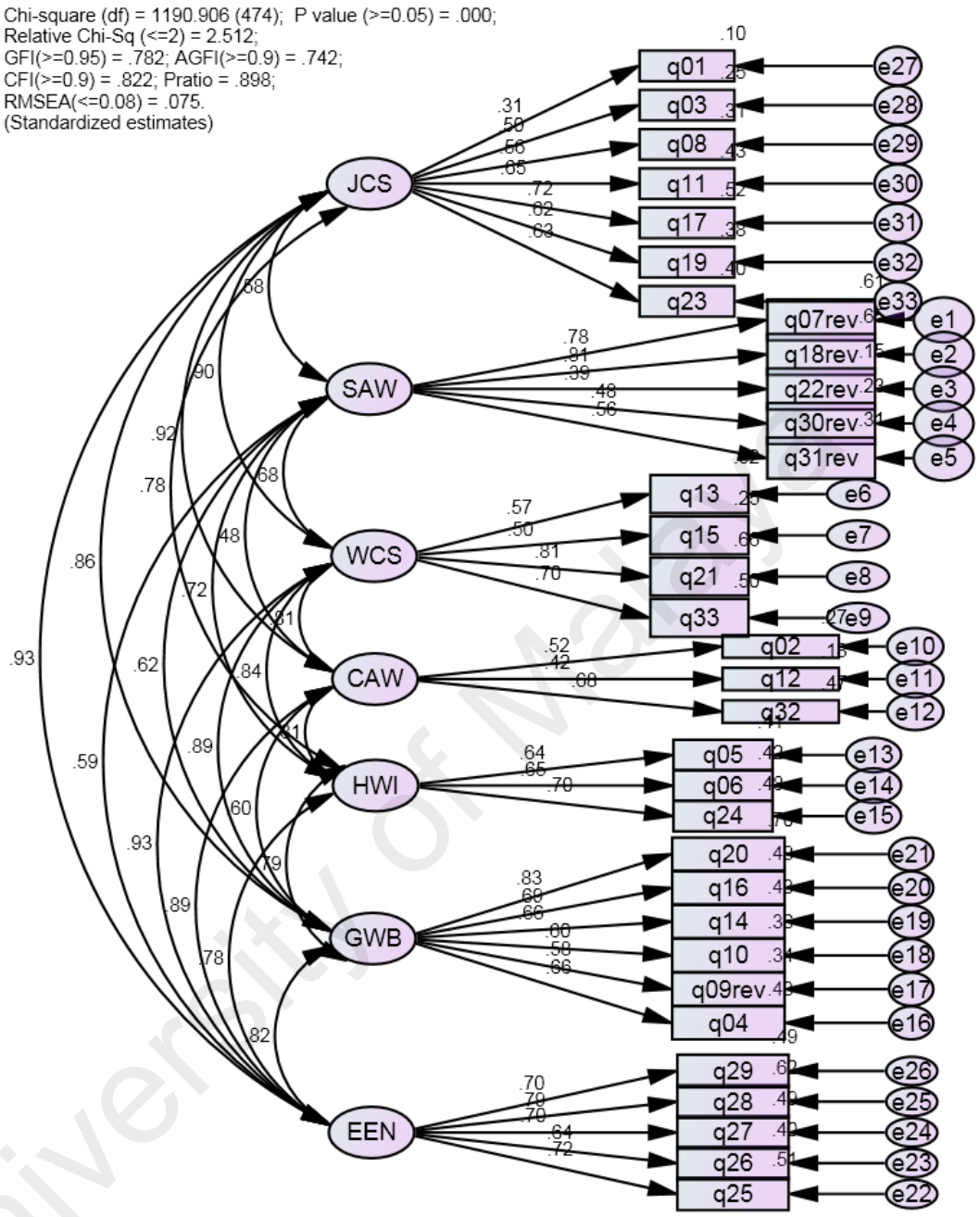

Figure 4.1 Confirmatory factor analysis to test fit of Malaysian data to the original 7-factor model

Upon checking each construct's correlation with another construct to determine discriminant validity, it was found that there was multicollinearity between JCS and the 'Working Conditions' (WCS) and 'Control at Work' (CAW) constructs. However, the CAW items were relatively low-loading as compared to other item loadings. WCS also showed multi-collinearity with GWB and EEN constructs. For further clarification, a factor extraction was carried out, including all items found relevant for the constructs, as previously explained. The Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity was referred to. The KMO value was 0.925 indicating sampling adequacy and Bartlett's test showed that the correlations between items were sufficiently large to conduct an EFA ($p<0.001$). Thus the model could be reduced into dimensions.

The factor extraction resulted in a 5-factor model. These factors were GWB, EEN, SAW, HWI and one factor which had both JCS and CAW items. There was a clear grouping of items belonging to GWB which was the strongest factor and EEN items. However, only two SAW items were extracted, that is "I often feel pressured at work" (item 7) and "I often feel excessive levels of stress at work" (item 18). The HWI construct was also extracted with two items, whichwere items 5 and 6. There was a cross-loading of two items from SAW into the HWI group. These SAW items were "I am pressured to work long hours" (item 30) and "I have unrealistic time pressures" (item 31). These two SAW which cross-loaded were removed.

One factor extracted, which was the second strongest, was a mix of three JCS and three CAW items. As it was shown that there was multicollinearity between the JCS and CAW constructs, and the CAW items had low loadings during pooled analysis, it was decided to omit the CAW from the model, as it was redundant and multicollinear with JCS. Only one item was extracted from the WCS construct, but it cross-loaded

with GWB. As it was shown earlier that WCS was multicollinear with JCS, GWB and EEN, it was decided that it was a redundant construct for the final model.

A Work-Related Quality Of Life Malaysian model was created with five factors: GWB, JCS, EEN and HWI and SAW. The items which were extracted with no cross-loadings were included in the model. The fit indices showed good fit: Relative Chi-sq=1.6 (≤2), GFI =0.95 (≥0.95), AGFI=0.92 (≥0.9), CFI=0.97 (≥0.9), RMSEA=0.05 (≤0.08) (See Table 4.3 and Figure 4.2).

Table 4.3 The fitness indices for the new measurement model

Name of category	Name of Index	Index Value	Comments
1.Absolute fit	RMSEA	0.05	
	GFI	0.95	
2.Incremental fit	CFI	0.97	The required levels were achieved
	AGFI	0.92	
3.Parsimonious fit	Chisq/dif (Relative Chi-square)	1.6	

For convergent validity and also reliability, the average variance extracted (AVE) for all factors were 0.5 or more.(See Table 4.4). For construct validity, all fitness indices for the models have met the required level.For discriminant validity, redundant items have been deleted and the correlation between constructs in the final model is less than 0.85(See Figure 4.2). However, as shown in the Discriminant Validity Index Summary (Table 4.5), the diagonal values (in bold) is the square root of the AVE while the other values are correlation between respective constructs. The discriminant validity for all the constructs is achieved when the diagonal value (which is in bold) is higher than the values in its row and column.There appears to be good correlation between JCS and GWB, probably due to the inter-relationship of these two factors, but not to the

extent of multicollinearity of these factors within the model (less than 0.85). There is good discriminant validity for other constructs.

For internal reliability, the Cronbach Alpha and composite reliability (CR) were all 0.7 or more except for HWI, which was 0.6. However, for composite reliability, all the values were at least 0.6 or higher, indicating good reliability. Results from 1000 bootstrap re-samples showed good cross-validity of the new model, too (Bollen-Stein bootstrap $p = 0.14$). The new Malay validated Work-Related Quality of Life Scale-2 is shown in the appendix. (See appendices N and O).

The overall QOWL was determined by calculating the average scores of factors for respondents. There was a strong, significant correlation between the QOWL and the final item of the scale, "I am satisfied with the overall quality of my working life" which reflected perceived QOWL ($r=0.7$, $p<0.001$). This last item was also included in the scale. The Malay Work-Related Quality of Life Scale-2 was used to assess the organisational outcome of quality of working life among respondents of the study.

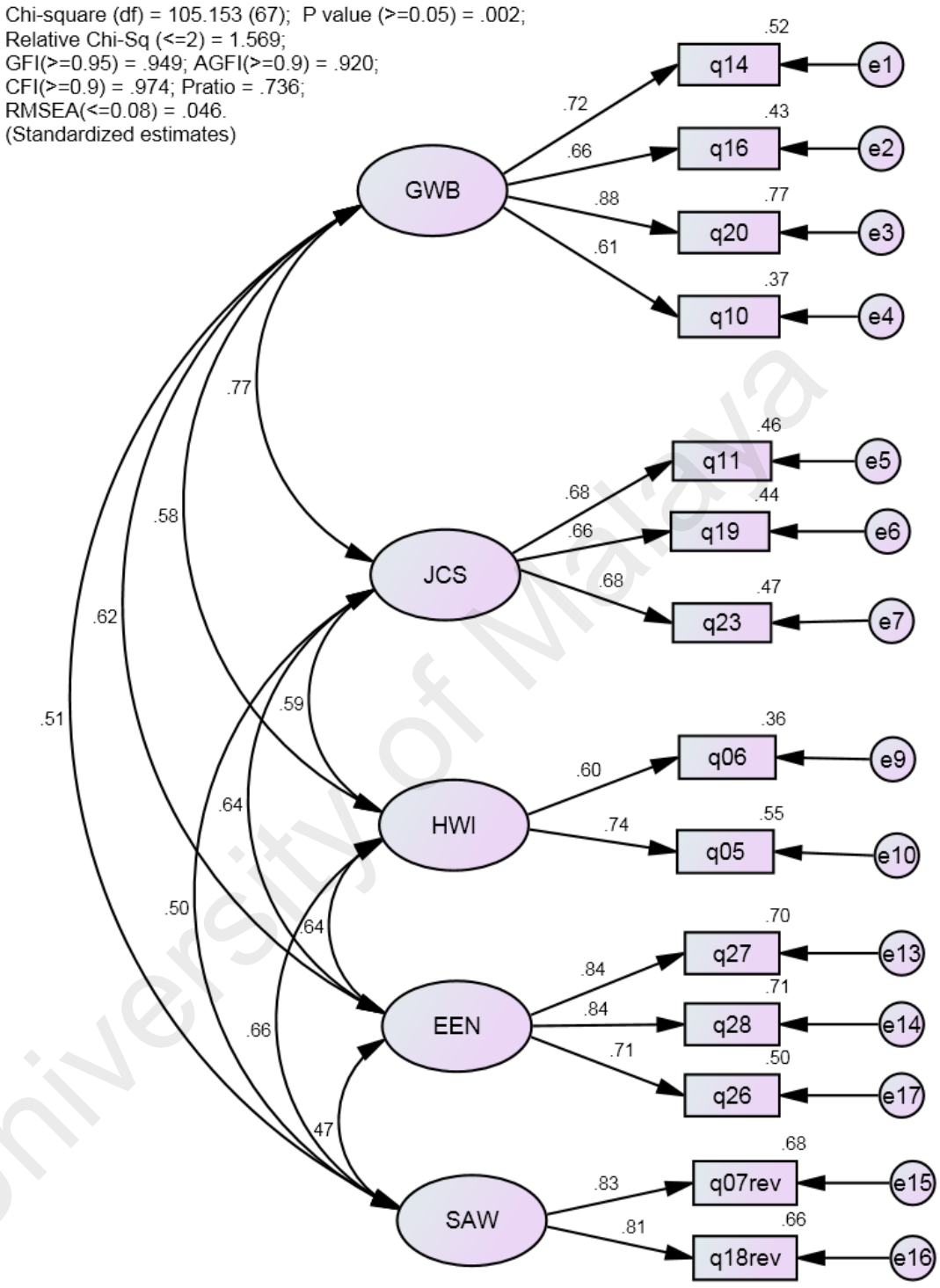

Figure 4.2 The new measurement model for the MalaysianWork-Related Quality of Life Scale-2

Table 4.4 The confirmatory factor analysis (CFA) summary for all constructs

Construct	Item	Factor Loading (L) (standardised)	Cronbach's Alpha (>0.7)	Composite Reliability (>0.6)	AVE (≥0.5)
Job & Career Satisfaction (JCS)	Q1	Items deleted due to low factor loadings	0.71	0.71	0.5
	Q3				
	Q8				
	Q17	Item deleted due to cross-loading			
	Q11	0.68			
	Q19	0.66			
	Q23	0.68			
Stress At Work (SAW)	**Q7(rev)**	0.83	0.8	0.80	0.7
	Q18(rev)	0.81			
	Q22(rev)	Item deleted due to low factor loading			
	Q30(rev)	Items deleted due to cross-loading			
	Q31(rev)				
Employee Engagement (EEN)	**Q26**	0.71	0.84	0.84	0.6
	Q27	0.84			
	Q28	0.84			
	Q25	Items deleted due to cross-loading			
	Q29				
General Well-Being (GWB)	**Q10**	0.61	0.81	0.81	0.5
	Q14	0.72			
	Q16	0.66			
	Q20	0.88			
	Q9(rev)	Item deleted due to cross loading			
	Q4	Item deleted due to low factor loading			
Home-Work Interface (HWI)	**Q5**	0.60	0.61	0.62	0.5
	Q6	0.74			
	Q24	Item deleted due to cross loading			
Control At Work (CAW)	Q2	Constructs deleted due to extremely high correlation (multicollinearity) with JCS.		--	--
	Q12				
	Q32				
Working Conditions (WCS)	Q13				
	Q15				
	Q21				
	Q33				

Note: 'rev' refers to reversed items when calculating scores; items in bold included in new scale.

Table 4.5 The discriminant validity index summary

Construct	JCS	SAW	EEN	GWB	HWI
JCS	**0.68**				
SAW	0.50	**0.82**			
EEN	0.64	0.47	**0.80**		
GWB	0.77	0.51	0.62	**0.72**	
HWI	0.59	0.66	0.64	0.58	**0.68**

4.2 Phase II: Evaluation of the 'Healthy Worker Programme'

The 'Healthy Worker Programme' was evaluated for its process (such as the uptake of its intervention components and retention rate in the programme), its impact on behavior, health and quality of working life (QOWL). QOWL is that part of quality of life that is influenced by work. QOWL is important to retain and attract workers to a worksite (Van Laar et al., 2007). Good health and a healthy lifestyle are beneficial to the workers, while a satisfactory quality of working life will attract workers to be more committed to the organisation and to continue working there. The results for the primary (weight and body mass index) and secondary outcomes (physical activity, dietary intake and QOWL) are preliminary data.

4.2.1 Process Evaluation

Both the intervention and control sites were government offices, located about an hour apart from each other to reduce contamination, within the nation's Federal Territories. The intervention site was a government administrative training facility while the control site was a national registration centre for births, deaths and marriages. There were approximately 500 and 1000 workers at the intervention and control sites respectively. Both had a gym,cafeteria, elevators and accessible stairs for worker use. Indoors, both work sites had long corridors and outdoors they were surrounded by paths and walkways as opportunities to walk about and increase their physical activity at

work. Both worksites participated in sports events organised by the government throughout the year. While most of the workers were officers and had desk-bound jobs, there were also support staff at both worksites such as technicians, despatch workers, clerks, drivers, guards and cooks. Most worked five days a week, while there were workers who worked at weekends. Those working at the weekend provided accommodation services at the intervention site, while at the control site, they were drivers, security guards or manned registration counters.

A total of 283 workers enrolled into the study, 132 at the intervention and 151 at the control site. There was approximately a participation rate of 26% (n=132) out of 500 staff at the intervention site and 15% (n=151) out of 1000 staff at the control site. Their mean age was 43 years (s.d.=11) at the intervention site and 40 years (s.d.=12) for the controls. The respondents were mostly Malays and married. There was similar gender distribution in both groups. At the intervention site, there were more respondents who had a higher degree and income. Between the two groups, there was no significant difference of dependents the respondents had. There were similar small proportions of those who had chronic illnesses, involved in slimming programs or an exercise programme. A summary of the socio-demographic details of the respondents are in Table 4.6.

The 'Healthy Worker Programme' was conducted as planned over six months' duration with monthly motivation distributed via office mail and a telephone motivation call carried out at mid-programme. The organisation provided support in coordinating venues for assessment of outcomes and delivery of prizes to workers who lost much weight. The organisation also had a health promotion booth during one of its corporate events which was open to the public to promote a healthy lifestyle. Environmental

modifications were carried out as planned. A more detailed evaluation of the cafeteria is explained later in this chapter.

As the 'Healthy Worker Programme' was six months long, with an assessment at the 9th month to look at sustainability of changes, the numbers of dropouts were recorded during the 6th month assessment. The dropouts included respondents who contacted the researchers to opt out of the study, reported that they were pregnant or had an illness which affected their ability to walk or participate in moderate physical activities, or ceased to work at the study sites. There was one death among the controls, this was due to cancer. The worker was in remission when she entered the study, however, her cancer worsened later and was not related to her participation as a control in the study. There were 18 (14%) and 21 (14%) dropouts from the intervention and control sites, respectively, at the end of 6 months (See Figure 4.3). This translated to a retention rate of 86% in the 'Healthy Worker Programme' and controls.

Table 4.6 Socio-demographic details of respondents who enrolled into the study (Phase II)

Characteristic		Intervention (n=132)	Controls (n=151)
Gender	**Male**	51(39%)	69(46%)
	Female	81(61%)	82(54%)
Mean age (years)		42.55 (sd=10.58)	39.52 (sd=12.07)
Ethnicity	**Malay**	122 (93%)	146 (97%)
	Other ethnicity	10 (7%)	5(3%)
Education Level	**SPM or lower**	43(35%)	69 (48%)
	Pre-university/ diploma	33(27%)	44(30%)
	University/ postgraduate	46(38%)	32(22%)
Marital Status	**Married**	105(80%)	108(73%)
	Not married	26(20%)	40(27%)
Monthly Household Income (RM)	**1500 or less**	18(14%)	34(23%)
	1501- 3000	42(32%)	49(33%)
	3001- RM6000	37(28%)	46(31%)
	>6000	32(18%)	19(9%)
Dependents ***(Example of types of dependents: infants, children, elderly, disabled)***	**None**	43 (34%)	50 (35%)
	Yes (one type)	61 (48%)	64 (45%)
	Yes(more than one type)	23 (18%)	29 (20%)
Has a chronic illness ***(eg. Diabetes high blood pressure, asthma)***		47(36%)	41(27%)
Attending a gym/exercise programme:		21(16%)	25(17%)
Involved in slimming programme:		8(6%)	10(7%)

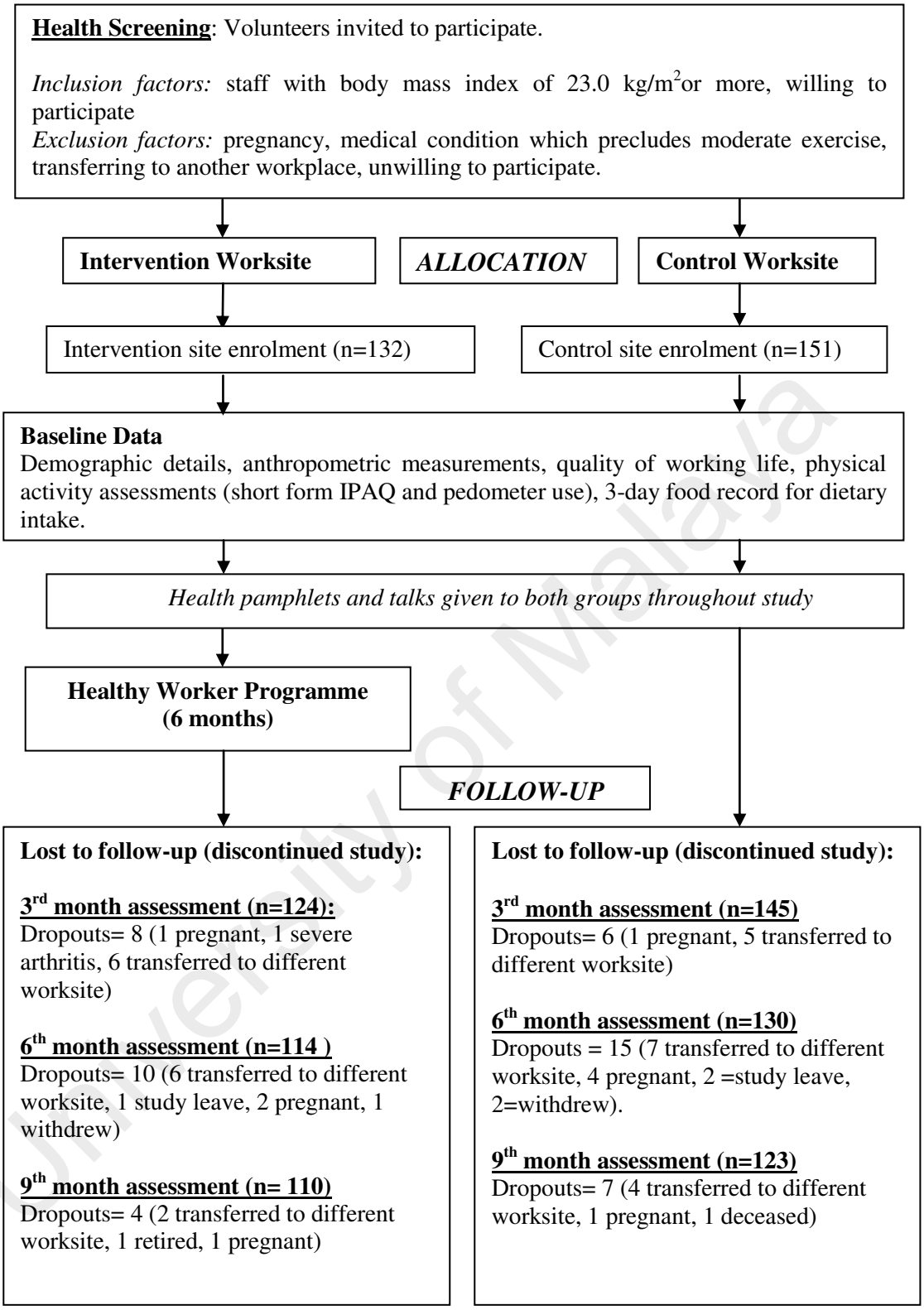

Figure 4.3 Flowchart of study (including dropouts)

It was challenging for workers to take part at every 3-monthly assessment in a work environment. Efforts were made such as allowing up to three days for workers to come for assessments at a designated area. If they did not come on the scheduled three days, meetings were held at their individual departments to assess them. However, there were times when they could not be met due to conflicting work schedules and work commitment. Results were analysed based on modified intention to treat, where data included in the analysis were those who were assessed at baseline and two out of three of the following assessments (3^{rd}, 6^{th} and 9^{th} months). For dietary analysis, where diets were re-assessed at programme end (6^{th} month) and at the 9^{th} month, respondents with baseline and at least one of the following two assessments' records (6^{th} and 9^{th} months) were analysed (See Figure 4.4). Missing data was imputed with values from their last reading. For the outcomes of weight (and BMI), steps taken per day and QOWL, there was approximately 10% missing data. For energy intake and overall PA level (using IPAQ), there was 18% and 17% missing data respectively.

Anthropometric measures were easier to obtain from working respondents compared to self-administered questionnaires and records. Checking for weight and calculating BMI was a quick and effective method to determine any health changes among respondents after physical activity and dietary intervention. Due to work commitments or respondent fatigue, there was poor response for assessments of physical activity (PA), dietary intake and quality of working life (QOWL) (See Table 4.10). There were many incomplete forms, or forms with missing data which could not be analysed. Respondents were given four forms to fill at each of the 3-monthly assessments: 7-day pedometer records, physical activity recall (IPAQ short form), quality of working life scale and 3-day dietary records. The use of a pedometer from the moment they wake up until they go to bed at night for a whole week and remembering to record all they eat and drink for three days may have imposed much inconvenience

for workers, especially when there were four data collections over the whole study period (baseline, 3rd, 6th and 9th months). The IPAQ forms could not be analysed if the respondent ticked any of the 'not sure' options for their physical activity assessments. Efforts were made to contact respondents to clarify any missing data or if they had ticked the 'not sure' option on the IPAQ form.

Using modified intention to treat, response rate was based on the primary outcomes of weight and BMI. At the end of the study (9th month), 93 (71%) respondents at the intervention and 90 (60%) respondents at the control site were analysed for their weight and BMI changes (See Figure 4.4 and Table 4.7). Data attrition rate using these outcomes was 29% at intervention and 40% control sites. Table 4.7 shows the numbers (and percentages) of respondents at both worksites whose outcomes for weight, BMI, PA, dietary intake and QOWL were included in the analyses.

Table 4.7 Respondents' participation in each assessment

	Intervention (N=132) N (%)	**Controls (N=151) N (%)**
Weight and BMI	93 (71%)	90 (60%)
Pedometer 7-day record	41 (31%)	37 (25%)
Dietary 3-day records	38 (29%)	45 (30%)
Quality of Working Life (QOWL)	37 (29%)	36 (24%)
IPAQ form (overall PA)	20 (15%)	20 (17%)

**Note: Based on modified intention to treat.*
Weight,BMI, PA and QOWL: had measurements for baseline and at least 2 out of 3 following assessments.
Dietary intake: had measurements for baseline and at least 1 of 2 following dietary assessments.

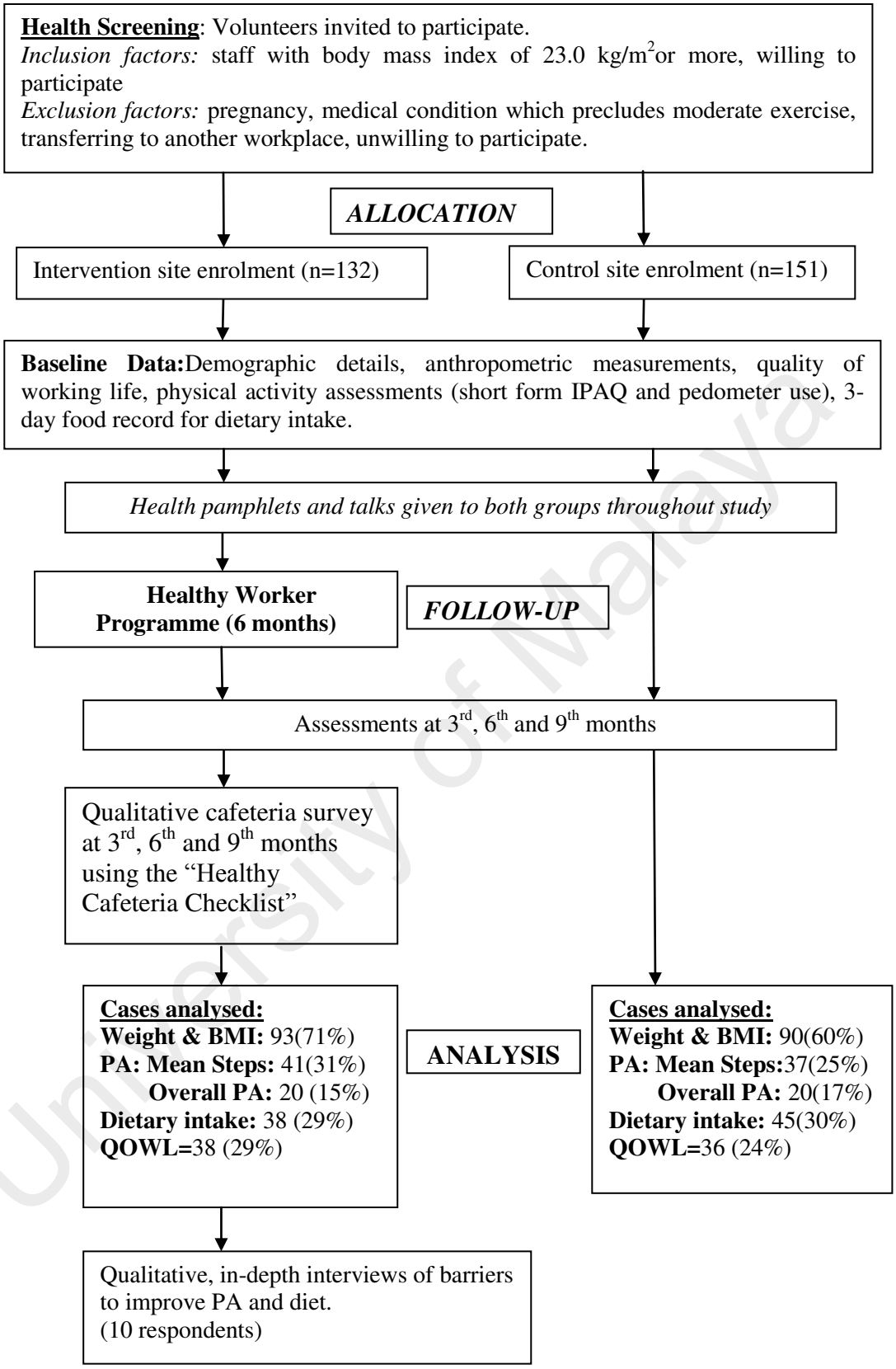

Figure 4.4 Flowchart of study (based on modified intention to treat)

Table 4.8 shows a comparison of respondents and non-respondents, based on the modified intention to treat analysis. Respondents were those included in the analysis,

while non-respondents were not. Non-respondents appeared to be slightly younger with a mean age of 38.5 years, compared to respondents which had a mean age of 42.3 years ($p<0.05$). There was also a significant difference between the education levels of respondents and non-respondents. There were more respondents from the lower education group (up to high school level). A higher percentage of non-respondents held university and postgraduate degrees. It is probable that those who were highly educated, held higher positions and may have had more work commitments to be actively involved in the study. There were no significant differences between non-respondent rates for marital status, gender, presence of chronic disease, worksite or participation in an exercise or slimming programme at baseline. It appears that more effort may be needed to sustain participation of those with higher education backgrounds in the programme.

Table 4.8 Socio-demographic details of respondents and non-respondents

	Respondent (n=183)	Non-respondents (n=100)	p-value
Age (years)	42.3	38.5	***0.007[a]****
Gender: Male	40.4%	46.0%	NS[b]
Female	59.6%	54.0%	
Education level:			
Up to SPM	50.3%	27.1%	***<0.001[b]****
Pre-university	30.4%	26.0%	
University Degree	10.5%	28.1%	
Post-graduate	8.8%	18.8%	
Marital status:			
Married	77.0%	72.0%	NS[b]
Single/Divorced/Widowed	23.0%	28.0%	
Has a chronic disease:			
No	64.1%	75.8%	NS[b]
Yes	35.9%	24.2%	
Attending gym/exercise program:			
No	84.7%	81.6%	NS[b]
Yes	15.3%	18.4%	
In slimming programme:			
No	93.4%	93.9%	NS[b]
Yes	6.6%	6.1%	
Worksite:			
Intervention	50.8%	39.0%	NS[b]
Control	49.2%	61.0%	

*[a]independent T-test; [b]Chi-square Test;*significant difference (p<0.05); NS-not significant*

4.2.1.1 Uptake of intervention components

A total of 79 respondents (84% of respondents included in analysis) returned their programme evaluation forms at the end of six months at the intervention site. The respondents' participation and feedback on intervention components are shown in Table 4.9. A high percentage of respondents stated that they read the health posters (96%) and found the pedometer motivated them to increase their PA (94%). Many also found the calorie display at the cafeteria encouraged them to eat healthily (84%).Somerespondents

tried out the health tips and recipes (65%) and involved family members to improve diet and physical activity (77%). A total of 51% of respondents stated they always read monthly health and motivational tips, while 47% only read them some of the time. A total of 43% thought the phone call motivated them. However, 38% was unable to participate in the motivational phone call. This was possible due to respondents being unavailable at the time of calls.

Table 4.9 Respondents' participation and feedback on intervention components

Intervention	*Percentage (n=79)*
Read health posters	96%
Found pedometers helpful to improve PA	94%
Display of calories at the cafeteria motivates to eat healthily	84%
Tried out healthy tips	84%
Involved family members in making healthy changes to diet and PA	77%
Tried out healthy recipes	65%
Read monthly health tips and motivation:	
Yes	51%
Sometimes	47%
No	2%
Found motivational phone call helpful:	
Yes	43%
No	19%
Unable to be contacted	38%

4.2.1.2 Evaluation of healthy food choices at the cafeteria

Information on healthy food choices and its preparation and checklists on a "healthy menu at the cafeteria" were given to the cafeteria operator. The cafeteria operator received the health information well and accommodated to the display of calorie and fat content of general foods on tables. Unfortunately, due to his busy schedule, the cafeteria operator was unable to join in the health talks regarding healthy

eating and preparation of food, however health pamphlets regarding these topics were given to him. Uninformed checks were carried out by the researcher at the cafeteria every three months to evaluate any improvements to provide healthy foods (See Appendix R). Feedback was given to the cafeteria operator and he was continually encouraged to provide healthy food options for the workers.

(a) ***Positive points***

Throughout the programme, positive points are sauces (gravy) and salad dressings were served separately. Desserts were prepared in small portions. Mineral and drinking water were available for the workers. It was observed that by the programme end (6^{th} month), there were more healthyoptions of fresh foods (fruits slices, juices and vegetables salads). Whole meal options were also available at breakfast. Three months after the programme ended, there appeared to be further improvement, where at least half of dishes were prepared in a healthier manner such as steamed, baked and stewed. Western menus were also included such as roasted meat and baked potatoes.

(b) ***Negative points***

Dairy products were not low-fat and at times, there was more than one dishwith coconut milk. Coconut milk is ubiquitous in many Malaysian dishes. Also, there was not enough high-fibre grain choices. More than half of desserts were prepared in less healthy methods, which were high in fat content such as pastries, cakes, ice creams or fried local desserts. Low-fat salad dressing was unavailable.

(c) ***Overall observation***

Overall, using the Healthy Cafeteria Checklist, there has not been much change in the reduction of less healthy options (pastries, high-fat desserts, use of coconut milk). However, there appeared to be a wider option of food choices towards the end of the study to include healthier options for staff. It would have been better to reduce the numbers of high-fat and sugar options at the cafeteria. The cafeteria operator was independent of the organisation and could not be instructed to make changes, only encouraged to do so to support the on-going workplace intervention. Workers were given a wider range of foods to select from, including healthy options for weight management.

4.2.1.3 Barriers for improving physical activity and dietary intake

Respondents were purposively selected covering diverse backgrounds including gender,age groups, work categories and levels of achievement in the programme. They were interviewed regarding barriers for improving PA and dietary intake. Table 4.10 shows the different backgrounds of workers interviewed. Saturation point of barriers identified by respondents occurred by the tenth interview.

Table 4.10 Characteristics of interviewed respondents

No	Gender	Job category	Age (years)	Race	Marital status	Comments
1	Male	Officer	32	Malay	Married	Low PA level.
2	Male	Support staff	40	Malay	Married	Highly active. Top ten 'Pedometer Challenge' winner.
3	Male	Support staff	40	Indian	Married	Active. Top ten 'Pedometer Challenge' winner.
4	Male	Officer	40	Malay	Married	Low PA levels
5	Male	Officer	53	Malay	Married	Moderate PA levels. Achieved high PA level at one assessment.
6	Male	Officer (Unit Head)	50	Malay	Married	Achieved high PA levels.
7	Female	Officer	34	Indian	Single	Moderate level of PA on average. Achieved high level of PA at one assessment.
8	Female	Support staff	57	Chinese	Married	Good improvement in PA levels. Top ten 'Pedometer Challenge' winner
9	Female	Support staff	52	Malay	Married	Low levels of PA.
10	Female	Support staff	52	Malay	Married	High PA levels.

From the in-depth interviews, the barriers were grouped into four main themes. They were:

1. Environmental exposures

Environmental exposures pose a challenge to respondents as they influence eating and activity choices, whether it be at home, work or other social context. Respondents stated that their environment at work, home or in social circles exposed them to many different types of food and activities. Where there was opportunity to be physically active at the workplace such as during inter-office sports, workers may

become more active. However, when there were no sporting activities at the office, workers may be less active:

"In terms of exercising for me, mostly is like a work as well you know, like *sukan*(sports) ya."(Participant no. 7)

The types of food available at work, such as that served during meetings, events or at the office cafeteria can influence their eating patterns. The same influences also occurred when they were at home or involved in other social activities. They said that it was difficult not to be influenced by such exposures to unhealthy food and lifestyle options available in the workplace, at home or at social events:

"Kekangan menghalang jaga pemakanan kalau kita balik kampung… ataupun ada majlis-majlis… Kalau satu hari tu sampai ada tiga majlis (Laughs). Faham-faham je lah." ("Barriers which stop me from taking care of my diet if I go back to my hometown…or there are ceremonies…If in one day, there are up to three ceremonies (laughs). You understand.") (Participant No. 4)

"And in term of dietary intake maybe the challenge that I face is because coming from…hmm…Indian background maybe you know in terms of preparation of food you know, you have like, I mean when they cook food you know, is like a lot of oil and you know, sugar and like all those things." (Participant No. 7)

This reinforces the importance of support within work, family and social life circles to achieve and maintain a healthy lifestyle for weight management. Interventions should take into account positive or negative effects from the environment.

2. Health conditions

Health conditions such as arthritis or muscle aches limit the type of physical activity a respondent can do. Even though respondents who could walk and do moderate activity were included in the study, poor health conditions such as during acute illness (influenza) or mild osteoarthritis may preclude them from vigorous activity. Those who are overweight and obese and lead sedentary lifestyles may also have difficulty in carrying out physical activity. Muscle weakness can lead to aches and pains when they try to improve their levels activity:

"Saya yang lain-lain tak ada masalah.Sakit tak ada.Tapi lenguh tu je ada masalah.Berat badan." ("I don't have any problems. No illnesses. But I get muscle aches. My body is heavy.") (Participant No. 9)

"*Minat memang minat.Kasut siap beli kalau nak 'jogging'nya.Dengarnya orang nak pergi.Nak.Siap beli seluar bagai kalau nak pergi.Tapi nak pergi…pergi tu pergi. Lepas tu karang duduk je lah tengok je lah dia orang…dah kakilenguh kalau berjalan pun Doktor."* (I am interested. I even bought jogging shoes. If people want to go jogging, I want, too. I already bought pants to go. But, to go.. I do go. Then I will just sit and watch people..my legs ache when I walk even, Doctor".) (Participant No. 9)

A talk by a sports medicine specialist on how to exercise safely, particularly for those with arthritis, was given at both worksites. However, this may not be adequate and perhaps a more tailored approach is required for those who have mild osteoarthritis to teach them how to exercise safely, such as through low impact exercises in water and using gym equipment such as the stationary bicycle which has less impact on the knees and other joints. It is the usual practice of doctors to encourage weight loss for overweight and obese individuals who have mild osteoarthritis of the knees to reduce

burden on these load-bearing joints. Not knowing how to exercise properly for those with mild osteoarthritis, may reduce their physical activity levels and this may further increase their weight, which in turn can accelerate their arthritic condition.

3. Poor knowledge on how to reduce weight through dietary changes

It was noticed during interviews that despite health information given, some respondents explained that they tried to reduce their calorie intake by skipping meals. Dinner was usually the skipped meal which may causehunger and gastritis. This could reduce their motivation:

"*Kadang-kadang buat-buat tidur-tidur awal, tak nak makan.Tengah-tengah malam karang lapar.Kata…laparnya perut. Pedihnya perut…".*(Sometimes I try to sleep early, so I don't eat. In the middle of the night, I will be hungry. I will say, 'my stomach is hungry'. My stomach is painful…"). (Participant No. 9)

It appeared that there were respondents who still did not understand how to change their dietary patterns towards a healthier one for weight management. Perhaps more emphasis on healthy eating behaviour is needed in the programme to curb skipping meals and substitute this with consumption of healthier, low calorie meals instead. It may be useful to include a dietitian to advise respondents regularly to improve their healthy eating habits and of energy balance for weight control.

4. Psychological barrier

Respondents also mentioned psychological barriers, which included poor motivation, lack of discipline, improper time management, a strong appetite and

preferences for calorie-rich foods. Poor time management, motivation and discipline were barriers for improving PA among workers and prevented them from walking more often at the office, at home or at weekends. Respondents said that time was not an issue and that if anyone wanted to exercise, one could make the time:

"*Sebenarnya tak ada halangan.Cuma halangan tu kita yang buat sendiri.Contohnya masa kan. Masa untuk exercise ke ape benda. Sebenarnya masa kita 24hours.More than enough*." ('Actually there are no barriers. Only barriers we create ourselves. An example is time. Time for exercise or whatever. Actually we have 24 hours. More than enough.") (Participant No. 2).

"Tak…tak…tak…Semua tu tak ada masalah.Cuma kita…kita freekan masa… kita lah.Tak ada kerja kita pergi jogging. So macam tu lah kita...kita dapatkan...kita cuba dapatkan masa yang betul lah untuk buat latihan ke apa." ("No..no..no. All that is not a problem. We just have to create free time. When we do not have anything to do, we go jogging. So, that is how we get enough time to exercise or something.") (Participant No. 5).

A strong appetite for foods appeared to be a barrier for some to reduce their portions of food or change to healthier dishes. Personal preferences and habit of consuming oily, deep-fried, coconut-milk rich or sweet dishes make it difficult for some to switch to alternative methods of cooking such as steaming, stewing or grilling. It appears that some respondents find it difficult to change their habits and preferenceswhich affect their activity and diet:

"*...Tapi sebab gaya hidup kita suka relaks*." ("…But I like a relaxing lifestyle.") (Participant No. 4)

"Kita sendiri tahu, Doktor, makanan-makanan yang kita boleh makan.Tapi tulah nak mengelakkan benda tu..tak tahulah. Makan buah, sekejap je mahu dia. Lepas tu tak mahu dah, dah tak nak dah, dah jemu dah buah. Bukan tak nak. Beli kadang-kadang sampai layu dalam peti ais macam tu. Anak pun tak makan.Kalau kita tak makan, anak tak makanlah.Kalau kita kopekkan, makan. Tapi, kita tak berapa nak makan buah." ("We know, Doctor, which foods we should eat. However, avoiding certain foods..I don't know. I would only eat fruits for a short while. After a time, I don't want it anymore, I get bored. It's not that I don't want to. Sometimes I buy and it rots in the fridge. Even my kids don't eat it. If I don't eat it, the kids won't eat it. If we peel the fruits, they will eat. But I don't like to eat fruits much.") (Participant No. 9).

"Akak ni kuat garam.Nak sampai rasa.Makan nasi, makan masakan nak kena sampai rasa. Kadang-kadang anak complain juga. Mak janganlah makan garam banyak sangat mak.Masak masin sangat." ("I like it salty. I like it tasty. When I eat rice, I eat any dish, it must be tasty. Sometimes my children complain also. Mom, don't take too much salt. The dish is too salty.") (Participant No. 9)

Perhaps counselling and more follow-up would be helpful to increase workers' motivation to make lifestyle changes towards a more active one and to slowly accept healthier dishes as a better choice to reduce risks of non-communicable diseases. It would be important to motivate parentsto choose healthy foods for the family and to create a culture or habit to eat healthily.

4.2.2 Behaviour and health changes

The analysis for health and behaviour and quality of working life outcomes was carried out using 'modified intention to treat'. However, an analysis 'as per protocol' was also carried out to determine if there were any differences between intervention group and controls. It was found that analysis 'as per protocol' gave similar results.

4.2.2.1Weight and body mass index

A total of 93 and 90 respondents completed the baseline and at least two out of three weight and body mass index assessments at the intervention and control sites respectively during follow up at the third month (mid-programme), sixth month (programme end) and ninth month (post-programme). There was close monitoring of respondents' weight with multiple assessments throughout the study. At baseline, the mean weight of respondents was 73.5 and 70.1 kilogrammes at the intervention and control worksites respectively, with no significant difference. Analysis of changes in weight and body mass index were controlled for factors of educational level, household income and baseline body mass index which were significantly different between groups at the beginning of the study.

a) Mean weight loss

At the third month (mid-programme), no weight loss was seen in the two groups. However, at the sixth month (programme end), there was significant weight change between intervention and control groups. A mean weight reduction of 1.2 kg was seen among the intervention group and a mean increase of 0.3 kg among the control group ($p<0.001$). Three months after the programme ended (at the ninth month) the intervention group showed a mean weight change of -0.3kg compared to their baseline

weight, while the control group maintained a mean increase of 0.3kg compared to baseline. There was no significant difference for weight change between the two groups at the ninth month.

Throughout the study, within groups, there was a significant weight change of -0.5 kilogrammes in the intervention group (95% CI: -0.9, -0.1). The control group showed a mean increase of 0.2 kg, however this was not significant (95% CI: -0.2; 0.6). Overall, there was a mean weight difference of-0.7 kg between the intervention and control groups throughout the study (95% CI: -1.3, -0.1). On average, those in the 'Healthy Worker Programme'significantly reduced more weight compared to controls. Figure 4.5 shows the weight changes compared to baseline for each group over the study period.Changes in weight and body mass index throughout the study are summarised in Table 4.11.

b) Clinically significant weight loss

As much as five to ten percent reduction of initial weight is recommended for overweight and obese individuals (MOH, 2013; NCCFN, 2010). At the third month (mid-programme), there appeared to be the same proportion of respondents, that is 4% at both worksites who managed to achieve 5% weight loss. However, at 6 months, at the end of the 'Healthy Worker Programme', significantly more respondents achieved this at the intervention site. A total of 14% of respondents achieved at least 5% of weight loss at the intervention site, while among the controls, the proportion remained the same as in the third month, that is 4%. Those who were in the intervention group were 1.6 times more likely to lose at least 5% of their body weight compared to controls (RR = 1.6; 95% CI: 1.2, 2.2). Table 4.11 summarizes changes in weight and body mass index at different time points.

c) Sustainability of weight changes

Three months after the 'Healthy Worker Programme' ended, there was a slight drop from 14% to 12% of respondents who had at least 5% weight loss (compared to baseline) within the intervention group. There was also positive change among the controls at this time (study end), where there was an increase from 4% to 8% of respondents who lost at least 5% of their original weight.

However, those who were in the 'Healthy Worker Programme' were 1.2 times more likely to have a weight reduction of at least 5% at the 9^{th} month of the study (three months post-programme) (RR= 1.2; 95% CI: 0.8, 1.8).This difference was not statistically significant. It was interesting to note that there were more than 10% of respondents in the intervention group who managed to reduce at least 5% of their original weight by programme end and this figure was sustained three months post-programme.

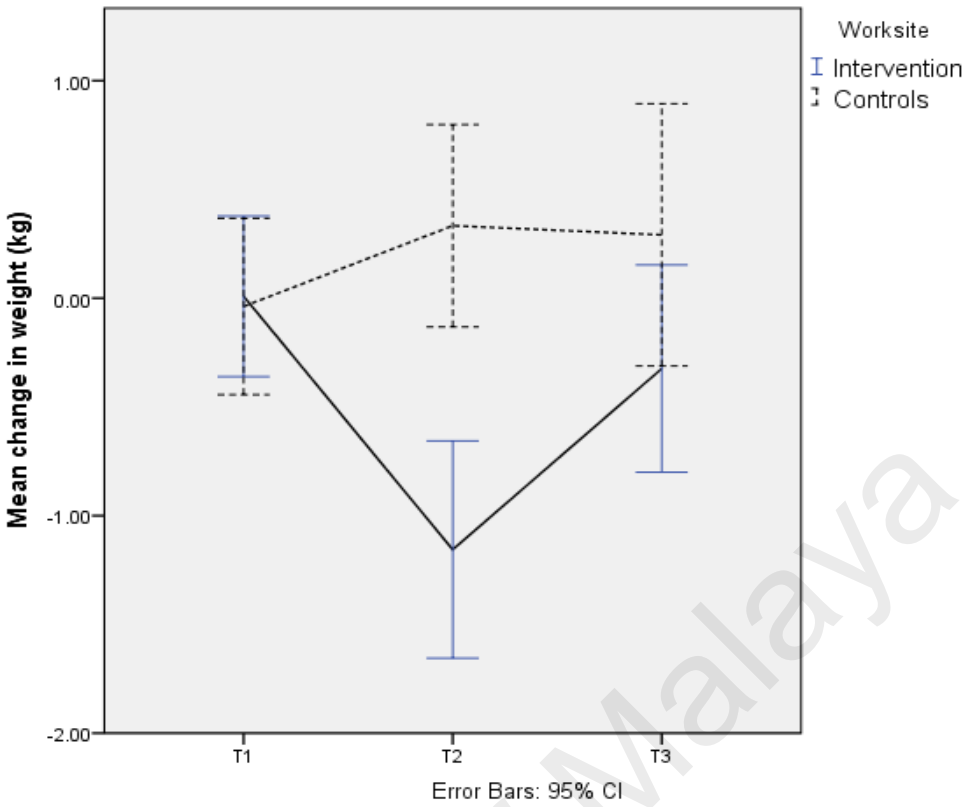

Figure 4.5 Change in weight compared to baseline with time

(T1: 3rd month/mid-programme; T2: 6th month/programme end; T3: 9th month/post-programme)

Table 4.11 Changes in weight and BMI compared to baseline at 3rd month (mid-programme), 6th month (programme end) and 9th month (post-programme)

Changes	Time	Intervention (N=93) Mean (sd) n (%)	Control (N=90) Mean(sd) n (%)	Overall mean difference (intervention –controls)	*p-value
Change in weight (kg)	3rd month	+0.01(1.79)	-0.04 (1.94)	**-0.68***	[a]*Significant difference (p=0.003) within groups, And between groups (p=0.02)*
	6th month	**-1.16 (2.42)***	**+0.33 (2.22)***		
	9th month	-0.32 (2.31)	+0.29 (2.88)		
Change in BMI (kg/m^2)	3rd month	-0.001(0.709)	+0.006(0.743)	**-0.28***	[a]*Significant difference (p<0.001) within groups, And between groups (p=0.02)*
	6th month	**-0.46 (0.95)***	**+0.14 (0.88)***		
	9th month	-0.13 (0.92)	+0.12 (1.1)		
5-15% weight loss	3rd month	4 (4%)	4 (4%)		NS
	6th month	**13 (14%)**	**4(4%)**		**0.03***
	9th month	11(12%)	7(8%)		NS

[a]*ANCOVA repeated measures;*significant difference (p<0.05), NS-not significant*

d) Body mass index (BMI)

At baseline, the average BMI of the respondents was higher at the intervention site at 29.0 kg/m^2compared to 27.6 kg/m^2 among controls (p=0.006). Even though this difference was statistically significant, clinically both average body mass indices were within the Obese I category (BMI=27.5-34.9kg/m^2) using the Malaysian Ministry of Health Clinical Practice Guidelines (MOH, 2004).

At the third month (mid-programme), there was virtually no change in BMI in both groups.At the sixth month (programme end), there was a mean BMI reduction of 0.5kg/m^2 among the intervention group and an increase of 0.1 kg/m^2 among controls compared to baseline (p<0.001). There was a significant mean difference of -0.6kg/m^2in BMI changebetween the intervention and control groups (95% CI: -0.9, -0.3).

Sustainability of changes were modest at the 9th month (3 months post-programme) among the intervention group, where BMI difference compared to baseline was reduced compared to the 6th month (programme end). There was only a mean difference of -0.13kg/m^2 in the intervention group and +0.12 kg/m^2 among controls. The mean BMI difference between the intervention and control groups was -0.25kg/m^2, but not significant(95% CI: -0.55, 0.05).

Overall, throughout the study, there was significant difference in BMI change between groups, where a mean difference of -0.19 kg/m^2 was seen between respondents of the 'Healthy Worker Programme' and controls (95% CI: -0.35, -0.04).

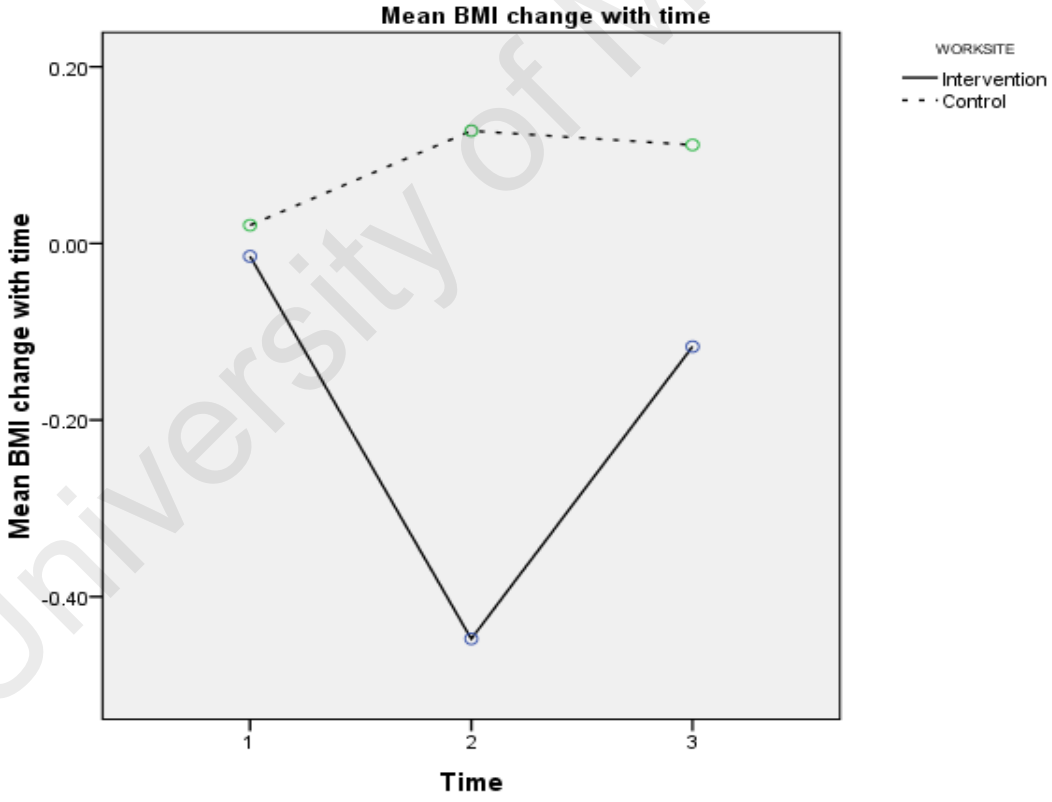

Figure 4.6 Change in BMI (kg/m^2) compared to baseline with time

(Time 1: 3rd month/mid-programme; Time 2: 6th month/programme end;

Time 3: 9th month/post-programme)

e) BMI categories

At the intervention site, 46.2% (n=43) of respondents were overweight, 39.8% (n=37) were classified as obese type 1, 11.8% (n=11) were obese type 2 and 2.2% (n=2) were obese type 3. In the control group, 61.1% (n=55) were overweight, 34.4% (n=31) were obese type 1, 4.4% (n=4) were obese type 2. There were no respondents classified as obese type 3 in the control group.

There were a few respondents who managed to achieve normal weight categories in both the intervention and control groups. One respondent (1%) from the intervention group and four respondents (4%) from the control group managed to achieve a normal BMI at the 3rd month. At both the 6th and 9th months, there was one respondent (1%) in the intervention group and two respondents in the control group who achieved normal BMI. Those who achieved normal BMI were from the overweight category and managed to lose a few kilogrammes to achieve a normal weight range. It is possible that at mid-programme, there were a few more controls who managed to achieve normal BMI compared to the intervention group because on average, there were more respondents from the overweight category among the controls (61.1%) compared to the intervention group (46.2%) at baseline. The average weight and BMI were also higher among the intervention group than controls at baseline. It is possible that with minimal intervention such as the availability of health pamphlets and talks given to both groups, some healthy behavioural changes has occurred leading to weight loss. However, this effect waned in the control group with time. It appears that with a lack of a structured workplace health programme at the worksite, the number of controls who achieved normal BMI reduced at the sixth and ninth months.

4.2.2.2 Physical Activity (PA) Levels

(a) ***Mean Daily Steps***

A total of 41 and 37 respondents' pedometer records were analysed at the intervention and control sites respectively. At baseline, the mean daily steps in the intervention compared to control group was 6954 and 7498 steps respectively, with no significant difference. Only 17% at the intervention site and 16% of controls achieved the recommended 10,000 steps per day (Tudor-Locke, 2004). The mean daily steps taken by respondents gradually increased in the intervention group, while it decreased among controls (See Figure 4.7).

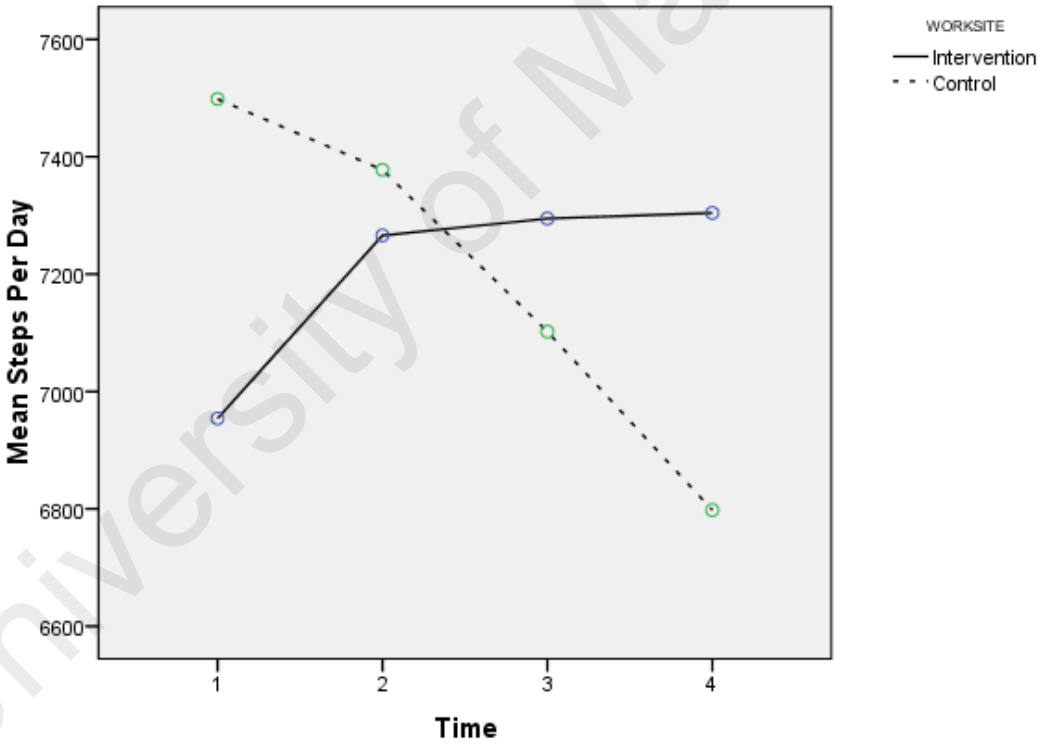

Figure 4.7 Changes in mean of steps taken per day between groups (Time 1: Baseline; Time 2: 3rd month/mid-programme; Time 3: 6th month/programme end; Time 4: 9th month/ post-programme)

At programme end, those at the intervention site were 1.3 times more likely to have achieved the 10,000 steps target (95% CI: 0.8, 2.1). Three months post-programme, those who followed the programme averaged 665 steps more than the controls (95% CI:-539; 1869) and were 1.8 times more likely to have reached the target of 10,000 steps a day (95% CI: 1.2; 2.5). A total of 24% of respondents achieved the target of 10,000 steps a day at the intervention site compared to 5% at the control site at the ninth month (p=0.02). Those who followed the programme were also 1.3 times more likely to maintain or increase their daily mean steps (95% CI: 0.9; 2.0). Similar results were observed when results were analysed as per protocol. Tables 4.12 and 4.13 sum up results of mean steps taken by respondents. At all assessments, overall, men recorded significantly more steps than women, that is an average of 1750 steps more per day.

Table 4.12 Achievement of 10,000 steps at mid-programme (3rd month), programme end (6th month) and post-programme (9th month).

Changes	Time	Intervention (N=41) N (%)	Control (N=37) N (%)	p-value
Achieved average of 10,000 steps per day	Baseline	7 (17%)	6 (16%)	NS
	3rd month	8 (20%)	3 (8%)	NS
	6th month	7 (17%)	4(11%)	NS
	9th month	***10 (24%)***	***2 (5%)***	***0.02****

**significant difference (p<0.05); NS-not significant*

Table 4.13 Average steps per day at mid-programme (3rd month), end (6th month) and post-programme (9th month) among intervention and control groups.

	Time	Intervention (I) (N=41) Mean (sd)	Control (C) (N=38) Mean(sd);	Mean Difference (I) - (C)	95% CI
Average steps per day	**Baseline**	6954 (3440)	7498 (2644)	-544	-1939 ;850
	3rd month	7266(3782)	7404(2079)	-138	-1497;1221
	6th month	7295(2913)	7136(1811)	+159	-921; 1240
	9th month	7304(3236)	6639(2031)	+665	-539, 1869

**significant difference (p<0.05)*

(b) ***Overall physical activity (PA)***

Overall physical activity was measured using the IPAQ short form questionnaire. However, there was poor response for this questionnaire and results need to be interpreted with care. This could have been due to respondent fatigue. The IPAQ questionnaire may have been challenging to fill out. Respondents were required to recall their involvement in different types of PA, such as walking, moderate and vigorous activities. They had to recall the frequency and the duration of these activities in the previous week. Many respondents ticked the 'unsure' option for these activities, rendering the questionnaire unable to be analysed.

There were 20 respondents from the intervention group and 27 from the controls whose data was analysed. There was significant, moderate correlation between mean steps per day and the physical activity levels (MET-mins/week) (r=0.5, p=0.01). At baseline, there were lower levels of activity at the intervention site compared to controls (p=0.01). There was no significant difference of PA between both groups at mid-programme and at its end. Post-programme, at the ninth month, there was significant difference between PA levels of both groups. More respondents of the intervention

group were found to report moderate and high levels of PA compared to the controls. Among controls, there was an increase in those who reported low levels of PA.

There was gradual improvement among the respondents at the intervention site, until they surpassed the PA levels of controls by the 9th month. This showed possibility of sustainability of improvement in PA with the programme, as there was continuous increase in PA among the intervention group after the programme ended. The results were also analysed as per protocol with similar results, showing that on average, the intervention group had a high PA level (>3,000 MET-mins/week) from the third month onwards, compared to the controls who had moderate levels. It is possible that changes in lifestyle to improve PA can be built up gradually and sustained. With no active programme, health talks and pamphlets alone appeared unable to sustain respondents' motivation, as seen in the controls. (See Table 4.14 and Figure 4.8).

Table 4.14 Changes in overall physical activity (PA)

Changes	Time		Intervention (I) (N=20) n (%); Mean (sd)	Control (C) (N=27) n (%); Mean(sd)	Mean difference (I)-(C)	p-value; (95% CI)
PA level	**Baseline**	***Low***	**10 (50%)**	**3 (11%)**	--	***0.01[a]***
		Moderate	**8(40%)**	**19(70%)**		
		High	**2 (10%)**	**5 (19%)**		
	3rd month	*Low*	5 (25%)	7(26%)	--	0.39
		Moderate	6 (30%)	13(48%)		
		High	9(45%)	7 (26%)		
	6th month	*Low*	4(20%)	6 (22%)	**--**	0.98
		Moderate	12 (60%)	16 (60%)		
		High	4(20%)	5 (18%)		
	9th month	***Low***	**1(5%)**	**12 (45%)**	--	***0.01 ****
		Moderate	**13 (65%)**	**9 (33%)**		
		High	**6 (30%)**	**6 (22%)**		
Average MET-mins per week	Baseline	-	1719 (2432)	2040 (1686)	-321	(-1530; 888)
	3rd month	-	2909 (2759)	2857 (2806)	+322	(-1334;1977)
	6th month	-	2547 (2346)	2124 (2377)	+423	(-1017;1863)
	9th month	-	2632(2674)	2514 (2759)	+118	(-1501;1736)

**significant difference (p<0.05); mid-programme (3rd month), programme end (6th month) and post-programme (9th month); PA as measured by the short form IPAQ.*

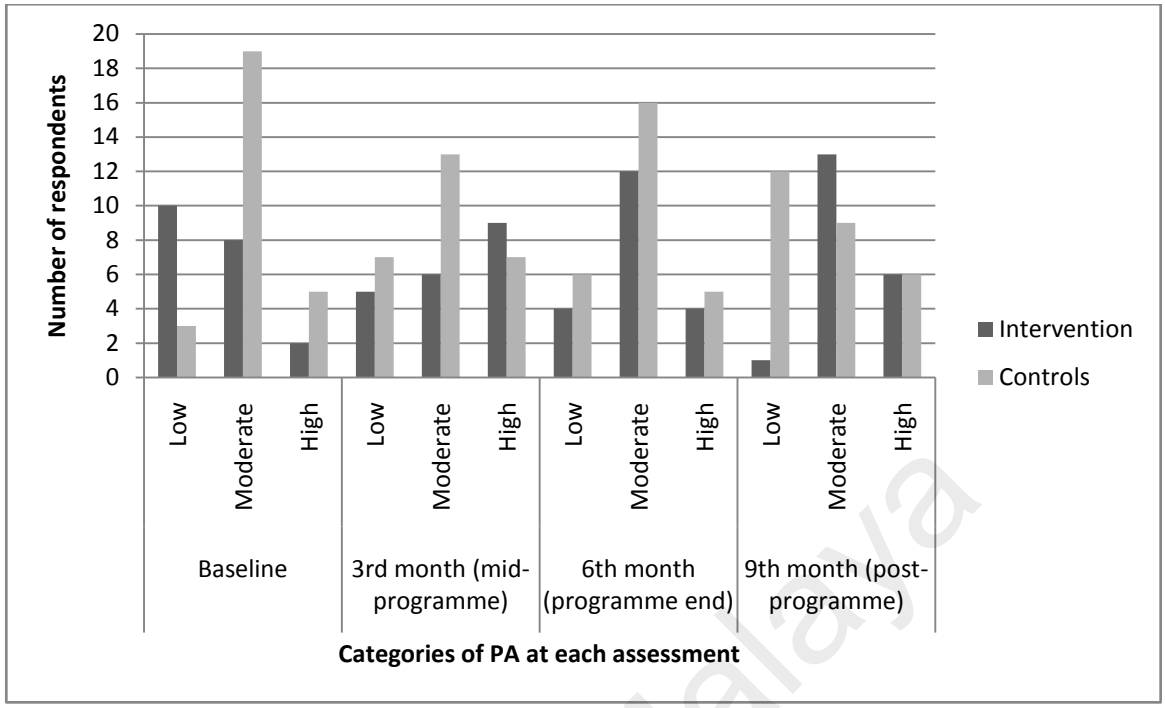

Figure 4.8 Changes in PA levels with time

4.2.2.3 Dietary Intake

There were 82 respondents whose results were analysed, that is 38 respondents from the intervention group and 44 controls. The results need to be interpreted with care due to the small sample size of returned completed diet records. There was no significant difference of macro- or micronutrient intakes at baseline between groups. (See Table 4.15). Figure 4.9 shows the mean changes in daily energy intake, where T1, T2, T3 are baseline, sixth month (programme end) and the ninth month (post-programme) respectively. Overall, there was a reduction of calorie intake between the 9thmonth compared to baseline. However, there was no significant difference within or between groups. (See Table 4.16). The results were similar with as per protocol analysis. It is important to note however that workers were given advice on how to include a healthy diet into their lifestyle and not just the knowledge on energy balance.

Table 4.15 Baseline daily dietary intake of respondents

	Intervention (n=38) Mean (sd)	**Controls (n=44) Mean (sd)**	**p-value**
Energy Intake (kcal)	1447 (332)	1454 (434)	NS
Carbohydrate (g)	198 (48)	205 (66)	NS
Protein(g)	55 (14)	53 (18)	NS
Fat(g)	49 (16)	46 (20)	NS
Fibre(g)	4.6 (2.2)	4.5 (2.8)	NS
Vitamin C (mg)	57 (41)	63 (60)	NS
Calcium (mg)	422 (217)	407 (192)	NS
Iron (mg)	14 (6)	12 (5)	NS
Sugar (g)	36 (22)	33 (19)	NS
Sodium (mg)	2110 (768)	1812 (878)	NS

significant level p<0.05; NS-not significant

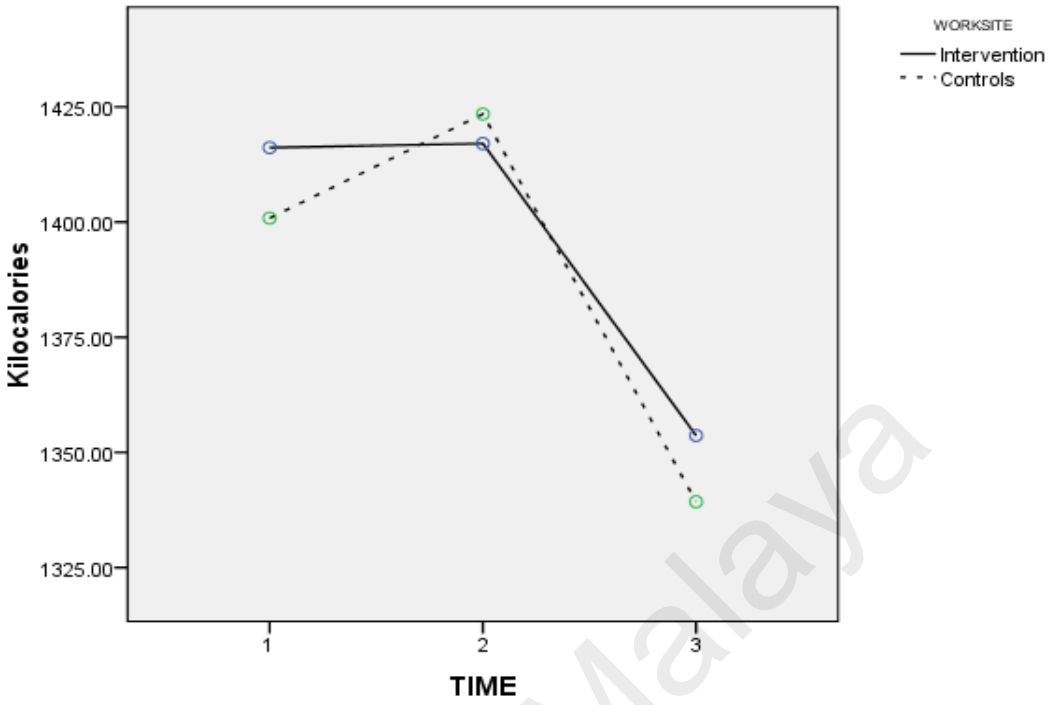

Figure 4.9 Changes in mean daily energy intake

(Time 1: baseline; Time 2: 6th month/programme end;

Time 3: 9th month/post-programme)

Table 4.16 Energy intake of respondents

		Intervention (n=38) Mean (s.d.)	Control (n= 44) Mean (s.d.)	p-value[a]
Energy Intake (kilocalories)	**Baseline**	1447 (332)	1454 (434)	*No significant difference between or within groups*
	6th month	1459(354)	1406 (329)	
	9th month	1381 (415)	1321 (344)	

[a]*Repeated measures ANOVA; significant level p<0.05;*
6th month- programme end; 9th month –post-programme

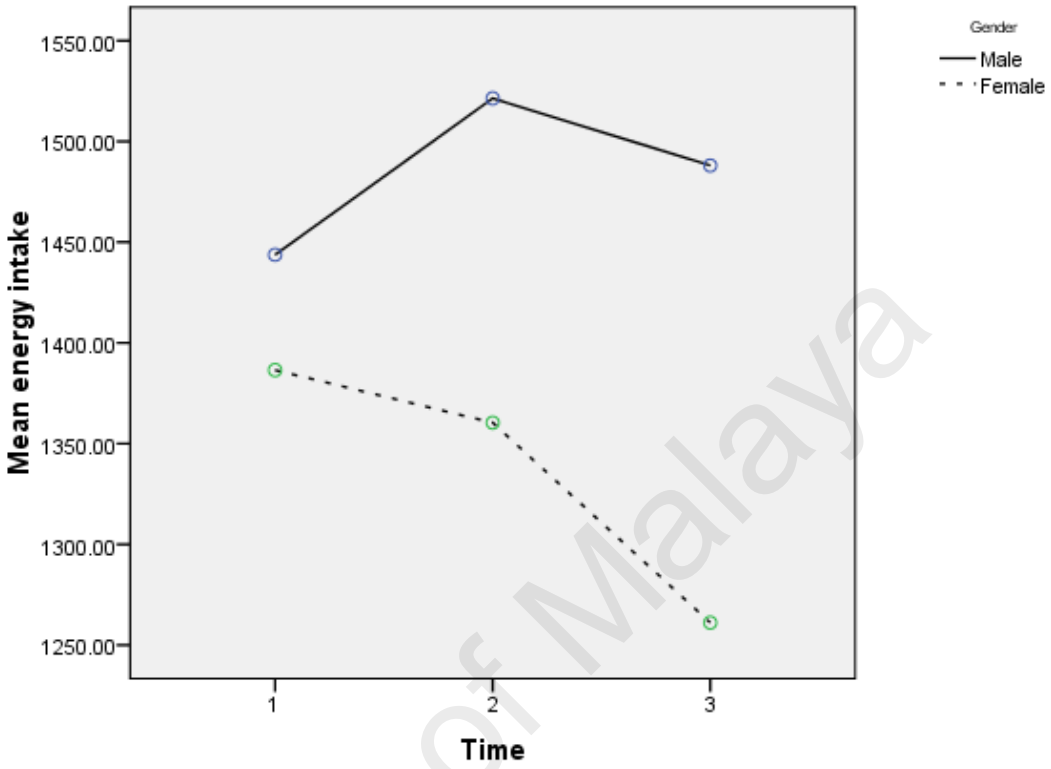

Figure 4.10 Overall mean daily energy intake (kcals) according to gender (Time 1: baseline; Time 2: 6th month/programme end; Time 3: 9th month/post-programme)

There was a significant difference between the energy intakes of different genders (p=0.02). The men averaged 1484 kilocalories, while the women 1336 kilocalories for energy intake. There was a significant difference in protein intake between genders where males consumed on average 59g and females 51g daily. There was a trend in reduction of energy intake overall among women, where they consumed an average reduction of 55 kilocalories at the 6th month and 176 kilocalories at study end compared to baseline (See Figure 4.10). There was overall reduction in all macronutrient intakes among women respondents, while no particular trend was seen

among the men. However, there was no overall difference between percentages of macronutrient daily intakes between genders.

As for the separate nutrients, there was a significant overall mean difference between the percentage of carbohydrate daily intake between baseline and at the 6th month, that is a reduction of 3% (p=0.04). At the ninth month, there was also an overall significant mean reduction of 20 grams of carbohydrates (80 kilocalories) compared to baseline (See Table 4.17). Changes for crude fibre and micronutrients are shown in Table 4.18. No other significant differences were observed among the other nutrients (fat, sodium, sugar, vitamin C, fibre, iron, calcium and protein). No other significant differences were seen for the macro- or micronutrients overall, within or between groups.

Throughout the study, overall energy intake of both groups were on average, 54% from carbohydrate, 15% from protein and 30% from fat intake. The Recommended Nutrient Intakes for Malaysians (NCFFN, 2005) states that from overall daily energy intake, 55 to 70 percent of daily energy intake should be from carbohydrates, 10 to 15 percent from protein and 20 to 30 percent from total fat. The percentages of protein and fat intakes were at the maximum recommended. Carbohydrate intake was just a little below the recommended 55 percent.

Table 4.17 Carbohydrate, protein, fat and sugar daily intake

Nutrient	Time	Intervention (n=38) Mean (sd);%	Control (n=44) Mean (sd);%	p-value[a]
Carbohydrate (g)	**Baseline**	198 (48)	204 (66)	***Overall significant mean reduction of 20g between baseline and 9th month, (p=0.0l)***
	6th month	196 (60)	181g (55)	
	9th month	191 (66)	172g (49)	
Carbohydrate (% of mean energy intake)	**Baseline**	55%	56%	***Overall significant reduction of 3% at 6th month compared to baseline (p=0.04)***
	6th month	54%	52%	
	9th month	55%	53%	
Protein (g);	**Baseline**	54.8 (14.0)	53.2 (18.1)	*NS*
	6th month	55.6 (17.6)	55.0 (15.9)	
	9th month	51.8 (16.3)	51.6 (15.9)	
Protein (% of mean energy intake)	**Baseline**	15%	15%	*NS*
	6th month	15%	16%	
	9th month	15%	15%	
Fat (g)	**Baseline**	49g (16.0)	45g (19.5)	*NS*
	6th month	49g (15.9)	47g (14.5)	
	9th month	46g (14.1)	45g (15.4)	
Fat (% of mean energy intake)	**Baseline**	30%	28%	*NS*
	6th month	30%	31%	
	9th month	30%	30 %	
Sugar (g)	**Baseline**	36 (23)	32 (19)	*NS*
	6th month	40 (44)	30 (17)	
	9th month	39 (44)	31 (22)	
Sugar (% of mean energy intake)	**Baseline**	9.7 (4.9)	9.3(5.2)	*NS*
	6th month	10.0(7.2)	8.4(4.2)	
	9th month	10.7(8.2)	9.7(6.3)	

[a]Repeated measures ANOVA; significant level p<0.05;
NS-not significant at 6th and 9th months compared to baseline;
6th month- programme end; 9th month –post-programme

Table 4.18 Daily intake of crude fiber and micro-nutrients

Nutrients	Time	Intervention (n=38) Mean (s.d.)	Controls (n=44) Mean (s.d.)	p-value[a]
Crude Fibre (g)	**Baseline**	4.6 (2.2)	4.5 (2.8)	*NS*
	6th month	4.9 (2.4)	4.5 (2.8)	
	9th month	4.2 (2.2)	4.3 (2.8)	
Vitamin C (mg)	**Baseline**	58 (41)	63 (60)	*NS*
	6th month	56 (37)	62 (59)	
	9th month	69 (46)	65 (63)	
Iron (mg)	**Baseline**	14 (6)	12 (5)	*NS*
	6th month	14 (6)	13 (5)	
	9th month	15 (12)	12 (4)	
Calcium (mg)	**Baseline**	422 (217)	405 (190)	*NS*
	6th month	388 (169)	433 (206)	
	9th month	393 (155)	424 (206)	
Sodium (mg)	**Baseline**	2110 (768)	1804 (870)	*NS*
	6th month	2074 (712)	2101 (1018)	
	9th month	2115 (871)	1964 (936)	

[a]Repeated measures ANOVA; significant level p<0.05; NS-not significant
6th month- programme end; 9th month –post-programme

Intakes for sodium, crude fibre, vitamin C, iron and calcium are shown in Table 4.18. There was no significant difference of mean intakes of these nutrients either within or between groups throughout the study. The World Health Organization (WHO) strongly recommends less than 2g (2000 mg) a day of sodium (5g/day of salt) for adults to reduce blood pressure and risk for cardiovascular disease (WHO, 2012). In the intervention group, the mean sodium intake exceeded the 2 grammes per day recommended limit for all three assessments (baseline, sixth and ninth months). Among controls, this limit was exceeded at the sixth month, while the intakes were a little under the limitat baseline and ninth months. Overall, mean daily intake of sodium was 2023mg.

Calcium intake was analysed according to gender, following different recommended levels. For males, the average intake was 425mg a day. The intake for

females up to 50 years of age was 409mg a day, while for older women (more than 50 years old) it was 372mg a day. This is rather worrying as the recommended calcium intake was 800mg a day for males up to 65 years and females up to 50 years old. For females aged 51 years and above, the recommended calcium daily intake is 1000mg (NCCFN, 2005). There were no significant differences of calcium consumption between intervention and control groups. For the male respondents, only one respondent achieved the 800 mg a day recommended intake at baseline (3%) and none at follow-up assessments. At baseline, five females (10%) consumed at least 800mg of calcium a day and two women (4%) achieved at least 800 mg of calcium a day at programme end (6^{th} month) and post-programme (9^{th} month).

The mean sugar intake among overall respondents throughout the study was 35g. This was equivalent to a mean of 10% of their energy intake. This figure was within the recommended level of not more than 15% of total energy intake, according to the Technical Sub-comitteeon Energy and Macronutrients (NCCFN, 2005). There was no significant difference between the two intervention and control groups in terms of sugar consumption contributing to percentage of energy intake, throughout the study.

The vitamin C consumption was compared to the daily recommended intake of 70 mg (NCCFN, 2005). At baseline, the intervention group consumed less vitamin C with a daily average of 58mg, while the control group consumed 63mg. While there was little change at programme end, at post-programme, the intervention group had increased their mean dietary vitamin C intake by 11 milligrams compared to baseline. There was little change in vitamin C intake among controls.

For iron intake, there were different recommended levels according to gender. The average daily intake for men overall was 14mg which was the lower border of the recommended level. However for women up to 50 years of age, their average intake of

13mg overall did not meet the recommended nutrient intake of at least 29 mg. For overall women, who were 51 years old and above, their average daily iron intake was 12 mg, which was slightly more than the recommended intake of 11mg for women of that age group (NCCFN, 2005).

The overall mean intake of crude fibre among respondents, was 4.5g. It is important to note thattheNutritionist Pro software,utilized to calculate fibre intake,had a database for crude fibre and not dietary fibre, although crude fibre is a part of dietary fibre. Therefore, the results for dietary fibre would be expected to be much higher than the crude fibre calculated by the Nutritionist Pro software. The Malaysian Dietary Guidelines recommend 25g of dietary fibre per day as in the Malaysian Dietary Guidelines (NCCFN, 2010). It is interesting to note that with the modest reduction of carbohydrate at the end of the study, there was also a slight drop in crude fibre intake. This may be due to a reduction in consumption of rice which is Malaysians' staple food, and rice may be an important source of fibre among Malaysians.

4.2.2.4 Quality of working life (QOWL)

(a) ***Baseline QOWL and its factors***

Quality of working life was measured by examining the average scores for each factor. The Malaysian version of the Work-Related Quality of Life-2 Scale included the factors General Well-Being (GWB), Job and Career Satisfaction (JCS), Stress At Work (SAW), Employee Engagement (EEN) and Home-Work Interface (HWI). The mean scores are based on the Likert Scale of 1 to 5, where 1 is "strongly disagree", 2 is "disagree", 3 is "neutral", 4 is "agree" and 5 is "strongly agree". At baseline, the QOWL mean scores (calculated from GWB, JCS, SAW, EEN and HWI scores) were 3.79 and 3.89 at the intervention and control sites respectively, with no significant

difference. These scores were close to a rating of 4 in terms of agreeing with a good QOWL. For the factors that make up QOWL, mean scores for all factors were not significantly different at baseline, except for "Stress At Work" (SAW). (See Table 4.19).Unreversed scores for SAW are presented, so that low scores reflect low levels of stress and vice versa. Mean SAW score was significantly higher, that is 2.60 among the intervention group and 2.25 among the controls. However, the mean QOWL scores which included the calculation of SAW, were not significantly different between groups.

Table 4.19 Baseline QOWL and its factors

	Intervention n=36 mean (s.d.)	**Control n=35 mean (s.d.)**	**p-value**
Overall QOWL	3.79 (0.37)	3.89 (0.35)	NS
JCS	3.64 (0.65)	3.64 (0.57)	NS
SAW	**2.60 (0.72)**	**2.25 (0.67)**	**0.04***
GWB	3.80 (0.44)	3.87 (0.53)	NS
HWI	4.07 (0.54)	4.10 (0.48)	NS
EEN	4.05 (0.37)	4.09 (0.46)	NS

*NS=not significant, *significant ($p<0.05$)*

The QOWL could have been affected by events related to work or conditions at home through the Home-Work Interface (HWI) factor. The study began near the beginning of the year and ended towards the end of the year. Average QOWL scores for both groups reduced at the third month, then gradually improved towards the end of the study as shown in Figure 4.11and Table 4.20. It is interesting to note, that after the generally dip seen in QOWL in both groups at the 3rd month, the overall QOWL increased more in the intervention group (surpassing its baseline readings) compared to controls which did not improve beyond its baseline level. The reason for the reduction in mean QOWL in both groups at the third month was not explored, but it is possible that this was due to temporal changes in the work environment that affected both groups at this time period.

Figure 4.11 Overall quality of working life of respondents

(Time 1: Baseline; Time 2: 3rd month/mid-programme; Time 3: 6th month/programme end; Time 4: 9th month/ post-programme)

Changes compared to baseline, after controlling for significant differences between groups for household income, education level and BMI are shown in Figure 4.12. An increase of mean QOWL score compared to baseline was seen in the intervention group in the 6th and 9th months. Significant mean difference between the worksites was seen at the ninth month (post-programme) (See Table 4.20). QOWL appeared to improve modestly after the programme ended among the intervention group. After controlling for factors that differed significantly between groups at baseline, there wason average, higher QOWL among the respondents in the intervention group compared to controls. There was a significant mean score difference of +0.12 between those in the 'Healthy Worker Programme' compared to controlsthroughout the

study (95% CI: 0.01; 0.24).The effect size of the programme improving QOWL was modest (partial eta square= 0.06, p=0.04). There was no statistical significant difference seen within groups.

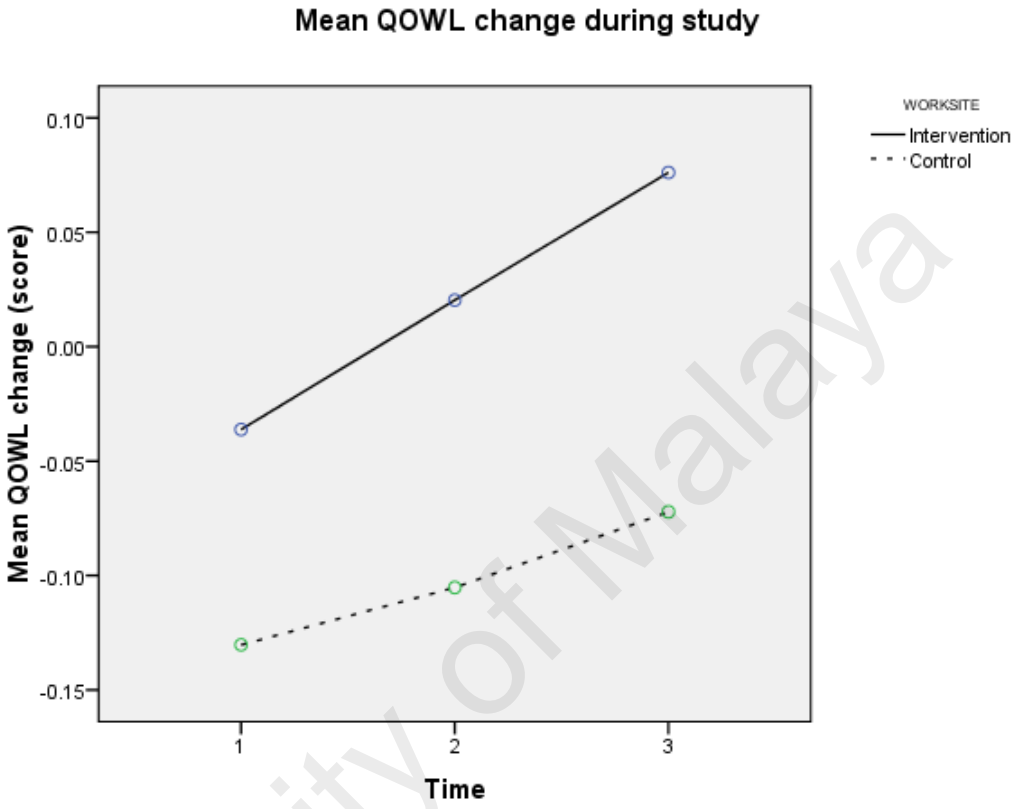

Figure 4.12 Change in quality of working life compared to baseline

(Time 1: 3rd month/mid-programme; Time 2: 6th month/programme end; Time 3: 9th month/post-programme)

Table 4.20 Mean change in QOWL scores compared to baseline (as calculated from factors)

Time	Mean change in QOWL Score		
	Intervention (n=37) Mean (sd)	Controls (n=36) Mean (sd)	95% CI[a]
3rd month (mid-programme)	-0.04 (0.28)	-0.12 (0.20)	-0.02, 0.21
6th month (programme end)	+0.02 (0.34)	-0.10 (0.22)	-0.02, 0.27
9th month (Post-Programme)	**+0.06 (0.34)**	**-0.06 (0.24)**	**0.01, 0.30***

[a]*Repeated Measures ANCOVA; *significant level<0.05*

b) QOWL factors

There appeared to be an increase in 'General Well-Being' and a reduction in 'Stress At Work' among the intervention group compared to controls, which contributed to an increase in QOWL with time. 'Job and Career Satisfaction' and 'General Well-Being' were improved beyond baseline and 'Stress At Work' was reduced below baseline in the intervention group by study end. No particular trend of improvement beyond baseline was seen among controls with time.It is possible that the control group showed temporal QOWL changes throughout the year. Mean scores for 'Home-Work Interface' and 'Employee Engagement' scores did not appear to show any particular trend in both groups.

The trends in the mean scores for QOWL factors for both groups are presented for baseline, third, sixth and ninth months(See Figures 4.13, 4.15, 4.17, 4.19, 4.21).Changes from baseline are also shown for the third, sixth and ninth months, controlled for significant differences between groups at baseline (education level, household income and BMI).(See Figures 4.14, 4.16, 4.18, 4.20, 4.22). No statistically significant difference between and within groups for the individual factors of QOWL

were seen. However, improvements in any of the score of factors contributed to overall increase in mean QOWL of the group. Changes in the factors for QOWL during the study are seen in Table 4.21.

Table 4.21 Changes in QOWL factors among respondents with time

Factor		Mean Score (SD)				p-value[a]
		Baseline	3rd month (mid-programme)	6th month (Programme end)	9th month (Post-programme)	
GWB	Intervention	3.80(0.44)	3.85(0.48)	3.85(0.36)	3.85(0.41)	
	Controls	3.87(0.53)	3.78(0.55)	3.84(0.49)	3.83(0.53)	
JCS	Intervention	3.64(0.65)	3.60(0.59)	3.63(0.51)	3.69(0.48)	
	Controls	3.64(0.57)	3.49(0.67)	3.51(0.61)	3.65(0.50)	*No significant difference within or between groups.*
SAW	Intervention	2.60(0.72)	2.64(0.73)	2.54(0.62)	2.35(0.59)	
	Controls	2.25(0.67)	2.38(0.73)	2.40(0.67)	2.25(0.67)	
HWI	Intervention	4.07(0.54)	3.93(0.41)	4.11(0.46)	4.04(0.40)	
	Controls	4.10(0.48)	3.96(0.45)	3.95(0.52)	3.97(0.43)	
EEN	Intervention	4.05(0.38)	4.03(0.44)	4.01(0.52)	4.05(0.50)	
	Controls	4.09(0.46)	3.98(0.48)	4.04(0.47)	3.97(0.50)	

[a]*Repeated measures ANCOVA, significance level <0.05; adjusted for baseline difference (GWB-General Well-Being; JCS-Job & Career Satisfaction; SAW-Stress At Work; HWI-Home-Work Interface, EEN-Employee Engagement).*

i. Job and Career Satisfaction (JCS)

For both groups, there appeared to be a reduction in 'Job and Career Satisfaction' (JCS) at the 3rd month, after which there was an improvement. It was interesting to note that there was less reduction of JCS at the 3rd month in the intervention group compared to controls. JCS continued to increase even after the programme ended and was even higher than at baseline for those who participated in the programme. On average, JCS was much better among the intervention group throughout the study, compared to controls (See Figure 4.13). Change from baseline in both groups is shown in Figure 4.14.

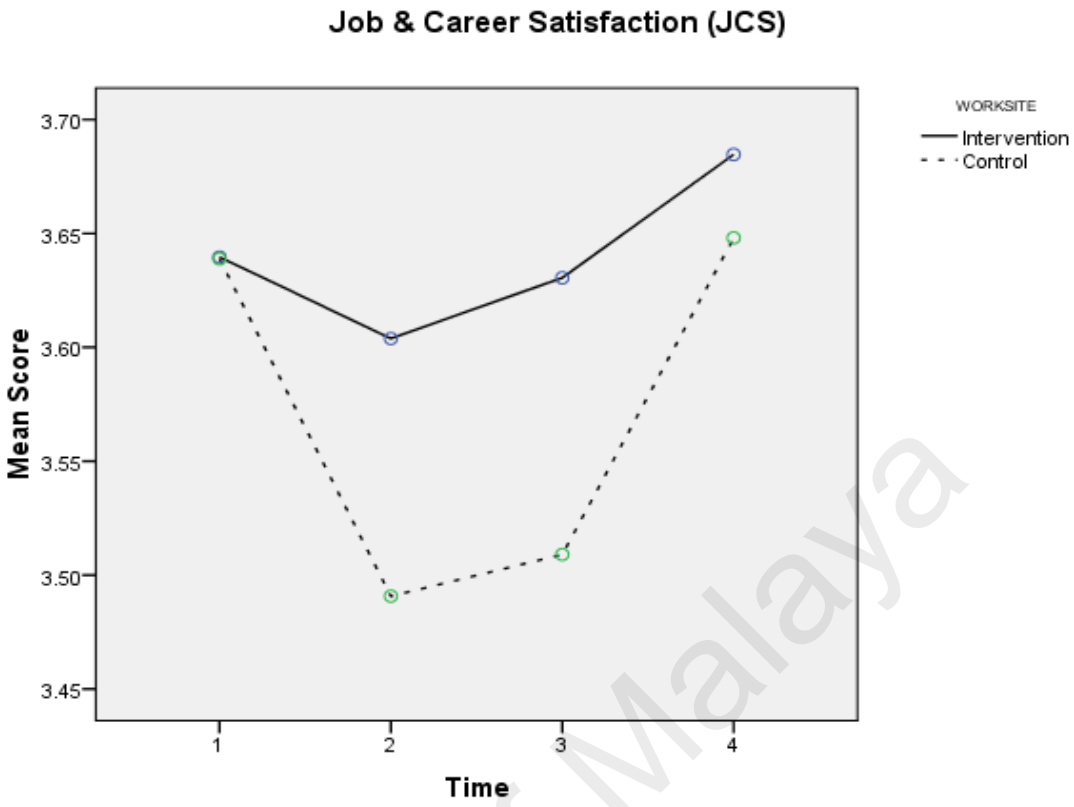

Figure 4.13 Job and Career Satisfaction

(Time 1: Baseline; Time 2: 3rd month/mid-programme; Time 3: 6th month/programme end; Time 4: 9th month/ post-programme)

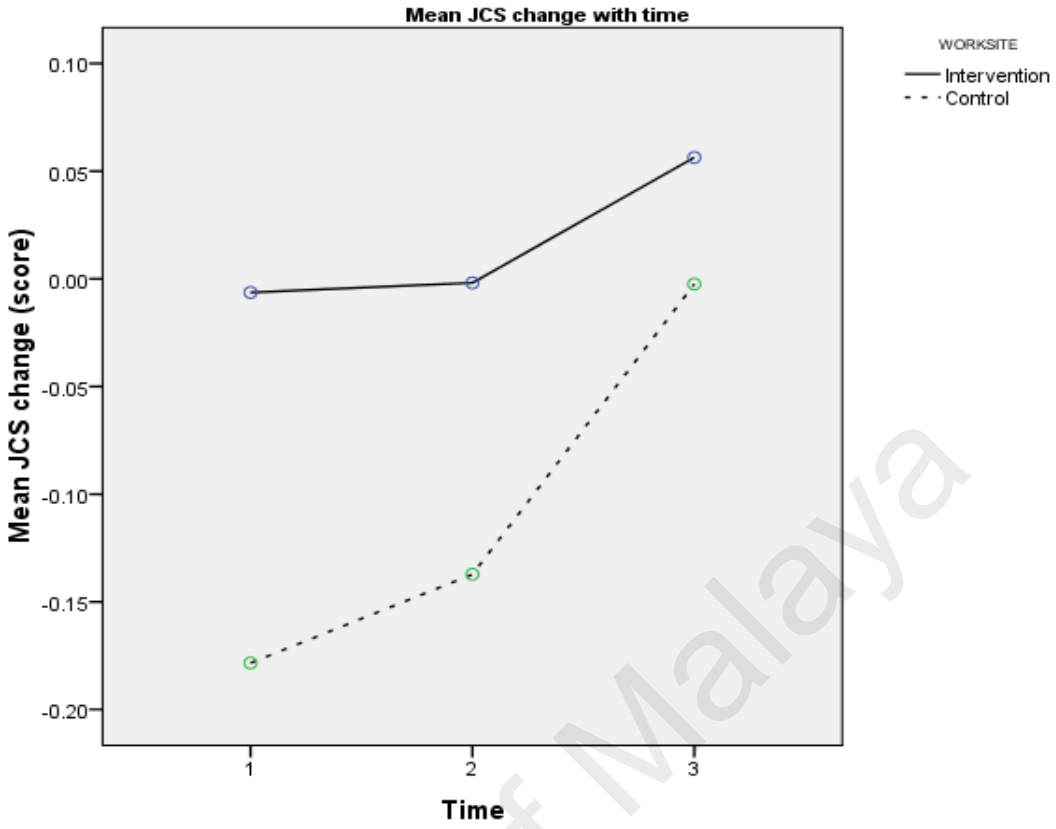

Figure 4.14 Change in 'Job and Career Satisfaction' compared to baseline

(Time 1: 3rd month/mid-programme; Time 2: 6th month/programme end; Time 3: 9th month/post-programme)

ii. Stress At Work (SAW)

There appeared to be a slight increase in stress levels at the third month in both groups. This could have been due to temporal changes where there was a gradual increase of work at the beginning of the year and the third month assessment coincided with this period. The intervention group showed a mean reduction of stress levels at programme end (6th month) compared to controls. For the intervention group, the stress levels continued to reduce to below their baseline levels post-programme (9th month). As for the control group, there was an increasing trend in stress levels up to the 6th month, which reduced to baseline level at the 9th month. It is as possible that temporal

changes is reflected in the controls where SAW increases towards the middle of the year and declines towards the end as seen in controls(See Figure 4.15). Mean changes compared to baseline in both groups is shown in Figure 4.16.

Figure 4.15 Stress at Work

(Time 1: Baseline; Time 2: 3rd month/mid-programme; Time 3: 6th month/programme end; Time 4: 9th month/ post-programme)

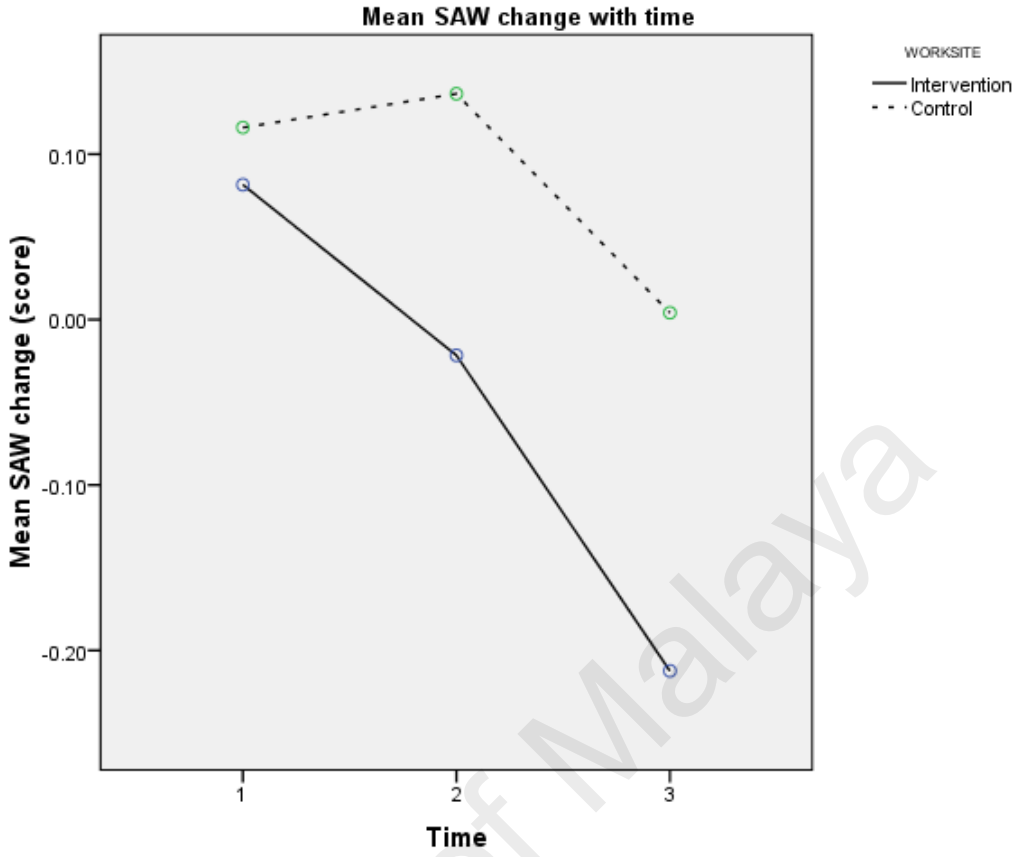

Figure 4.16 Change in 'Stress At Work' compared to baseline

(Time 1: 3rd month/mid-programme; Time 2: 6th month/programme end;

Time 3: 9th month/post-programme)

iii. General Well-Being (GWB)

An improvement was seen for General Well-Being (GWB) among workers in the intervention group from the 3rd month and sustained till programme end, compared to controls who showed no particular trend(See Figure 4.17).GWB changes in comparison to baseline are shown in Figure 4.18.

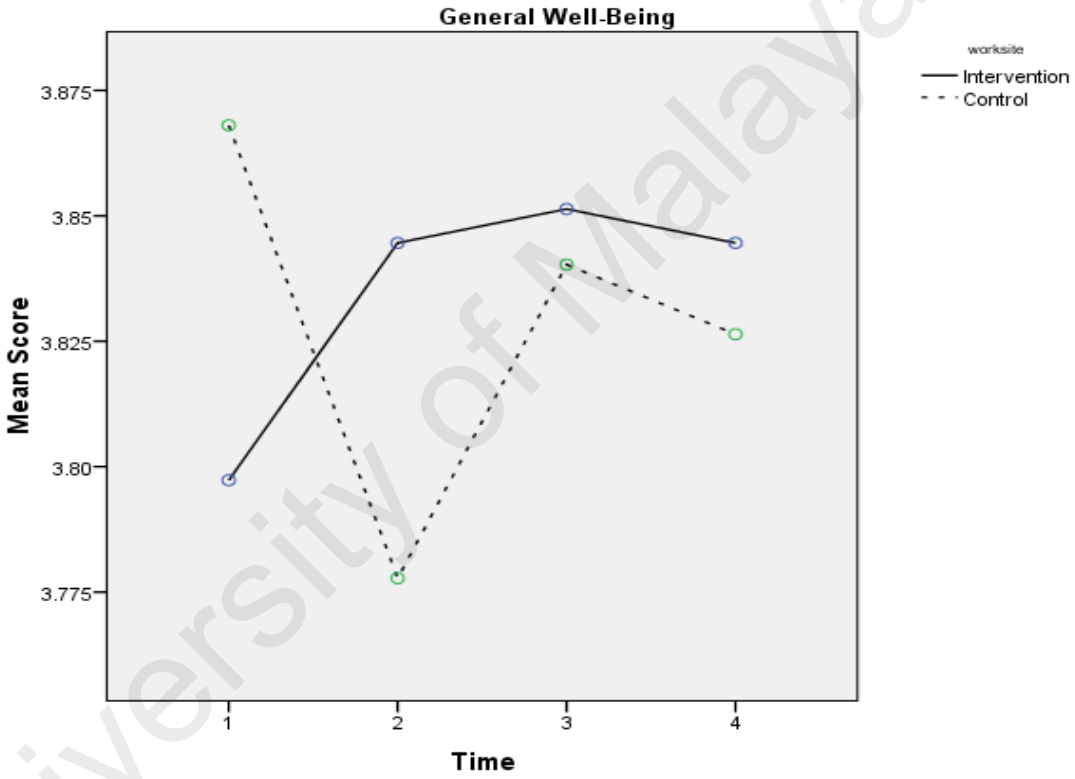

Figure 4.17 General Well-Being scores with time

(Time 1: Baseline; Time 2: 3rd month/mid-programme; Time 3: 6th month/programme end; Time 4: 9th month/ post-programme)

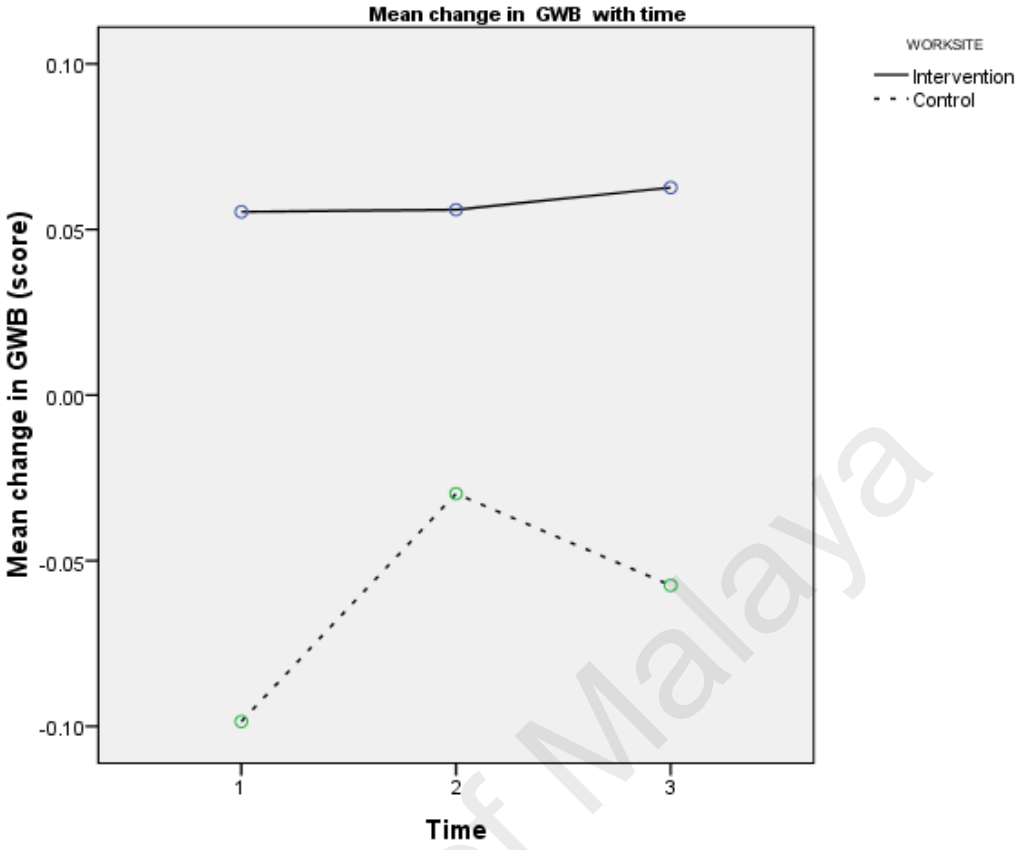

Figure 4.18 Change in 'General Well-Being' compared to baseline (Time 1: 3rd month/mid-programme; Time 2: 6th month/programme end; Time 3: 9th month/post-programme)

iv. Home-Work Interface

Both intervention and control groups experienced a mean reduction of Home-Work Interface (HWI) mean scores at the 3rd month. It was possible that this may be due to adaptation to changes at work and in the home in the earlier part of the year. Among the controls who were not exposed to the 'Healthy Worker Programme', there appeared to be low scores for HWI. Such a trend may be due to stresses at home and work due to both work and personal commitments in the middle of the year.

It was interesting to note that on the contrary, there was an increase in HWI beyond the baseline, seen at programme end (6th month) among the intervention group. The 'Healthy Worker Programme' included a component of intervention which encouraged participation of family and friends in eating healthily and being active. This intervention included the provision of recipes to be tried at home such as during holidays and tips on how to include family members in improving physical activity and diet. The intervention may have promoted more family interaction through healthy activities. However, the HWI mean score was not sustained post-programme, and showed a decline at the 9th month in the intervention group (See Figure 4.19). Figure 4.20 shows comparison of HWI scores to baseline.

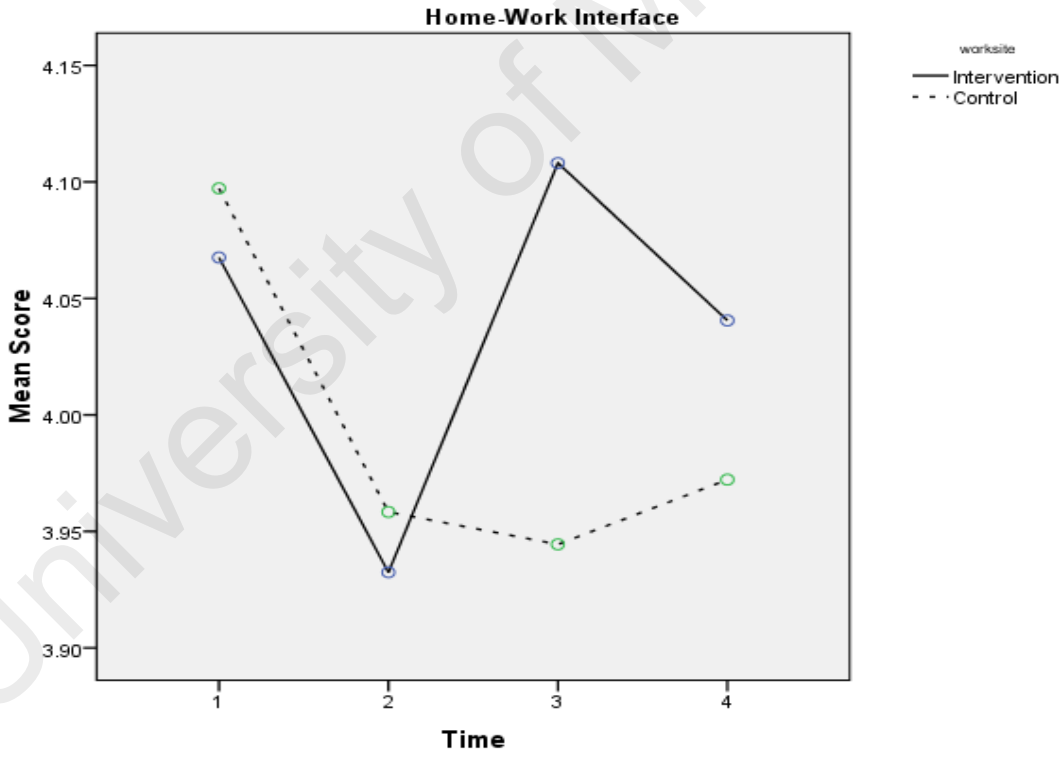

Figure 4.19 Home-Work Interface
(Time 1: Baseline; Time 2: 3rd month/mid-programme; Time 3: 6th month/programme end; Time 4: 9th month/ post programme)

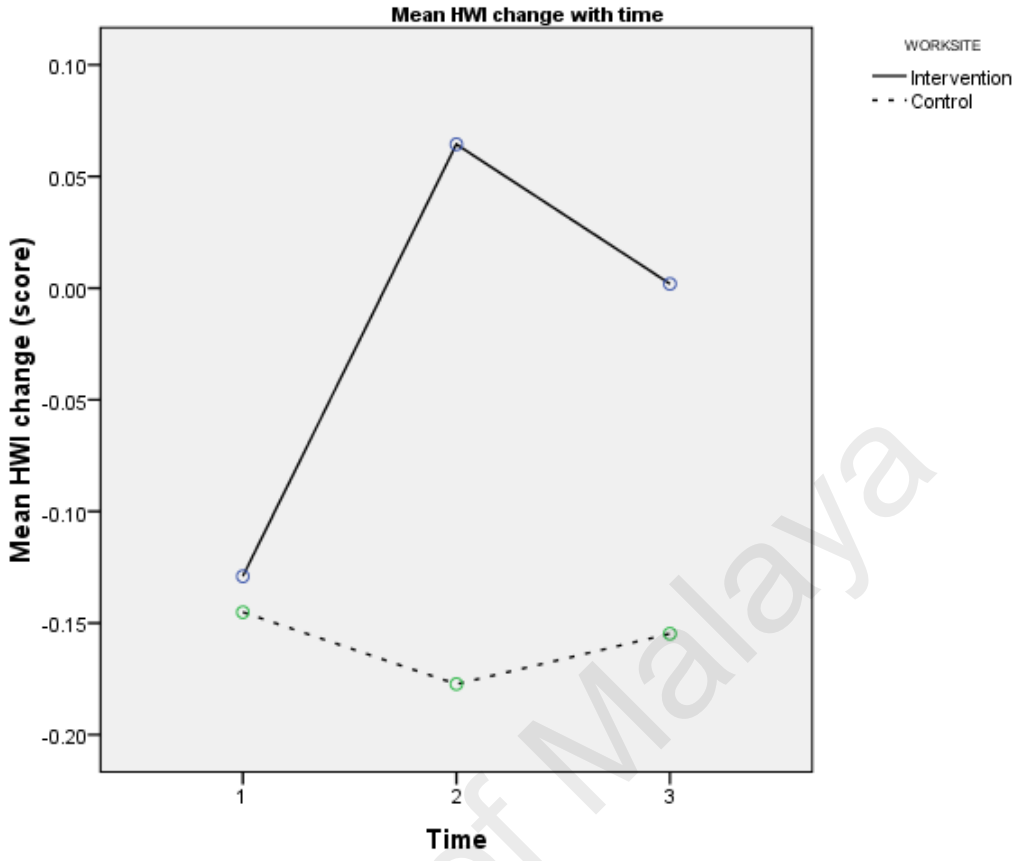

Figure 4.20 Change in 'Home-Work Interface' compared to baseline

(Time 1: 3rd month/mid-programme; Time 2: 6th month/programme end;

Time 3: 9th month/post-programme)

v. Employee Engagement

Employee engagement (EEN) factor reflects the 'positive attitude held by the employee towards the organisation and its values'. In this study, we did not find any improvement in the Employee Engagement factor with the 'Healthy Worker Programme'. Among the intervention group, after a slight reduction at the 3rd and 6th months, it increased towards baseline levels at the 9th month (post-programme). For controls, it fluctuated and dropped below baseline levels at the 9th month. (See Figure 4.21).Changes compared to baseline is shown in Figure 4.22.

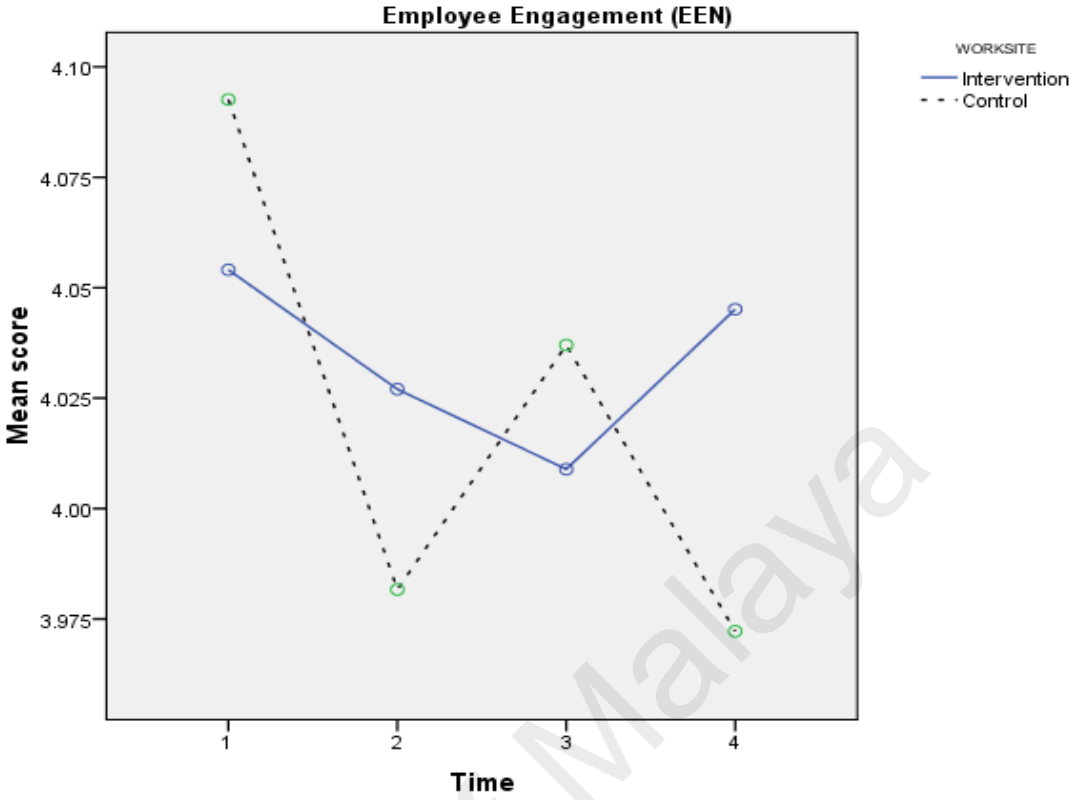

Figure 4.21 Employee Engagement

(Time 1: Baseline; Time 2: 3rd month/mid-programme; Time 3: 6thmonth/programme end; Time 4: 9th month/ post programme)

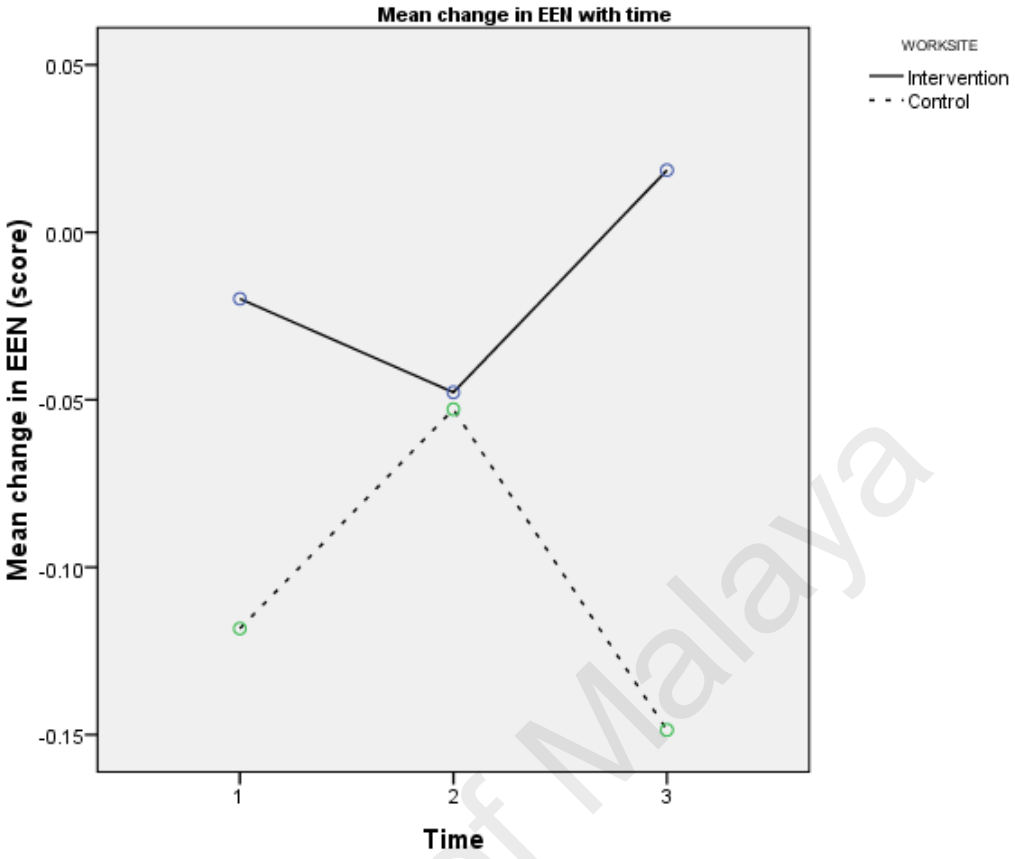

Figure 4.22 Change in 'Employee Engagement' compared to baseline (Time 1: 3rd month/mid-programme; Time 2: 6th month/programme end; Time 3: 9th month/post-programme)

c) Perceived overall QOWL

Perceived changes to overall QOWL, as felt by respondents, was also determined using the last item, "I am satisfied with the overall quality of my working life", in the Work-Related Quality of Life Scale-2. This item was not included in the calculation of QOWL factors, but was a subjective reflection of respondents' QOWL perception. From the validation study, there was a strong, significant correlation of 0.7 between the respondent's perception of QOWL and the calculated QOWL based on its factors.

Table 4.22 shows the percentages of respondents agreeing to a perception of good QOWL (scored '4' for 'agree' or '5' for 'strongly agree'). There were significantly lower percentages of respondents who perceived good QOWL (76%) in the intervention group, compared to controls (97%) at baseline. It was interesting to note that there was an increase of perceived good QOWL to 92% among the intervention group by mid-programme, a percentage which appeared to be sustained until post-programme. The percentage of respondents perceiving good QOWL among controls gradually declined with each assessment, from 97% (at baseline) to 86% at the ninth month. However, these changes were not significantly different between groups.

Table 4.22 Percentage of respondents' perceiving good QOWL during assessments

	% Perceived good QOWL (scores of 4 & 5)		**p-value**
Time	**Intervention (n=37)**	**Controls (n=36)**	
Baseline	75.7	97.2	**0.001***
Mid-programme(3rd month)	91.9	94.4	NS
Programme end (6th month)	91.9	91.7	NS
Post-programme (9th month)	91.9	86.1	NS

**denotes significance at alpha <0.05, NS-not significant*

CHAPTER 5: DISCUSSION

This chapter discusses the two phases of the study. In the first phase, the validation of the Malay translation of the Work-Related Quality of Life Scale-2 (WRQLS-2) was undertaken. The Malay WRQLS-2 was found to have good validity and reliability to determine the quality of working life (QOWL) ofMalaysian workers. In the second phase of the study, preliminary findings include a significantly higher proportion of those in the 'Healthy Worker Programme'who had lost at least 5% of their original weight compared to controls (14% vs 4% respectively). There was an increasing trend of physical activity levels and QOWL among programme respondents compared to controls. The results of the scale validation and the preliminary results of the programme, its strengths and limitations and ways to improve it further are presented in this section. Results of validation of the Work-Related Quality of Life Scales (versions 1 and 2) and other similar workplace interventions are discussed.

5.1 Phase I: Malay translation and validation of the Work-Related Quality Of Life Scale-2 (WRQLS-2)

The study confirms that the Malay translation of the WRQLS-2 has good construct validity and reliability to determine the quality of working life of Malaysian workers. This was the first Malay translation and validation of the Work-Related Quality of Life Scale-2. The Work-Related Quality of Life Malaysian model has 5-factors, that is"General Well-Being" (GWB), "Job Career Satisfaction" (JCS), "Employee Engagement" (EEN), "Home-Work Interface" (HWI) and "Stress at Work" (SAW). The "Control At Work" (CAW) and "Working Conditions" from the original English model had high multicollinearity and was considered redundant for the Malaysian model. The first version of the English scale (Work-Related Quality of Life

Scale) which had six factors (without 'Employee Engagement') was translated into Malay and validated by Chen and colleagues (2014). Their model had five factors, that isGWB, JCS, SAW, CAW and a HWI/WCS factor. The Home/Work Interface (HWI) and Working Conditions (WCS) were integrated as one factor (HWI/WCS) (Chen et al., 2014).

The Work-Related Quality of Life Scale-2, which included the Employee Engagement (EEN) factor was translated into the Thai and Chinese languages and validated among nurses (Lin et al., 2013; Sirisawad et al., 2014). Both Thai and Chinese scales included all seven factors as in the original English version. The EEN factor that was incorporated in the English Work-Related Quality of Life model was found to be a strong and stable factor in our latest Malaysian model. This factor is important in determining QOWL as it denotes the positive attitudes held by the employee towards the organisation and its values (QOWL, 2015).

The validation of the Thai and Chinese Work-Related Quality of Life Scale-2 (WRQLS-2) and the Malay Work-Related Quality Of Life Scale (first version) used principle component analysis only and lacked confirmatory factor analysis (CFA) to examine the factors of their model (Chen et al., 2014, Lin et al., 2013, Sirisawad et al., 2014). The Thai and Chinese WRQLS-2 scales were only validated in one group of workers,specifically among nurses. The Malaysian WRQLS-2 scale in this study was validated among two groups of workers, that is health care workers (which included nurses, doctors, physiotherapists and hospital attendants) and also office workers (which included administrators, managers, lawyers, bank officers, secretaries and clerks).

Different work environment and cultures may cause varying perceptions of quality of working life (QOWL). There are also varying policies, rules and regulations for good working conditions in different countries. Different cultural norms may

influence initiatives to bring about change to the work environment (Gelfand et al., 2007).In the United Kingdom, 'Job and Career Satisfaction' (JCS), 'Working Conditions' (WCS) and 'Control At Work' (CAW) could be appreciated as different domains. In our Malaysian study, 'Job and Career Satisfaction' appeared to be highly inter-related with a worker's satisfaction of their working conditions and the degree of control at work. This may be indicative that, there may be a general need to improve working conditions and decision-making opportunities for Malaysian workers. There may be higher standards of working conditions and control at work (ability to influence change at work) in a developed country. The working conditions in Malaysia can beimproved to reach the standard of a developed nation, such as through ensuring better tools and safer work environments. The nation is still improving its working environment and practices to become safer (Ahasan, 2014). More opportunities for workers to voice their opinions and influence change at the workplace maybenefit workers. Workers' unions which look into the welfare of workers are not commonplace in Malaysia. In 2012, it was reported that there were only 9% of workers in Malaysia which have joined unions (Bernama, 2012).

Besides local work practices, such differences in cultural values and general perceptions of workers of a certain country may also have an influence on perception of items in a questionnaire designed in a developed country like the United Kingdom in assessing quality of working life in the local context. Other studies also translated scales into the Malay language for use at the workplace, such as a study by Rosnawati and colleagues (2010) for the Nursing Stress Scale, and by Edimansyah and colleagues (2006) for the Job Content Questionnaire. They found that when one compared the same scales, which has been translated to be used in different countries, the Cronbach alphas for the total and domains of the scale varied between countries.

Differences in cultures may also influence the relevance of certain items in a translated scale (Weeks, Swerissen, & Belfrage, 2007).Translation of questionnaires developed in one country may create items, which are less appropriate or irrelevant in another country of varying culture (Cha, Kim, & Erlen, 2007; Liu, Borg, & Spector, 2004; Weeks et al., 2007). This may have caused some items to have been removed due to low loadings in the scale. Schwartz and colleagues (1999) demonstrated that cultural values could affect perceptions of work. Different cultures may generally have different values, such as egalitarian, mastery, harmonious, intellectual autonomy, affective autonomy, conservatism, hierarchy. Conservatism emphasises on maintenance of the status quo and traditional order (in the family, tradition, religion). A culture with strong hierarchy values, believes in unequal distribution of power, roles and resources. Egalitarianism promotes transcendence of selfish interests for the welfare of others. Mastery emphasises being assertive, successful or daring. A harmonious culture promotes fitting in well with the environment. An affective autonomy emphasises on individuals pursuing pleasure, excitement, varied life, while a culture which values intellectual autonomy emphasises individuals pursuing personal ideas, creativity, broad-mindedness. Intellectual autonomy is highly valued in Germany, and very unimportant in Nepal. Sweden and Denmark value egalitarianism, affective and intellectual autonomy. Power and prestige would motivate workers in countries which value mastery and heriarchy, such as in the USA and China, but these incentives would be opposed to in countries like Sweden and Finland which value harmony and egalitarianism values. In countries which value conservatism values, pursuing individualistic goals would be discouraged. Countries which are geographically situated close to one another tend to have similar cultural values, and this may be due to their shared history (Schwartz, 1999).

Even though the Malay WRQLS-2 is different from the UK scale, it is of public health interest to know the QOWL among workers to improve occupational health, even though factors for QOWL may vary. It could be that this succinct Malay scale is most appropriate for capturing QOWL in the Malay-speaking population. This is something to consider when comparing QOWL between countries. Even though the results may not be directly comparable, it is still an important aspect of occupational health to assess. It would be interesting to see further research on the construct validity and reliability of the WRQLS-2 Scale in other countries in Asia.

5.2 Phase II: The 'Healthy Worker Programme'

The 'Healthy Worker Programme' promoted a healthy lifestyle through improving dietary intake and physical activity at the workplace among overweight and obese individuals. At the end of the programme, the proportion that lost at least five percent of their original weight was significantly more in the intervention group, that is 14% among the intervention group and 4% among controls. Those who were in the intervention group were 1.6 times more likely to lose at least 5% of their body weight compared to controls (RR = 1.6; 95% CI: 1.2, 2.2). At post-programme, the proportion who lost five percent of their original weight were 12% among the intervention group and 8% among controls. However, this difference was not significant at this stage.

At programme end (6^{th} month), respondents at the intervention site were 1.3 times more likely to achieve 10,000 steps target (95% CI: 0.8, 2.1).There was gradual improvement among the intervention group which continued after the programme ended. Post-programme (9^{th} month), those in the programme were 1.8 times more likely to reach target of 10,000 steps a day (95% CI: 1.2; 2.5). For dietary intake, there was significant overall mean reduction of 3% carbohydrate daily intake between baseline

and at programme end (6th month). There were no other significant differences were seen for the macro- or micronutrients overall, within or between groups. An increase of mean QOWL score compared to baseline was seen in the intervention group at programme end (6th month). QOWL continued to increase modestly for the intervention group at post-programme. There was a mean score difference of +0.12 in QOWL between the intervention group compared to controls (95% CI: 0.01, 0.24). There was an increase in 'General Well-Being' and reduction in 'Stress At Work' among those in the programme.

In this section, the evaluation of the programme beginning from the retention rate, data attrition rate and feedback on the programme components. The primary outcome is discussed next, that is regarding weight and body mass index changes. This is followed with discussion on the results of secondary outcomes, that is the physical activity, dietary intake and quality of working life changes. However, due to poor response in returning forms for the secondary outcomes, data has to be interpreted with caution.

5.2.1 Program evaluation

5.2.1.1 Retention rate and data attrition

In the 'Healthy Worker Programme', there was a retention rate of 86%, taking into account the number of respondents who opted out, became pregnant or transferred to another workplace. This is a relatively high retention rate as most pedometer interventions (to increase physical activity) had retention rates which ranged between 40% and 80% (Marshall et al., 2004). A systematic review of workplace intervention toimprove diets also showed retention rates between 21% and 100% (Mhurchu et al., 2010).

While it was easier to get on-the-spot assessments of weight and calculate their BMI, it proved harder to get respondents to return their 7-day pedometer records, 3-day dietary records, IPAQ and QOWL forms during the assessments which were held at baseline, third, sixth and ninth months. Results should be interpreted with care. Those who returned completed forms for baseline and also two out of three following assessments were included in the study, for weight, PA and QOWL. Completed baseline and one out of two following assessments was required for dietary intake. With this method to include into the analysis, data from only 71% of respondents could be analysed for the primary outcome of weight change.A poorer response (<35%) for returned forms was seen for the secondary outcomes of physical activity, dietary intake and QOWL.

Multiple follow up assessments were challenging to carry out at a workplace. This was anticipated to be a problem and the top management at both sites delegated the task to the Human Resource Department to inform workers regarding the dates on which the assessments were conducted and to facilitate the study in any way they could. The Human Resource Departments gave much assistance in informing respondents on dates of assessment and also dedicated a room and a few personnel to facilitate the three-monthly assessments. However, despite these efforts, many respondents did not come to all the assessments or return their forms. Differing schedules of workers were often a logistic problem for data collection.It was possible that there was respondent fatigue or respondents were busy with work commitments, resulting lower returns of records and questionnaires. Better attendance at assessments and return of forms could have been achieved if top management made it a priority for workers to attend follow-up assessments or scheduling dedicated times for this.

5.2.1.2 Evaluation of programme components

A total of 84% of respondents in this programme (whose results were analysed) returned evaluation forms regarding uptake of the intervention components. Many claimed to have read health posters and found pedometers helpful to improve their PA. Many also tried the health tips given via the 'Healthy Worker Programme' and involved family members in making healthy changes to their diet and PA. A total of 65% tried healthy recipes given.

The advantage of receiving health information through the mail as in the 'Healthy Worker Programme' is that there is an opportunity to peruse their content at leisure. Such health information could also be brought home to be shared with family and friends, who may in turn give additional social support to improve their lifestyles to a healthier one. The use of the office despatch system allowed for the monthly motivation to be sent directly to the workers. About half (51%) of respondents stated to have read all the health motivational information given to them, while another 47% said that they sometimes read them, and a very small number, 2% did not read them.

Slightly less than half of those who returned their feedback evaluations (43%) found the single motivational phone call helpful. A total of 38% did not participate in the phone call motivation. There were respondents who were not able to be contacted by phone. About 19% of the respondents reported that the call was not helpful. A systematic review of telephone interventions for physical activity and dietary behaviour change by Eakin and colleagues (2007) reported that positive outcomes using telephone interventions varied between 21% and 91%. In this study, the motivational call was a short one, of about fifteen minutes, delivered by a nutritionist involved in the study. The call was made at mid-programme to deliver the respondents' latest results at their last assessment and to give motivation to continue efforts to improve their diet and PA.

Such a telephone call intervention was also carried out three months after the beginning of a worksite health programme by Muto and colleagues (2006) to give advice and motivate workers to take care of their health. The telephone call was delivered after individual counseling in their programme (Muto el al., 2006).

Telephone interventions have been used successfully to promote improvements to physical activity and dietary intake as suggested in systematic reviews(Eakin et al, 2007; Goode et al., 2012). Such interventions are commonly used with other forms of intervention such as printed health materials.In this study, workers were provided feedback after their mid-programme assessment and were motivated to continue to improve or maintain ther health behaviour by a nutritionist. The telephone call provided only one contact point for health advice at mid-programme for participants. More exposures for health advice came from the monthly health information/newsletters and workplace environmental modification over six months. The brief motivation counselling via telephone might be more effective in its delivery with the use of a structured and systematic approach. A study by Lin and colleagues (2016) in their trial found 'motivational interviewing' to be a useful strategy for telephone-based health promotion and this could be considered for future studies. However, a systematic review of telephone interventions found that there was no difference in the effectiveness between telephone counseling delivered through use of motivational interviewing compared to a brief counseling over the phone (Goode et al., 2012). An automated telephone counseling intervention was also observed to be as equally effective as human advice for physical activity (Goode et al., 2012). According to Pronk (2012), in current health initiatives which are designed to be comprehensive and multi-level, the telephone intervention may be useful for some, but not all health program participants.

5.2.2 BMI and weight changes

5.2.2.1 Clinically significant weight loss (5% weight loss)

At the end of the programme, the proportion who lost at least five percent of their original weight (clinically significant weight loss) was 14% among the intervention group and 4% among controls (p=0.03). Those who were in the intervention group were 1.6 times more likely to lose at least 5% of their body weight compared to controls (RR = 1.6; 95% CI: 1.2, 2.2). At post-programme, the proportion who lost five percent of their original weight were 12% among the intervention group and 8% among controls.At this time point, the intervention group were 1.2 times more likely to have lost at least five percent of their original weight compared to controls (RR= 1.2; 95% CI: 0.8, 1.8).

These results were comparable to a local study by Appukutty and colleagues (2014) which was carried out among overweight and obese government servants. Their programme included 5 exercise sessions weekly, dietary advice and behavioural counseling and reported 14% of respondents who lost five to 10 percent of their body weight. At least a change of five per cent weight reduction from original weight is recommended to be beneficial for those overweight and obese (MOH, 2013; NCCFN, 2010). A recent study by Miller and colleagues (2015) which was conducted among university employees with pre-diabetes, showed an average reduction of weight by 5.5% compared to controls (0.35%). This study included 16 weeks of weekly exercise (60 minute sessions), diet and weight self-monitoring records, goal setting of 10,000 steps per day and were given a booklet of calories (Miller et al, 2015).

There is a lack of workplace physical and/or dietary intake interventions which observe clinically significant weight loss (reduction of at least 5% of original weight). Systematic reviews for such interventions usually report mean weight and body mass

index reduction (Anderson et al., 2009; Verweij et al., 2011). This appears to be astrength of this study and its results can contribute towards the dearth of this information.

5.2.2.2 Mean BMI and weight reduction

Among programme respondents, there was also amean reduction of 0.5 kg/m^2 in BMI and 1.2 kg in weight among respondents of the programme.This is comparable to the mean reduction seen in two meta-analyses of worksite interventions of physical activity and dietary intake by Verweij and colleagues (2011) and Anderson and colleagues (2009) which reported BMI reduction of 0.3 kg/$m^2$and 0.5 kg/m^2 respectively. The meta-analyses also reported similar mean reduction in weight to this study (Anderson et al., 2009; Verweij et al., 2011). These findings were found across various worksite settings and appeared to be applicable to both males and females (Anderson et al., 2009).

Other similar workplace intervention studies which lasted for six months had variable results. A study by Kim and colleagues (2015) which delivered tailored text messages every alternate day to an intervention and control group of male, obese employees found a mean weight reduction of 1.71 kg in the intervention group while the controls reduced 1.56 kg (with no significant difference). Carter and colleagues (2013) in their pilot study among overweight employees observed a reduction of 4.6 kg among those who participated in a smartphone application intervention, “My Meal Mate” (self monitoring of diet and physical activity), while those who participated in a slimming website reduced 1.3 kg and those who used a food paper diary with a calorie count reduced 2.9 kg. A study by Arao and colleagues (2007) reported a reduction of 0.6 kg/m^2 in body mass index.

A study by Salinardi and colleagues (2013) which consisted of two phases, that is a six month weight loss phase, followed by a six-month weight maintenance phase, observed significant mean weight loss of 8kg among the intervention group. Their dietary intake intervention included recommendation for reduced energy, low glycaemic, high-fibre diet and education for behavioural change (Salinardi et al, 2013).Linde and colleagues (2012) who carried out environmental modification for physical activity and dietary intake at the workplace over two years, reported no significant weight changes. Morgan and colleagues (2011) in their three-month "Workplace POWER" programme among obese male shift workers, which included one information session, programme booklets, group-based financial incentives and an online component, observed a reduction of 4 kgs for weight and 1.3 kg/m^2 for BMI. Another 18-month study by French and colleagues (2010) of employees of bus garages, included monthly meetings, healthy alternatives in vending machines, upgraded gym conditions, farmer's markets, peer-mentoring, weighing competitions and food and physical activity programs. In this study, the intervention group reduced their BMI by 0.14 kg/m^2 (French et al., 2010). It was found that modifying the environment of the workplace towards one which promoted healthier choices with more chance of increasing physical activity and a good diet, may reduce weight in workers by an additional 0.29 kg. Thus an environmental modification of a worksite to facilitate physical activity and good dietary intake is recommended (Engbers et al., 2005; Gudzune et al., 2013; Verweij et al., 2010).

5.2.3 Physical Activity (PA)

In the 'Healthy Worker Programme', 20% of respondents at the intervention site and 8% among controls achieved at least 10,000 steps a day at mid-programme (3rd month). At programme end (6^{th} month), 17% among the intervention group and 11% among controls achieved this target. However, there was much increase of mean steps taken per day, post-programme (9th month) among the intervention group, where 24% achieved this target and only 5% among controls, showing good sustainability of positive effects of the programme in the short term. There was also an increase in overall physical activity levels observed from the IPAQ. Respondents from the intervention group mostly had low PA at baseline, compared to controls. This level of PA increased gradually, even after the programme ended. Three months post-programme, the PA level among respondents at the intervention site was significantly higher than in controls, with most achieving moderate (65%) and high (30%) levels of PA and few in the low level category (5%). They also recorded an average of 423 MET-mins/week more than controls at programme end. However, the respondents who returned the IPAQ were few and results should be interpreted with caution. Those who returned these forms may have been more motivated to improve among both intervention and control groups.

The presence of the pedometer itself may have motivated respondents to walk more to record their steps for a week. The pedometer is known to increase motivation to walk in individuals (Bravata et al., 2007). However, this effect would have been present in both intervention and controls. A meta-analysis by Conn and colleagues (2011) found that workplace pedometer interventions to increase PA for healthy adults were modestly effective. A mean effect size of 0.19 between intervention and control respondents was seen, equivalent to a difference of 496 steps per day.The characteristics of the respondents were not found to be related to the PA effect sizes (Conn et al., 2011). In

our study, at baseline, respondents at the intervention site were on average taking about 500 steps less than controls. However, by programme end, they had increased their average steps per day to slightly more than controls. Three months after the programme ended, respondents at the intervention site were walking an average of 665 steps per day more than controls.

A meta-analysis of studies of workplace physical activity interventions showed improvements in physical activity behaviour, fitness, anthropometric measurements and lipid levels (Conn et al., 2009). In our study, physical activity was assessed objectively by pedometers to measure steps taken per day and subjectively using the IPAQ for overall PA. At baseline, there was a significant but weak correlation of 30%, between steps per day and overall physical activity ($r=0.3, p=0.02$). A study by Dishman and colleagues (2009) found pedometer readings correlated by 16% and 20% with moderate activity. This may be because walking is only a part of the PA undertaken by individuals and pedometers cannot record PA that does not involve taking steps, particularly activities which uses more of the upper body such as lifting, mopping and gardening. The pedometer would also be unable to measure some types of PA such as cycling and swimming.An accelerometer would have been better at capturing overall PA as it can detect the pattern, frequency, duration and intensity of PA by the user, while a pedometer only captures the quantity of steps taken only. However, accelerometers are more expensive than pedometers (Berlin et al., 2006).

Workplace health promotions have resulted in increased physical activity (Aldana et al., 2005; Arao et al., 2007; Maruyama et al., 2010). A three month study involving sixteen worksites found that a physical activity intervention had improved regular participation in moderate and vigorous activity among 51% of staff at intervention sites, compared to 25% at control sites (Dishman et al., 2009). A workplace

physical activity programme which used the participative approach by workers was also found to reduce sedentary time during working hours. This was associated with workers doing light intensity activities at work and taking frequent breaks from sedentary time (Parry et al., 2013). In a study by Healy and colleagues (2011), breaks from sedentary time such as at the workplace, should be encouraged, as it reduces cardiovascular risk.

A systematic review of pedometer interventions to increase PA by Bravata and colleagues (2007) found no association between the number of steps per day and weight loss. In our study, the reduction in weight and BMI was moderately correlated with overall PA, but not the number of steps per day in this study. There was also no association seen with calorie intake. The weight loss seen in our study was probably attributed to increase in total physical activity levels which included activities which could not be measured by pedometers and also a reduced calorie intake.There was a low response rate for physical activity and dietary intake records, making it difficult to conclude which factor- physical activity or dietary intake- contributed mostly to weight loss among respondents. A mediation analysis in future studies with more physical activity and dietary intake data may be able to show the relationship between these factors and weight loss.

Exercise was found to be associated with a reduction in cardiovascular risks even though no weight loss is seen (Shaw et al., 2006). A meta-analysis conducted on pedometer based interventions to promote PA, showed an increase of PA by 26.9% over baseline and a decrease in systolic blood pressure by 3.8 mmHg (95% CI: 1.7, 5.9). The decreases in blood pressure was seen independent of weight loss also, which shows the benefits of physical activity even if weight loss in not achieved (Bravata et al., 2007). In middle-aged persons, a reduction of blood pressure by 2 mmHg would involve 10% lower stroke mortality and 7% lower mortality from ischaemic heart disease and

vascular causes (Lewington et al., 2002). Even if weight loss is not detectable or minimal, physical activity would be beneficial in reducing cardiovascular risks in the population (Bravata et al., 2007). It has also been found in a study of diabetics by Casey and colleages (2010), that walking was an activity that participants endorsed, whether it was for leisure, transportation or planned exercise. Initiatives to improve PA also promote worker well-being in many ways, not just through weight loss.

5.2.4 Dietary Intake

In this study, no significant change was seen between or within intervention and control groups. However, a modest decrease in energy intake was seen in both groups at study end (9^{th}month). In the study, both groups recorded on average of about 1400 kilocalories a day at baseline and at the end of the programme (6^{th} month). At study end (9^{th} month), both groups consumed on average about 100 kilocalories less, about 1300 kilocalories per day. However, this was not statistically significant.

Examining the data on macronutrients, the drop in calorie intake appeared to be from a significant overall reduction of carbohydrate intake compared to baseline. There was little or no change in protein and fat intake throughout the study. The proportions of the macronutrients (carbohydrate, protein and fat) were within the recommended levels. However, the contribution to daily calorie intake from fat was about 30% in both groups throughout the study, which is the maximum recommended level per day (NCFFN, 2005). This shows that counselling may be required to motivate overweight and obese workers to eat healthier foods or foods prepared in a healthier manner so as to reduce their fat intake.

A systematic review of workplace dietary interventions by Mhurchu and colleagues (2010) and other workplace health promotions by Aldana and colleagues

(2005) and Moy and colleagues (2008) have shown improvement in dietary intake of workers such as more fruits and vegetables and less fat intake. A canteen intervention at the workplace, which included healthy food labeling, found there was a mean decrease in calories in meals consumed at the canteen (Lassen et al., 2013). French and colleagues (2010) used dietary recall to study effects on energy intake among garage workers for a workplace dietary intervention over 18 months and found a significant difference between changes in energy intake between intervention and control groups. Mean reduction of 499 kilocalories was seen among the intervention group, while the control group reduced mean energy intake by 96 kilocalories (French et al., 2010). Moy and colleagues (2008) carried out a 2-year workplace dietary intervention among male security guards and reported that no significant changes in energy intake were seen between intervention and control groups.

In the study, for micro-nutrients, there was little change in vitamin C consumption in both groups at the sixth month (programme end) but at the end of the study (9^{th}month), the intervention group's mean vitamin C consumption had increased by 11 mg, approaching the recommended consumption per day. There was little change among controls at study end. Vitamin C consumption is reflective of fruits and vegetable intake among respondents. Also, it was observed that in the intervention group,meansodium consumption was slightly above the recommended 2 grammes per day. In the control group, its consumption was within the recommended intake at baseline and the ninth month and exceeded 2 grammes per day at the sixth month. There appeared to be no change in its trend of intake for both groups. Increased salt consumption can occur when eating out such as at food stalls or restaurants where there is much saltand sauces added to foods to make it tastier. Processed foods may also have high sodium content such as in breads (NCCFN, 2010). Overall, sugar intake in both groups was observed to beat about 10% of total daily energy intake, which was within

the recommended level of less than 15% of total calorie intake (NCCFN, 2005). There was no significant change in sugar consumption in both groups. While sugar intake appeared to be within recommended dietary limits, dietary counselling could be required to motivate workers to avoid high sodium-containing foods as this would increase risks for hypertension (NCCFN, 2010). Salt and sodium intake should be kept to a minimum to prevent non-communicable diseases.

From the dietary records received from respondents, some important dietary issues were also observed. On average, respondents were not reporting enough calcium intake. Respondents were recording an intake which was about half of what was recommended. It was even more worrying that women over 50 years of age were consuming, on average, even less than half or their recommended calcium intake of 1000mg. This could increase risks of developing osteoporosis later in life (NCCFN, 2010).

Women below 50 years of age were also, on average, not getting enough daily iron intake. Their average intake was 13mg, while the recommended level was at least 29 mg daily. Iron intake was within the lower border of the recommended range for men. Such results may indicate that women of child-bearing age in this study may be susceptible to iron-deficiency anaemia which can affect energy levels and overall health. These results were similar to an earlier Malaysian Adult Nutrition Study (MANS) which reported that females consumed half of the recommended daily intake for calcium (Karupiah et al., 2012; Mirnalini et al., 2008) and iron (Mirnalini et al., 2008). However, the results of dietary intake in this study should be interpreted with caution as there was poor response from respondents to return their 3-day dietary records.

There appeared to be little change in dietary intake of respondents within the period of this study. As BMI can also be used to measure the effectiveness of a dietary intake intervention (Cox, 2003), it may be a better indicator for evaluation of this programme.Also, the programme could be improved to increase efforts to reduce fat intake and address dietary inadequacies observed. Dietitians could be included in future programmes to assess diets of workers and give dietary advice.

5.2.5 Quality of Working Life (QOWL)

Quality of working life (QOWL) is an important outcome for both the worker and the organisation as it encompasses the factors of 'Stress At Work', 'Job and Career Satisfaction', 'Employee Engagement', 'Control at Work' and 'Home-Work Interface' (Lin et al., 2013; Sirisawasd et al., 2014). In this study, there appeared to be reduction of QOWL in both intervention and control groups at the third month of the study which is possibly due to temporal change at that time of the year. As the study began near the beginning of the year, the third month coincided with the first half of the year, and there may have been lower QOWL at that time of the year, due to possible increase in workload or an adjustment period to work and home activities around that time period. It was interesting to note that while the trend in QOWL in both groups increased after the third month of the study, it was the intervention group which showed a better increase, surpassing its baseline at the sixth (at programme end) and ninth months (post-programme). The QOWL in the control group did not increase beyond its baseline. There was a significant mean score difference of +0.12 (95% CI: 0.01, 0.24) between those in the 'Healthy Worker Programme' and controls. However, the effect size is modest (partial eta square= 0.06, p= 0.04).

Respondents in the 'Healthy Worker Programme' showed a trend of increase in the 'General Well-Being' factor and a reduction in the 'Stress At Work' factor, which contributed to an increase in QOWL throughout the study. At the sixth month (programme end), the intervention group's mean scores for 'General Well-Being' and 'Home-Work Interface' showed an increase beyond baseline, while mean score for "Stress At Work" was reduced below the baseline, indicating a reduction in stress felt that was related to work.'Job and Career Satisfaction' increased and 'Stress at Work' decreased further post-programme at the ninth month, which contributed to more improvement to QOWL in the intervention group.

No improvement was seen in 'Employee Engagement' (EEN) in both groups. The EEN factor reflects the 'positive attitude held by an employee towards the organisation and its values'. EEN appeared to reduce throughout the study and return towards the baseline towards the study end among the intervention group and it fluctuated among controls. The 'Healthy Worker Programme' was carried out with the support from the management. The management made available venues and a few staff to help coordinate programme activities. They were also involved in giving prizes to respondents who managed to lose weight.Perhaps an improvement to the 'Healthy Worker Programme' would be to include more efforts from the management and workers themselves to become more actively involved in such a health promotion at the workplace. An enhanced, participatory approachmay improve health behaviour (Parry et al., 2013) and also the image of a workplace, where management and employees work to together to promote health in an interactive manner. A more caring attitude shown by the management where worker health is also a priority may improve EEN.

The control group did not show any trend of improvements in QOWL factor scores beyond their baseline. Changes for this group's QOWL and QOWL factors may

be influenced by temporal changes at work and the home. Temporal changes at home may influence QOWL through the 'Home-Work Interface' factor. However, the changes in QOWL factors (JCS, SAW, CAW, HWI and EEN) within and between groups were not statistically significant.

The difference in 'perceived QOWL', which was respondents' subjective rating of their QOWL, was significant within groups, but not between groups. Perceived QOWL increased significantly in the intervention group and reduced within the control group. The proportion who perceived good QOWL increased from 76% to 92% at mid-programme, which was maintained till post-programme among those in the 'Healthy Worker Programme'.

Initiatives to improve PA may promote worker well-being in many ways. A multi-component workplace health promotion in the United Kingdom among 618 workers found a reduction in health risk factors and absenteeism, while promoting increased performance (Mills et al., 2007). A meta-analysis of studies of workplace physical activity interventions observed improvements in work attendance and job stress (Conn et al., 2009). A systematic review and meta-analysis of various types of work health promotion from 1970 to 2005, found that exercise increases overall well-being (RR=1.25), mental well-being (RR=1.55), work ability (RR=1.38) and reduces sickness absences (RR=0.10). Workplace health promotions targeting healthy lifestyles also reduces sickness absences (RR=0.80) (Kuopolla et al., 2008). Another recent systematic review by Chu and colleagues (2014) also found improved mental health outcomes among workers who participated in physical interventions at worksites. Yoga and physical activity programmes were found to reduce anxiety and depressive symptoms among workers (Chu et al., 2014). It appears that workplace health promotionscan affect workers' ability to work positively (Kuopolla et al., 2008).

Perceived work ability among female workers who do physical work, also was found to be modestly increased following a workplace intervention of physical activity once a week (Nurminen et al., 2002).

It is possible that the maintenance of improved levels of physical activity seen among those who were in the 'Healthy Worker Programme' until the end of the study could have improved their Quality of Working Life. Workers in the programme appear to report lowering levels of stress related to work and improved general well being compared to baseline. However, these preliminary results need to be interpreted with care as it was based on a small sample size of respondents in the study.

5.2.6 Barriers to improve PA and dietary intake

In this study, barriers to improve dietary intake and physical activity were environmental exposures which can influence daily choices, poor health, inadequate knowledge on how to reduce weight through dietary changes and psychological barriers. Respondents stated that most of the time, environmental exposures would be influential in the choice of food and physical activity. An environment where unhealthy choices were predominant would make it challenging for workers to maintain a healthy diet or make time to be physically active. Examples given included foods high in sugar, fats and calories were regularly made available, such as during office meetings, at home and during social events at weekends. The office environment could influence workers to be active or sedentary. Workers will be more active during inter-office games, but may return to a sedentary lifestyle after that.

Poor health such as mild arthritis or any acute illnesses, would also prevent workers from being involved in rigorous activities. Co-morbidities have been found to derail participants from a regular exercise routine (Casey, De Civita & Dasgupta, 2010).

There were also respondents in the 'Healthy Worker Programme'who had poorunderstanding of how to make dietary changes to reduce weight. Such respondents stated that they had skipped meals, especially dinner to lose weight. Some had complained of gastritis due to skipping meals and this deterred them from making dietary changes. This shows that there were workers who had poor understanding of how to make dietary changes for a healthier lifestyle.

Respondents also mentioned psychological barriers such as poor discipline and time management. Some had difficulty overcoming personal preferences and a strong appetite for calorie-rich foods. Habitual conditioning in such persons, probably since young, could have developed a taste for less healthy foods. Poor motivation was also mentioned as a barrier to continuously maintain a healthy diet and physical activity level. It was interesting to note that when asked whether lack of time was a barrier, respondents interviewed mentioned that a person's attitude was the most important factor in making a healthy change to one's life and that one had to make the time to be physically active. In a study by Casey and colleagues (2010), focus group discussions showed that motivation was a critical factor in exercising during and after a health programme. Monitoring and encouragement from programme staff were regarded important among programme participants (Casey et al., 2010).

5.2.7 Ways to improve the programme

The 'Healthy Worker Programme' multiple levels of intervention were carried out as scheduled with the support of the organization, the cafeteria operator and the participants. Participants' feedback on components was discussed in the results section. Feedback included whether they read health posters all the time, or received a motivational call or tried any of the health tips given. Many claimed to have read the

health posters, tried out health tips given and found the display of calories at the cafeteria motivated them to eat healthily. The majority involved family members in making healthy changes to their physical activity and diets and tried healthy recipes distributed. Some read the monthly health tips every time, while others only read them sometimes. Nearly half of the participants who gave feedback, informed that the the motivational phone call was helpful.The programme showed 14% of workers in the intervention group lost a significant percentage of their body weight at programme end, and these results appear sustainable in the short term. There was also increased physical activity in the same group, which continued to increase post-programme. Modest increase in quality of working life was also seen after programme ended.

A review of workplace health promotion and interventions showed that best results were achieved through comprehensive multimodal (or systemic) programs which include relational and behavioural elements. Singular interventions showed less effectiveness. Interventions targeted at helping individuals were more successful than targeting the whole organisation (Goldgruber et al., 2010). A two-year, multi-component worksite environmental intervention trial to prevent weight gain found that there was no difference in weight change between the intervention site and controls. It is possible that to be successful, a health promotional programme should include an environmental and an individually targeted component, such as counselling (Gudzune et al., 2013; Linde et al., 2012; Chau, 2009.). More intensive modes of intervention, especially with giving of information and behavioural counselling may have greater impacts (Anderson et al., 2009). The 'Healthy Worker Programme' may have its strengths in having multiple elements to interact with workers, however the program could be improved by increasing contact time with respondents to give one to one counselling and personal delivery of information to yield better results (Conn et al., 2009; Gudzune, 2013).

Even though the programme is tailored for minimal disruption of activities at the workplace, exercise classes, sporting games and other physical activity could be arranged at the workplace after office hours, at lunch time or during weekends to encourage workers to lead a more active lifestyle. A variety of physical activity could be organised for workers based on preferences. Exercise sessions which are trendy, such as different types of dance classes or yoga could stir interest in those who would like to try new ways of keeping fit. Self-defence or martial arts classes may also be attractive to some workers. A review by Bottorff and colleagues (2015) on interventions that promote physical activity among men stated that while men are more difficult to engage in such health programmes, gender-specific activities such as organised sports (eg. football) may increase their physical activity levels. Programmes with diverse components which may include online and mobile interventions, may be successful if it is simple, clear and tailored to men's preferences (Bottorff et al., 2015).

It was evident from the interviews that there were workers who still did not understand that skipping meals is discouraged and that consuming healthy foods with lower calories would be better. A dietitian may be included in future programmes. A dietitian may carry out dietary assessments of workers and give advice on making healthy changes to diets and of energy balance for weight control.

Counselling and motivational sessions with workers may increase and maintain their motivation. Group-based counselling and educational sessions may also increase the programme's positive effects (Norton et al., 2011). A psychologist can be included in the programme to carry out such counselling and motivational exercises among workers. The programme can also be improved by strengthening efforts to educate respondents on how to eat healthier portions and foods with lower calories.Cooking demonstration or classes for workers, their family members or friends may be useful to

share practical skills in preparing well-balanced, healthy meals with low fat and calories. As the 'Healthy Worker Programme' includes a social component, this would be one method to include spouses, partners, family members, housemates or friends in efforts to maintain a healthy lifestyle. Support from the immediate social circles is important for continuous motivation to achieve a healthy weight (Heath et al., 2012). In this study, healthy recipes were shared with workers and this may not be enough to maintain interest in preparing healthy foods.

Special attention and counselling on safe, low-impact exercise for those who have health conditions such as arthritis may aid in weight management in affected workers. Sports physicians may be involved to provide hands-on training for methods to exercise. Physical trainers can also provide exercise sessions for those who require special low-impact exercises. The 'Healthy Worker Programme' could be improved by having counsellors to remind overweight and obese individuals of the benefits of taking care of their diets and physical activity levels even if weight loss is slow or gradual to occur.

Workplace health promotions should be seen as part of the work culture of any organisation, instead of a short term intervention. Both physical and psychosocial environments should be targeted to effect healthy change (Kuopolla et al., 2008). This could be part of a corporate strategy for worker well-being and possibly increase productivity (Pronk et al., 2009). There should be more employer commitment and support to ensure successful participation of staff in workplace health programmes and to facilitate behaviour change to a healthier one (Marshall et al., 2004; Sparling, 2010). A participatory approach to workplace health promotions has been found to reduce sedentary time (Parry et al., 2013). A dietary and PA intervention reported that more social support from the workplace was associated with a 14% increase in mean PA

score and 4% higher mean fruits and vegetables consumption compared to a workplace with less support (Tamers et al., 2011). Participatory approaches where workers are involved in designing of the health promotion and the use of effective communication strategies to engage workers of various backgrounds may aid in improving the effectiveness of a programme. More participation from the top management (employer) may also increase motivation for workers to become more involved. This may also increase employee engagement. Newer communication methods include the use of mobile devices. Smartphones applications can be used to deliver daily advice and motivation for increasing physical activity (Bort-Roig et al., 2014) and weight loss (Carter et al., 2013).The use of incentives may also be beneficial for encouraging workers to stay fit. However, more research is needed to determine the optimal timing, magnitude and structure of incentives for maximum impact on workers (Strickland et al., 2015).

The 'Healthy Worker Programme' could be improved with more involvement of from all levels of workers, that is from the top management to the middle grade and the supporting staff. A better show of commitment and dedication from top management towards promoting a health programme would facilitate programme implementation, regular assessments and data collection during the programme. In this programme, incentives were given to encourage workers to continue participating in the programme and as a show of appreciation by the organisation for the workers' efforts to lose weight and maintain good physical activity. The organisation could also recognise good levels of physical activity and healthy weight loss (or weight maintenance) among staff as an achievement awarded yearly.

Sub-populations within the workforce should not be left behind in health promotional activities and workers with risk factors should be targeted specifically.

Tailored programmes may be beneficial for such workers (Pronk et al., 2009; Sparling, 2010). It has been recommended that workplace health promotions target employees which are less active as such interventions usually attract more motivated workers or those who are motivated to change (De Cocker et al., 2009; Marshall et al., 2004). For this study, the 'Healthy Worker Programme' recruited volunteer workers. It may be more effective if the organisation made the programme integral with work and every worker had the same opportunity to improve their diets and physical activity.

In this programme, the cafeteria operator was encouraged to provide healthy dishes. A good change observed was healthier foods were added to the array of food provided. However, the usual high-calorie foods, such as pastries, cakes, and dishes cooked with coconut milk were still available as usual. To accentuate the program's effectiveness, the organisation may make it a policy for cafeteria operators to provide a healthier selection of foods and beverage and not allowing less healthy desserts and dishes. An example would be to include healthier alternatives of rice which is commonly served. This would include Basmati or brown rice (Diabetes Counselling Online, 2015). The organisation may also provide healthier foods for a reduced price as part of its efforts to improve worker health (Strickland et al., 2015). A systematic review by Steyn and colleagues (2009) of nutrition interventions at the workplace reported that key success factors were a combination of nutrition and physical activity component, dietitians were involved in nutrition education, changes were made in the cafeteria (such as increased availability and advertisement of healthy foods), tailored feedback on diet for respondents, participation from employees in planning and managing programmes, reduced prices for healthy foods and using the stages of change theory to deliver intervention. These methods may also be integrated into the 'Healthy Worker Programme' to increase its effects.

There are common conditions that enable improvement of workers' physical activity. Such enablers may be incorporated into the programme's multi-level intervention, depending on its feasibility and suitability for an organisation. These include workplace policies such as flexible working hours or recreation teams to encourage workers to do more physical activity. Other environmental modification could be changing rooms with showers for the comfort of those who exercise. Provision of well-equipped kitchens, fruit boxes or cooking demonstrations at work also encourages healthy eating (Blackford et al., 2013).

Blackford and colleagues (2013) reported that the most preferred method for distribution of health promotional information was through emails or on the internet (Blackford et al., 2013). In this study, emails and the internet were not used to deliver health motivation. This was to reduce the likelihood of contamination as government officers from both sites may be able to share knowledge through the forwarding of emails and links through the internet. All forms of office communication tools can be used to advocate the message of a healthy lifestyle. In a meta-analysis by Davies and colleagues (2012), there appeared to be a small, significant, positive effect on participants' physical activity level ($d=0.14$, $p<0.01$) through internet-delivered interventions such as through emails and websites. However, this small, positive effect would translate to much increase in physical activity levelsat the population level (Davies et al., 2012).

Smartphone technology can also be incorporated as an improvement to the 'Healthy Worker Programme'. Smartphones can be used to influence and increase physical activity in the population (Bort-Roig et al., 2014). A systematic review by Bort-Roig and colleagues (2014) reported that smartphone technology which may be incorporated or linked to an application, has the potential to promote physical activity

among its users. According to the review, studies reported a moderate to excellent capability to measure physical activity and the novelty of the smartphone may make it a public health tool to promote an active lifestyle. Online expert consultation, social support networking and real-time feedback appear to be some strategies which may motivate individuals through their smartphones. However, this technology is still new and more studies are required to determine its effectiveness (Bort-Roig et al., 2014).

Sparling (2010) outlined key principles to consider when implementing a workplace health promotion. These include acquiring meaningful feedback from workers, appealing incentives, linking the workplace health promotion to occupational health and safety activities and extending its activities to workers' families to strengthen social support (Sparling, 2010). These recommendations could be used to improve this programme. There could be better engagement of workers through more activities which include family members or friends. The organisation could hold events which promote healthy lifestyles such as through sporting games, cycling events, outing at parks or walkathons. Healthy food preparations demonstrations can also be held and healthy meals served at such events.

A meta-analysis by Richardson and colleagues (2008) studied walking interventions using pedometers, which ranged from four weeks to a year. The study reported more weight loss with longer durations of interventions (Richardson et al., 2008). Another way to possibly improve the programme would be to increase its duration to increase effects on physical activity levels.

In terms of sustainability of changes, a qualitative study by Casey and colleagues (2010) revealed that Type-2 diabetic participants of a supervised exercise programme feared being left alone when the programme ended and not knowing who to turn to for support and encouragement to keep up their physical activity levels. Walking

appeared to be a favoured activity when the programme ended. However, while some participants could continue their exercise programme with the support of family and friends, there were others who felt that more could be done by programme staff to facilitate participants to make the transition into a personal exercise routine post-programme. Such suggestions included recommendation of local gyms or a follow-up every three or six months by the programme staff (Casey et al., 2010). In improving the 'Healthy Worker Programme', similar steps could be taken to aid the transition of workers into maintaining a healthy lifestyle.Walking at their own pace would be a good and safe recommendation for exercise among workers, especially for those who cannot do rigorous or high impact activities. Other exercises such as strengthening exercises can also be carried out.

While there are many ways to improve the programme, perhaps the most important would be to provide more interactive, educational sessions with multi-disciplinary teams including sport physicians and dietitians and also motivational sessions. This is to tackle the barriers that respondents have mentioned, that is psychological barriers (such as poor motivation, lack of discipline and poor time management), poor knowledge on how to eat healthily to lose weight and poor health such as mild arthritis and muscle aches. The barrier or challenge of environmental exposures such as being exposed to calorie-dense foods such as at the office and during social events or a sedentary environment, can also be tackled with these motivational and health education sessions. Dietary advice such as to reduce portion size or to select healthier low-calorie foods at events would be beneficial. Advice on how to make changes to lifestyle to become more active through exercises which are suitable for different fitness levels or for those with poorer health status (with arthritis and myalgia) would enable smoother transition towards a more active lifestyle. Motivation from a behavioral psychologist which includes tips to enhance discipline and improve time

management will counter psychological barriers felt by some. With such information and behavioural skills at hand, it would be easier to make healthier choices regardless of whether the environment at work or elsewhere was obesogenic in nature.

5.2.8 Limitations of the study

During the first phase of the study, a limitation is that the Work-Related Quality of Life Scale-2 (WRQLS-2) validation was carried out in urban areas and among two groups of workers only. There were also more female workers than males in the sampling. This appears to be a limitation in the study, as it does not represent the ideal gender distribution. However, the scale shows good cross-validity and may be applicable to other population groups in Malaysia. The test-retest procedure was also not undertaken for the scale and this could be done for future studies.The difference in items that are retained in the Malay WRQLS-2 compared to the original English scale, limits the scale's use for direct comparison with other countries which use the original version. However, through the validation process, the essence of the domains which make up quality of working life should have been retained and reflect an individual's QOWL as probably influenced by the local culture. This may make it relatively comparable with QOWL in other countries, which can also be affected by what is accepted by the local, social norms there.

A validation of the original, untranslated scale among English-speaking Malaysian workers may reveal if the same model applies, and whether the Malay model is different due to translational biases. As Malaysia is trying to improve its status to a developed country in the near future, a validation of the scale may be appropriate with an elevated status, to ensure its current applicability with more expectations from workers and organisations.

In the second phase of the study, that is the pilot-testing of the 'Healthy Worker Programme', it was limited in its design, which was quasi-experimental and not a randomised, controlled trial. Despite its limitations, this type of study design is commonly utilised and implemented in many other workplace health interventions where one worksite is designated as the intervention site and another worksite as controls (Berry & Mirabito, 2010; De Cocker et al., 2010; Lassen et al., 2013; Moy et al., 2008; Muto et al., 2006).

Participation in the study was on a voluntary basis and workers were not selected through random sampling. This is a common limitation in most workplace interventions where workers volunteer to join a health study. This method of sampling may introduce selection bias as the programme might attract workers who are more motivated and interested in taking care of their health.It may miss out workers who are less motivated, who may be more in need for a lifestyle intervention. There was also attrition bias as the number of cases analysed reduced due to loss to follow-up over nine months. Such missing data could be due to respondents not completing questionnaires or were unavailable to be assessed at any of the time points (3^{rd}, 6^{th} or 9^{th} months). Sometimes a respondent was unavailable at one assessment, but participated in the following assessment. Such missing data from loss to follow up or incomplete questionnaires may contribute to missing data bias and can affect the validity of the study, contributing to study limitation. Missing data was treated with the carrying forward of the last reading.This method of missing data management was used in other weight loss studies (Astrup et al., 2009; Greenway et al., 2010).In future studies, perhaps the linear mixed model analysis could be used to reduce treatment effect bias (Lüdtke, Robitzsch, & Grund, 2016; Prakash et al., 2008). However, the data was also analysed as 'per protocol' which showed similar results to analysis by 'modified intention to treat'.

Workers who continue to participate until the end of the study may also be those who are most motivated and results may reflect improvements in this sub-group of respondents (De Cocker et al., 2009; Marshall et al., 2004).It would be ideal if a workplace could incorporate a continuous health programme into their work culture, so that less motivated workers always have the support to make healthy lifestyle changes.

Although all efforts were made to match both workplaces as closely as possible, where both were government offices with a cafeteria, gym, stairs, walkways and surrounded by parks, it was difficult to find two workplaces with an identical nature of work. There is the possibility that their different natures of work and environment may affect workers' physical activity, diets and quality of working life. There was also a possibility of cross-contamination of control workers if there were any inter-governmental meetings or training sessions where controls visited the intervention workplace and became exposed to intervention. However, such meetings would not be common as they were from different government ministries and some components of intervention, such as phone calls and monthly motivational packs, were delivered directly to respondents.

While BMI is a most useful population measure for overweight and obesity among adults, it is only a rough guide as it is an index of weight for a person's height. The BMI does not take into account a person's fatty tissue or degree of fatness (WHO, 2015). Different individuals can have different percentages of fatty tissue and still have the same BMI (WHO, 2004). Muscular persons may be heavier with more muscle mass than fat. Two different persons of equal height may have different compositions of fat and muscle which adds to their weight, thus having the same BMI, but one having more fat than the other.

In this study, body fat or muscle analysis was not undertaken. This would have been beneficial in observing body fat and muscle composition changes with the weight loss. It is possible that there would have been no weight change seen, but there could have been a reduction of body fat and an increase in body muscle percentage. This would have been a healthy body composition change, while weight loss would not be seen in such a case (Prentice & Jebb, 2001). Also, other measurements related to non-communicable disease risk such as measurements of waist circumference and waist-hip ratio (Cairns et al., 2014; Queiroga et al., 2014) were not carried out in the study. These measurements could be conducted in future studies.

Other limitations include the possibility of respondent fatigue due to many questionnaires administered (7-day pedometer record, short form IPAQ, 3-day diet record and the WRQLS-2). Only a small percentage of workers could spend the time to record their dietary intake, PA and QOWL. While the primary outcome of weight change was easier to obtain through the weighing of respondents, it appears that collection of data through records for the secondary outcomes of changes to diet, physical activity and QOWL, was more challenging to carry out at a workplace. More support from the top management would encourage workers to participate in returning records and questionnaires to determine the effects of such a programme. The results for diet, physical activity and QOWL should be interpreted with caution as they are of small sample sizes, with a slight difference between the study arm response rates. With small sample sizes, it is difficult to ascertain which component, physical activity or dietary intake, played a more significant role in reducing weight among respondents. However, it has been found that an intervention with both components usually had a higher success rate in reducing weight, especially with an environmental intervention (Verweij et al., 2010). Physical activity and dietary records which were returned and analysed may have also come from the more motivated individuals and not

representative of all respondents in the study.However, this is common limitation of workplace health promotions where the more motivated workers would be more active in becoming involved (De Cocker et al., 2009; Marshall et al., 2004).

Data on PA, diet and QOWL from questionnaires were also self-reported and may have mis-reporting bias. Recall bias could occur in the IPAQ and QOWL forms. The IPAQ enquires about physical activity that respondents engaged in for the last seven days. For the dietary records, respondents may under-eat, under- or over-report on days when their food intake were documented (Crawford et al., 1994). However, the 3-day diet record is known to be a relatively effective and practical method to determine food intake (Crawford et al., 1994).This is because respondents record their diets on the same day, while other methods such as the 24-hour diet recall requires respondents to record what they ate the previous day and the food frequency questionnaire enquires how frequently a person ate a certain type of food in a previous time period.Another limitation in dietary analysis is the Nutritionist Pro database available at the time of the study contained crude and not dietary fibre. This limited the analysis to consumption of crude fibre only (a subset of dietary fibre). Results could not be compared to the Recommended Nutrient Intakes for Malaysia for dietary fibre. The data for dietary intake was also collected at baseline, programme end and post-programme. There was no mid-programme collection of dietary intake. In future, this could be carried out to observe any changes mid-programme among respondents.

The use of pedometers provided an objective way to measure respondents' daily steps, however there was still a possibility of mis-reporting when respondents self-recorded steps into a form. Due to logistical problems of collecting all pedometers immediately after respondents had finished using them, it was difficult to counter-check the 7-day memory of the pedometers with the number of steps in respondents' records.

Another limitation of the pedometer step records was that there was no documentation of the time the pedometers were worn. This makes it difficult to assess if respondents really wore the pedometers for as long as possible, that is from the time they woke up until they went to sleep at night. Also, results of the study may be affected by the "Hawthorne" effect where respondents may have behaved differently when they know they were being observed. However, it is possible that this effect may be seen in both intervention and control groups.

Assessment of physical activity with a pedometer would also be limited to ambulatory movements only such as walking and running with the pedometer. Non-ambulatory physical activity such as cycling and lifting would not be assessed. The pedometer also could not be used for physical activity in water such as swimming or water sports. It also cannot detect the pattern such as the intensity and duration of physical activity like an accelerometer (Norton et al., 2011).A pedometer may also be affected by a tilt when in use. The use of pedometers by obese individuals may cause it to tilt at the waist and affect step counts (Tudor-Locke et al., 2011). However, an accelerometer is much more expensive, making it less practical for use in a large cohort. Objective assessment of steps taken per day may be affected by pedometer use, as the pedometer can promote an increase in physical activity (Norton et al., 2011). However, this may occur in both groups and would have cancelled off such effects.

The programme also used the Socio-Ecological Model to deliver intervention at multiple levels. Using this model, there can be interaction of influences from each level and it can be difficult to discern which level of intervention would have caused a behavioural change in an individual (Glanz et al., 2008). This was a limitation of the study.

The 'Healthy Worker Programme' was a complex intervention with multiple components which interacted with one another with the aim of reducing workers' weight as a primary outcome. While process evaluation was carried out on the main intervention components (such as monthly motivation, calorie display at the cafeteria, family involvement in diet and physical activity changes) not all effects on the organisation, inter-personal relationships and individual were evaluated for the programmes' effect. Examples of areas not assessed included respondents' staircase use, gym use and whether motivation from peers in the newsletter was found to be useful. These could be assessed in future studies. Respondent feedback was also limited to mostly 'Yes' or 'No' answers for their involvement in the intervention components and whether they thought that the intervention were helpful. Questions included whether they read the monthly health motivation, the health posters, whether they found the phone call or calorie display at the cafeteria motivating or if they tried out any of the healthy recipes or tips with friends and family. (See Appendix H).The feedback evaluation could be improved in future studies by using a Likert scale which allows workers to answer in terms of different grades of agreement to a certain component for behavioural change (Losby & Wetmore, 2012; SurveyLegend, 2014).

The qualitative inquiry was carried out to determine types of barriers the workers faced in improving their physical activity and dietary intake as recommended in the monthly motivation packs, health poster displays, co-worker motivation, telephone call and with the aid of table top displays of calorie and fat content in foods at the cafeteria.Bort-Roig and colleagues (2014) also used a qualitative method to explore barriers to uptake of their strategy to sit less and move more at the workplace in their process evaluation. However, a limitation of the qualitative interview is that it was not undertaken to examine the perception of workers towards the different intervention components, as some of this area was covered in the feedback forms which included

questions on whether workers found certain interventions helpful or motivating, or whether they tried out or read any health tips. The feedback forms contained mostly 'Yes' and 'No' options. The interviews helped to uncover the programme's weaknesses instead by collecting information on what were barriers and this can facilitate areas of in which it can be improved. Another limitation is that the interview did not cover enablers to improving their physical activity and dietary intake or how they would like to improve the programme. Workers were also not asked regarding why some did not return completed forms for information on their diet, physical activity and QOWL. This would have given more insight on the best way to conduct assessments. This information could be collected in future studies. The qualitative evaluation utilised in-depth interviews rather than focus group discussions for pragmatic reasons as many workers had different schedules and work commitments.

Another study limitation for the qualitative interview is that the researcher was the interviewer and both interviewer and interviewee knew each other through program activities. This could have influenced the comments made by the workers regarding the 'Health Worker Programme' and lack of reflexivity in the analysis. Other limitations included the researcher being the data coder and transcripts were not returned to the workers for feedback, of which may have impacted on the interpretation of the results. In future studies, interviews with participants could be conducted with a third party or an interviewer who is not familiar with the programme or participants. Transcripts could also be returned to workers for feedback and coded by more than one data coder to increase credibility.

Other limitations in the study include confounding factors, where weight loss could have occurred due to other motivators, such as influence of friends, family, colleagues or other health campaigns. It was considered in the designing stage that

health campaigns may be a confounding factor, as there may be health promotions over the local media or within the government sector. Both worksites were government organisations, therefore would be exposed to similar governmental efforts which promoted health such as through inter-governmental agency sporting games or events. Throughout the study, both workplaces had sporting events intermittently. Sporting events tended to occur towards the middle of the year and occurred in both workplaces.Motivation from friends and family outside the programme were a confounding factor which cannot be controlled and is considered a study limitation. As for QOWL, confounding factors included events outside of the programme which could affect a person's well-being, stress at work and other factors of QOWL. As this was considered earlier, it was decided to choose two workplaces with similar work environments, where most workers worked in an office environment. Also, as QOWL can also be affected by the Home-Work Interface component, workers were also assessed for dependents at home. It was found that there were no significant differences between the two groups' dependents at home. These confounding factors were considered and steps were taken to keep the background and environment of both groups as similar as possible.

In this study, incentives such as prizes were given at organisational meetings or at respective offices after the third and sixth monthly assessments to those who lost much weight and had the most number of steps. Although the incentives given were a reflection of organisational support towards the programme and to increase motivation among employees to lose weight, the incentives provided might have also exerted an effect on workers.There was a possibility that workers may have reacted positively due to the incentives, rather than the true effect of the programme.

Also, in this study, sustainable changes were assessed in the short term, that is three months after the programme ended. It would be interesting to measure the sustainability of effects for a longer time frame in future. Generalisability of the study was also limited to office workers in the urban federal territories. Respondents were mostly desk-bound workers, government workers and of Malay ethnicity. Future studies could be carried out among other groups of workers, with a more varied ethnic composition at other regions in Malaysia to test the reproducibility of the effectiveness of the programme under different study conditions.

5.2.9 Strengths of the studies

This study conducted the first validation of a Malay Work-Related Quality of Life Scale-2. It was also carried out among both private and government sectors, including different job categories of healthcare and office workers to measure the quality of working life. There appears to be a dearth of information of changes in quality of working life among workers exposed to workplace health promotion, which was addressed in this study. There is also a lack of studies focusing on temporal changes in quality of working life of workers throughout the year. As the Work-Related Quality of Life Scale-2 (WRQLS-2) is relatively new, there is a lack of published studies using this scale for physical activity and dietary intake interventions and other types of health promotion. It is important from an occupational health point of view to understand the organisational impact of a workplace health promotion on workers' QOWL. This study is also the first to use the Malay translation of the WRQLS-2 to determine QOWL among Malaysian workers.

In the second phase, the study utilised a quasi-experimental study design, which was to reduce contamination bias between workers. One site was used for intervention,

while another site, which was located some distance away, was used as a control site. The presence of controls allowed a comparison group to study the effects of maturation bias and temporal changes. The control group reflected changes that could occur among workers with minimal health information such as pamphlets and talks and also exposure to other health campaigns that the public would be normally exposed to over time through media or other events in the local community. Changes occurring among controls can also show Hawthorne effects on a cohort within a health study.

This intervention was designed to be easy to implement, where minimal personnel are required to coordinate and oversee activities. This study design is similar to another quasi-experimental, multi-strategy workplace physical activity intervention programme by De Cocker and colleagues (2010) where minimal contact and personnel were required to create an easy to implement workplace health promotion with positive outcomes. In this study, only one researcher and a nutritionist coordinated the intervention activities, such as preparation of monthly motivational packs, motivational telephone calls and placement of environmental prompts (eg. health posters, calorie displays and 'use of staircase' prompt). Additional personnel such as nurses were required during the recruitment period and three-monthly assessments. Human resource personnel from the worksites helped coordinate venues and official letters to staff to invite them for assessments at the worksite. Top management and also the cafeteria operator were involved in supporting the programme through giving gifts to workers who succeeded in losing weight and providing healthier foods, respectively. The programme encouraged the workers to make healthy changes by themselves by providing a more conducive atmosphere to increase physical activity and improve their diet. In this intervention, no exercise sessions were given because it was tailored to be as minimally intrusive as possible to the worksite environment. Instead, it gave encouragement to workers to become more physically active using their pedometers as

a guide to walk more in and out of the office and involving themselves with more physical activity which includes exercise, sports and other activities at the office, home or other venues. The programme delivers advice that household chores, gardening or just being active such as playing with one's children provide chances to increase activity levels. While being easy to implement (with minimal dedicated staff), it is on average, as effective compared to other studies in reducing weight among workers. In this study, workers reduced an average of 1.2 kg for their weight and 0.5 kg/m^2 for theirBMI, which were similar to the average results of other workplace physical activity and dietary intake interventions observed in meta-analyses by Verweij and colleagues (2011) and Anderson and colleagues (2009). As for clinically significant weight loss, that is at least 5% weight loss of their original weight, as many as 14% of respondents lost this amount of weight at programme end. As many as 12% still showed clinically significant weight loss at three months after the programme ended.

A major strength of this study is the use of the socio-ecological approach which takes into account that the individual is influenced through his or her thought process and through interaction with others, the organisation, society and environment. This approach allows the intervention to be targeted through these factors to allow maximal influence to the person and others around him or her, as opposed to other health intervention approaches which may target to influence the individual only. The study used a complex intervention, where intervention was targeted at multiple levels, with interaction between the levels, using the socio-ecological approach. This included health education, motivation, environmental modification and positive enforcement from colleagues and top management. This form of intervention mimics a more real life-like environment where a person would be influenced by friends, colleagues, bosses or work culture and environment to support changes in thinking and behavior.

One of its intervention included support from top management and to encourage the organisation itself to generate ideas and action for promoting health as part of its work activities. Not many interventions include a component where the top management is involved. In this study, top management gave cooperation. Appreciation by top management in terms of giving gifts during official events, to those who managed to lose weight or took the most steps in the 'Pedometer Challenge' served as a morale boost and also provoked a sense of organisational commitment towards workers' well-being. Changes were also seen in top management where they requested for a booth for health screening at a corporate event, to promote physical activity, healthy eating and general health awareness among workers and the public.

Environmental modification to facilitate change in the individual is highly recommended to reduce obesity (Bhurosy & Jeewon, 2014). Good support from the cafeteria operator helped to provide a wider array of choices of food for workers with healthy options. Table-top calendars of calories and fat content in common foods allowed workers to be able to learn more about which foods were a healthier choice. Healthy recipes were given to educate workers of healthier options. Environmental prompts such as reminders to use the staircase as a way to be more physically active encouraged a healthier lifestyle.

Delivery of a structured programme where monthly motivation targeted a specific topic related to improving one's PA and diet allowed workers to gradually make changes in their lifestyle. The monthly motivation information also allowed workers to read them at their own time at the office or at home, compared to health talks, which many found hard to attend due to work commitments. The intervention was designed to be a practical one that can be easily adopted (and adapted if necessary) by other workplaces. The use of monthly motivational packs can easily be distributed via

office mail and read at the leisure of workers, even at home. The health tips given include changes one can make at the office and at home with friends and family, making staying healthy easier and more sustainable. Environmental modification such as strategic display of health posters is easy to apply to work environments.

Giving encouragement to workers through telephone calls may be helpful for some busy workers who may not have the time to attend face to face counselling sessions while at work. However, there were no series of health talks, healthy food preparation classes or sessions for exercise/sports and counselling as part of this intervention as it was designed to be carried out with minimal disruption of office activities. The intervention instead encouraged workers, colleagues, family members and also the organisation to increase efforts in improving health in and out of the office. The worker and organisation were encouraged to seek out or organise such health-related activities instead of having to attend formal sessions, to allow flexibility of how they would like to improve their diets and PA, as sometimes respondents may find it difficult to follow formal exercise sessions or health talks due to other commitments during or after working hours.

Another strength of the study is the multiple assessments conducted. The intervention group and controls were assessed at baseline, third month (mid-programme), sixth month (programme end) and at the ninth month, that is at three months after the programme ended for changes in weight, body mass index, physical activity, energy intake and quality of working life. For energy intake, assessments were undertaken at all these time points except at mid-programme. This was to reduce respondent fatigue. There are few published workplace intervention studies with multiple assessments. The study also included an assessment for sustainable changes after the programme ended. A systematic review by Stephens and colleagues (2014) of

interventions to improve physical activity and diet to reduce overweight and obesity prevalence, showed that there was a lack of studies which determined sustainable changes in weight loss and health behaviour after an intervention ended.

This study also used objective measurements to complement subjective ones. Weight and body mass index were used to determine the effects of the study. Pedometers gauged steps taken by workers while a physical activity questionnaire required respondents to recall overall physical activity in the previous week. The research assistant involved in assessments and entering of data was blinded to the intervention to reduce bias. Another strength of this study is that clinically meaningful weight loss (that is at least 5% of weight loss) is reported and not just the mean weight changes found (Anderson et al., 2009).

There are also few studies which assessed total energy, macro- and micronutrient intake as an outcome of a dietary intervention. This appears to be one of the strengths of this study. Most studies used weight and/or body mass index changes as an outcome of workplace dietary intervention (Appukutty et al., 2014; Carter et al., 2013; Kim et al., 2015; Lemon et al., 2010; Linde et al., 2012; Maruyama et al., 2010; Morgan et al., 2011; Moy et al., 2008; Salinardi et al., 2013). Dietary behaviour, especially fruit and vegetable intake, was usually observed through food frequency questionnaires (Aldana et al., 2005; Arao et al., 2007; Freak-Poli et al., 2011; Maruyama et al., 2010; Miller et al., 2015; Morgan et al., 2011; Tamers et al., 2011). However, there is no validated Malay food frequency questionnaire for adults yet. Energy intake observation was carried out in workplace dietary interventions by French and colleagues (2010) among garage workers and Moy and colleagues (2008) among male security guards. French and colleagues (2010) reported energy intake only while

Moy and colleagues (2008) also reported changes in macro-nutrient intake, saturated, mono- and polyunsaturated fat and cholesterol intake.

Besides quantitative measurements, this study also conducted a process evaluation which involved qualitative inquiry to explore barriers that workers faced in improving their physical activity and dietary intake. It was important to understand what the workers found challenging in making behavioural changes to reduce their weight. Such barriers could be tackled as an improvement of the programme in a later study. The qualitative inquiry included respondents from as varied a background as possible, including a range of workers from new, young workers in their twenties till those who were about to retire. Most of the workers were Malays and a few were of Chinese, Indian and other ethnic backgrounds. The interviews included workers of different ethnicities so as to get a more comprehensive feedback. The interviews also included both genders and also different categories of staff to capture information from those of different positions and socio-economic backgrounds as to the challenges they facedin achieving a healthier lifestyle.

This study also addressed the lack of published research on changes in quality of working life (QOWL) as an outcome of a health intervention. There have been publications on changes of quality of life (QOL) and work-related outcomes such as job stress, job satisfaction and work ability as a result of physical activity interventions as mentioned in a systematic review by Conn and colleagues (2009) and in a study by Nurminen and colleagues (2002). The QOWL is unique as it is the quality of life related to work. It can be interpreted as one dimension as in an overall QOWL and it can also be analysed by its factors such as job and career satisfaction, employee engagement, stress at work, home-work interface and general well-being (Lin et al., 2013; Sirisawasd et al., 2014). The Work-Related Quality of Life Scale-2 (WRQLS-2) has only been in

use since the year 2011 and there are not many publications on its use as yet. There is a lack of studies using the WRQLS-2 and the earlier version of this scale, the Work-Related Quality of Life Scale to look at QOWL impact of health promotions. Assesing QOWL is important from an occupational health and organisation's point of views.

5.2.10. Future studies

5.2.10.1 Quality of working life

For the Work-Related Quality of Life Scale-2, future studies could be carried outon its validity among more categories of workers. As the scale was validated among health care workers and those who worked in offices, it would be interesting to determine if quality of working life is perceived in a similar manner among those who work outside of the healthcare or office environment such as teachers, lawyers, actors, factory workers, waiters and waitresses, researchers, agricultural workers or in the armed forces. Workers in the rural areas could also be included to determine the scale's usefulness in different population groups which may vary in work norms.It would be interesting to observe whether similar or different constructs are included in quality of working life in other nations in South East Asia or the Asian region. This could be compared to see if countries of similar cultures may interpret QOWL in a similar manner compared to countries which are more different in culture, such as those in Europe or the Americas. In this study, the test-retest procedure was not carried out. This could be done in future studies.

As this is the first known use of the Work-Related Quality of Life Scale-2 in a longitudinal study, it would be interesting to carry out further research to observe temporal QOWL changes in workers throught the working year as seen among controls of the study, that is whether QOWL tends to reduce after the beginning of the year and

gradually returns to baseline towards the end of the year.The Malay WRQLS-2 could also be used to determine the changes in quality of working life of workers, if they changed with any organisational change. The impact on QOWL could be assessed with changes in company policy or adoption of programmes. The scale would be useful to indicate which changes in the organisation would benefit and attract employees.

5.2.10.2 'Healthy Worker Programme'

The 'Healthy Worker Programme', which is a form of complex intervention,allows adaptation to each work setting according to its resources and limitations. The programme is tailored to include multiple intervention from many levels and allow workers to improve themselves while at work or outside of office hours (such as at weekends with family and friends). However, there are inadequacies seen during its process evaluation which can be improved. The programme could be further improved by providing counselling for workers to increase their motivation to elevate their physical activity and improve their dietary intake to lose weight. A multi-professional team which can be made up of various health care workers including doctors, nutritionists, dietitians, behavioural consultants, psychologists, sports medicine specialists and physical trainers can help in improving the delivery of intervention components.

In future studies, there can be further improvement to capture the dietary fibre and also portions of fruit and vegetable consumption. This can be analysed through the dietary records returned by respondents, to determine if they adhere to the recommended five portions of fruits and vegetables a day, that is two fruit portions and three vegetables portion (NCCFN, 2010). Dietary cholesterol could also be included in

the analysis. A mid-programme assessment of dietary intake can also be carried out to observe changes during this time period.

In addition to body mass index, perhaps another outcome of body fat and muscle composition could be added, that is through use of a bioelectrical impedance analysis (BIA). This would allow better monitoring of healthy changes in physical activity and dietary intake, as the BMI does not take into account the different compositions of muscle and fat in the body. Other anthropometric measurements such as waist circumference and waist-hip ratio which are related to non-communicable disease risks can also be included as outcomes for future studies (Cairns et al., 2014; Queiroga et al., 2014). However, analysis of body fat and muscle analysis, waist circumference and waist-hip ratio need to be carried out bytrained personnel so as to ensure that measurements are as accurate as possible. Future studies could also include analysis of other health parameters such as blood pressure (diastolic and systolic), blood lipid and glucose levels. Resting heart rate, muscle strength and flexibility can also be other outcomes of interestfor fitness (Cairns et al., 2014; Queiroga et al., 2014).

Also, one way to improve return rates of forms would be to individually interview respondents for their physical activity levels and quality of working life, with the IPAQ and WRQLS-2 when carrying out the three-monthly assessments. More dedicated research assistants to personally collect pedometers after the seventh day of pedometer use and keying-in of steps taken for each of the last seven days would improve accuracy of step records. Step records could also include time of pedometer wear as to assess how long respondents have worn the pedometer, to reflect their daily step measurement. Research assistants could also call participants to get a verbal response of what they had eaten and record their diets on their behalf. This would greatly reduce the burden of recording participant steps and diets to reduce respondent

fatigue. Another method to manage the challenge of missing data from repeated assessments, would be to use the linear mixed models method, instead of the "last observation carried forward method". Use of linear mixed model for analysis could reduce treatment effect bias (Lüdtke, Robitzsch, & Grund, 2016; Prakash et al., 2008).

In this study, only short term sustainability of changes has been assessed, that is three months after the programme ended.Weight loss, physical activity and quality of working life appeared to be sustainable in the short term. Future studies can be conducted to determine the sustainability of changes over a longer term, such as in six months or a year. This would give more insight on long term impact that such a programme may have among workers. Perhaps with better understanding of changes in human behaviour such as at what point a person loses motivation to maintain a healthy lifestyle, a better workplace health promotion can be designed. Follow-up 'refresher' motivation may be required at such time points to inject a much-needed inspiration to stimulate workers' efforts to continue a healthy lifestyle.

Future studies may be of longer duration to give more time to workers to be exposed to a conducive environment and social support to improve their physical activity and dietary intake to achieve a healthy weight. A longer time period may allow healthy choices to become a habit instead of a conscious choice that a worker needs to make. Also, there could be more use of smart gadgets to incorporate a novelty effect to an intervention. With younger workers and older ones who have an interest in new technology, applications for smartphones (Bort-Roig et al., 2014) or watches which have a fitness tracker to monitor heart rates, steps taken and sleep patterns may provide some stimulation to keep fit in a trendy manner. Improved social support can be achieved with adding a social website component to the intervention, such as Facebook or a Whatsapp group, where workers can upload their achievements, share tips on

healthy recipes, motivate each other and arrange physical activity with one another to maintain an interest in a healthy lifestyle (Middelweerd et al., 2015).

In this study, the post-intervention feedback consisted of 'Yes/No' questions, regarding the workers' participation in the programme intervention components (such as reading or using the distributed or exhibited materials) or to determine whether the workers found some components of the intervention helpful (such as whether they found the motivational phone call helpful).(See Appendix H). In future, a Likert scale could be used instead of 'Yes/No' questions, which allows workers to answer in terms of different grades of agreement to a certain component for behavioural change (Losby & Wetmore, 2012; SurveyLegend, 2014).

The qualitative evaluation of the workplace intervention could include a more thorough and in-depth interview of respondents in the study. Focus group discussions (FGD) could be carried out at a convenient time to gather more information from respondents. Issues to discuss could include enablers or factors which facilitate workers to achieve and maintain an active lifestyle and healthy diet to lose weight. Respondents could also discuss with peers regarding their opinions of the programme and any unachieved expectations. They could also give more ideas on ways to make improvements to increase its effectiveness. Respondents can also be queried regarding data collection methods, such as problems they encountered in giving information on diet and physical activity, why they did not return completed questionnaires and what would facilitate them in collecting and supplying such information. This may make it easier to understand how different categories of workers are affected by a workplace health programme, which may influence their participation.

Future studies could include a change in workplace policy. A policy to commit to worker health may bring about changes to the work schedule or worker benefits, such

as paid time off to exercise or free use of fitness centres for workers. Incentives such as recognition for maintaining an ideal weight, participation in sports activities and efforts in peer-counselling to promote a healthy lifestyle as additional workplace commitments may be of benefit for both employee and the employer's image. There is a lack of analysis of effects of policy change on reducing the prevalence of obesity and this would be a good focus for future studies (Stephens et al., 2014).Future studies could also include a more comprehensive process evaluation which includes assessment of the effects on the organisation, social circles and the individual. These may encompass any changes in the use of gyms of sporting facilities, staircase use and the effectiveness of motivation from peers.

The 'Healthy Worker Programme' could also be carried out among other groups of workers to determine its effectiveness. Future studies can be conducted in other areas of Malaysia, such as in rural areas or in private sector organisations. The programme could be implemented in organisations with workers of varied ethnicities.

A cost-effective analysis can also be carried out in future studies. This could determine if such a programme would benefit an organisation by reducing costs incurred for medical treatments or reducing absenteeism rates. If the programme is cost-effective, it would be beneficial to be implemented by organisations.

5.2.11 Implications to public health practice

5.2.11.1 Use of the Malay Work-Related Quality of Life Scale-2 among Malaysian workers

Quality of working life (QOWL) is an important aspect of a worker's life. Many adults work, with some families having both parents and maybe other family members working. Much time may be spent working and it is pertinent to have good QOWL. In

this study, the Malay Work-Related Quality of Life Scale-2 (WRQLS-2) was validated for use in improving occupational health through assessing the quality of working life of Malaysian workers. The scale showed good convergent and construct validity and also reliability. It can be used to examine the different aspects of QOWL, that is their Job and Career Satisfaction, General Well-Being, Stress At Work, Home-Work Interface and Employee Engagement. The scale also measures overall and perceived QOWL. Poor well-being, or employee engagement,low job and career satisfaction, work stress or conflicts between home and working conditions could be detected as it affects the workers' QOWL.

It would be good public health practice to routinely monitor and carry out surveillance on the QOWL of workers to guide dynamic improvements at workplaces.The WRQLS-2 Scale would be useful to gauge the QOWL of workers in organisations and steer changes towards a more positive and worker-friendly atmosphere. Changes can be made to working conditions such as allowing a degree of flexibility in working arrangements to allow a better home-work interface, especially with workers who have other family commitments at home. Other changes such as improving equipment at the workplace, facilities, career development opportunities or allowing workers more influence at work, may improve job and career satisfaction. Work demands may be reviewed to reduce stress at work. The Malay WRQLS-2 can be used to observe for any improvements to QOWL with such changes in the organisation. These steps can be useful to increase QOWL among workers and promote their retention at organisations.

The WRQLS-2 has also been validated in other countries which resulted in Thai and Chinese versions of the scale (Lin et al., 2013; Sirisawad et al., 2014). Using the WRQLS-2 to determine QOWL, we can observe QOWL that is reported in different

countries and strive to improve the Malaysian QOWL. The scale can also be used to compare different QOWL among different occupations in Malaysia, or between different workplaces within the same occupational category. A poor QOWL may be an indicator to make changes to the workplace, management or working conditions to improve lives of workers. The scale would be useful in the many different industries to improve occupational health. A policy which is sensitive towards the QOWL of workers would also be recommendable to improve this area of public health.

5.2.11.2 The 'Healthy Worker Programme' for weight loss and QOWL

Overweight and obesity has become a major, global health challenge. It was reported that no nation has been able to successfully tackle this health problem in the last 33 years (Ng et al., 2014). In 2011, there were calls for urgent action in Southeast Asia as unhealthy diets and inadequate physical activity contributed towards development of non-communicable diseases (NCDs) which were responsible for 60% of deaths (Dans et al., 2011). The rise in NCD trend has seen many efforts at local and global levels for intervention to promote health among the population (Dans et al., 2011; Mustapha et al., 2014; Ng et al., 2014; Scarborough et al., 2011; Sparling, 2010). Workplace health promotion has also been one of the targets of healthy lifestyle promotion in Malaysia (Mustapha et al., 2014). Workers make up a substantial proportion of the public. Organisations which provide medical benefits for workers have also seen the importance of promoting worker wellness (Carnethonet al., 2009; Sparling, 2010). Finkelstein and colleagues (2014) reported that obesity affects the health of workers and can cost organisations a substantial amount from medical expenditures and through loss of productivity as a result of absenteeism and presenteeism. It was estimated that with the reduction of obesity prevalence in workers,

especially those who have a body mass index of more than 35 kg/m^2, could lead to significant savings for organisations (Finkelstein et al., 2014). While workplace health promotions may be important from the organisation and employer points of view, there is evidence that workers are also interested in being involved in healthy lifestyle changes (Kilpatrick et al., 2014). A study by Kilpatrick and colleagues (2014) reported that public sector employees had a perception of their own health needs which corresponded to their own health-related behaviours, weight status and stress experienced. 'Energy balance' health change targets, such as making changes to their physical activity, diet and weight were popular choices among employees. The study reported that most of the employees were ready to change their lifestyle or already making changes to achieve these targets (Kilpatrick et al., 2014). This is most encouraging from the aspect of public health in the quest to reduce obesity and prevalence of non-communicable diseases as it creates a win-win situation for both employer and employee.

The 'Healthy Worker Programme' was developed using the Socio-Ecological Model to deliver a complex intervention to reduce weight and improve quality of working life among overweight and obese Malaysian workers.Prelimnary data observed more than 10% of workers succeeded in reducing at least five per cent of their weight by study end and this effect was sustained three months after the programme ended. It was also interesting to note that even within the control group, where only health talks and pamphlets were given, 4% and 8% achieved similar weight loss at the 6th and 9th months respectively. It would be of public health interest that any amount of intervention may be more beneficial than none at all and a more intensive programme appears to reap better results among workers. The study also recommends support from different levels of intervention, such as from top management and colleagues which

may play a role in giving the much needed drive to motivate workers to care for their health.

Results from the process evaluation of this study are useful for public health practitioners to understand better the challenges of implementing a workplace health promotion. A health programme coordinator may take into account participation rates of a multi-component approach used in this study and its attrition rates. The 'Healthy Worker Programme' demonstrated good potential at retaining 86% of its respondents in the programme. However, not all respondents came to all of the three-monthly assessments or completed their questionnaires. It appears that at a workplace, weighing respondents is a quick and effective method in assessing health outcomes, while trying to assess physical activity, dietary intake and quality of working life may be more challenging.This may be due to multiple assessments, questionnaires (IPAQ and WRQLS-2) and records (steps taken and diet) to fill and workers had time constraints and other work commitments. This could have led to a low response of returning forms to capture physical activity, dietary intake and quality of working life.

Preliminary data from this study shows the feasibility of multiple levels of intervention at the worksite. Most workers read the health posters displayed at the organisation at strategic places such as along corridors and on bulletin boards at the cafeteria and offices. Many also found the pedometers helpful in improving physical activity. The majority found the display of calories in common foods at the cafeteria motivated them to eat healthily. Many also involved family members in making healthy changes to their diet and physical activity and tried out healthy tips and recipes given in the monthly motivational packs. Most workers read the monthly health tips and motivation which were distributed. Some workers answered the motivational phone calls which were carried out at mid-programme and found them helpful.

The study also offers ways of delivering environmental modification at the cafeteria and other public areas at the workplace. Changes observed at the cafeteria every three months, as a result of the programme, are important. Post-intervention, barriers to improving physical activity and dietary intake among workers included environmental influence, poor health, inadequate knowledge on eating healthily and psychological barriers such as poor motivation and lack of discipline. Measures can be taken to address such barriers and limitations of the study in future.

The 'Healthy Worker Programme' has shown in this preliminary data, that there may be positive psychological outcome on workers. There is a lack of literature focussing on quality of working life as an outcome of physical activity and dietary intake interventions. Therefore, this study is of occupational health importance. Occupational physicians will find it of interest that there was a reduction of stress at work, improvement in general well-being and significant increase in overall quality of working life among programme respondents, which was sustained post-programme. Job and career satisfaction also showed an increase post-programme. However, the effects that this programme had on QOWL were modest and data needs to be interpreted with care due to poor response rates. Further revision to the Healthy Worker Programme to include components to improve it further and another evaluation will be required before the programme could be promoted on a wider scale among workplaces.

CHAPTER 6: CONCLUSION & RECOMMENDATIONS

6.1 Conclusion

In its preliminary findings, the 'Healthy Worker Programme', a multi-component physical activity and dietary intake intervention for a workplace which was conducted over six months, could significantly reduce weight and body mass index (BMI) among overweight and obese office workers. The weight and BMI reduction seen in this programme is comparable to other workplace physical activity and dietary intake interventions as seen in meta-analyses (Anderson et al., 2009; Verweij et al., 2011). This study contributes to the growing body of evidence that workplace health promotions can be useful for weight management among workers. This study also observed sustainability of changes post-programme, which is not commonly assessed in other similar, workplace studies. Weight reduction appears to be sustainable in the short termwith the 'Healthy Worker Programme', with more than 10% of respondents still maintaining clinically significant weight loss, post-programme. Even though this proportion appears to be small in the study, the benefits may be more impactful at the population level.

In the first phase of the study, the Work-Related Quality of Life Scale-2 (WRQLS-2) was translated and validated in the Malay language. This was the first time the scale was validated in Malay, creating a Malaysian model for Quality of Working Life (QOWL).There is also a lack of published studies of use of the WRQLS-2 in longitudinal studies and in workplace physical activity and dietary intake interventions.In this preliminary study, modest changes to QOWL were observed throughout the programme and at post-programme.

Quality of working life is an important area of occupational health. However, its perception may vary between countries due to cultural influences and differing work environments. The Malay validated Work-Related Quality of Life Scale 2 (WRQLS-2) can be used to determine the QOWL of Malaysian office and health care workers. It can be useful in measuring QOWL outcomes with changes or implementation of programmes at an organisation.

While data was limited due to poor response for physical activity, dietary intake and quality of working life, there appeared to be modest, positive improvement in physical activity and QOWL of workers in the programme. Overall QOWL scores were seen to increase through reduced 'Stress At Work' and improved 'General Well-Being' of workers. However, results for physical activity and QOWL changes have to be interpreted with care. Further revision and evaluation of the programme component is required to obtain more information on physical activity, dietary intake and QOWL changes and to improve its health impact. From these preliminary findings, the programme has potential to reduce risks for the development of chronic diseases which are associated with obesity.

6.2 Recommendations

Malaysia has rapidly urbanised and more Malaysians are becoming overweight and obese (Khambalia& Seen, 2010). Its rate of overweight and obesity is one of the highest in South East Asia among adults, adolescents and children (Hazreen et al., 2014; Nget al., 2014). It is a national urgency to improve the health status of Malaysians through aggressive promotions of healthy lifestyle. Interventions on a broader aspect such as making changes to the environment to facilitate healthy behaviour are recommended to combat the obesity epidemic (Bhurosy & Jeewon, 2014). One method

of improving health would be through workplace health programmes, as many spend their time at the workplace every day. The workplace also may contribute to an unhealthy environment such as a sedentary lifestyle and also exposures to high-calorie and fattening foods.

It is recommended that workplaces instil a health programme to emphasise its commitment towards their most valuable assets, whichare their workers. A healthier worker, with a good quality of working life, will be able to contribute to society for many more years, compared to one who succumbs prematurely to non-communicable disease, work stress and other unhealthy working conditions.The 'Healthy Worker Programme' provides interventions at multiple levels, whichare at the intrapersonal, interpersonal and organisational levels. Key stakeholders can facilitate the adoption of wokplace health programs in an organisation. The organisation may use various communication tools it deems suitable to deliver health promotional messages, using this template.

The 'Healthy Worker Programme' could be improved by counselling workers to motivate them further in achieving healthy eating practices and higher physical activity levels. It would be advisable that corporate culture gravitate towards a more caring one, where worker health is deemed important and proactive measures taken to ensure the well-being of workers, both physically and mentally. Encouragement from bosses and support from colleagues may influence workers to make healthier changes. Changes can be made at the cafeteria to improve provision of healthier foods and restriction of less healthy, fattening and calorie-dense dishes. This can be brought about by awarding contracts to cafeteria operators who supply healthy foods at affordable rates at the workplace. Policy change either by the government or at the organisation level to support a healthy lifestyle can help curb obesity (Stephens et al., 2014).

With an intervention package which involves changes that can be made at home too, the beneficial effects of this programme may also extend to children of workers and reduce risks of overweight and obesity among the next generation. According to the WHO (2015), in the year 2013, it was estimated that 42 million children worldwide under the age of five years were either overweight or obese.The Malaysian Health and Adolescents Longitudinal Research Team (MyHEART) studyof 1361 schoolchildren(13 year olds) found that at baseline, 15.4% were overweight and 8.5% were obese (Hazreen et al., 2014). A workplace health programme that promotes a sustainable healthy lifestyle such as through regular physical activity levels involving family members (such as children) could play a role in reducing risks of obesity and NCDs in the future adult population. Obese children have a higher risk of adult obesity, premature death and disabilities in adulthood (WHO, 2015).

Physical activity workplace interventions can also increase productivity and its benefits include reduction of sick leave (Proper et al., 2006). Ill health due to physical inactivity and poor diet contributes to the economic burden to a country in its expenditure towards treatment of non-communicable diseases (Scarborough et al., 2011; Verweij et al., 2010). Such a health promotional exercise at work may also have positive effects on worker well-being, ability to cope with stress at work and quality of working life in general.More studies are required to determine QOWL changes with workplace physical activity and dietary intake interventions.

In an overview of current evidence for improving physical activity and diet in the population to reduce population prevalence of overweight and obesity by Stephens and colleagues (2014), it was found that while there were many interventions which can successfully improve diets and physical activity, obesity continued to increase in prevalence. There appeared to be a lack of sustained, healthy behavioural changes to

satisfactorily reverse obesity rates. It was recommended that such intervention strategies be used at a population level such as through community-based approaches or policy change. It would be a great benefit to public health if all workplaces adopt and practisethe policy for reducing risks of obesity and non-communicable disease among workers.More ecological studies are required to determine effects of such approaches to the general public and the sustainability of health behaviour change. The review suggested that while from an epidemiologist's point of view, randomised controlled trials may be the gold standard, ecological studies are informative to understand how strategies applied broadly to the public such as through policy change may affect health behaviour and outcome. Outcome measurement and monitoring should become standard practice in policy implementation. The 'Healthy Worker Programme' can be further improved and evaluated to improve its implementation and health impacts, so that it can be used more widely at local worksites.

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LIST OF PUBLICATIONS AND PAPERS PRESENTED

A) Publications:

i) Sulaiman, N.S., Choo, W.Y., Mat Yassim, A.R., Van Laar, D., Chinna, K. & Hazreen, A.M. (2015). Assessing Quality of Working Life among Malaysian Workers. *Journal of Asia Pacific Public Health*, 46th APACPH Conference Supplement, 1-7. DOI: 10.1177/1010539515583331

ii) Nur Suffia S., Choo W.Y. & Hazreen A.M. (2015). Process Evaluation of the 'Healthy Worker Programme' for Weight Reduction and to Improve Quality of Working Life. *Malaysian Journal of Public Health Medicine*, 15 (Supplement 1), 30.

B) Papers Presented:

i) *The "Healthy Worker" programme to improve physical activity, dietary intake and quality of working life among office workers in Malaysia: A quasi-experimental study*. Poster presented at the Annual Meeting of the International Society for Behavioral Nutrition and Physical Activity (ISBNPA), May 22-25, 2013, in Ghent, Belgium.

ii) *The 'Healthy Worker Programme' physical activity and dietary intervention for weight management*. Poster presented at the International Committee on Occupational Medicine (ICOM), 17-18 May, 2014, in Kuala Lumpur, Malaysia.

iii) *Assessing quality of working life among Malaysian workers*. Poster presented at the Asia Pacific Academic Consortium of Public Health (APACPH) Conference,17-19 October ,2014, in Kuala Lumpur, Malaysia.

iv) *Process evaluation of the 'Healthy Worker Programme' for weight reduction and improvement of quality of working life.* Poster presented at the 6th Perak Health Conference, 17-19 August, 2015, in Ipoh, Malaysia. *1st Place Winner for Poster Free Paper Presentation.*

v) A review of health-related outcome of workplace physical activity and dietary interventions. Poster presented at the Nutrition Society of Malaysia 31st Annual Scientific Conference, 31st May- 1st June 2016, Kuala Lumpur.