PSYCHOMETRIC PROPERTIES OF MODIFIED YALE FOOD ADDICTION SCALE 2.0 MALAY VERSION

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ABSTRACT

Background Certain food has been found to demonstrate addictive-like eating in some individuals, giving rise to the concept of food addiction. Its association with obesity has been demonstrated in many studies done previously. Obesity continues to grow as a major health risk globally and recently, it has become a global epidemic. To date, there is no established criteria to assess for food addiction yet as this topic of research is still relatively in its early stage. The Modified Yale Food Addiction Scale 2.0 (mYFAS 2.0), the latest and shorter version of the Yale Food Addiction Scale is the only self-report measurement designed to assess addictive-like eating. This study aims to examine the psychometric properties of mYFAS 2.0 Malay version. **Method** A cross-sectional study conducted in 4 stages was carried out in the University Malaya Medical Center (UMMC). For stage 1, mYFAS 2.0 was translated into the Malay language. For stage 2, a pilot test involving 30 medical staff was performed. Stage 3 was conducted on 30 medical students to assess internal consistency and test-retest reliability. Internal consistency was determined using Cronbach's alpha. Test-retest reliability was evaluated at two weeks after the initial assessment and was determined by Intraclass Correlation (ICC). For stage 4, a validity test was carried out involving 144 overweight and obese participants attending the Sports Medicine Outpatient Clinic. Convergent validity was done with the Malay Binge Eating Scale (BES). Construct validity was determined with Confirmatory Factor Analysis. **Result** The mYFAS 2.0 Malay version has good reliability with internal consistency measured with Cronbach's alpha = 0.92 and test-retest reliability measured with Intraclass Correlation (ICC) ranged from 0.550 to 0.868. There is a significant strong positive correlation between mYFAS 2.0 Malay version symptom score with BES Malay version score ($r = 0.545$, $p < 0.01$). The mYFAS 2.0 Malay version is a 9-items one-factor

model and it has failed to replicate the original 13-items one-factor model. The final model achieved best model fit after removal of 2 items; the goodness of fit index (GFI) = 0.943; the adjusted goodness of fit index (AGFI) = 0.898; the comparative fit index (CFI) = 0.984; the root means square error of approximation (RMSEA) = 0.05. Another 2 items had to be removed to achieve ideal values for Composite Reliability (CR) = 0.902 and Average Variance Extracted (AVE) = 0.507. The 9-items mYFAS 2.0 Malay version has good sensitivity (92.3%) and specificity (96.9%) as a screening instrument. **Conclusion** The 13-items mYFAS 2.0 Malay version is a reliable measure but has limitations in its construct validity. The modified version of 9-items mYFAS 2.0 Malay version has better validity and reliability. It also has good sensitivity and specificity as a screening instrument.

Keywords Yale Food Addiction Scale, Binge Eating Scale, Validity, Reliability, Confirmatory Factor Analysis

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ABSTRAK

Latar Belakang Sesetengah makanan tertentu boleh menyebabkan tabiat ketagihan untuk sesetengah individu, menyumbang kepada masalah ketagihan makanan. Kaitannya dengan masalah obesiti telah banyak didemonstrasikan oleh banyak kajian sebelum ini. Masalah obes berterusan menjadi masalah kesihatan utama di peringkat global dan kebelakangan ini, masalah obes telah menjadi epidemik di peringkat global. Sehingga kini, tiada kriteria telah dipersetujui untuk menilai ketagihan makanan kerana topik ini masih lagi di peringkat awal. "Modified Yale Food Addiction Scale 2.0", soal-selidik versi ringkas dan terkini daripada "Yale Food Adiction Scale 2.0" adalah satu-satunya soal-selidik untuk memeriksa gejala ketagihan makanan. Kajian ini bertujuan untuk menentukan ciri-ciri psikometrik mYFAS 2.0 versi Bahasa Melayu. **Metodologi** Satu kajian rentas telah dijalankan dalam 4 peringkat di Pusat Perubatan Universiti Malaya (PPUM). Untuk peringkat 1, mYFAS 2.0 diterjemahkan kepada Bahasa Melayu. Untuk peringkat 2, kajian perintis melibatkan 30 staf perubatan telah dilakukan. Peringkat 3 pula telah dilakukan ke atas 30 pelajar perubatan untuk mengkaji "internal consistency" dan "test-retest reliability". "Internal consistency" ditentukan menggunakan "Cronbach's alpha". "Test-retest reliability" dijalankan selepas dua minggu daripada pemeriksaaan awal dan menggunakan "Intraclass Correlation" (ICC). Untuk peringkat 4, "validity test" melibatkan 144 responden yang mempunyai berat badan berlebihan dan obes yang hadir ke Klinik Luar Perubatan Sukan telah dijalankan. "Convergent validity" dibandingkan dengan Skala Tabiat Pemakanan. "Construct validity" ditentukan dengan "Confirmatory Factor Analysis". **Keputusan** mYFAS 2.0 versi Bahasa Melayu mempunyai nilai "reliability" yang bagus, di mana "internal consistency" yang diukur menggunakan "Cronbach's alpha" = 0.92 dan "test-retest reliability" menggunakan "Intraclass

Correlation" menunjukkan nilai antara 0.550 hingga 0.868. Terdapat kaitan positif yang signifikan antara skor gejala mYFAS 2.0 versi Bahasa Melayu dengan Skala Tabiat Pemakanan ($r = 0.545$, $p < 0.01$). mYFAS 2.0 versi Bahasa Melayu adalah model satu-faktor dengan 9 item dan telah gagal untuk mereplika model asal satu-faktor dengan 13 item. Model akhir berjaya mencapai kesesuaian model terbaik setelah 2 item dibuang; GFI = 0.943; AGFI = 0.898; CFI = 0.984; RMSEA = 0.05. 2 item lagi perlu dibuang untuk mencapai nilai ideal CR = 0.902 dan AVE = 0.507. mYFAS 2.0 versi Bahasa Melayu dengan 9 item mempunyai sensitiviti (92.3%) dan spesifisiti (96.9%) yang bagus sebagai skala pemeriksaan. **Kesimpulan** mYFAS 2.0 versi Bahasa Melayu yang mempunyai 13 item adalah skala yang mempunyai "reliability" yang bagus, tetapi terdapat batasan untuk "construct validity". mYFAS 2.0 versi Bahasa Melayu yang telah diubah suai menjadi 9 item pula mempunyai "construct validity" dan "reliability" yang bagus. mYFAS 2.0 versi Bahasa Melayu dengan 9 item mempunayai sensitiviti dan spesifisiti yang bagus sebagai skala pemeriksaan.

Kata kunci Yale Food Addiction Scale, Binge Eating Scale, Validity, Reliability, Confirmatory Factor Analysis

CONTENTS **PAGE**

LIST OF FIGURES

FIGURE **PAGE**

LIST OF TABLES

TABLES **PAGE**

LIST OF ABBREVIATIONS

YFAS	Yale Food Addiction Scale
mYFAS	Modified Yale Food Addiction Scale
HHS	Department of Health and Human Services United States of America
WHO	World Health Organization
BES	Binge Eating Scale
NICHD	National Institute of Child Health and Human Development
CDC	Centers for Disease Control and Prevention
NHLBI	National Heart, Lung, and Blood Institute
APA	American Psychiatric Association
ROC	Receiving Operating Characteristic

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

Addiction is a multifaceted condition of brain disease which is characterized by a compulsion to pursue and consume the substance, a lack of control over drug-seeking and drug consumption behaviours up to the point that it dominates their life, and continuous use despite its consequences (APA, 2017). It is considered as a brain disorder as it involves functional changes in the brain reward system, self-control and stress mechanism. The functional changes may persist for a long time even after an individual has abstained from taking a substance (Goldstein & Volkow, 2011). At the same time, it can also affect brain circuit regulating memory and motivation which collectively leads to psychological, biological, social and spiritual problems (American Society of Addiction Medicine, 2011)

Addiction is more commonly associated with substances such as cannabis, heroin, nicotine or alcohol. Most of the substances with the ability to affect the central nervous system originated from plant and were accidentally discovered by the ancient food-gatherers at the dawn of humanity, in pre-pottery Neolithic time, approximately 8000 B.C (Glennon, 1996; Shultes, 1976). However, in the Old World, approximately 10,000 years ago, during Neolithic times, only a few of the substances were widely used. They consisted of products of poppy (opium, morphine), hemp (hashish, marijuana), numerous fermented organic materials (alcohol) and certain types of mushroom (Scott, 1969; Shultes, 1976). In the New World, which dated as early as 600 AD, new addiction-forming compounds such as tobacco (nicotine) and cocaine were newly developed and widely used (Hughes, 2001; Johanson & Fischman, 1989). Starting from the 19th century, the evolution of medicinal chemistry influenced the development of synthetic compounds

such as barbiturates, benzodiazepines and amphetamines (Jarvik, 1970; Ballenger, 2001). These substances were originally manufactured for therapeutic purposes. However, due to its high potential of being abused, it gave rise to new problems involving designer drugs and recreational drugs.

For many years, the concept of addiction is used solely and exclusively for psychotropic substances. However, nowadays, this term is also commonly applied to a heterogenous group of syndromes known as "no-drug addictions", "behavioural addictions" or "new addictions" (Konkoly Thege et al., 2015). A number of behavioural addictions have been hypothesized as sharing similar characteristics with substance addictions and listed in Diagnostic and Statistical Manual, 4th Edition (DSM-IV-TR) as impulse control disorders, such as pathological gambling and kleptomania (APA, 2000). A few years later, DSM-5 made more changes to this addiction-related topic. Gambling disorder was no longer under impulse control disorders and was included under substance-related and addictive disorder (APA, 2013). Another form of non-substance addiction such as internet gaming disorder was listed in Section 3 for conditions that required additional investigation. Apart from DSM, there are various non-substance addiction that has been described in literature such as sex-addiction (Dell'Osso et al., 2006), exercise addiction or overtraining syndrome (Egorov & Szabo, 2013), compulsive buying (Dell'Osso et al., 2008), work addiction or workaholism (Giannini & Scabia, 2014), love addiction (Reynaud, 2010) and technological addiction (Yau et al., 2013).

It is worthwhile to note that the concept of food addiction, another example of non-substance addiction was first proposed in the mid-1950s (Randolph, 1956). However, it was not only until recently that the impression that a person can be addicted to food has gained more support and recognized more widely. Food addiction is defined as a lack of control regarding intake of food with continuous longing for food and failed efforts to restrict the amount of food even though having knowledge of its harmful implications

(Ziauddeen et al., 2012). Even though food is part of an essential in human's life and eating is a common human activity, some foods do have strong addictive and rewarding effects analogous to drugs (Gearhardt et al., 2009). Using the DSM-IV-TR diagnostic criteria for substance dependence, Gearhardt et al. (2009) suggested the concept of food addiction towards certain foods as a specific phenotype, especially processed foods that were rich in sugar, fat and salt. To date, this topic is more widely recognized and there are also increasing number of scientific researches leading towards widespread credibility and recognition of the science of food addiction (Kenny, 2011; Spring et al., 2008; Sinha, 2018; Gearhardt et al., 2009; Hollander et al., 2002; Volkow et al., 2013; Roop et al., 2002).

On the other hand, obesity is recognized as a major health concern and its prevalence is increasing every year (WHO, 2000). Approximately 16% of the global burden disease was estimated to be attributed by excessive body weight (Hossain et al., 2007). The World Health Organization (WHO) stated that worldwide, over 600 million adults are obese (WHO, 2018). Despite the progressive effort on addressing obesity, the prevalence is persistently increasing (Lopez-Legarrea et al., 2015). This phenomenon suggested an additional underlying aetiology which might be involved in this disease. New theories associating obesity and food addiction have been postulated (Gold et al., 2003). Recent research findings concluded that high calorie and palatable food might have addictive potential (Ziauddeen et al., 2012). At the same time, around half of obese individual seeking bariatric surgery were found to fulfill criteria for food addiction (Meule et al., 2014).

Over recent years, Malaysia had been labeled as being the "fattest" country in South East Asia (New Straits Times, 2014). A few years later, nothing had changed as Malaysia still had the most obese population in this region (New Straits Times, 2017). The latest National Health and Morbidity Surveys 2015 reported that overweight population had

increased two-fold in less than two decades while the obese population had significant four times increment (Ministry of Health Malaysia, 2015). This is very concerning as overweight and obesity problem are not just giving impact on the health aspect of the individuals involved, but also to the country by increasing the economic burden. It was estimated that Malaysia had to spend around RM 4 to 8 billion which was approximately up to one-fifth of Malaysia's total healthcare expenditure in overweight and obesity-related problem (New Straits Times, 2017). The significant major impact of overweight and obesity problem to individuals and the country warranted for the effective measure to curb this issue. Over the past few years, more and more findings found the association between obesity and food addiction (Brownell & Gold, 2012; Gearhardt et al., 2014; Volkow et al., 2007). Therefore, it is imperative for food addiction issue to be recognized and addressed in Malaysia to subsequently prevent the overweight and obesity issue from becoming a major epidemic problem.

To measure food addiction, Gearhardt et al. (2009) created the Yale Food Addiction Scale (YFAS), a self-report instrument, based on DSM-IV-TR criteria for substance dependence. With the emergence of DSM-5, a newer version of the YFAS, named as YFAS 2.0 was created to take into consideration the new DSM-5 criteria for substance use disorder (Gearhardt et al., 2016). Subsequently, a short version of YFAS 2.0 was available and later known as the modified YFAS 2.0 or mYFAS 2.0 (Schulte & Gearhardt, 2017).

The YFAS 2.0 and mYFAS 2.0 has been translated and validated in different settings and language previously (Meule & Gearhardt, 2014; Torres et al., 2017; Brunault et al., 2016) but has never been translated into the Malay language nor validated in Malaysia. As it is a self-report measurement, a good understanding of the instrument is critical to ensure the results obtained are accurate. Therefore, this study aims to translate and investigate the psychometric properties of mYFAS 2.0 Malay version.

CHAPTER 2

LITERATURE REVIEW

2.1 Addiction

2.1.1 Definition and Prevalence

Addiction is a complex disorder that affects neurotransmission and its interaction with the brain structure that regulates reward system including anterior cingulate cortex, nucleus accumbens, amygdala and basal forebrain (American Society of Addiction Medicine, 2011). It also disturbs the interaction between cortical, hippocampal circuits and brain reward system which results in a response from biological and behavioural aspect to external cues, due to the memory of prior exposures to rewards. Consequently, this leads to disturbance in hierarchies of motivation and at the same time makes addictive behaviour predominate an individual's life and displace the normal healthy self-care related behaviours. Individuals with addiction will have psychological effects which distort their thinking and behaviour and physical effects, which manifested by a disturbance in normal body functions (APA, 2017). People engage in certain behaviours in addition to taking substances as an attempt to relax or reward themselves. However, over time, these practices makes people believe that they cannot enjoy life without using substances or that they cannot even live without them.

Addiction diseases can be considered as one of the most common modern diseases. Directly or indirectly, they affect all stages of an individual's life and disrupt human's function in personal, family, social and professional aspect. Various researches noted the wide distribution of addiction problem in the general population and some areas

also has epidemic proportions. Many severe diseases that often lead to death are associated with smoking and alcoholism, right after cardiovascular disease and cancer, is the third most frequent disease (Dimitrijevic, 2015). Drug abuse, especially of multiple substances, is a concerning problem, particularly among the adolescent group.

The most prevalent substance of dependence in 2015 was alcohol with estimated cases of 63.5 million globally (Peacock et al., 2018). Cannabis and opioids dependence, on the other hand, has the highest number of illicit drug dependence, with 19.8 million cases and 16.7 million cases respectively. As for amphetamine and cocaine dependence, these substances were found to be less prevalent, with estimated cases of 6.6 million and 3.9 million respectively. Different regions were found to have different distribution of substances that were prevalent. For example, the North America region (United States of America and Canada) which belongs to the high-income region, had one of the highest rates of opioid, cocaine and cannabis dependence. In contrast, Sub- Saharan Africa region had the lowest prevalence of opioid, amphetamine, cocaine and cannabis dependence. As for alcohol dependence, Eastern Europe had the highest rate while the cases in North Africa and Middle East were the lowest.

In Malaysia, between January 2010 and February 2016, a total of 131, 841 of people with drug addiction problem had been registered in Malaysia (New Straits Times, 2016). Among these figures, 97% of them were male while female contributed to only 3%. When divided according to age, most of the people with drug addiction problem belongs in the age group 20 to 39 years old (70%), followed by 40 years old and above (20%) and 19 years old and below (10%). From 2015 to 2016, the number of drug addiction cases in Malaysia increased by 14% from 26,668 to 30,847 (New Straits Times, 2017). Cases involving new individual with drug addiction problem also showed an increment of 13% during the same period. According to statistics by the National Anti-Drug Agency, around 25,922 individuals were arrested due to drug addiction in 2017

(Borneo Post Online, 2018). Majority of those arrested were Malays (81%), followed by Chinese (7.5%), Indians (6.8%), Sabahans (3.9%), Sarawakians (0.4%) and others (0.6%). More than 70% comprised of people with recurrence drug addiction problem, while the rest was new cases.

2.1.2 Types of Addiction

Frankly, the concept of addiction is quite difficult to be interpreted and some controversies have risen with the usage of the term addiction. Nevertheless, the definition revolves around the concept of dependence on a substance or activity (Widyanto & McMurran, 2004). Before this, "non-substance related behavioural addiction" was not included in either two internationally used diagnostic manuals of mental disorders which are DSM-IV-TR and International Classification of Disease 10th Edition (ICD-10) (APA, 2000; WHO, 2016). Very recently, DSM-5 included some of the non-substance addiction such as gambling disorder under "substance-related and addictive disorder" chapter (APA, 2013). In addition, internet gaming disorder was also listed for further investigation. In contrast to the widely accepted belief that considers addiction to be dependence on chemical substance and drugs such as heroin, alcohol and nicotine, experts in behaviour science had a different belief. They believe that any source that has the capability of stimulating an individual will have the potential to become addictive (Peele & Brodsky, 1979). Apart from psychoactive substance ingestion, several behaviours can produce short-term reward that can cause persistent behaviour, regardless of the knowledge of harmful implication (Jon E et al., 2010). One example of the persistent behaviour is lack of control over it, which is one of the core symptoms of dependence or addiction on a psychoactive substance. The resemblance gave rise to the concept of

"behavioural addictions" or "non-substance addiction". Behavioural addictions can be defined as syndromes equivalent to substance addiction, but rather than ingestion of a psychoactive substance, it has behavioural focus (Jon E et al., 2010). The principle of behavioural addictions has certain scientific and clinical empirical value, but still remain controversial and always become the topic of debate.

The change of behaviours from habits into obligatory behaviour, such as drug abuse, gambling, computer gaming, chatting or internet browsing, can be regarded as the beginning of addiction (Peele & Brodsky, 1979). Peele popularized the idea that true addiction can present even without the presence of psychotropic drugs. Peele believed that individuals with addiction are dependent on a specific type of experiences, and the reactions to a particular chemical substance are only one example of such experiences. Using Peele's idea, some authors proposed the idea that addiction can also occur without involving chemical intoxicant or substance (Griffiths, 1999; Young, 2004). The "addiction" term has been applied to indicate certain extreme of behaviours such as video game playing (Keepers, 1990; Sadeghian, 2006), gambling (Griffiths, 1990) , sports and physical exercise (Morgan, 1979), pathological working (Vaugeois, 2006), eating disorders (Lesieur & Blume, 1993) and media use (Horvath, 2004; Kubey et al., 2001). Even though these behavioural addictions do not include any substance or chemical intoxicant, some researchers suggested that some fundamental indicators of behavioural addiction are comparable to substance or chemical addiction (Lesieur & Blume, 1993). At present, researchers highlighted that for the diagnosis of behavioural addiction, it is essential to determine the presence of functional impairments in interpersonal relationships, at work, or other social situations (Widyanto & Griffiths, 2006). On the other hand, some experts believe that behavioural addictions can be active such as playing computer games, or passive such as watching television. Moreover, it also commonly has

reinforcing features which most probably play a role in contributing to the advancement of addictive tendencies.

2.1.3 Behavioural Addiction

The core symptom of behavioural addictions is the failure to resist temptation, drive or impulse to carry out an act that has adverse consequences to the particular person or to others (APA, 2000). A repeated pattern of behaviour that has this core symptom is what characterized each behavioural addiction. Ultimately, disturbance in other domains will also occur with the repetitive involvement or engagement in these behaviours. In this context, similarities between behavioural addiction and substance use disorders are observed. Individuals that have an addiction to substance also reported a problem in battling the urge to drink or consume drugs. In addition, both type of addiction also has likenesses in natural history, phenomenology and harmful implications. The onset for both of them started in adolescence and young adulthood (Chambers & Potenza, 2003). Compared to older adults, both types of addiction have higher rates in adolescence and early adult age group. Substance addiction and behaviour addiction also that can demonstrate chronic and relapsing patterns of illness. However, even without formal treatment, many people may recover on their own or spontaneously quit (Slutske, 2006).

Behavioural addictions are commonly preceded by feelings of "arousal or tension prior to committing the act" and "gratification, relief or pleasure when the act are carried out" (APA, 2000). These behaviours are noted to have ego-syntonic nature that is comparable to the substance use behaviours. On the other hand, it is in contrast with ego-dystonic nature of the obsessive-compulsive disorder. Nevertheless, with time, both substance addictions and behavioural addictions can become more ego-dystonic and less

ego-syntonic, as the behaviour and substance use become more of a compulsion and less pleasurable or the motivation is driven more by negative reinforcement and less by positive reinforcement (Potenza et al., 2009; Brewer & Potenza, 2008). Both types of addictions have similarities in phenomenological aspect in which a lot of individuals with behavioural addiction describe the presence of craving state or urge before initiating the behaviour, which much resembles a person with substance use disorders before the consumption of substance (de Castro et al., 2007). In addition, these behaviours typically able to reduce anxiety and leads to a positive mood state, or "high" state, akin to substance intoxication. Cravings in both behavioural and substance use disorder may be attributed by emotional dysregulation. Reduce in positive mood effects with repetitive behaviours or a need to increase the intensity or frequency of behaviour in order to obtain similar mood effect has been found in individuals with kleptomania, pathological gambling, compulsive buying and compulsive sexual behaviour (Blanco et al., 2001; Grant et al., 2006; Grant & Potenza, 2008). This occurrence is also known as tolerance.

Moreover, while abstaining from the behaviours, people with behavioural addiction also reported a dysphoric state which is comparable to withdrawal. Nevertheless, unlike withdrawal due to substance, there is no report of serious withdrawal states or physiological disturbance from behavioural addictions. At the same time, financial and marital problems are also found to be a common occurrence in behavioural addictions, similar to substance use disorders (Ledgerwood et al., 2007). Also, as in substance use disorder, individuals with behavioural addictions were found to commit illegal acts frequently, such as theft and embezzlement to either cope with the consequences of the behaviour or fund their addictive behaviour.

Diagnostic criteria for behavioural addiction can be better explained using Goodman criteria (Goodman, 1990) or Griffiths criteria (Griffiths, 1996) as below:

Goodman Criteria (1990):

A. Repeated failure to resist impulses to engage in a specific behaviour.
B. Increasing sense of tension instantly before initiating the behaviour.
C. Pleasure or relief when engaging in the behaviour.
D. A feeling of loss of control at the time of engaging in the behaviour.
E. At least five of the following criteria:
    1. Recurrent preoccupation with the behaviour or with action that is preparatory to the behaviour.
    2. Frequent engagement in the behaviour over a longer time than intended or to a greater extent.
    3. Recurrent attempts to control, reduce or abort the behaviour.
    4. A significant amount of time spent in activities needed for the behaviour, engaging in the behaviour, or recuperating from its effects.
    5. Recurrent engagement in the behaviour until unable to fulfil academic, occupational, social or domestic obligations.
    6. Important occupational, social or recreational activities given up or decreased because of the behaviour.
    7. The behaviour is continued despite noted to have a recurrent or persistent financial, social, physical or psychological problem that is due to or aggravated by the behaviour.
    8. Tolerance: requirement to increase the frequency or intensity of the behaviour to achieve the desired effect or weakened effect with continuous behaviour of equal intensity.
    9. Feeling restless or irritable when unable to participate in the behaviour.
F. Some symptoms of the disturbance have continued for a duration of at least one month, or have happened frequently over a longer period.

Griffith Criteria (1996):

1. Salience:

   When the activity becomes the central activity in individuals' lives and governs their thinking (cognitive distortions and preoccupations), behaviour (a decline of socialised behaviour) and feelings (cravings).

2. Mood modification:

   A complication (such as an arousing "buzz" or "high" or a feeling of escape) of engagement in a specific activity; can be seen as a coping mechanism.

3. Tolerance:

   The amounts or intensity of the particular activity have to be increased to achieve a feeling of fulfillment.

4. Withdrawal symptoms:

   A negative state of feeling (such as irritability or moodiness) and/ or physical effects (such as "the shakes").

5. Conflict:

   Development of conflicts between addicts and those around them (interpersonal) or intrapsychic conflict in the addicted individual (between the desire not to give in to the tensions and the psychological need to participate in the activity which is caused by addiction to the particular activity).

6. Relapse:

   The inclination to return to earlier patterns of the particular activity after an abstinence period or control over the behaviour.

2.2 Food Addiction

The foods people prefer to eat are usually those that have excessive fat, salt and sugar. Previously, diet used to have only small amounts of these substances (Armelagos, 2010). However, the increasing quantities of the consumption of these hyper-palatable foods currently showed that they have an addictive potential similar to traditional addictive drugs (Kenny, 2011; Gearhardt et al., in press; Spring et al., 2008). The food addiction concept is founded on the principle that some highly processed and palatable foods such as chocolate, pizza and chips might demonstrate properties similar to addiction in some individual (Sinha, 2018).

A significant number of human behaviours such as reward processing and motivated behaviours are modulated by the dopaminergic system. Therefore, all drugs with the potential to be abused increases the concentration of dopamine in the extracellular part of the mesolimbic and striatum regions (Di Chiara, 2002). Addictive drugs such as cocaine and amphetamine had been noted to increase extracellular dopamine in the nucleus accumbens, which is the main region of the brain that is involved in reinforced behaviours (Di Chiara, 2002). Similarly, exposure to rewarding food had been proven to stimulate the transmission of the dopaminergic pathway in the nucleus accumbens (Roitman et al., 2004).

Both alcohol and consumption of food that is especially high in fat, salt or sugar activate similar brain pathways and can cause the brain to release endogenous opiates (Gearhardt et al., 2009). Using neuroimaging modalities, another study that investigated food addiction in accordance to DSM criteria for substance dependence also acknowledged the resemblance in neural responses between traditional addiction and addictive-like eating (Gearhardt et al., 2011). The nucleus accumbens, which have a role

in regulating brain's pleasure center demonstrated similar increased in cell activation for both food and drug abuse (Volkow et al., 2013; Roop et al., 2002; Hollander et al., 2002).

For the diagnosis of food addiction, similar to any other addiction, the presence of at least three of the subsequent symptoms are required (Avena & Gold, 2011):

1. Tolerance

   Studies conducted on laboratory rats suggested the existence of tolerance. Despite that, little research evidence has been found on adult food addiction, most probably due to methodological difficulties (Avena et al., 2011). For substance addiction such as alcohol or nicotine, the consumption starts during the period of adolescence. In contrast, the consumption of highly fatty or sugary food starts during infancy period. Therefore, it is difficult to involve young children for research purpose. It is suggested that for very young children, sugar can be an effective analgesic (Dimitrijevic et al., 2015). However, when children started to take food high in sugar regularly by the age of 18 months, these effects will disappear. In order to achieve more accurate results, research relating to tolerance should start at that time. Even though there are studies that indicate tolerance in the adult population, it is undeniable that more information can be obtained if studies are done at an early age. In addition, overeaters were found to eat more often and in increasing quantities as the disease progress (Dimitrijevic et al., 2015). They have less control over eating behaviour and spend more time eating. It is imperative to investigate further regarding different types of food that can cause tolerance. If tolerance develops for foods like fruits and vegetables, these effects can be argued as not connected with the addictive process.

2. Abstinence symptoms.

   Researches done on animals indicate that if a restriction of proper input of desired food is applied, abstinence symptoms may occur (Avena et al., 2011). For example, rats were exposed to hyper-palatable food rich in sugar in a controlled laboratory study and it was found that the rats were "overeating" as long as the food was available. Subsequently, the rats were noted to develop a tolerance for particular food gradually. The rats would have signs similar to abstinence symptoms when the food was restricted such as tremor, fever and aggression. At the same time, signs of craving for substances that have effects similar to amphetamines were also demonstrated. Unfortunately, there is not enough evidence of similar signs and symptoms among the human population. Mostly only self-reported statements on how they have tremors, chills or sweating over adherence to the diet. This warrants for a more systematic study of these criterias in the future.

3. Loss of control.

   Loss of control is one of the features of bulimia nervosa and overeating disorder such as binge eating disorder (Juli, 2012). They prefer to eat alone, eat when they are not hungry and eat faster than other people until they become ill. There is a sense of disgust, shame, guilt and depression after an episode of overeating. The consumption of food rich in fat and sugar become the trigger. Up to 4% of the population is found to have these features (Dimitrijevic et al., 2015). Uncontrolled eating can also be found in a nonclinical population. Around 9% of normal weight individual and 21% of medium obese individual demonstrate features of occasional mild overeating. The occurrence of this symptom is documented among these people. These individuals do not control their eating even though

they are concerned about their weight. Also, persistent food marketing is also another factor that contributes to overeating.

4. Persistent desire or repeated failed efforts to stop consumption.

   This criterion is very frequently found anywhere. Annually, the investment in diet products and programs to lose weight is estimated to be around 33 billion dollars (Dimitrijevic et al., 2015). There is indisputable evidence that suggests around 37% of children who attend primary school has the desire to reduce food consumption. On the other hand, 83% of participants in different dietary treatments were noted to have a recurrence of failures.

5. Important activities are reduced or sacrificed.

   There is evidence that showed that the participants prefer to choose unhealthy food over healthy food. Moreover, rather than taking part in other activities that can bring satisfaction, these people would rather eat (Dimitrijevic et al., 2015). When the desire for food consumption increase, to acquire and consume certain food, they can decrease all other activities that can make them feel happy.

6. A significant amount of time spent in abstaining from eating or to recover from the effect of consuming certain foods.

   To date, there are only self-reported statements of patients who were struggling in refraining from consuming hyper-palatable food during the dietary program and still no empirical data yet,. This type of food has high calorie, but low in nutrition as it is cheap and easily accessible in huge quantities.

7. Continuous use in spite of physical and psychological problem.

   A research was done where electric shock was given on laboratory rats exposed to hyper-palatable food rich in sugar. At the end of the study, the researchers found that the rats continuously consume the foods despite the painful stimuli given (Taylor et al., 2010). Similar results were obtained for studies in humans as well. People continued to eat certain types of food even though it has adverse consequences (Dimitrijevic et al., 2015). In a study regarding heart disease health care, respondents were informed that they would be excluded from the program if there was any consumption of chocolate. From a total of 1200 participants, 139 of them were found to consume chocolate and had to be excluded. This finding supported the reality of this criterion. For decades, the potential of addiction to food has been the subject of discussion. Uniqueness for food addiction diagnostic criterias have emerged in DSM-5, where the criteria for substance dependence and abuse were combined. Initially, even though there were many studies that talk about the suitability of DSM-IV substance dependence criteria to be applied for eating behaviour, the adaptation of the new additional criteria in DSM-5 to eating disorder was yet to be established (Meule & Gearhardt, 2014). It was not until 2016 where Gearhardt et al. developed a modified version of Yale Food Addiction Scale (YFAS) in which the additional criteria for substance use disorder was also adapted for food addiction.

8. Clinical significance of distress.

   At least three of the listed symptoms need to be established to make a diagnosis of substance dependence, with the addition of clinically significant deterioration or distress symptom (APA, 2000). Some researches recorded certain indications of discomfort or distress, even though the level was not directly measured. In a

sample of 4283 respondents, rather than be fat, around 46% of them were found to be willing to abandon one year of their life while 15% willing to waive ten years (Avena & Gold, 2010). In addition, rather than being obese, a quarter of them would rather have no children, one third would choose to be divorced and approximately 14% prefer to have an alcohol problem. Studies that were done previously found out that the most common symptoms of food addiction are an attempt to decrease food consumption, taking big amounts of food over a long period and continuous use in spite of adverse consequences (Meule, 2010). Among the less common symptoms were time spent on purchasing and consuming food and tolerance. The rarest symptoms were a decrease of occupational, social or recreational activities and withdrawal.

Guidelines on the treatment for food addiction were suggested by Gearhardt et al. (2011) in which the principle has similarities with the management for obesity. Firstly, we should only eat when we feel hungry. At the same time, we should avoid starvation or abstinence from food as these in turn would stimulate cravings. Any stressful condition should be avoided if possible. This was due to the fact that some people consumed food more than normal amounts when they were under stress as food had the ability to lessen anxiety. However, it was wrong to use food as a medium to recover from emotional distress. Healthier strategy to cope with the feeling of sadness, anxiety and anger needed to be explored. Exercising regularly had been proven to bring pleasurable feeling similar to consuming highly-palatable food. Dimitrijevic et al. (2015) concluded that exercise could increase dopamine receptors in the brain. In addition, acknowledging that certain behaviours are of personal responsibility is an important component to achieve successful treatment. The treatment of food addiction is also influenced greatly by the food processing and the

food marketing industry. The food industry had allowed the manufacturing of unhealthy salty, sweet and fatty foods that were cheap, had high calorie, low nutritional content, readily available and had the potential to be addictive. To prevent food addiction, the potential use of public health policy should be considered. Similar policy against alcohol and tobacco could be used in the prevention of food addiction. Studies had found out that, when there was an increase in the price, the availability would reduce, which led to the marketing to become negative and minimized (Rogers, 2011; Fortuna, 2012). Subsequently, there would be a reduction of these particular products and finally improvement in public health.

Apart from that, scientists were also diligently working on developing medications that could help in the treatment of food addiction. The new hopeful drug was ribonamant, in which the effect was still tested on animals (Liebman, 2012). There were also other drugs still in progress to solve the problem of obesity and addiction, and to affect brain process and reward system.

2.2.1 Food Addiction and Mental Health

In general, food addiction was associated with psychological maladjustment and a higher likelihood of severe eating pathology, especially in patients with concurrent binge eating disorder. In a sample of normal weight participants, Gearhardt et al. (2009) noted that, compared to other measures of eating pathology, food addiction was able to predict binge eating behaviours. Also, food addiction was also related to emotional eating. On the other hand, obese adults who met criteria for food addiction were found to have higher levels of depression, impulsive trait and binge eating compared to the control group (Davis et al., 2011). Likewise, in patients with binge eating disorder who at the same time had a diagnosis of food addiction, they were noted to have a higher risk of

mood disorder (Gearhardt et al., 2011). Furthermore, these patients were found to have higher emotional dysregulation, poorer self-esteem and depressed affect.

Due to the high association between food addiction and binge eating, and the overlap of symptoms between these two conditions, the concept behind food addiction and mental health was also explained by the association between binge eating behaviour and mental health. Compared to the general population, binge eaters had a higher rate of psychiatric condition involving negative emotional situation. For example, people with binge eating disorder or bulimia nervosa were noted to have increased prevalence of anxiety disorders, bipolar disorder, major depression and alcohol or drug abuse (Hudson et al., 2007). The severity of mood problem in binge eaters was further demonstrated by the very high rates of suicidal ideation in this population (Swanson et al., 2011). More than half of teenagers with bulimia and around 30% of people with binge eating disorder reported having suicidal ideas. Moreover, approximately one-third of teenage bulimics reported having attempted suicide. However, there was no established causality direction between binge eating and major depression as it may be reciprocal (Spoor et al., 2006). Antidepressants such as selective serotonin reuptake inhibitor (SSRI) or tricyclic had been shown to reduce the frequency and severity of binge eating symptoms (Brownley et al., 2007).

2.2.2 Instruments to Measure Food Addiction

To date, there are no established criterias to evaluate food addiction yet as this topic of research is still relatively in its early stage. A psychometrically valid instrument also was not widely available, until recently. In 2007, based on the diagnostic criteria of addiction in DSM-IV, Cassin and Ranson used a structured clinical interview and later structured an interview-based instrument on Goodman criteria for behavioural addiction

(Dimitrijevic et al., 2015). In 2009, the self-reported Eating Behaviours Questionnaire (EBQ) was developed to investigate food addiction in a paediatric sample (Merlo et al., 2009). Three crucial components of food addictions were explored, which were the attempts to cut down, compulsive use and continued use despite adverse consequences. It has 20 items with a Likert-scale score, from "never" to "always". This questionnaire has a straightforward question: "Do you think you are addicted to food?" Marlo et al. concluded that approximately 15.2% of the children fulfill the criteria for food addiction. A positive correlation between the EBQ score and BMI was also found (Meule, 2010). This questionnaire, despite having good psychometric properties, nevertheless, no attempt has been done to adapt this instrument to an adult population until now (Imperatori et al., 2016). Another example, the Palatable Eating Motives Scale (PEMS) is a robust scale that has been validated to identify motivations for eating highly-palatable foods (Burgess et al., 2014). This instrument able to detect motives such as social (to celebrate a special event with friends), reward enhancement (because it gives a pleasurable feeling), coping (to forget about problems) and conformity (because family or friends want you to eat or drink certain food or drinks). PEMS demonstrated good convergent validity with YFAS scores and it can assess a certain aspect of food addiction (Lerma-Cabrera et al., 2016). It also has been shown to have an association with addictive-like eating (Joyner et al., 2015). However, this instrument only has some aspects of food addiction criteria and does not directly measure the level of food addiction.

In the clinical and non-clinical sample, the Yale Food Addiction Scale (YFAS) is the most commonly used tool to assess food addiction. It consisted of 25 items and it was initially based on criteria for substance dependence in DSM-IV-TR and scales to evaluate behavioural addictions such as sex, exercise and gambling (Gearhardt et al., 2009). The scales that were used as sources include the Carnes' Sexual Addiction Screening Tool,

Exercise Dependence Scale and South Oaks Gambling Screen. Adaptation on the questions was made to measure the full array of criteria linked to the consumption of high sugar and high-fat foods. The authors developed the initial pool of questions prior to review by any experts. After that, the questions were reviewed by a panel of experts in eating pathology, obesity and addiction field. Furthermore, clinical patients receiving treatment for binge eating also reviewed the content for clarity and relevance.

Based on the feedback from the experts and patients, 2 to 4 questions were selected for each of the seven dependence criterias. Also, two questions for clinical significance were added, which assessed the degree of significant impairment or distress caused by eating behaviour. A combination of dichotomous and frequency scoring were decided for the scoring options. Frequency scoring was applied for behaviours that might also present in non-problem eaters such as dieting, emotional eating and excess consumption. On the other hand, dichotomous scoring was used for questions with more severe criterias and with a high likelihood of eating problems such as continuous food consumption in a specific way despite emotional or physical problems. The instructions for the questionnaire specifically made reference to foods high in sugar, carbohydrate and fat content as these types of foods are favoured by individuals with eating problems (Allison & Timmerman, 2007). YFAS has been validated in numerous languages and countries (Meule & Gearhardt, 2014, Torres et al., 2017, Brunault et al., 2016) and it has shown good reliability, a single-factor structure and adequate convergent validity with construct to assess binge eating (Meule & Gearhardt, 2014).

A new version of the YFAS was developed in accordance with the changes in substance use disorder criteria in DSM- 5 and was later named as the YFAS version 2.0. The original YFAS items only evaluated symptoms of substance dependence without the assessment on substance abuse symptoms. Therefore, questions that reflected substance abuse criteria that were added on DSM-5 criteria for substance use disorder were added

to YFAS 2.0. The new additional questions evaluated criteria of use regardless of social or interpersonal consequences, use in physically hazardous situations and failure in role obligations (Gearhardt et al., 2016). The completely new criteria for craving was added as well. To improve the accuracy in groups with lower education level, the language difficulty of YFAS 2.0 was lowered to the sixth-grade reading level according to the Automated Readability Index, the SMOG Index and the Flesch-Kincaid grade-level readability scores. The term "withdrawal" was removed but the concept of withdrawal was maintained. Other changes included the use of past tense for all items, increased options for response answer and rewording of some questions to enhance clarity. The collection of potential questions for the YFAS 2.0 was reviewed by nine experts in eating pathology, obesity, psychopathology, addiction and measurement development fields. After all the feedbacks reviewed by the authors, 35 questions reflecting DSM-5 criteria for substance use disorder were finalized. The YFAS 2.0 no longer have dichotomous scoring like YFAS. There were two scoring options: (a) a continuous score of total symptoms and (b) diagnosis of food addiction according to the total number of symptoms and the presence of clinically significant impairment. Using the Receiver Operator Characteristic (ROC) curve, a threshold cutoff for each question was determined. If one or more of the corresponding questions for each criterion met the threshold, the diagnostic criteria for that particular criteria were considered to be met. The scoring options mirrored the same criteria required for substance use disorder diagnosis in DSM-5 (APA, 2013). The YFAS 2.0 specified cutoffs for different severity of the disorder, in line with the changes in DSM-5. Presence of 2 to 3 symptoms would be classified as mild, 4 to 5 symptoms classified as moderate and 6 or more symptoms classified as severe. Food addiction diagnosis can only be established with the presence of clinically significant impairment or distress.

CFA was done on the YFAS 2.0 and the confirmatory fit index (CFI = 0.958) and Tucker-Lewis Index (TLI = 0.974) values proposed good fit for the one-factor model. However, the root-mean-square error of approximation (RMSEA) value was not ideal (0.108). All criteria had factor loading 0.77 and higher for the one-factor model. The two-factor solution was examined, separating dependence and abuse. However, the model fit indices for the two-factor model were not significantly improved (CFI=0.962; TLI=0.975; RMSEA=0.098). In addition, the two factors were found to be highly correlated. Therefore, a one-factor solution was retained. This was in line with the examination of the factor structure of substance use disorder done previously which also extracted one-factor structure. This indicated that criteria for abuse and dependence are not 2 independent entities but could be considered as a single unidimensional continuum of risk (Gillespie et al., 2007). In comparison to the original YFAS, the YFAS 2.0 was noted to have better internal consistency (Gearhardt et al., 2016). It also has similar convergent, discriminant and incremental validity with eating-related scale. Approximately 6% more participants were noted to fulfil the diagnostic threshold of YFAS 2.0 compared to the original YFAS during the validation study for YFAS 2.0 (Gearhardt et al., 2016). This might be because the YFAS 2.0 evaluated both criteria previously categorized as dependence and abuse, while the original YFAS only assessed dependence criteria.

More recently, in 2017, a shorter version of YFAS 2.0, known as the modified YFAS 2.0 or mYFAS 2.0 was developed and it only has 13 items (Schulte & Gearhardt, 2017). This latest version was noted to have good reliability, a one-factor structure, discriminant validity with measures such as dietary restraint, convergent validity with related constructs such as weight cycling and incremental validity as evidenced by its link with the frequency of binge eating beyond a limit of disinhibited eating (Schulte & Gearhardt, 2017). To develop the mYFAS 2.0, a confirmatory factor analysis was done on the result

obtained from the full YFAS 2.0 validation study in 2016. A one-factor solution was utilized based on the validation paper. Factor loadings for all 33 questions that assess 11 YFAS 2.0 symptoms were examined. For each symptom, the corresponding questions that have the highest factor loading were retained for the mYFAS 2.0. Finally, the two impairment and distress questions were added, thus producing 13-items mYFAS 2.0. The scoring for the mYFAS 2.0 was similar to YFAS 2.0; continuous symptoms counts or diagnostic threshold (2 or more symptoms plus distress symptom).

To use YFAS 2.0 or mYFAS 2.0, some adjustment might be required in accordance with the targeted countries. Cultural and language difference needed to be taken into consideration. YFAS 2.0 and mYFAS 2.0 was developed in a western country. Attempt to translate and validate these instruments so far was done in western countries as well (Torres et al., 2017; Brunault et al., 2016). As yet, no attempt to translate or validate this instrument from countries in other continent was done.

Until now, there is no available structured clinical interview for food addiction. The reason probably because there is no established diagnosis for food addiction up til now. Food addiction also is a relatively new topic and is not yet included in DSM-5 as a disorder.

2.3 Obesity

2.3.1 Obesity as Global Epidemic

Obesity is a multifactorial, multifaceted condition involving an excessive amount of body fat (Ministry of Health Malaysia, 2004). It is a chronic disorder that requires thorough health care and follow-up. It persistently grows as a major health risk globally

and recently, it is considered as a global epidemic (WHO, 2000). Compared to underweight people, there are more people who are overweight and obese globally (WHO, 2018). This phenomenon occurs in every region excluding parts of Asia and sub-Saharan Africa. For the last three decades, the total population of overweight and obese people increased around three times more which was from approximately 857 million 40 years ago to 2.1 billion in 2013 (Ng et al., 2014). Worldwide, approximately 38% of females and 36.9% of males were found to be overweight or obese (Ng et al., 2014). More recently, in 2016, around 1.9 billion adults who were 18 years old and above were found to be overweight. Among this population, approximately 650 million adults were obese (WHO, 2018). In other words, 39% of adults above 18 years old were noted to be overweight, among which 40% of women and 39% of men were overweight. In general, for the global adult population, around 13% of them were obese, which contributed to 11% of male and 15% of female worldwide.

In 2016, approximately 41 million children of 5 years old and below were found to be overweight or obese (WHO, 2018). Among these children, half of them lived in Asia. Previously, overweight and obesity were once thought to be a problem of countries with high-income earning. In contrast, recently, this problem is noted to be increasing in countries with middle and low-income earning, especially in an urban area. Since the year 2000, the number of overweight children below five years old in Africa showed an increase of 50%. According to the WHO (WHO) report released in 2018, for older children above five years old up to adolescent, over 340 million of them were noted to have excessive body weight in 2016. The occurrence of overweight and obesity in this age group also showed dramatic increment from just 4% in 1975 to 18% 41 years later. The rise happened equally among both genders. Less than 1% of them were obese more than 40 years ago, but at the present time, more than 124 million were obese and comprised of 8% of boys and 6% of girls.

Thus far, although debatable, the most useful measure of overweight and obesity is still body mass index (BMI) (Hu, 2008). The BMI values according to WHO are the same for all genders and all ages for adults as follows:

Table 2.1: BMI Classification According to WHO

Classification	BMI (kg/m^2)
Underweight	< 18.5
Normal weight	18.5 – 24.9
Overweight	≥25
Pre-obese	25.0 – 29.9
Obesity I	30.0 – 34.9
Obesity II	35.0 – 39.9
Obesity III	≥ 40.0

2.3.2 Obesity in Malaysia

In 2006, 2011 and 2015, National Health and Morbidity Surveys (NHMSs) were carried out in Malaysia. These surveys revealed a growing trend of overweight and obesity rates in Malaysian adults aged 18 years and older (Ministry of Health Malaysia, 2015). According to NHMS in 2015, among adults age 18 years old and above, the rate of overweight was 30% whereas obesity was 17.7% (Star2, 2018). This showed dramatic increment compared to NHMS 1996 in which the prevalence for overweight was 16.6% while obesity was 4.4%. In just under two decades, the prevalence of overweight had increased 80.7% more while obesity showed a surprising increment of 302%. In Southeast Asia, the highest rate of obesity and overweight is in Malaysia (New Straits Times, 2017).

In general, among all age groups, the rate of obesity was 13.3%, while overweight was 38.5%.

According to WHO classification on BMI, the overweight started at 25 kg/m^2 and above while obesity is 30 kg/m^2 (WHO, 1998). However, based on scientific evidence, different cut-off point values of BMI were necessary to determine overweight and obesity in the Asian population. This was because, in comparison to Europeans, Asians have different associations between the percentage of body fat, BMI and health risks (Deurenberg 2002, Wildman et al., 2004). There is a high prevalence of cardiovascular risk factors and type 2 diabetes mellitus in certain parts of Asia for BMI below the cut-off points classification according to WHO (Ministry of Health Malaysia, 2004). Various evidence from few Asian countries including India (Reddy et al., 2002; Yajnik, 2002), Hong Kong (Ko et al., 1999), Singapore (Deurenberg, 2001), China (Jia et al., 2002; Zhou, 2002) and Japan are available to demonstrate that at lower BMI values, the risk of co-morbidities already started to increase. In comparison to European populations, at similar BMI, a large number of Asian populations are noted to have a higher body fat percentage (Gurrici, 1998; Wang et al., 1994). In accordance with these undisputable evidence, The Malaysian Clinical Practical Guidelines (CPG) on Management of Obesity 2004 outlined different BMI classification which is slightly different from WHO classification as follows:

Table 2.2: BMI Classification for Asian Population

Classification	BMI (kg/m^2)
Underweight	< 18.5
Normal weight	18.5 – 22.9
Overweight	≥23
Pre-obese	23.0 – 27.4
Obesity I	27.5 – 34.9
Obesity II	35.0 – 39.9
Obesity III	≥ 40.0

2.3.3 Causes/Factors of Obesity

Overweight and obesity is a multifactorial condition. Many factors that involve genetic, metabolic, behavioural and environmental influences interact with each other thus results in these disorders. The speed of obesity epidemic increment suggests that rather than biological changes, the environmental and behavioural factors play a big part in fuelling the epidemic (Stein & Colditz, 2004). The decrease of energy expenditure, an increase of energy consumption, or a mixture of both will lead to an obvious increase in weight due to positive energy residue. Over time, changes in activity levels and eating habits will occur. However, knowledge regarding the details of these particular changes in behaviour is not well explored. With regards to evaluation regarding calorie intake, large national studies in United States of America concluded varied results (Harnack et al., 2000). The analysis from the collected data of the National Health and Nutrition Examination Survey suggests that between 1971 and 2000, the average energy intake showed increment (CDC, 2004). However, no obvious difference in calorie intake

documented in other surveys such as the Continuing Survey of Food Intake by individuals and the Nationwide Food Consumption Survey (Popkin et al., 2001).

The idea of increased energy intake is also supported by ecological data, in addition to the results collected from national surveys (Harnack et al., 2000). Even though there is an increment in the accessibility and intake of food with lower content of fat over time, there is an emergence of trends that could influence the increase of energy residue and the evident upsurge in obesity rate. Such examples include more food such as fast foods consumed outside home (Nielsen et al., 2002; Harnack et al., 2000), higher availability of per capita energy (Frazao, 1999), bigger portion sizes of food (Smiciklas-Wright et al., 2003) and larger intake of soft drinks (French et al., 2003). The inconsistencies on available data regarding energy intake suggest the increasing level of obesity may be more strictly connected to energy expenditure changes. As for energy intake, there is a growing number of recreational facilities, health clubs and homes equipped with workout apparatus (Jeffery & Utter, 2003).

Nevertheless, at the same time, there is also a rising trend of sedentary lifestyle activities such as playing video game and watching television. These activities are linked with increasing weight in children and adults (Gortmaker et al., 1990). However, it is uncertain whether this association is attributed to the corresponding increment in food intake or reduction in physical activity (Jeffery & Utter, 2003). In general, the level of leisure-time activity showed no significant changes (CDC, 2001). What undoubtedly has changed is, however, the level of activity required for daily living and work (Hill & Melanson, 1999). With technology advancement, the requirement for cycling and walking for transportation has greatly reduced (Stein & Colditz, 2004). Household physical activities are also reducing due to household devices that are widely available now. Energy requirement for certain occupation has also decreased due to the easily accessible mechanized labour aids. In general, jobs have become more sedentary.

According to the report by Department of Health and Human Services United States of America (HHS) in 1996, more than half of Americans do not take part in routine physical activity and a quarter of them are almost completely sedentary. Moreover, the school also demonstrated a reduction in physical activities and almost 50% of young Americans between 12 years old and 21 years old are not physically active regularly.

On the other hand, it is worthwhile to note that genetic plays a certain role in obesity. Certain disorders, for example, Prader-Willi syndrome has been found to be able to directly cause obesity (NICHD, 2016). A person's vulnerability to gain weight can also be attributed to genetic (CDC, 2018). However, scientists believe that even though genes can increase a person's susceptibility in becoming obese, external factors such as the excess supply of food or less physical activity is still necessary excess weight gain to happen. Apart from that, certain hormonal problems such as Cushing syndrome, hypothyroidism and polycystic ovarian syndrome can also contribute to overweight and obesity problem (NICHD, 2016). Some medicines also can cause an increase in weight such as antidepressants, corticosteroids and antiepileptic medications (NHLBI, 2012).

Even though the complexities of the interaction between different factors of overweight and obesity are not fully understood, more evidence suggested that the disparity between energy expenditure and energy intake plays a dominant role in an epidemic of overweight and obesity.

2.3.4 Impact of Obesity

Due to its huge indirect impact on the social and economy aspect, obesity remained as a major public health burden. This impact was brought upon by its high association with various comorbidities (Lopez-Legarrea et al., 2015). Around 16% of the global burden disease was attributable to excessive body weight (Hossain et al., 2007). Public

health can have a devastating impact even with a small rise in weight across a population. In a country such as the United States, obesity may be responsible for around 300,000 deaths every year (Allison et al., 1999). This leads to obesity to become the second most common preventable cause of death in this country (NHLBI, 1998). The risk of multiple conditions such as cardiovascular disease, type 2 diabetes mellitus, premature death and cancer increase along with each increase in weight (HHS, 2001). The risk for these diseases also begins to increase for people who have BMI at the upper border of the normal range and not just exclusively for those in overweight and obese categories (Field et al., 2001). Excess body weight may be the cause of 20% to 30% of mortality in patients with cardiovascular disease (Seidell et al., 1996). In comparison to people with normal body weight, individuals who are overweight or obese have double to triple times the risk to develop cardiovascular disease (Rimm et al., 1995) and they have a higher rate of mortality (Seidell et al., 1996). Excess weight in younger age is a predictive factor of cardiovascular heart disease mortality (Must et al., 1992).

Also, overweight and obesity are also commonly associated with overweight and obesity (Must et al., 1999). Between blood pressure and BMI, there is a significant positive relationship in which higher blood pressure is noted for an individual with higher weight and more weight gain (Witteman et al., 1989; Field et al., 1999). For women, they are three times more likely to develop hypertension if they are overweight and six times more likely if they are obese, compared with the normal-weight individual (Witteman et al., 1989). Apart from that, obesity is also closely linked with other illness such as type 2 diabetes. An individual with obesity has a ten times higher likelihood to develop diabetes, compared with a non-obese individual which suggested a significant positive association between type 2 diabetes and BMI (Colditz et al., 1995). At the same time, waist circumference, weight gain and the ratio of waist and hip are also strongly linked with the risk of diabetes (Carey et al., 1997).

Furthermore, various researches done on obesity found a significant relationship with increased risk of cerebrovascular disease. Rexrode et al. (1997) concluded that obese women had two times higher likelihood to develop ischemic stroke in comparison to leaner women. As for men, the significant linear relationship between stroke and BMI (Field et al., 2001) and waist/hip ratio (Walker et al., 1996) has also been found. In addition, there is evidence that suggests the link between overweight and obesity with cancer. Internationally, overweight and obesity are estimated be responsible for around 11% of colon cancer, 9% of postmenopausal breast cancer, 37% of oesophageal cancer, a quarter of renal cancer and up to 39% of endometrial cancer (WHO, 2002). In general, as much as 20% of cancer deaths in female and 14% in men are accountable to overweight and obesity (Calle et al., 2003). It is also worthwhile to note that the risk of illness such as dyslipidemia, asthma and sleep apnea are also increased due to overweight and obesity (HHS, 2001). Apart from that, illness such as cataracts (Weintraub et al., 2002), benign prostatic hyperplasia (Giovannucci et al., 1994), depression, social discrimination, menstrual irregularities and pregnancy complication are also linked to obesity (HHS, 2001). Obesity also has a negative impact on vitality, physical functioning and general quality of life (Fine et al., 1999; Coakley et al., 1998).

Apart from widespread health effect, excessive weight also results in tremendous burden economically. In a developed country such as America, obesity is estimated to costs the country 117 billion dollars every year (HHS, 2001). In Malaysia, the direct and indirect costs of obesity are documented to be the highest in ASEAN countries, accounting for one-fifth of national healthcare spending (Star2, 2018). The direct costs involve the medications, doctor visits, hospital admission and stay as well as nursing home placement. Indirect costs refer to lost productivity and income caused by illness or early death (Wolf, 1998). The additional health care costs associated with obesity are almost as high as those linked with smoking (Thompson et al., 1999). The estimation,

however, is likely much higher as it does not completely identify the cost associated with overweight individuals who are not yet obese and other costly conditions that are linked with obesity such as sleep apnoea, reduced physical functioning, cataracts and pregnancy complications. In Malaysia, obesity-linked diseases reduce the productive years by 6 to 11 years among the male population with obesity (Star2, 2018). As for obese females, the loss of productive years is higher and range from 7 to 12 years.

2.3.5 Treatment of Obesity

European Clinical Practice Guidelines for Management of Obesity in Adults outlined a simple algorithm for the treatment of obesity (Tsigos et al., 2008). Firstly, rather than weight loss alone, for certain patients such as those with overweight BMI, further weight gain prevention is the appropriate target. Objectives of weight loss should be realistic, practical, individualised and aim for long-term. Obesity complication should also be managed such as optimisation of sugar control, blood pressure and dyslipidemia. Psychosocial conditions caused by obesity such as affective problem, body image disturbance, low self-esteem and eating disorders should also be addressed. Obesity is a chronic illness. Therefore, regular follow-up and continuous supervision is important to prevent the rebound of weight regain, screen disease risk and manage co-morbidities (Anderson et al., 2001)

European Clinical Practice Guidelines for Management of Obesity in Adults also explained regarding specific components for obesity (Tsigos et al., 2008). Advice concerning diet should promote healthy eating and emphasize the importance to increase intake of cereals, grain and fibre as well as fruit and vegetables. Food diary that is self-recorded also plays a role in evaluating the diet qualitatively. Cognitive Behavioural Therapies (CBT) has been shown to assist the patient in modifying their insight and

understanding of issues regarding weight management, obesity and its complication. Furthermore, physical activity of moderate intensity (such as gardening and house chores) not only encourage fat loss and increasing energy expenditure, it also has extra benefits such as improves glucose tolerance, normalise blood pressure, improve self-esteem and also reduce anxiety and depression (Kay & Fiatarone Singh, 2006).

Existence of psychological or psychiatric issues should be recognised and addressed early as it can interfere with successful obesity management. Patients can also be given pharmacological treatment as there are three licensed drugs that are available which are orlistat, sibutramine and rimonabant. Similar weight loss of moderate nature was achieved by all three drugs (Christensen et al., 2007). For patients with obesity class III, surgical treatment can be taken into consideration as it is the most efficacious treatments for long-term loss of weight in morbid obesity patients (Ridley, 2005).

2.4 Obesity and Mental Health

To date, researches regarding obesity mainly focused on understanding the outcome related to physical health associated with overweight and obesity such as the high risk of diabetes, hypertension and myocardial infarction (Field et al., 2001). Newer studies have explored the relationship between psychosocial well-being and obesity. By applying a bio-psychosocial perspective, obesity has multifactorial causes. Thus the relationship between obesity and the psychosocial domain is also multifactorial. Anywhere across the word, beauty is placed on a high pedestal and ideas of "ideal" body shape is defined as athletic and slim (Brownell, 1991). Slimness is viewed as attractive, safe and controlled while fatness is linked with labels such as unattractive, uncontrolled and lazy (Latner & Stunkard, 2003). As a result, overweight and obese people are frequently stigmatised. They are also more likely to experience verbal abuse (Falkner et

al., 2001), social isolation and low self-esteem (Porter et al., 2010). Various types of advertising and media represented these "ideals", such as routine image editing to remove skin flaws, body figure enhancement or elongation of legs that are thought as not reflecting the "ideal" body shape (Hankey & Wheelan, 2018). Approximately 38% of the female gender is on a weight management diet at any particular time (Biener & Heaton, 1995). Nevertheless, the pressure for "ideal" body image applies also to men, with the existence of increasing adverts emphasising on male gender to appear athletic and fit (Hankey & Wheelan, 2018).

Unfortunately, despite the proposed association between obesity and psychosocial factors, a lot of weight loss treatment still predominantly focus on outcome related to physical health and give minor care to the outcome on the psychosocial aspect (Barlow, 2007). The motivation to take part in weight management programs is more likely to be increased for an individual with a better state of psychosocial well-being (Hankey & Wheelan, 2018). Also, condition such as inactivity, comfort eating, poorer diet and alcohol misuse are more likely to occur in an individual having a psychological condition such as low mood and anxiety. Therefore, studies have supported the fact that there is an association between psychological condition, particularly anxiety and depression (Strine et al., 2008). As such, understanding the relationship between psychosocial factors and obesity is an imperative aspect of increasing the effectiveness of weight management interventions.

WHO reported that globally, depression affects around 350 million people and is considered to be among the highest causes of disability (WHO, 2012). The high prevalence of both depression and obesity proposed the existence of a relationship between these two conditions (Stunkard et al., 2003). From a psychiatric point of view, the relationship is not surprising as DSM-5 listed symptoms such as an increase in food intake and decrease in physical activity as part of criteria for depression, which are also

symptoms linked to weight gain (de Wit et al., 2010). Moreover, other psychosocial factors such as stigmatisation of obese individuals and negative body image may also cause low self-esteem, psychological distress and other depressive symptoms (Ross, 1994). Nevertheless, so far, there is no community-based study that explored this relationship (Stunkard et al., 2003). The rate of depression in the community is so high. Therefore, even if the rate of depression in patients with obesity are not higher than normal, it should still be viewed as a significant issue (Hankey & Wheelan, 2018). Clinically, it is important due to the fact of the known relationship between depression and comfort eating, reduced activity and lack of motivation, which make the decisions to sustain weight loss to become harder.

The most prevalent mental health disorder in Western regions nowadays is an anxiety disorder, with 25% of individuals affected by any form of anxiety disorder at some point in their life (Kessler & Wang, 2008). It is characterized by a range of psychological symptoms including excessive worries, fear and apprehension with physical symptoms such as palpitation, shortness of breath, fatigue and sleeping difficulty. Some researchers suggested obesity to be a risk factor for anxiety disorder (Parikh et al., 2007) while others suggested the other way around, that anxiety disorder is a risk factor for obesity (Canetti et al., 2002). A number of pathways linking obesity and anxiety disorders have been proposed. For example, like the relationship with depression, weight-related discrimination and stigmatisation may be stressful to an individual, causing the anxious feeling and strategies such as avoidance or staying at home as a way to not encounter the discrimination (Ashmore et al., 2008). Subsequently, this may lead to a decrease in physical and social activities, and an increase in energy intake, which consequently causes further weight gain. Furthermore, obesity can have negative effects on physical health and quality of life which are particularly distressing and isolating, which increases the risk of anxiety (Sareen et al., 2006). It can be summarized as the

fewer people do, the worse they feel. After that, the worse they feel, the less they do. There is a continuous harmful cycle that interconnecting both factors. Individuals who are obese may face high pressure from people around them to gain control over their weight, which is stressful, especially if they have experienced repeated failures previously. The concern with dieting and weight loss is associated with anxiety (Horner & Utermohlen, 1993). Anxiety has also been proposed as a trigger for emotional eating, with experimental evidence showing that food consumption in obese individuals is increased due to anxiety (Ganley, 1989).

What people think will affect their feeling and action. For example, if two people are overweight, one may feel completely comfortable about one's body shape and weight and see oneself as beautiful. However, the other one may hate one's looks, feel his or her eating habit is uncontrolled and swinging between every new diet only to fail later, which eventually lead to a feeling of depression. Just like a vicious cycle, as how a person feels can affect behaviour, the worsening of anxiety and depression can bring forth additional behaviours such as avoidance, withdrawal, comfort eating, too much alcohol consumption, comfort eating or acting in such ways that clarified to themselves how unattractive they are (Williams, 2009). Obesity causes a significant challenge to individuals, families and society. Even though viewed mainly as a physical condition associated with physical comorbidities, there are significant important psychological negative effects in terms of low confidence, anxiety, depression and associated eating disorders such as bulimia nervosa and binge eating disorder (Hankey & Wheelan, 2018).

2.4.1 Obesity and Addiction

When being applied to excessive overeating, the DSM-5 criteria for substance use disorder seems to have external validity (Barry et al., 2009). People who are obese frequently consume food more than their initial intention and make repetitive yet eventually unsuccessful attempts to curb the overeating issue. An individual's ability to take part in social, recreational and occupational activities may also be affected by obesity (Barry et al., 2009). Despite knowing that it can cause obesity and contribute to serious health problems, a number of individuals continuously eat excessively (James et al., 2004; Volkow & O'Brien, 2007). These similarities fuel the movement that suggested obesity or overeating be included in DSM-5, with criteria for diagnosis to be based on substance use disorder. DSM-5 currently has a diagnosis of Binge Eating Disorder, which involves unable to control eating habit and eating large quantities of food within a short period (APA, 2013). However, at present, there is no category for chronic overeating diagnosis yet. There are experts who expressed reluctance regarding the creation of diagnosis analogous to "Food Dependence" or "Overeating Disorder". The argument given is unlike alcohol and drugs, food is imperative for life and it is impossible to practice abstinence from food (Devlin, 2007). In addition, physiological symptoms of dependence such as craving, tolerance and withdrawal for food are not well understood and there is yet any definite definition until now.

Epidemiological studies investigating the association between obesity and substance use disorders produce mixed results. In the National Epidemiological Survey on Alcohol and Related Conditions (NESARC), Petry et al. (2008) found that higher BMI is associated with increased lifetime rates of alcohol use disorders. The same data also showed that overweight and obese men have a higher prevalence of lifetime alcohol abuse and dependence compared to normal weight men, but no significant association for

women (Barry & Petry, 2009). Another study that observed participants from 13 countries found a link between the decreased likelihood of past-year alcohol use disorders with obesity in the United States, but not the other 12 countries (Scott et al., 2008). These differences between lifetime and past-year alcohol use disorders suggest the possibility that vulnerability to weight gain is increased by recovery from an alcohol use disorder. In line with this idea, John et al. (John et al., 2005) found that former male heavy alcohol drinkers have increased risk for overweight but not for current drinkers. The differing findings between gender may also indicate the different habit of drinking among men and women, with men adding alcohol calories to their diets while women are replacing alcohol calories for other energy sources (Colditz et al., 1991).

The link between illicit drug use disorders and BMI are more difficult to be determined as epidemiological studies with a significant quantity of individuals having drug use disorders are rare. Simon et al. (Simon et al., 2006) found that obesity has a relationship with a lower probability of a lifetime substance use disorder diagnosis, a category that involved both illicit drug use and alcohol. One study utilizing NESARC data concluded that obesity is associated with a lower likelihood of past-year drug dependence diagnosis but not a past-year diagnosis of drug abuse (Pickering et al., 2007). Studies investigating the association between obesity and nicotine dependence also showed ambiguous results. Among male gender, an association was found between overweight or obesity and history of daily smoking but not current smoking (John et al., 2006).

On the other hand, other studies found that higher body weight has a lower likelihood of both lifetime and past-year nicotine dependence among men (Barry & Petry, 2009; Pickering et al., 2007). At the same time, another study noted that current smokers have similar obesity risk with non-smokers, but the risk of obesity will increase with increment of cigarettes per day among smokers (Chiolero at al., 2007). Among young

adults, those with obesity were found to have higher rates of smoking and smoked a higher number of cigarettes per day compared to their overweight and normal weight peers (Zimlichman, 2005).

For bariatric surgery candidates, around one-third of them reported a lifetime history of any substance use disorders (Kalarchian et al., 2007), more than twice as much the rate in general population (Kessler et al., 2003). There is a striking difference between the current and lifetime prevalence of substance use disorders among bariatric surgery patients in which only 1.7% reported a current substance use disorder. Even though there was no exploration on the chronology of obesity development relative to substance use disorder, this prominent difference in lifetime compared with past-year prevalence suggest the probability of overeating as a replacement for substance use for some individuals (Kalarchian et al., 2007). Moreover, women undergoing weight loss treatment demonstrated lower rates of past-year alcohol and cannabis use with increasing body weight which further support this idea (Kleiner et al., 2004; Warren et al., 2005). Among patients enrolling in residential alcohol treatment, more than half of them were found to be overweight or obese (Jarvis et al., 2007). A post-mortem study in Sweden showed that around 45% of deceased individuals that have illicit drug disorders were overweight or obese (Rajs et al., 2004).

In general, the variation in results for different substances makes it tough to draw any definite conclusions about the relationship between obesity and addictions. However, it is essential to take into consideration that the associations are complicated by the different potential physiological effects of different substances on body weight. For example, unlike illicit drugs and nicotine, alcohol has calories which may contribute to higher body weight (Colditz et al., 1991). On the other hand, nicotine increases metabolism thus probably contributing to lower body weight (Schechter & Cook, 1976).

2.4.2 Obesity and Food Addiction

The prevalence rates of obesity have been proven to be continuously increasing, despite the advancing progression of study regarding it in its field (Lopez-Legarrea et al., 2015). This suggests that there may be other additional elements that are involved in the pathogenesis of this disease. Furthermore, even if various weight loss programs have been shown to be effective, the effort to maintain the weight loss was noted to be quite a challenge to the people involved (de la Iglesia et al., 2014). Additionally, society's strong motivation to lose weight combined with the great amount of energy and resources spent on the ''obesity epidemic'' suggests that the problem of obesity is not driven by a lack of motivation or effort (de la Iglesia et al., 2014). Addiction to certain types of food, particularly highly-processed or hyper-palatable foods had been suggested to be one of the factors leading to overweight and obesity (Brownell & Gold, 2012). Some individuals eat certain foods in larger amounts than necessary in order to stay healthy. This practice highly suggestive of the lack of control in behaviour concerning food (Ziauddeen et al., 2012).

Research from the addiction and nutrition fields concluded that obesity and substance dependence is associated with a similar neural mechanism with regards to brain neuroadaptive response to rewards circuit or action mechanism (Volkow et al., 2007). Furthermore, some eating disorder that is often linked to obesity such as binge eating disorder is characterised by addictive-like behaviours, which is loss of control over consumption and continued use despite negative consequence (Gearhardt et al., 2009). A study published by Meule et al. (2014) in 2014 noted a significant portion of obese patients who underwent bariatric surgery, which was approximately 40%, fulfilled criteria for food addiction. Furthermore, opiate blockers such as naloxone have been

found to have the ability to reduce the consumption and preference for sweet and high-fat foods in both normal weight and obese binge eaters (Drewnowski et al., 1995).

Furthermore, neuroimaging studies also demonstrated similarities between obesity and addictive-like behaviours. Both addiction and obesity are linked with a low amount of D2 dopamine receptors in the brain (Volkow et al., 2008; Wang et al., 2001). This suggested that they are more vulnerable to food or drug intake and less sensitive to reward stimuli. Individuals with higher body mass index (BMI) had been noted to have a lower number of D2 dopamine receptor (Wang et al., 2001). The decrease in striatal D2 density is associated with a reduction of metabolism in cerebral areas, prefrontal and orbitofrontal cortex that modulate inhibitory control over consumption (Volkow et al., 2008). Consequently, in response to palatable food images versus control images, more activation of reward and attention regions are exhibited by obese individuals compared to those with normal weight (Nummenmaa et al., 2012; Stice et al., 2008). This finding suggested that the impulsive and compulsive behaviours displayed by obese individuals were greatly influenced by the deficit in reward processing. These observations could explain why, despite adverse financial, health and social consequences, the consummatory behaviours in obesity and drug addiction continuously persisted.

The mechanism for food intake regulation can be either due to biological needs (homeostatic) or driven by pleasure or rewarding feeling (hedonic) (Pandit et al., 2011). This idea is further demonstrated when people continue eating although energy requirements have been met. It should be noted that the idea of biological drive versus pleasure is not mutually exclusive, but it will have various interconnections (Lutter & Nestler. 2009). Regulators of the homeostatic mechanism of hunger and satiety, such as ghrelin, leptin and insulin can mediate the homeostatic and hedonic systems of food consumption and influencing the dopaminergic system (Kenny, 2011). Even though it is secreted by adipose tissue, leptin receptors are present on midbrain dopamine neurons

(Elmquist, 1998). The infusion of leptin into tegmental ventral, which is a reward system brain region, reduce food intake and impedes the activity of dopamine neurons (Hommel, 2006). This evidently proposed that mesolimbic dopamine pathways can regulate the effect of leptin on food intake. Thus, the principle of food addiction claims that some highly processed foods can have high addictive potential and probably responsible for some cases of obesity and eating disorders (Gold et al., 2003). Recently, subjects with compulsive overeating have been shown to consume higher amounts of some macronutrients such as fats and proteins compared with subjects without criteria for food addiction (Pedram et al., 2013). It is well established that hyperphagia which is induced by the consumption of foods high in fat and refined sugars is affected by mesolimbic and nigrostriatal dopaminergic inputs. For example, eating highly palatable food, such as sugar, stimulate the release of endogenous opioids in the nucleus accumbens (Ragnauth et al., 2000) and activates the dopaminergic reward mechanism (Rada et al., 2005). Moreover, studies involving rats exposed to intermittent sugar solution demonstrated components of addiction such as the increase of daily sugar intake, signs of withdrawal, craving and cross-sensitisation to alcohol and amphetamine (Avena et al., 2008). These data proposed that certain foods are highly rewarding and have the potential to trigger addictive-like behaviours in laboratory animals as well as humans.

Studies utilising YFAS showed that patients with a high score in the scale have more frequent binge eating episodes (Burmeister et al., 2013). The prevalence of food addiction interestingly has a positive correlation with the measurement of adiposities such as body fat and BMI (Gearhardt et al., 2014). This data supports the idea that food addiction is probably an important factor in the development of obesity in human and it is linked with the severity of obesity, from normal to obese individuals. Moreover, people who are obese and have less weight loss response to treatment (Burmeister et al., 2013) and more weight gain after bariatric surgery obtained higher YFAS scores (Clark &

Saules, 2013). Therefore, it is wise for weight-loss treatments to consider the role of food addiction as an underlying psychological factor that contributes to the difficulty in the treatment. It is also worthwhile to discuss the influence of personality traits as impulsivity for example, is associated with alcohol and drug misuse (de Wit, 2009). In the context of food addiction, newer research has shown that obese individuals with high YFAS scores are more impulsive and demonstrated more emotional reactivity than their counterparts (Davis et al., 2011). These findings suggest that there is a psycho-behavioural profile in food addiction, similar to conventional drug use disorders.

Even though the idea of food addiction is proposed, it is highly unlikely that all foods have addictive potential. Food industries have manufactured processed foods by adding sugar, fat or salt which can maximise the reinforcing properties of traditional foods such as fruits and vegetables (Lerma-Cabrera et al., 2016). The high hedonic value which indicated by the high palatability of this processed food, stimulate individuals to eat more. Therefore, certain processed food probably has high addictive potential and responsible for certain eating disorders such as obesity (Gold et al., 2003). Even though not much evidence can be found in humans, researches done on animals suggest that processed food is linked with addictive-like eating. Avena et al. (2012) found that excessive sugar intake leads to neurochemical signs of dependence which is increased release of dopamine and acetylcholine in addition to behavioural signs of dependence which is increased intake of sugar after a period of abstinence and cross-sensitivity to drugs of abuse. At the same time, the overconsumption of palatable food has been shown to trigger down-regulation of striatal D2 receptors similar to the action of drugs (Johnson & Kenny, 2010). This highly suggests that obesity and addiction may share the same underlying mechanism driven by pleasure.

Nonetheless, not everyone who is exposed to highly palatable food will develop obesity. Knowledge with regards to the biological and behavioural motives or reasons

that lead people to eat highly palatable foods may explain the vulnerability or resilience in the context of obesity. This, in turn, can help in designing personalised treatment to combat obesity.

CHAPTER 3

OBJECTIVES

3.1 Rationale of Study

The mYFAS 2.0 is a reliable and valid instrument that is currently most frequently used to measure food addiction. It has been translated into different languages and maintained its good reliability and validity values. However, at present, it has not been translated into the Malay language and has not been validated in Malaysia. Therefore, this study aims to evaluate the validity and reliability of the mYFAS 2.0 Malay version. Specifically, this study aims to examine the psychometric properties of mYFAS 2.0 Malay version. It is hoped that with the adaptation of a reliable and valid Malay version instrument, it will be a valuable tool for early detection and intervention of food addiction in the Malaysian population. As food addiction and obesity are closely related, at the same time, this research also hopes to intervene on the alarming issue of obesity in the Malaysian population.

3.2 General Objective

To investigate psychometric properties of Modified Yale Food Addiction Scale 2.0 Malay version questionnaire by evaluating its reliability and validity in the Malaysian population.

3.3 Specific Objective

1. To translate the Modified Yale Food Addiction Scale 2.0 into Malay version questionnaire.
2. To determine face validity of the Modified Yale Food Addiction Scale 2.0 Malay version questionnaire.
3. To determine internal consistency and test-retest reliability of the Modified Yale Food Addiction Scale 2.0 Malay version questionnaire
4. To determine the convergent validity of the Modified Yale Food Addiction scale 2.0 with Malay Binge Eating Scale.
5. To assess construct validity of the Modified Yale Food Addiction Scale 2.0 Malay version questionnaire

3.4 Research Hypothesis

1. mYFAS 2.0 Malay version has good internal consistency and test-retest reliability.
2. mYFAS 2.0 Malay version has strong convergent validity with Binge Eating Scale.
3. mYFAS 2.0 Malay version has one-factor structure.

CHAPTER 4

METHODOLOGY

4.1 Research Design

This is a hospital-based, cross-sectional study.

4.2 Study Period

Data for this research study was collected within four months from early August 2018 until end of November 2018. The sample was accessed from the study site on random days from Monday to Friday based on the convenience of the investigator.

4.3 Study Location

This study was conducted in the University Malaya Medical Centre (UMMC). UMMC, or also called as Pusat Perubatan Universiti Malaya (PPUM) in the Malay language, is located in Kuala Lumpur which is the federal capital of Malaysia. In 2018, Kuala Lumpur had a total population of 1.8 million people and it is the most populous city in Malaysia (Department of Statistics Malaysia, 2019). UMMC functions as a tertiary center for the referral and treatment of multiple disciplines.

Specifically, this study was conducted at the Department of Psychological Medicine for stage 1 to 3 and Sports Medicine Outpatient Clinic for stage 4. The Department of Psychological Medicine has a good number of psychiatry consultants and specialists in various subspecialties that have the expertise to provide counseling and treatment for a variety of psychiatry illness. Specifically, there are 3 Addiction Psychiatry Specialists who are well-trained for a wide variety of addiction disorders. This department has 2 inpatient wards and 1 outpatient clinic that are equipped with medical staffs who have deep knowledge regarding psychiatry illness and its management. There are also medical students from nearby University Malaya who attach themselves for a certain period of time as part of their undergraduate clinical practice. This information indicates the suitability of the Department of Psychological Medicine UMMC to be the study site for stage 1 to 3 of this research.

The Department of Sports Medicine UMMC provides clinical approaches for two main areas of expertise which are sports medicine as well as fitness and exercise medicine. It has a specific clinic which provides exercise prescriptions for various medical morbidity such as obesity which runs every day from Monday to Friday. Therefore, a good number of overweight and obese patients are readily available every day and it is a suitable place for stage 4 of this research.

4.4 Participants and Procedures

This study was conducted in 4 stages.

Stage 1: Translation of The English Version of Modified Yale Food Addiction Scale 2.0 Into Malay Version

Permission to use and translate the questionnaire was obtained from the original author, Ashley Gearhardt. The translation process was carried out according to Brislin et al. (1973) back-translation method and guided by the conceptual framework by Beaton et al. (2005). The process involved a panel of experts comprised of 2 final year master trainees in psychiatry with experience of at least 4 years in psychiatry for forward translation and two Addiction Psychiatrist with an experience more than 5 years in psychiatry for back translation. The experts were chosen from people who has a good command of both Malay and English languages. Documents such as consent form and information sheet about the scope and purpose of the translation were provided to the translator. Translators were also informed regarding the target population of the study and the medium of the instrument that would be administered.

The researchers reviewed the two forward and two backward translated version of the questionnaire in a meeting. The sentences of the translated version and the backward translation were reviewed and compared with the original English questionnaire. Modifications were made based on the feedback and consensus among the researchers. At the end of this process, a draft version of mYFAS 2.0 Malay version was produced.

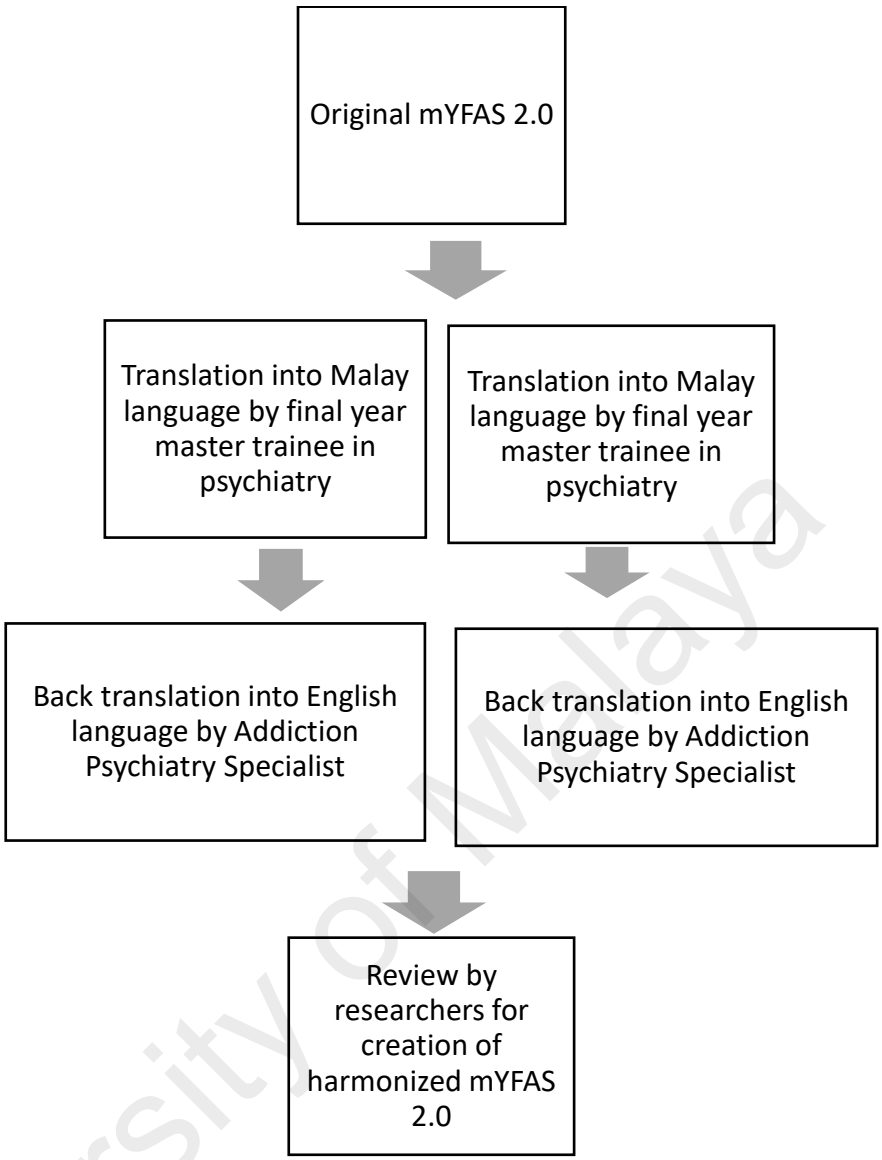

Figure 4.1: Flowchart for Translation Process (Stage 1)

Stage 2: Pilot Test to Determine Face Validity

Face validity indicates the questionnaire appears to be appropriately measuring the construct of interest. It is the easiest validation process to undertake. It is a subjective assessment, therefore it is the weakest form of validity (Trochim, 2001). It evaluates the appearance of the questionnaire in terms of feasibility, readability, consistency of style and formatting, and the clarity of the language used.

The draft version was pilot tested among 30 medical staffs from the psychiatric ward at UMMC who has a good command of Malay language.

The pilot testing was carried out to identify the problem in the translated questionnaire. The subjects were informed about the objectives of the study. The researchers asked the participants regarding the clarity of the questions, understanding of the words and easiness to answer. The comments were addressed and adjustments were made. After that, the modified version was further reviewed by the researchers and a final version of mYFAS 2.0 Malay Version was produced. The aim of the pilot study was to evaluate aspects pertaining to the language and understanding of the translated questionnaire, and not on the content or the concept of food addiction. The inclusion criteria was only good command of Malay language. Therefore, real patients were not deemed necessary to be chosen as the sample.

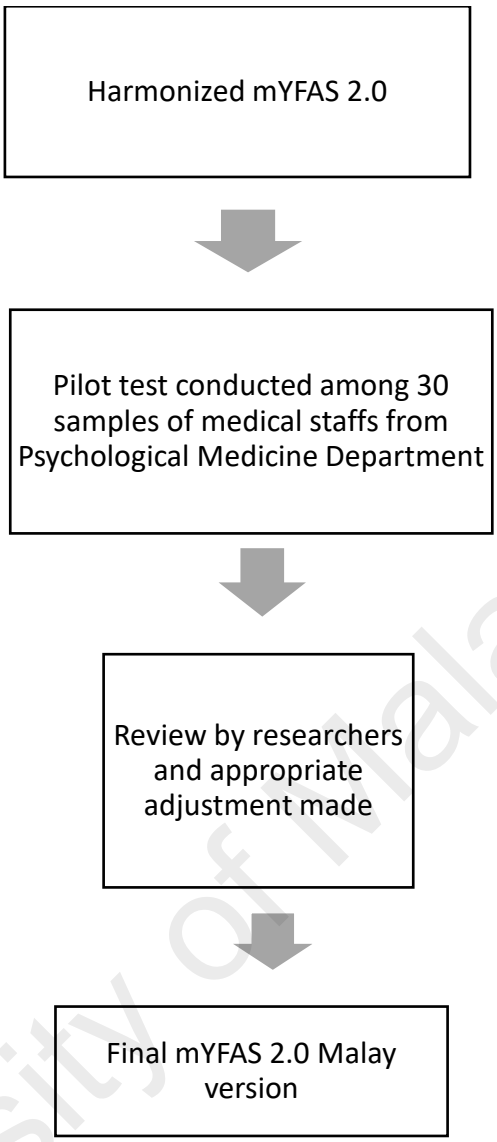

Figure 4.2: Flowchart for Pilot Study (Stage 2)

Stage 3: Determination of Internal Consistency and Test-Retest Reliability

Internal consistency examines the inter-item correlations within an instrument and indicates how well the items fit together conceptually (DeVon et al., 2007).

Yurdugül (2008) analysed a sample size of 30 and found that the Cronbach's alpha coefficients were reliable. Hence, 30 subjects comprised of University of Malaya medical students who were undergoing clinical practice at UMMC was used for determination of

internal consistency. Subjects were included if they were 18 years old and above, have good command in Malay and English language and able to give informed consent.

Test-retest reliability was determined by administering the same tool to the same group of samples on two separate occasions. The stability of the instruments will be indicated by the correlation between the scores on separate occasions (DeVon et al., 2007). Two weeks of interval time for retesting was applied (Waltz et al., 2005). The same 30 subjects who was recruited for reliability analysis which was internal consistency were recruited again after two weeks for determination of test-retest reliability of mYFAS 2.0 Malay version.

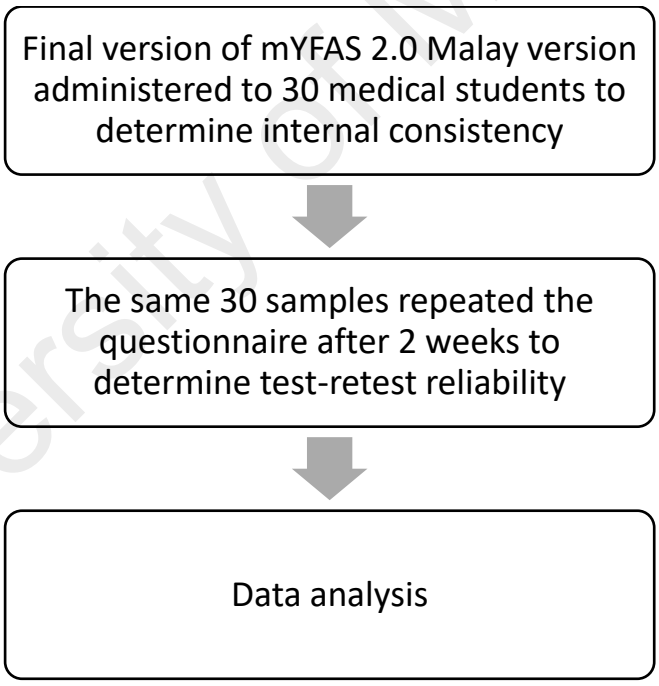

Figure 4.3: Flowchart of Reliability Test (Stage 3)

Stage 4: Determination of Construct Validity

There were various recommendations concerning sample size in factor analysis. However, none are founded on a strict theoretical or empirical basis. One of the recommendations was following the principle of subject-to-variable ratio. Some suggested there should be at least 10 cases for each item in the instrument being used. (Everitt, 1975; Nunnally, 1978).

Therefore, in this study, the subject-to-variable ratio of 1:10 was applied for factor analysis. Modified Yale Food Addiction 2.0 Scale has 13 items. Hence, 130 samples were selected from overweight (pre-obese) and obese patients attending Sports Medicine outpatient clinic in UMMC. Convenient sampling was used to select the participants. Overweight and obese patients were selected because a lot of studies has demonstrated an association between obesity and food addiction (Gearhardt et al., 2009; Volkow et al., 2008; Wang et al., 2001).

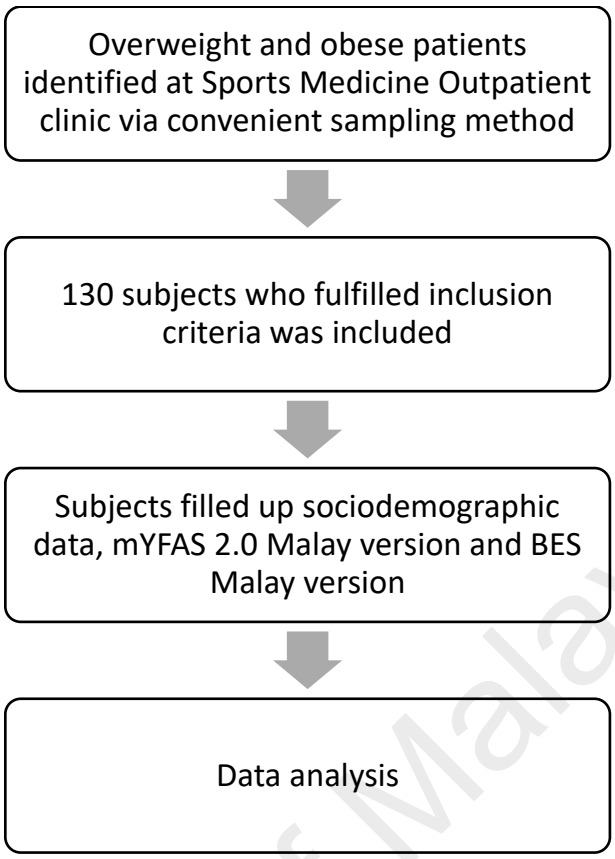

Figure 4.4: Flowchart of Validation Test (Stage 4)

4.5 Inclusion and exclusion criteria

Criteria for selecting the participants were as follows:

1) Subjects aged 18 years old and above
2) Had body mass index (BMI) of 23 or more
3) Had a good command of Malay and English language
4) Able to give informed consent.

Subjects were excluded if they have any form of cognitive impairment such as intellectual disability or dementia.

4.6 Study Instrument

4.6.1 Modified Yale Food Addiction Scale 2.0

It is a 13 Likert-type item questionnaire which took approximately 15 minutes to be administered. The items are based on substance use disorders criteria in DSM-5, while two items indicate the clinical significance of the symptoms. The questionnaire can be rated either as a continuous score or categorically. At the same time, the result also will show whether participants have no food addiction, mild, moderate or severe (Schulte & Gearhardt, 2017).

Each question corresponds to DSM-5 criteria of substance use disorders as followed:

1. Question 1:

   Substance is taken in larger amount and for a longer period than intended

2. Question 2:

   Much time/activity to obtain, use, recover

3. Question 3:

   Important social, occupational, or recreational activities given up or reduced

4. Question 4:

   Characteristic withdrawal symptoms; substance is taken to relieve withdrawal

5. Questions 5 & Question 6:

   Use causes clinically significant impairment or distress

6. Question 7:

   Failure to fulfill major role obligation (e.g., work, school, home)

7. Question 8:

   Use continues despite knowledge of adverse consequences (e.g., emotional problems, physical problems)

8. Question 9:

   Tolerance (marked increase in amount; marked decrease in effect)

9. Question 10:

   Craving, or a strong desire or urge to use

10. Question 11:

    Persistent desire or repeated unsuccessful attempts to quit

11. Question 12:

    Use in physically hazardous situations

12. Question 13:

    Continued use despite social or interpersonal problems

Each question has a different threshold which should be determined whether it met the threshold based on the Likert-score as follows:

1) Once a month (≥2): Question 3, Question 7, Question 12, Question 13

2) Once a week (≥4): Question 1, Question 4, Question 8, Question 10

3) Two to three times a week (≥5): Question 2, Question 5, Question 6, Question 9, Question 11

If the question met the threshold, a score of 1 would be given. If the question did not meet the threshold, a score of 0 would be given.

To rate the score categorically according to symptom criteria, it would be determined based on the threshold score. Respondents are considered to have specific symptom criteria if the threshold was met, in which the threshold score is 1 or above. For example, respondent is concluded as having craving symptom if he had Likert-scale score 4 or above for question 10.

For symptom count scoring option, all the scores for each of the 11 criteria, without scores for Question 5 and 6 which indicate the clinical significance criteria should be added. The score will range from 0 (0 symptoms) to 11 (11 symptoms).

For diagnostic scoring option, both the symptom count and the clinical significance criteria are used. The details are as follows:

No Food Addiction = 1 or fewer symptoms

No Food Addiction = Does not meet criteria for clinical significance

Mild Food Addiction = 2 or 3 symptoms and meet criteria for clinical significance

Moderate Food Addiction = 4 or 5 symptoms and meet criteria for clinical significance

Severe Food Addiction = 6 or more symptoms and meet criteria for clinical significance

4.6.2 Binge Eating Scale

It is a 16-item questionnaire which measures the severity of binge eating using behavioural, affective, and cognitive symptoms. The cut-off score of 18 and above is interpreted as having Binge Eating Disorder (Gormally et al., 1982). It is a reliable tool for assessing binge eating disorder. Higher Binge Eating Scale scores has been shown to be associated with the symptom score of Yale Food Addiction Scale (Brunault et al, 2016). It has been validated into the Malay language in 2013 by Robert et al.

4.6.3 Sociodemographic Questionnaire

Relevant background information including age, gender, ethnicity, marital status, education level, religion, occupation, household income, height, weight and level of physical activities.

4.7 Data Analysis

Statistical Package for the Social Sciences (SPSS) software version 23 was used to measure internal consistency and test-retest reliability. Internal consistency was measured using Cronbach's alpha. Test-retest reliability was analysed using intraclass correlation (ICC). Convergent validity with the Binge Eating Scale was assessed. Construct validity was measured with Confirmatory Factor Analysis using AMOS software.

4.8 Ethical Consideration

This research project was first proposed to the Research Committee, Department of Psychological Medicine, UMMC. It was later reviewed and approved by the Research and Ethics Committee, UMMC with the reference number 2018724-6516 (Refer to Appendix A)

All the participants involved in this study were asked for written consent. The obtained information would be kept strictly confidential unless the health or safety of the participants were at stake.

Hardcopy and softcopy data will be kept by the principal investigator for seven years. It will be destroyed accordingly afterward.

Participants were allowed to decline participation and to withdraw from the study at any point without the need to give the reason. Refusal to participate or withdrawal from the study will not cause any implication on the participants. Participants detected to have food addiction symptoms were given options to be referred for formal psychiatric assessment and further management.

CHAPTER 5

RESULTS

5.1 Result from Stage 1 (Translation process)

Few adjustments had to be made in the translation process to ensure more accurate meaning and structurally correct sentences. Moreover, cultural difference was also taken into consideration to better suit a conservative country that prioritise high moral values like Malaysia. The adjustments are as follows:

1. The sentences had to be rearranged to suit the Malay language sentence structure. For example, in English, adjective preceded noun while in Malay language, it is the other way around. Therefore, words such as “fatty foods” were translated as “makanan berlemak” and “sugary drinks” as “minuman manis”.
2. There were also words in English in which one word had to be translated using few words in the Malay language, to give a more accurate definition. For example, word such as “similar” was translated into “lebih kurang sama” instead of “sama” since “sama” would mean exactly the same.
3. Words that were considered as “strong word” and could give extreme negative undertone were avoided and replaced with milder form. For example, “ill” was translated into “tidak sihat” instead of “sakit”, “emotional problems” translated into “gangguan emosi” instead of “masalah emosi”.

5.2 Results from Stage 2 (Pilot Test)

30 medical staff took part in the Pilot test. Three of them complained that the instruction given for mYFAS 2.0 Malay version was not clear. All of them suggested for additional instruction “dan BULATKAN jawapan yang anda rasa paling tepat berkenaan tabiat pemakanan anda” to be added at the end of the sentence “Apabila soalan-soalan berikut bertanya berkenaan dengan “MAKANAN TERTENTU”, sila fikirkan mana-mana makanan atau minuman yang lebih kurang sama seperti yang diterangkan di kategori makanan di atas”. Therefore, the additional instruction was added into the Malay version questionnaire.

5.3 Results from Stage 3 (Reliability Test)

5.3.1 Sociodemographic Data

The sociodemographic data of participants involved in Stage 3 of this study is summarized in Table 5.1 below. A total of 30 participants were recruited. The gender distribution was roughly equal among male and female participants. The median age of the respondents was 20 years. Median height and weight were 1.6m and 59kg respectively. As for BMI, the median value was 22.9 kg/m^2, which is the upper limit of normal BMI (Ministry of Health Malaysia, 2004). Approximately half of the participants belongs in the pre-obese and obese BMI classification (43.3% in pre-obese, 3.3% in obese I). Majority of the respondents were Malay which attributed to 76.7% of the total samples. This is followed by Chinese (13.3%), Indian (6.7%) and others (3.3%). It should be noted

that the ethnic distribution for the participants follows the overall ethnic distribution in Malaysia (Department of Statistics Malaysia, 2015). Majority of the participants are Muslim (80%). All of them (100%) are single, have tertiary education level and students. This is expected as the samples are comprised of University of Malaya medical students. Most of them came from a higher social class family, as 73.3% of them have household income more than RM5000. More than half participated in some physical activities (60%), followed by routinely exercise (23.3%) and no physical activities (16.7%)

Table 5.1: Sociodemographic Data for Participants in Stage 3 (n=30)

Demographic variables	n (%)	Median (IQR)	Standard Deviation
Gender			
Male	16 (53.3)		
Female	14 (46.7)		
Age (years)		20.0 (3.0)	1.65
Height (meter)		1.6 (0.1)	0.83
Weight (kilogram)		59.0 (15.0)	10.43
BMI (kg/m^2)		22.9 (3.6)	2.64
BMI Classification (kg/m^2)			
Underweight (< 18.5)	2 (6.7)		
Normal (18.5 – 22.9)	14 (46.7)		
Pre-obese (23.0 – 27.4)	13 (43.3)		
Obese I (27.5 – 34.9)	1 (3.3)		
Race			
Malay	23 (76.7)		
Chinese	4 (13.3)		
Indian	2 (6.7)		
Others	1 (3.3)		
Religion			
Islam	24 (80)		
Buddhism	3 (10)		
Hinduism	1 (3.3)		
Christian	2 (6.7)		
Marital status			
Single	30 (100.0)		
Education level			
Tertiary	30 (100.0)		
Employment status			
Student	30 (100.0)		
Household income (in RM)			
< 1000	1 (3.3)		
1000-5000	7 (23.3)		
> 5000	22 (73.3)		
Exercise activities			
None	5 (16.7)		
Sometimes	18 (60.0)		
Routinely	7 (23.3)		

5.3.2 Reliability

Internal consistency measurement for mYFAS 2.0 Malay version is good. The Cronbach's alpha value is 0.920. The corrected item-total correlation (CITC) scores are presented in Table 4.1 The CITC values for all items are more than 0.3 which indicates no item-total correlation issue. However, Q3 has relatively low CITC score (0.455 <0.5) which indicate that this question may be problematic in downstream analysis.

Table 5.2: Modified Yale Food Addiction Scale 2.0 Malay Version reliability analysis (n=30)

Items	Mean (SD)	Corrected item-total correlation (CITC)	Cronbach's alpha if item deleted
Y1	2.37 (1.88)	0.715	0.912
Y2	2.23 (1.98)	0.629	0.917
Y3	0.87 (1.25)	0.455	0.920
Y4	1.47 (1.80)	0.714	0.912
Y5	1.07 (1.39)	0.844	0.907
Y6	0.97 (1.54)	0.808	0.907
Y7	0.43 (0.97)	0.610	0.916
Y8	1.30 (1.71)	0.747	0.910
Y9	0.97 (1.13)	0.716	0.913
Y10	1.20 (1.35)	0.711	0.912
Y11	1.47 (1.57)	0.525	0.919
Y12	0.50 (1.17)	0.708	0.913
Y13	0.43 (0.77)	0.549	0.919

SD = standard deviation.

The test-retest reliability measurement for mYFAS 2.0 Malay version is summarized in Table 4.2. The intraclass correlation (ICC) values ranged from 0.550 to 0.868. The preferred value for ICC is more than 0.75 (Streiner & Normal, 1995). However, Fleiss (1986) agreed that ICC values that are between 0.40 to 0.75 are considered "fair to good". Therefore, the overall test-retest reliability for mYFAS 2.0 Malay version is considered good, where most of the questions yield good reliability with relatively fair values for Question 3, 4, 5, 6, 9 and 13.

Table 5.3: Modified Yale Food Addiction Scale 2.0 Malay version test-retest reliability

Items	Intraclass correlation (ICC)	ICC 95% CI
Y1-YR1	0.800	0.565-0.906
Y2-YR2	0.811	0.555-0.914
Y3-YR3	0.723	0.420-0.868
Y4-YR4	0.687	0.349-0.850
Y5-YR5	0.534	0.034-0.777
Y6-YR6	0.634	0.251-0.823
Y7-YR7	0.862	0.713-0.934
Y8-YR8	0.814	0.612-0.911
Y9-YR9	0.550	0.088-0.782
Y10-YR10	0.813	0.612-0.911
Y11-YR11	0.806	0.595-0.908
Y12-YR12	0.868	0.726-0.937
Y13-YR13	0.606	0.169-0.813

YR = Question retest.

5.4 Results from Stage 4 (Validation Test)

5.4.1 Summary of Participation

During stage 4 of this study, which involved overweight and obese patients at UMMC Sports Medicine outpatient clinic, a total of 158 patients were approached for participation. However, only 144 respondents were included. The discrepancy was due to the following reasons:

- Refuse to participate (n=5)
- Incomplete forms (n=2)
- 7 patients were excluded from this study due to:
    - Unsatisfactory command of Malay language (n=5)
    - Less than 18 years old (n=2)

Therefore, the response rate was 91.1%. Figure 5.1 summarized the respondents' participation in this study.

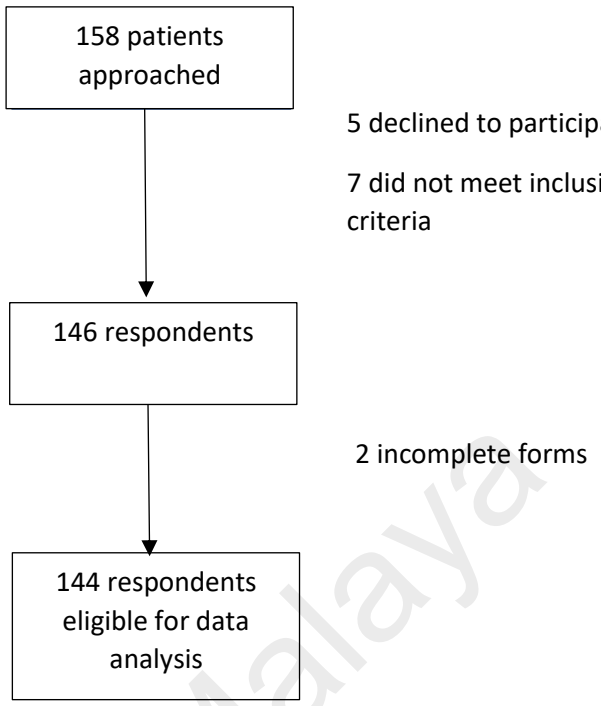

Figure 5.1: Summary of respondents' participation in the study

5.4.2 Sociodemographic Characteristics

The sociodemographic characteristics of the participants involved in Stage 4 of this study is summarized in Table 4.1. The gender distribution was equal between male and female participants. The median age of the participants was 49. The BMI ranged from 23.50 to 69.44 with a median of 30.76. Most of the participants (47.2%) were in Obese I classification. Malay ethnic group comprised the majority of those involved in this study (64.6%). More than half of the participants were married (69.4%) and had a tertiary level of education (66.7%). Approximately half of them worked in government or private sector (50%) and had a household income ranging between RM 1000 to RM 5000 (55.6%). Most of them admitted to engaging in some physical activities per week (58.3%).

Table 5.4: Sociodemographic data for participants in Stage 4 (n=144)

Demographic variables	n (%)	Median (IQR)	Standard Deviation
Gender			
Male	71 (49.3)		
Female	73 (50.7)		
Age (years)		49.00 (25.75)	15.41
Height (meter)		1.63 (0.13)	0.93
Weight (kilogram)		81.00 (25.00)	23.29
BMI (kg/m^2)		30.76 (8.53)	7.36
BMI Classification (kg/m^2)			
Pre-obese (23.0 – 27.4)	37 (25.7)		
Obese I (27.5 - 34.9)	68 (47.2)		
Obese II (35.0 – 39.9)	20 (13.9)		
Obese III (> 40.0)	19 (13.2)		
Race			
Malay	92 (64.6)		
Chinese	20 (13.9)		
Indian	25 (17.4)		
Others	6 (4.1)		
Religion			
Islam	97 (67.4)		
Buddhism	14 (9.7)		
Hinduism	18 (12.5)		
Christian	12 (8.3)		
Others	3 (2.1)		
Marital status			
Single	34 (23.6)		
Married	100 (69.4)		
Widow/widower	6 (4.2)		
Divorced	4 (2.8)		
Education level			
Primary	3 (2.0)		
Secondary	45 (31.3)		
Tertiary	96 (66.7)		
Employment status			
Unemployed	12 (8.3)		
Self-employed	17 (11.8)		
Government/Private sector	72 (50.0)		
Retired	32 (22.2)		
Student	11 (7.7)		
Household income (in RM)			
< 1000	11 (7.6)		
1000-5000	80 (55.6)		
> 5000	53 (36.8)		
Exercise activities			
None	11 (7.6)		
Sometimes	84 (58.3)		
Routinely	49 (34.0)		

The participants were then asked regarding the comorbid medical illness that they had. About one-fifth of them had diabetes mellitus (18.1%) and other illnesses such as ischemic heart disease, gastritis (18.1%). On the other hand, one-quarter of them was found to have hypertension (25%). A small amount of the participants also had dyslipidemia (9.7%) and ligament injury (5.6%).

Table 5.5: Descriptive statistic on clinical variables (n=144)

Clinical variables	n (%)
Diabetes Mellitus	
No	118 (81.9)
Yes	26 (18.1)
Hypertension	
No	108 (75.0)
Yes	36 (25.0)
Dyslipidaemia	
No	130 (90.3)
Yes	14 (9.7)
Ligament injury	
No	136 (94.4)
Yes	8 (5.6)
Other illnesses	
No	118 (81.9)
Yes	26 (18.1)

5.4.3 Convergent Validity

Convergent validity between mYFAS 2.0 Malay Version with BES Malay version was performed and summarized in Table 4.5. The partial correlation coefficient was adjusted for age, BMI, gender, race, marital status, level of education, employment status, household income, exercise activities and all clinical variables (except for ligament and other injuries). There was a strong positive correlation between mYFAS 2.0 Malay version symptom score with BES Malay version score ($r=0.545$, $p<0.01$). On the other

hand, the correlation between mYFAS 2.0 Malay version categorical diagnosis with BES Malay version score was moderately correlated (r=0.325, p<0.01). In addition, there was a weak positive correlation between mYFAS 2.0 Malay version clinical significance score with BES Malay version score (r=0.295, p<0.01).

Table 5.6: Convergent validity between Modified Yales Food Addiction Scale (MYFAS) (Symptoms, clinical and diagnosis) with Malay version Binge eating scale (BES)

	mYFAS (Symptoms)	**mYFAS (Clinical)**	**mYFAS (Diagnosis-categorical)**	**BES**
mYFAS (Symptoms)	1.000	0.461 (0.286-0.621)**	0.630 (0.438-0.781)**	0.545 (0.397-0.665)**
mYFAS (Clinical)	0.461 (0.286-0.621)**	1.000	0.762 (0.666-0.860)**	0.295 (0.127-0.452)**
mYFAS (Diagnosis-categorical)	0.630 (0.438-0.781)**	0.762 (0.666-0.860)**	1.000	0.325 (0.163-0.482)**
BES	0.545 (0.397-0.665)**	0.295 (0.127-0.452)**	0.325 (0.163-0.482)**	1.000

The 95% confident interval corresponding to each partial correlation coefficient was calculated based on 1000 bootstrap re-sampling technique.

** Significant at 0.01 level (two-tailed).

5.4.4 Construct Validity

As the mYFAS 2.0 Malay version was adopted from the original mYFAS 2.0, only CFA was done to analyse the construct validity. Previous studies on mYFAS 2.0 extracted single-factor construct (Meule & Gearhardt, 2014; Torres et al., 2017). Therefore, CFA for mYFAS 2.0 Malay Version was performed using SPSS AMOS Version 23 with 1 construct and 13 items. The path model is shown in Figure 5.1. However, the model fit values were not sufficient (GFI=0.809; AGFI=0.733; CFI=0.816; RMSEA=0.136). The factor loading (FL) value for each item is as shown in Table 5.8 below.

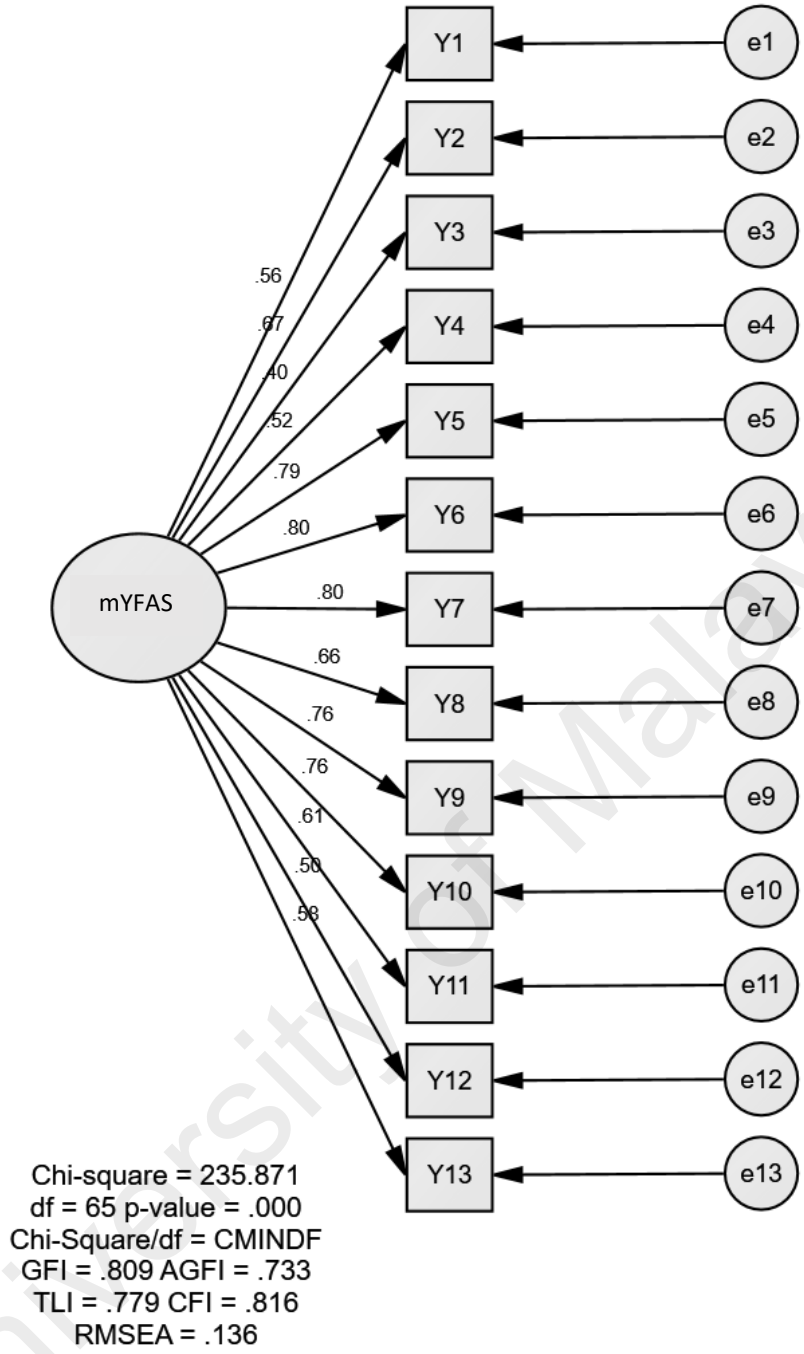

Figure 5.2: Structural Equation Model for mYFAS 2.0 Malay Version (13 Items)

Table 5.7: Factor loading for each item in CFA of mYFAS 2.0 Malay version

Items	Factor Loading
Y1	0.56
Y2	0.67
Y3	0.40
Y4	0.52
Y5	0.79
Y6	0.80
Y7	0.80
Y8	0.66
Y9	0.76
Y10	0.76
Y11	0.61
Y12	0.50
Y13	0.58

CFA was performed again by removing the question with the lowest FL, which was Question 3 (Y3) in which the FL was 0.40. The SEM path model for 1 construct with 12 items (after Question 3 was removed) is shown in Figure 5.2. All the FL were noted to be more than 0.5. However, the model fit values were still insufficient (GFI=0.938; AGFI=0.890; CFI=0.984; RMSEA=0.047).

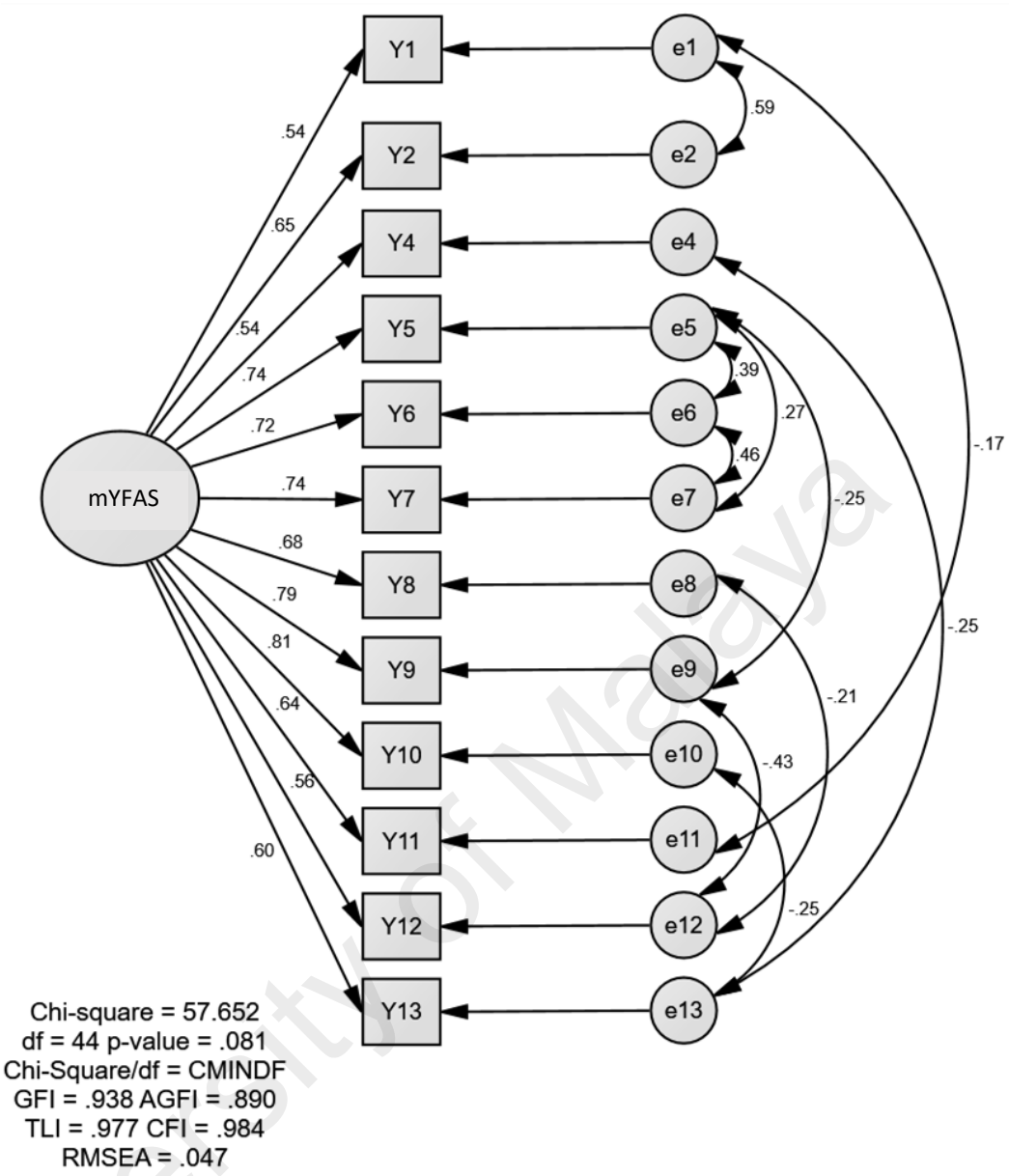

Figure 5.3: Structural Equation Model for mYFAS 2.0 Malay Version (12 Items)

CFA was performed again by removing Question 12 as the FL was the second lowest after Question 3 which was 0.5. The SEM path model for 1 construct with 11 items (after Question 3 and Question 12 were removed) is shown in Figure 5.3. All the FL were noted to be more than 0.5. The model fit values were relatively sufficient (GFI=0.943; AGFI=0.898; CFI=0.984; RMSEA=0.050).

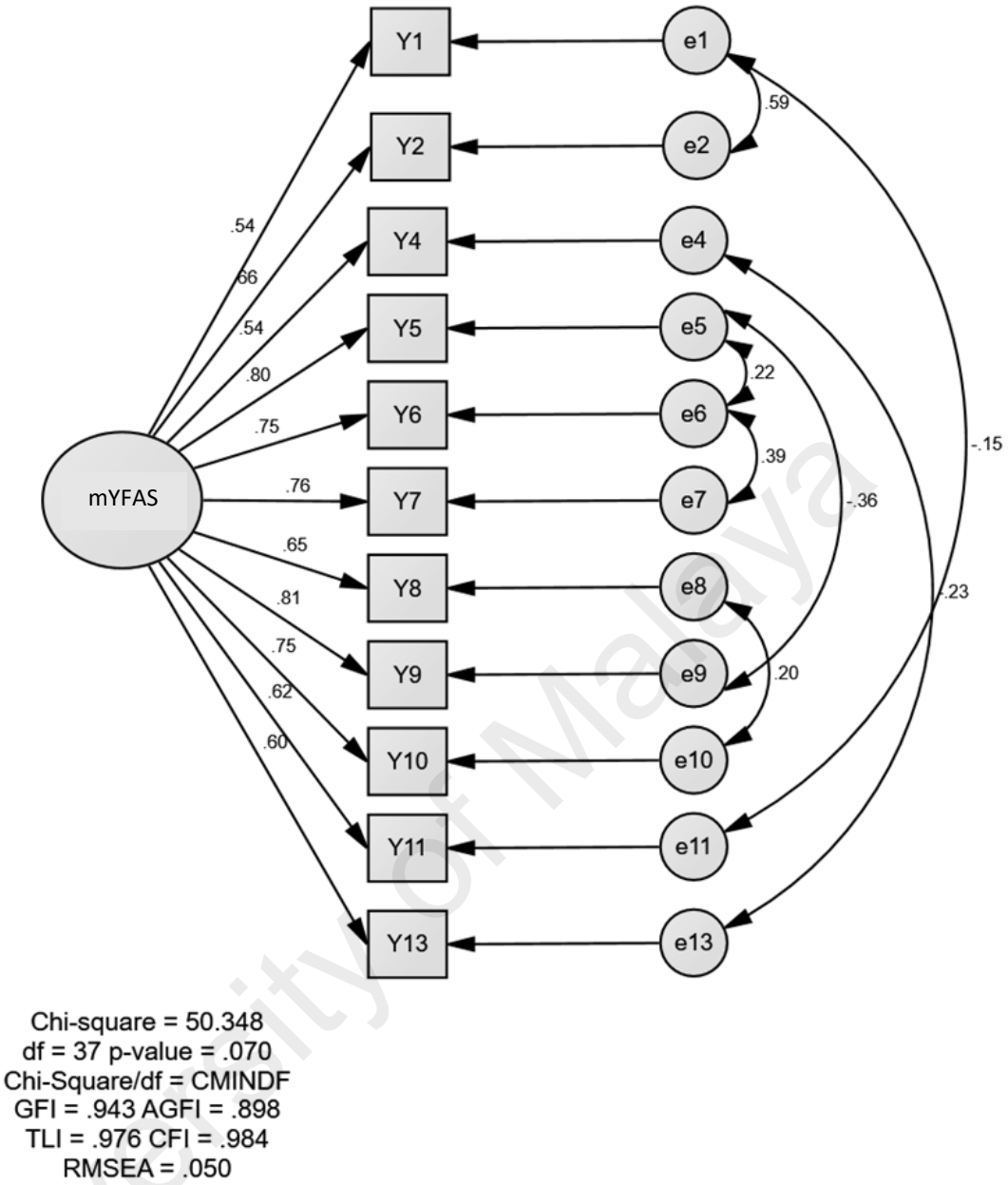

Figure 5.4: Structural Equation Model for mYFAS 2.0 Malay Version (11 Items)

The Composite Reliability (CR) and Average Variance Extracted (AVE) of mYFAS 2.0 Malay version were calculated. The ideal value for CR should be more than 0.7 while AVE should be less than 0.5 (Hu & Bentler, 1999). Therefore, the item with the lowest FL in mYFAS 2.0 Malay version with 11 items was removed one by one until the

ideal values of CR and AVE were achieved. The respective CR and AVE values are shown in Table 5.9 below.

Table 5.8: CR and AVE values with removal of certain items

Item removed	CR	AVE
None (11 items retained)	0.905	0.469
Y1 (FL = 0.54)	0.904	0.487
Y1 & Y4 (FL = 0.54)	0.902	0.507

The final model resulted in 9-items mYFAS 2.0 Malay version after removal of Question 1, 3, 4 and 12.

5.4.5 Sensitivity & Specificity

The Receiving Operating Characteristic (ROC) curve was plotted to determine the sensitivity and specificity of 9-items mYFAS 2.0 Malay version as shown in Figure 5.4. The sensitivity and specificity of the sum of all scores for 9-items were generated and shown in Table 5.10 below. The area under the curve (AUC) was 0.986 (95% Confidence Interval 0.965 – 1.0, $p < 0.001$). This value indicated that the 9-items mYFAS 2.0 Malay version scale has good accuracy in differentiating those with food addiction from those without. At the cut-off score of 27, the sensitivity of the scale was 92.3% while the specificity was 96.9%.

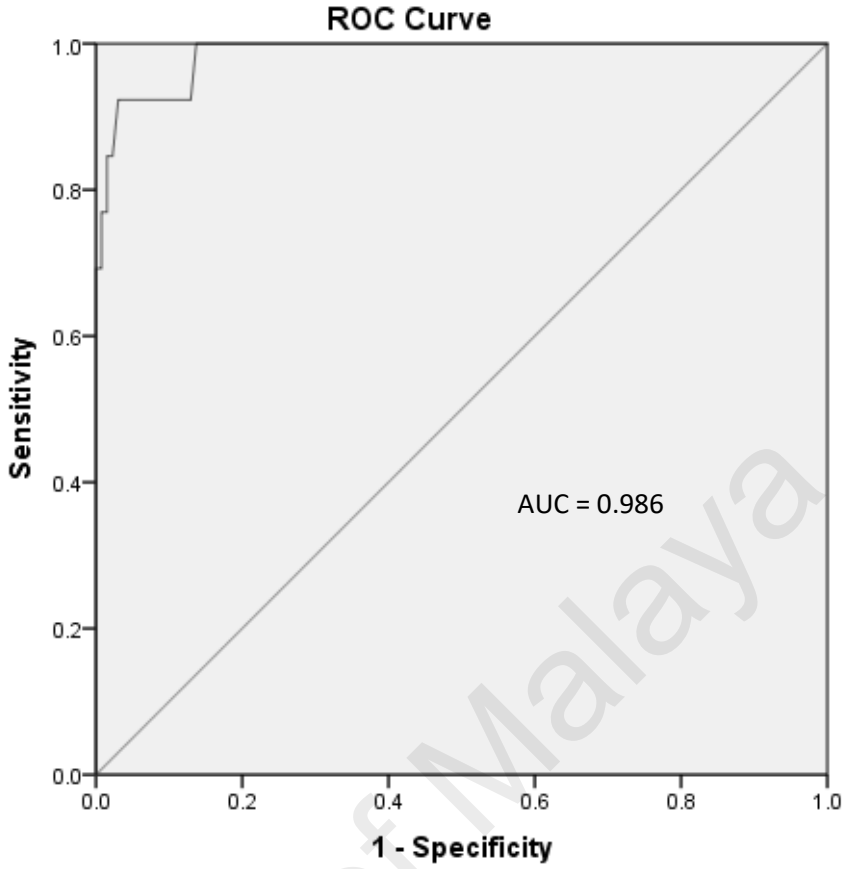

Figure 5.5: ROC plot for sensitivity and 1-specificity of 9-items mYFAS 2.0 Malay version

Table 5.9: Sensitivity and specificity at different cut-offs score

Cut-off Score	Sensitivity	Specificity
17.5	0.923	0.87
18.5	0.923	0.885
19.5	0.923	0.893
20.5	0.923	0.901
22	0.923	0.908
23.5	0.923	0.916
24.5	0.923	0.924
25.5	0.923	0.954
27	**0.923**	**0.969**
28.5	0.846	0.977
30	0.846	0.985
32	0.769	0.985
33.5	0.769	0.982

CHAPTER 6

DISCUSSION

The main objective of this study is to translate and examine the psychometric properties of mYFAS 2.0 Malay Version in Malaysian population by investigating its reliability and validity. Reliability and validity are two important elements in the assessment of a measurement instrument. Medical investigators diligently try to create reliable and valid tests and questionnaires as an effort to improve the accuracy of their evaluation on a patient. Reliability is the degree in which an instrument able to measure consistently and reflect a true change (Tavakol et al., 2008). On the other hand, validity examines the ability of an instrument to measures what it is supposed to measure. The reliability of an instrument is closely related to its validity. An instrument must be reliable for it to be considered valid. However, an instrument's reliability does not depend on its validity (Nunnally & Bernstein, 1994).

From this study, the findings concluded that mYFAS 2.0 Malay version has good internal consistency. The test-retest reliability, on the other hand, is good with some limitation. It is also positively correlated with BES Malay version. However, there are also some limitations in its construct validity.

The internal consistency of mYFAS 2.0 Malay Version was good with Cronbach's alpha value at 0.920. Cronbach's alpha is the most frequently used reliability statistic to establish internal consistency reliability (DeVon et al., 2007). This is in line with the previous studies which investigated the psychometric properties of newly developed English version of mYFAS 2.0 (Schulte & Gearhardt, 2017) and the Brazilian version (Paulo et al, 2018). This indicates that mYFAS 2.0 is an instrument in which all the

different items in it are highly correlated and fit together conceptually in different languages.

On another note, the test-retest reliability revealed overall good reliability with the exception of some questions that yield fair values. Test-retest reliability can be interpreted as a measure to determine the instrument's ability to produce consistent scores over time in a stable population (Aaronson et al., 2002). The test-retest reliability, unfortunately, can be affected by multiple factors. For example, the environment during the assessment carried out such as the administration method, type of instrument, characteristics of sample and raters have been known to be one of the factors (Roach, 2006). In addition, patients' psychological state or mood at the point of evaluation can also contribute to the discrepancies (Furr & Bacharach, 2013). Six questions that were noted to yield fair values were question 3, 4, 5, 6, 9 and 13. The fair values may be due to the length of the sentences. The sentences are noted to be comparatively longer compared to other questions that have good test-retest reliability result. In addition, these six questions use words that are repetitive in one sentence for example "jenis-jenis", "makanan-makanan", "kawan-kawan" and "masalah-masalah". The repetitive use of the same words can make the sentences appear more complex and lengthier. Consequently, lengthy and complex sentences may also affect the respondents' mood during the point of evaluation, thus causing the inconsistencies in the result during the initial test and the retest.

There is a strong positive correlation between mYFAS 2.0 Malay version symptoms scores with the Malay version of BES score. This result is similar to the previous study that compares the correlation between YFAS and BES (Brunault et al., 2016). In addition, Schulte and Gearhardt (2017) examine the correlation between mYFAS 2.0 symptom score and binge eating component in Eating Disorder Diagnostic Scale (EDDS) and found that these two elements have a strong positive correlation. On

the other hand, the mYFAS 2.0 Malay version categorical diagnosis has a moderate positive correlation with BES Malay version while the clinical significance score is weakly correlated with BES Malay version. These results are expected as both food addiction and binge eating has similarities in its addictive-like behaviour concerning food, which manifests as symptoms. However, they are both two different diagnoses and have other different criteria that characterised each disorder separately. At the same time, BES does not have a separate score for its clinical significance element which explains why the correlation is weak.

The construct validity for mYFAS 2.0 Malay version resulted in one-factor construct, similar to the previous studies involving the original English version (Schulte & Gerhardt, 2017) and the translated Brazilian version (Paulo et al., 2018). However, to achieve the ideal model fit indices, 2 questions had to be removed (Question 3 and Question 12). The final goodness-of-fit index were relatively sufficient (GFI=0.943; AGFI=0.898; CFI=0.984; RMSEA=0.050). All the other fit indices met the requirement for SEM analysis with the exception of AGFI which was just slightly below the threshold level. Preferably, the AGFI value should be more than 0.9 (Hooper et al., 2008). However, value above 0.8 is still considered as acceptable (Baumgartner & Homburg, 1995; Doll et al., 1994). For the model with 11 items, the CR was noted to be good which was 0.905. CR is another way to measure internal consistency, apart from Cronbach's alpha. The values range from 0 to 1. The CR value has to be higher than 0.70 to be considered good (Hair et al., 2014). However, the AVE value was noted to be below the threshold, which was 0.469. AVE value is used to assess the convergent validity of a construct, in which to measure the correlation level of different indicators in the same construct that are in agreement. AVE value ranges from 0 to 1. AVE value should be more than 0.50 to indicate sufficient convergent validity (Fornell & Larcker, 1981; Hair et al., 2014). Therefore, items with the lowest factor loading were deleted one by one until

both CR and AVE achieved ideal values. As a result, Question 1 and Question 4 had to be removed. With 9 items, the CR value was 0.902 while AVE value was 0.507. The final mYFAS 2.0 Malay version model that achieved good fit indices with sufficient CR and AVE values were one construct with 9 items (Question 1, 3, 4 and 12 were removed).

Question 1, 3, 4 and 12 were noted to have some issues which contributed to them being removed in the final model. Question 3 and 4 were noted to have relatively lower test-retest reliability value as well. Apart from that, on further inspection, these 4 questions had issues in the selection of words, the structure of the sentence and the overall content of the question which might not be suitable in this region due to the cultural difference. For example, the sentence "I ate to the point where I felt physically ill" for Question 1 had a rather vague meaning. During the data collection, a lot of respondents asked for further clarification for the exact meaning of Question 1, specifically the definition of "physically ill". Also, the sentence "I avoided work, school or social activities because I was afraid I would overeat there" for Question 3 could make an individual feels as if he was irresponsible and ill-mannered to be avoiding his obligation because of an eating problem. Question 4 used "gangguan emosi" which means emotional disturbance and could be considered as quite "strong words". Emotional disturbance is commonly associated with mental illness, which is still a stigma in a conservative country like Malaysia. Furthermore, Question 12 had a rather extreme negative connotation which might influence the respondents' answer. The sentence "I was so distracted by eating that I could have been hurt (e.g. when driving a car, crossing the street, operating machinery)" could make the respondent feel that it was not right for him to be losing focus due to eating problem, until to the point that it could bring injury. It might also be deemed as immoral from religion point of view, as it is considered sinful to indulge yourself in activities that could be hurtful. Respondents in a conservative country like Malaysia that prioritize high moral values may feel less inclined to answer these questions truthfully.

The difference in the language used is also possible to affect the semantic meaning of the questions and thus influencing the accurate meaning of the original version.

Apart from YFAS 2.0 or mYFAS 2.0, there was no other available scale that can be used to assess food addiction so far. Therefore, there is no other instrument that can be made as a gold standard to calculate sensitivity and specificity of mYFAS 2.0 Malay version. Therefore, ROC was used to calculate its sensitivity and specificity. At the cut-off score of 27, the sensitivity of the scale was 92.3% while the specificity was 96.9%. These values indicate that 9-items mYFAS 2.0 Malay version has good sensitivity and specificity. Sensitivity and specificity are statistical values that are commonly used to assess a clinical test. Sensitivity is the ability of the test to accurately detect patients that have the disease. On the other hand, specificity is defined as the ability of the test to accurately detect patients that do not have the disease (Lalkhen & McCluskey, 2008). Sensitivity and specificity are inversely proportional to one another. In the medical field, as it is non-invasive and relatively easy to administer, a questionnaire generally acts as a screening test to detect individuals that may have a certain disease before more thorough or invasive procedures are carried out. Therefore, a clinical questionnaire ideally should have high sensitivity. The acceptable minimum value for the sensitivity of a screening test is 70% (Glascoe, 2005; VanDerHeyden, 2011). At the same time, the specificity level ideally should not be low to minimize unnecessary referrals. Thus, Glascoe (2005) stated that the acceptable minimum value for specificity is 80%. Hence, the 9-items mYFAS 2.0 Malay version is a good screening instrument for food addiction. It is worthwhile to note that to date, there were no sensitivity nor specificity values had been examined for mYFAS 2.0, probably because the instrument was still relatively new. Nevertheless, using YFAS as the gold standard measure, the sensitivity for mYFAS was noted to be excellent which was 92.3% (Lameshow et al., 2016). There was no specificity value as Lameshow et al. (2016) derived the mYFAS result from the YFAS result and did not

administer the 2 instruments independently, which means no false positive result. The result was still noteworthy as it was the first and so far, only study to evaluate the sensitivity of the mYFAS.

The final model resulted in 9-items 1 factor structure of mYFAS 2.0 Malay version. As each item corresponds to each symptom of food addiction, the removal of any item will cause an inability to diagnose food addiction using this instrument. However, it may still be used as a screening instrument, by taking the cut-off score of 27 for the sum of all score of the 9 instruments. Further assessment should be done for any patient who scored 27 and above on this instrument to determine the presence of food addiction.

6.1 Limitations

There were several limitations in this study such as:

- Accurate meaning lost in translation. As portrayed in the result, the construct validity yields a different result with the original questionnaire where 4 questions have to be removed. One of the weaknesses of a translated questionnaire is the possibility of the actual meaning of words or sentences being lost during the translation process.
- The difference in culture attributed by geographical or religious variations between different samples can also contribute to the different results. For example, participants from a more conservative culture may practice some restraint and not be completely truthful when answering questions involving sensitive and controversial topic.
- A self-report measure is subjected to the understanding of the respondents answering the question. There is a possibility that some respondents may do not

fully understand the questions and do not have any means to clarify the exact meaning. This can also be called as a response bias.

- Generalizability of the findings in this study is under certain limitations as the study was conducted in a tertiary hospital center where the majority of the patients have high socio-economic status and finished tertiary education level. As a result, these results may not be applicable for individuals in a rural area where low socioeconomic status is predominant and most of them possibly do not study until tertiary level.
- The sample size for this study is relatively smaller (144 participants) compared to the studies conducted by Schulte & Gearhardt (2017) which recruited 225 participants and studies by Paulo et al., (2018) which included a large sample of 7639 respondents. Another previous study that investigated the minimum sample size requirement for different instrument found out that even though the "rule of thumb" suggests that ratio of 10 samples for every question is adequate, the larger sample size able to increase the power of the study and able to reduce the possibility of type 1 error and the incidence of "false positive" (Martin & Hollins Martin, 2017).
- The convenient or non-random sampling method used in this study may lead to sampling bias. The likelihood is higher when the study is conducted in a single setting based in a hospital. Thus, the sample chosen in this study might not represent the general population of overweight and obese individuals. Nevertheless, convenience sampling was chosen as the investigator faced difficulties with regards to costs, workforce and time spent that is required for random samples.
- The failure of mYFAS 2.0 Malay version to replicate the original instrument might indicate the presence of latent variables that could act as mediators or

confounders that were not identified in the study such as undiagnosed mental illness or eating habits.

6.2 Strength

The strengths of this study are listed below:

- This is the first study that attempted to translate mYFAS 2.0 into Malay language and to examine its psychometric properties.
- This study has determined the reliability and validity of the only instrument that measures food addiction in the Malaysian population.
- This study could assist in recognizing patient with food addiction in Malaysia. Thus, early intervention could be done.

CHAPTER 7

CONCLUSION

7.1 Recommendations and Clinical Implication

Few recommendations to improve the findings of this study are listed as follows:

- The response bias can be reduced by improving the anonymity of the respondents. Instead of giving the completed questionnaires personally to the researcher, it is recommended to provide a collection box for them.
- To recruit larger sample size, to ensure more power in the result.
- To employ language expert in translation process to ensure more accurate translation.
- To administer formal qualitative assessment to identify or omit variables that could be confounders or mediators for food addiction.

Few recommendations for future studies regarding the food addiction scale:

- Efforts should be made to develop structured clinical interview to diagnose food addiction. This could be a benchmark to assess sensitivity and specificity of mYFAS 2.0 scale.
- Future studies may attempt to translate and validate the full YFAS 2.0 scale into Malay language, instead of the mYFAS 2.0 since mYFAS 2.0 had been shown to have limitation due to the cultural differences. There are also more questions for each symptom in YFAS 2.0, thus, if the modified Malay version must remove

certain questions, there is higher likelihood that questions for all symptoms can still be retained.

Since the concept of food addiction was first proposed and the development of YFAS in 2009 followed by YFAS 2.0 and subsequently mYFAS 2.0, many researchers have translated YFAS into different language, but only 1 for mYFAS 2.0. As this is the first study that examined the psychometric properties of mYFAS 2.0 Malay version and the second study that attempted to translate the original mYFAS 2.0, it has several implications in future research on food addiction. What can be concluded from findings in this study and previous studies, is that the concept of food addiction has structural difficulties in measurement. Cultural difference and and the translation process may contribute to this problem.

7.2 Summary

This study was designed to examine the psychometric properties of mYFAS 2.0 Malay version. The finding from this study concluded that mYFAS 2.0 Malay version to be a reliable instrument. However, there was limitation in its construct validity which might be caused by the culture and language differences. This study demonstrated the structural difficulties in measuring food addiction and suggested that alternative model might be more suitable to measure food addiction in Malaysia. Hence, we proposed a modified version of 9-items mYFAS 2.0 based on the findings of construct validity. The results from this study had shown that 9-items mYFAS 2.0 Malay version is a reliable and valid screening instrument with good sensitivity and specificity for food addiction. However, the 9-items mYFAS 2.0 instrument could not be used for diagnostic purpose as

it could not diagnose food addiction. Future studies may focus on translating and validating the full YFAS 2.0 into Malay language or to develop structured clinical interview to diagnose food addiction to ensure more accurate diagnosis of food addiction.

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