INTERNET ENGAGEMENT AND ITS ASSOCIATION WITH WEIGHT PARAMETERS AMONG MALAYSIAN ADOLESCENTS

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FACULTY OF MEDICINE
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INTERNET ENGAGEMENT AND ITS ASSOCIATION WITH WEIGHT PARAMETERS AMONG MALAYSIAN ADOLESCENTS

ABSTRACT

This study determines the prevalence of regular Internet engagement among Malaysian adolescents to study the socio-demographic variation in Internet engagement. It identifies the association of Internet engagement/time spent on the Internet with weight parameters (body mass index, body fat percentage and waist circumference) and academic performance (aggregate, Malay language, English language, mathematics subject, and science subjects) among adolescents in Malaysia. This is a cross-sectional study which used primary (academic performance) and secondary data from the second wave of the Malaysian Health and Adolescents Longitudinal Research Team (MyHeART) Study Cohort. Collected MyHeART data included the measurement of height, weight, body fat composition, waist circumference, and self-administered questionnaires. The participants comprised 720 students attending year three public secondary schools from the Kuala Lumpur, Selangor and Perak, Malaysia. Sampling was done using a two-stage cluster sampling design. The prevalence of adolescents who engage on the Internet regularly was 85.3% (n=614). Chinese (OR: 9.873, CI: 2.188-44.552) and Malays (OR: 2.379, CI: 1.332-4.251) significantly engaged regularly on the Internet compared to Indians. Adolescents who schooled in urban areas significantly engaged regularly on the Internet compared to adolescents schooled in rural areas (OR: 2.663, CI: 1.719 – 4.125). There was no significant association between Internet engagement or time spent on the Internet with weight-related parameters. Non-parametric test results recorded that the mean ranks of overall academic performance (aggregate) was significantly (p-value 0.017) higher (which indicate poor academic performance) in adolescents who rarely engaged on the

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Internet (413.50), compared to the adolescents who spent on average ≥3hours per day (350.70) and average <3hours per day on the Internet (352.11). A positive significant association between Internet engagement and academic performance was found for English (OR=2.184, CI=1.112-4.289), mathematic (OR=2.093, CI=1.012-4.329) and aggregate; overall academic performance (OR=2.319, CI=1.118-4.810). Although generally the trend of less likelihood on getting excellent and average on academic performance was observed among participants who spent an average of ≥3 hours per day on the Internet compared to participants who spent <3 hours daily on the Internet, however, it is non-significant. The significant findings of the association between time spent on the Internet with mathematics and aggregate were perhaps the effect of a bigger sample size during the estimation in the population. Furthermore, the confidence interval that was close to one indicated that the result might be statistically significant but not clinically significant in view of the minimal differences within each group. Internet engagement and time spent on the Internet do not associate with weight-related parameters. However, engagement on the Internet was found to be beneficial for academic performance. Nevertheless, close monitoring, supervision, and guidance on Internet engagement among adolescents were relevant.

Keywords: Internet time, body composition, obesity, academic performance, adolescents

Words count: 456 words

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PENGLIBATAN DI INTERNET DAN PERKAITANNYA DENGAN PARAMETER BERAT BADAN DI KALANGAN REMAJA DI MALAYSIA

ABSTRAK

Objektif kajian ini adalah untuk menentukan kekerapan penglibatan Internet di kalangan remaja di Malaysia, dan untuk mengkaji kepelbagaian sosio-demografi dan hubungannya terhadap penglibatan Internet di kalangan mereka. Kajian ini bertujuan untuk mengenal pasti hubungan penglibatan / masa yang diperuntukkan untuk penggunaan Internet dengan parameter berat badan (indeks jisim tubuh badan, komposisi lemak badan dan lilitan pinggang) dan pencapaian akademik (agregat, mata pelajaran Bahasa Melayu, Bahasa Inggeris, Matematik dan Sains) di kalangan remaja di Malaysia. Ini adalah kajian keratan rentas yang menggunakan data primer (pencapaian akademik) dan data sekunder dari gelombang kedua Kajian Unjuran MyHeART. Data kajian MyHeART yang dikumpul termasuklah ukuran ketinggian, berat badan, komposisi lemak badan, lilitan pinggang, dan soal selidik yang diisi sendiri. Responden terdiri daripada 720 orang pelajar tingkatan tiga sekolah menengah kerajaan di sekitar kawasan Kuala Lumpur, Selangor dan Perak, Malaysia. Persampelan dilakukan secara dua peringkat melalui reka bentuk pensampelan kluster. Kekerapan penglibatan Internet di kalangan remaja adalah 85.3% (n = 614). Penglibatan remaja Cina (OR: 9.873, CI: 2.188-44.552) dan Melayu (OR: 2.379, CI: 1.332-4.251) terhadap kekerapan penggunaan Internet lebih signifikan berbanding dengan remaja India. Kekerapan penglibatan Internet remaja yang bersekolah di kawasan bandar lebih kerap berbanding dengan remaja yang bersekolah di kawasan luar bandar (OR: 2.663, CI: 1.719 - 4.125). Tidak ada hubungan secara signifikan ditemui antara penglibatan / masa yang diperuntukkan untuk penggunaan Internet dengan parameter berat badan. Hasil ujian bukan parametrik mencatatkan bahawa tahap keseluruhan pencapaian akademik (agregat) adalah signifikan (nilai p

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0.017). Agregat yang lebih tinggi (yang menunjukkan prestasi akademik yang kurang baik) ditemui pada remaja yang jarang menggunakan Internet / memperuntukkan purata 0 jam pada penggunaan Internet sehari (413.50), berbanding dengan remaja yang memperuntukkan secara purata ≥ 3 jam sehari (350.70) dan secara purata < 3 jam sehari pada penggunaan Internet (352.11). Hubungan positif antara penglibatan Internet dan prestasi akademik adalah untuk Bahasa Inggeris (OR=2.184, CI=1.112-4.289), Matematik (OR=2.093, CI=1.012-4.329) dan agregat/ prestasi akademik keseluruhan adalah (OR=2.319, CI=1.118-4.810). Walaupun secara amnya tren pelajar yang memperuntukan purata ≥ 3 jam kepada Internet adalah lebih rendah kemungkinan untuk mendapat prestasi akademik yang cemerlang dan sederhana berbanding pelajar yang memperuntukan purata < 3 jam kepada Internet, namun ianya tidak signifikan. Hasil signifikan yang diperolehi dalam perkaitan tentangmasa yang diperuntukkan untuk penggunaan Internet dengan matematik dan agregat mungkin disebabkan oleh efek terhadap penambahan kebesaran sampel semasa anggaran dalam populasi dilakukan. Tambahan pula selang keyakinan yang menghampiri kepada satu menandakan bahawa walaupun keputusan yang diperolehi adalah signifikan secara statistic tetapi mungkin tidak signifikan dari segi klinikal, memandangkan hanya terdapat perbezaan kecil dalam setiap kumpulan. Penglibatan Internet dan masa yang dihabiskan di Internet tidak dapat dikaitkan dengan parameter berat badan. Bagaimanapun, penglibatan Internet didapati memberi manfaat kepada remaja dari sudut pencapaian akademik. Walaubagaimanapun, pemantauan, pengawasan dan bimbingan terhadap penglibatan Internet di kalangan remaja masih relevan.

Kata kunci: masa di Internet, komposisi badan, obesiti, pencapaian akademik, remaja.

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LIST OF SYMBOLS AND ABBREVIATIONS

ARPAnet	-Advance Research Projects Agency network
BMI	-Body mass index
cm	-centimeter
GPA	-Grade Point Average
HELENA	-Healthy Lifestyle in Europe by Nutrition in Adolescents
IP	-Internet Protocol
IPH	-Institute for Public Health
kg	-kilogram
m^2	-square meters
mm	-milimetre
MOE	-Ministry of Education
MyHeART	-Malaysian Health and Adolescents Longitudinal Research Team
NCP	-Network Control Protocol
NHMS	-National Health Morbidity Survey
PAQ-C	-Physical Activity Questionnaire for Older Children
PE	-Physical Education
PEMANDU	-Malaysia's Performance Management & Delivery Unit
PI	-Primary investigator

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PISA	-Programme for International Student Assessment
PMR	-*Penilaian Menengah Rendah*
PT3	-*Pentaksiran Tingkatan* 3
SMK	-*Sekolah Menengah Kebangsaan* / Public Secondary Schools
SNS	-Social Networking Site
SPSS	-Statistical Package for Social Science
TCP	-Transmission Control Protocol
UK	-United Kingdom
US	-United State
WHO	-World Health & Organization

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CHAPTER 1: INTRODUCTION

The Internet is a global computer network, which consists of interconnected networks using standardized communication protocols. It is a rapidly growing tool for information and communication. Since its establishment in 1974, multiple evolutionary steps have turned the Internet to what it is nowadays. Today, the Internet is being used widely on a daily basis to almost everyone who has gained access to it. The Internet also has gained in popularity among all population groups, and especially among the younger generation.

The users of traditional media (like television and magazines) consumed only what was served to them by the media. With the Internet, however, its interactive modality allows users to decide what they want for themselves. This is one factor that makes the Internet a preferred media choice for all, particularly for youngsters. Thus, there is a very high chance that the use of the Internet will replace the use of traditional media in the future.

The Internet has become very influential in shaping our lifestyle today. The use of the Internet has significantly changed the way we communicate, work, learn, play, buy, sell, bank, and search for and share information. Thus, it has the ability to give benefits or risks relating to the economy, education, health, security, and relationships among users, either individually or globally.

The benefits and risks that the Internet possesses need to be studied carefully. Depending on the age, background, and geographical distribution of its users, different groups of people will gain benefits or risks in various aspects of their lives. For example, the use of the Internet may benefit the education of children in India, but at the same time it may cause risks for the health of children in the United States.

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Thus, knowing what we do about the impact of the Internet upon our lifestyle today, we can know for sure that it will further shape the lives of children and adolescents in the future.

1.1 THE ETIOLOGY OF INTERNET AND ITS EVOLUTION

The Internet is one of the biggest and most useful innovations of the current world. It has become one of the most powerful communication tools due to its worldwide broadcasting capability and the dissemination of information. The Internet is also a medium for collaboration and interaction among individuals, groups, or communities, regardless of their geographic location. It is one example of very successful research and development of information infrastructure. The innovation of the Internet began with early research that involved the government, academia, and industry.

The Internet started in the United States (US) in the early 1960s, when the US Department of Defense established the Advanced Research Projects Agency (ARPA). ARPA promoted research that would ensure that the US excel in any technological race, by producing innovative research ideas, providing meaningful technological impact, and acting on these ideas by developing prototype systems (Cohen-Almagor, 2011).

The idea of the Internet was first written about by J.C.R. Licklider of MIT in August 1962 (Licklider & Clark, 1962). He called it a "Galactic Network" concept, whereby he envisioned a globally interconnected set of computers in which everyone could quickly access data and programs from any site (Licklider & Clark, 1962). This network initially was meant for researchers to share each other's resources (such as hardware, software, services, and applications) and to maintain communication between distant locations when electrical transmissions were disrupted (Almagor 2011). Licklider then convinced his friends and other researchers of the importance of this networking concept.

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Leonard Kleinrock published the first paper on packet switching theory in July 1961 at Massachusetts Institute of Technology (Kleinrock, 1961). In 1964, the first book on the subject was published (Kleinrock, 2007). Kleinrock then convinced another researcher named Lawrence G .Roberts. Roberts with his friends Thomas Merrill later explored this concept further by connecting a computer in Massachusetts to a computer in California with a low-speed dial-up telephone line in 1965 (Marill & Roberts, 1966). Subsequently, he developed ARPAnet (ARPA network) and published work on the system at a conference. This conference was attended by other researchers who were doing research on a similar topic. Their research was done separately, at the same time, without any of the researchers knowing about the other work (Baran, 1964; Roberts, 1967).

ARPAnet was developed through research grants from the US Department of Defense's Advance Research Projects Agency (Cohen-Almagor, 2011). By 1969, four computers were connected together under the ARPAnet, and in the following years, more computers were added. In December 1970, the Network Working Group under S. Crocker finished an initial ARPAnet host-to-host protocol called the Network Control Protocol (NCP). After the implementation of the NCP, network users finally could begin to develop applications (Leiner et al., 2009).

The first public demonstration of ARPAnet to the public was organized by Bob Khan at the International Computer Communication Conference in October 1972. Ray Tomlinson wrote basic email message send and read software, and Roberts later expanded its utility by writing the first email program to list, selectively read, file, forward, and respond to messages. It is from there onwards that email took off as the largest network application for over a decade (Leiner et al., 2009).

The original ARPAnet further grew into the Internet. Khan introduced the idea of open-architecture networking called "Internetting" in 1972. Internetting is the open architecture networking in which the individual networks may be separately designed to

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have unique interfaces, specific environments, and user requirements of that network (Leiner et al., 2009).

Kahn decided to develop a new version of the protocol, called the Transmission Control Protocol/Internet Protocol (TCP/IP), which could meet the needs of an open-architecture network environment. While NCP tended to act like a device driver, the new protocol would be more like a communications protocol. Thus, in the spring of 1973, he collaborated with Vint Cerf, who had been involved in the original NCP design and development.

The collaboration of Kahn and Cerf developed the details of TCP/IP, in which data were organized into packages; these packages were transmitted, put into the right order on arrival at their destination, and checked for errors (Leiner et al., 2009). The importance of the TCP/IP protocol in the history of the Internet is so great that many people consider Cerf to be the father of the Internet (Cohen-Almagor, 2011). The term “Internet” was first used by Vint Cerf and Robert Kahn in their 1974 article about the TCP protocol (Vint & Kahn, 1974).

The entry of the Internet into a commercial phase started in the early 1980s, when dozens of vendors were incorporating TCP/IP into their products because they saw buyers for that approach to networking. Unfortunately they lacked both real information about how the technology was supposed to work and how the customers planned on using this approach to networking. In 1985, Dan Lynch arranged a three-day workshop for vendors to come learn about how TCP/IP worked (Leiner et al., 2009). The commercial phase of the Internet was facilitated by many factors: the upgrading of Internet links, the growing number of users worldwide, new software programs, and the instant and growing success of social networking sites (Cohen-Almagor, 2011). The Internet now is not just a “commodity” service but also one of the major supports of commercial services worldwide.

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Social media started when the Internet had already been established. There are many definitions of social media, which includes online communities, media sharing technologies, network gaming, instant messaging, blogging, forums, email, texting, and social networking websites (Boyd, 2008). Andreas Kaplan and Michael Haenlein defined social media as a group of Internet-based applications that built on the ideological and technological foundations that allowed the creation and exchange of user-generated content (Kaplan & Haenlein, 2010). Rogier Brussee and Erik Hekman argued that social media is a media supply chain in which large groups of consumers participate in the role of producer (Brussee & Hekman, 2009).

A social networking site (SNS) is a subset of social media (Boyd, 2008). A social networking site is an Internet-based service that allows a person to construct a public profile within a bounded system, articulate a list of friends (other users who share connections and who subscribe to the service or are users of the system), and view and/or share lists of connections with others within the system (Boyd & Ellison, 2007). Public profile displays and friends lists are crucial components in SNS that differentiate SNS from social media (Boyd & Ellison, 2007). Social network sites today have added multiple functions to enhance the services. Sites now consist of information sharing, picture sharing, and private messaging (Boyd & Ellison, 2007).

The first social network site, SixDegrees.com, launched in 1997 (Boyd & Ellison, 2007). Subsequently, AsianAvenue, BlackPlanet, MiGente, LiveJournal, and Ryze.com emerged. There are also social networking sites dedicated to a specific country, such as Cyworld for Korea and LunarStorm for Sweden (Boyd & Ellison, 2007). Social networking sites bloomed with the start of Friendster in 2002. In 2003, MySpace was founded by Tom Anderson and Chris De Wolfe and followed by Facebook in 2004 (Cohen-Almagor, 2011).

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Facebook was found by Mark Zuckerberg, Eduardo Saverin, Dustin Moskovitz, and Chris Hughes. It started as a social network for universities in the United States. However, in 2006 the network was extended beyond universities and offered free service for joining, but it makes a profit by advertising (Cohen-Almagor, 2011). Facebook has gained in popularity since its early days, and today it is one of the largest social network (Cohen-Almagor, 2011).

The Internet will continue to change and evolve at the speed of the computer industry if it is to remain relevant. With the success of the Internet, we can now observe the rapid growth of the network and thus the increasing number of its users. However, the most pressing question for the future of the Internet is not how the technology will change, but how the process of change and evolution itself will be managed by the users. Thus, users need to be ready for the impact that it will make upon their lives, education, health, and well-being.

1.2 INTRODUCTION OF INTERNET USAGE AMONG ADOLESCENTS IN MALAYSIA

One of the largest studies about Internet usage among Malaysian adolescents was the National Health Morbidity Survey (NHMS) 2017, which conducted by Institute of Public Health (IPH) Malaysia> NHMS 2017 study recruited 27,455 secondary school students throughout the entire states and federal in Malaysia. The overall prevalence of Internet use was 85.6% with an estimated projection to 1,835,343 school-going adolescents (IPH, 2017). In NHMS 2017, female adolescents had a slightly higher prevalence of Internet use (87.4%) compared to males (83.8%). In terms of ethnicity, Chinese recorded the highest prevalence of Internet usage (91.3%), followed by Malay (86.6%), others (78.6%), and Indian (78.3%). Adolescents who studied in urban areas had higher prevalence of Internet use (89.1%) compared to students from rural areas (81.2%) (IPH, 2017).

NHMS 2017 also found that form 5 students (17 years old) recorded the highest prevalence of Internet usage (93.5%), followed by form 4 (90.7%), form 3 (88.3%), form 2 (82.3%), and form 1 (74.2%). The upper form was shown to have higher prevalence compared to the lower form. These results show that as adolescents get older, the prevalence of Internet use among them increases. The highest prevalence of Internet users in Malaysia were in Kuala Lumpur (94.7%), followed by Putrajaya (94.5%) and Johor (93.0%). The lowest prevalence of Internet users in Malaysia was in Kelantan (72.5%). The prevalence of Internet users in Selangor was 87.4% and in Perak it was 82.4%. Proportions of device usage reported by Internet users were these: smartphone (93.7%), computer/laptop/notebook (57%), and tablet/iPad (26.1%) (IPH, 2017).

Another published work about Internet use among adolescents in Malaysia was a study that involved 535 form 4 adolescents from urban secondary schools in Penang (Tan et al., 2010). The study showed that participants accessed the Internet using facilities at home (46.7%), Internet cafes (14.0%), someone else's house (10.8%), at school (8.9%), and via mobile phones (7.9%). Forty-eight per cent of the participants reported that they accessed the Internet at least once or several times a day, while 29.9% of them accessed it a few times a week, 7.9% accessed it once a week, 8.2% accessed it a few times a month, and 5.8% accessed it once every few months (Tan et al., 2010).

When asked about time spent online per day, 38.5% of the adolescents reported spending more than 3 hours during weekends or holidays, and 18.2% spent a similar amount of time during normal school days (Tan et al., 2010). Two to three hours' time spent on the Internet was recorded among 20.7% of the adolescents during weekends or holidays and among 15.4% of them during normal school days. One to two hours' time

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spent on the Internet was recorded among 32.7% of the adolescents during weekends or holidays and among 39.2% of them during normal school days. The most popular websites among the adolescents in this study were search engines, entertainment sites (online videos and music), gaming activities, and social networking. Among regular online activities were online instant messaging, movies or music downloads, sending and receiving emails, and getting other types of information (Tan et al., 2010).

1.3 RATIONALE OF THE STUDY

Although most studies are interested in outcomes, for this study the actual main interest was the predictor: Internet engagement among Malaysian adolescents. The ability of the Internet to affect the lives of people who engage with it generated the question of how Internet engagement is associated with health risk factors and academic performance of adolescents in Malaysia.

The exposure to screen devices (television, computers, tablets, smartphones) among children and adolescents is a global concern. Since the dawn of television until the emergence of smartphones and tablets, many studies have been conducted to understand the impact of screen device utilization among the younger generation in terms of their education, health risk, and addiction (Arora et al., 2013; Bickham, Blood, Walls, Shrier, & Rich, 2013; Costigan, Barnett, Plotnikoff, & Lubans, 2013; De Jong et al., 2013; Elgar, Roberts, Moore, & Tudor-Smith, 2005; Epstein et al., 2008; Jackson, Von Eye, Fitzgerald, Witt, & Zhao, 2011; Kautiainen, Koivusilta, Lintonen, Virtanen, & Rimpelä, 2005; Leatherdale, 2010; Leatherdale & Harvey, 2015; Lenhart, Purcell, Smith, & Zickuhr, 2010).

Nowadays, most screen devices are built with Internet connectivity. Most devices contain applications for social media activities like social network sites, chat, video

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viewing, gaming, and many more. Using the Internet can be a complex experience that may involve the use of different types of applications simultaneously or multitasking with several other activities while engaging in it. Internet engagement is neither a homogenous behaviour nor does it lead to purely negative consequences. Hence, this may perhaps have contributed to inconsistent findings in prior research. Examining specific characteristics of adolescents' Internet engagement is important in order to determine its association with risks for developing a cardiovascular disease (as measure by weight parameters) and education (measured by academic performance). Thus, depending upon multiple factors, there are many possibilities for the impact of the Internet on adolescents' lives, especially on education and health (Costigan et al., 2013; Jackson et al., 2011; Rey-Lopez et al., 2008). Once the analysis of such factors has been accomplished, the development of effective interventions for adolescents will be possible.

Research in this field is important in view of the shift of technology from non-interactive media (e.g., television, movies) to interactive opportunities that require social interaction using such methods as social networking, email, and video chat (Jones & Fox, 2009). Young adults and adolescents are active in their participation with interactive technology (Lenhart et al., 2010). Furthermore, it may be that Internet use will replace television viewing in the future, as indicated in a study of media usage among female adolescents:

"In particular, children who come from higher socioeconomic status households watch less TV and are more likely to live in a home with a computer or Internet connection, raising the question of whether interactive media is in the process of replacing television as the most popular sedentary behavior among adolescents." (Schneider, Dunton, & Cooper, 2007)

The increasing prevalence of overweight and obesity among children and adolescents is a global public health concern. Childhood obesity increases the risk of adult obesity as

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well as chronic health problems such as diabetes, hypertension, hypercholesterolemia, cardiovascular disease, and premature death (Franks et al., 2010). National Health and Morbidity Survey conducted in Malaysia showed a steady increase in prevalence of obesity among children and adolescents aged less than 18 years. NHMS 2015 reported a national prevalence of obesity of 11.9% compared to 6.1% in 2011 (IPH, 2011, 2015).

The combination of high prevalence of Internet usage and increased prevalence of obesity among Malaysian adolescents seems not favourable to future health-related outcomes for Malaysians. Nevertheless this makes it essential to study the association between Internet engagement and weight parameters (as measured by body mass index (BMI), body fat percentage, and waist circumference) among adolescents in Malaysia.

Education is a way for poor people to empower and equip themselves with skills that they need, and to secure their lives in the future. Education is also a key contributor to economic development, as stated by a Malaysian government report:

“Education is one of the most critical drivers for our transformation from a middle- to high-income nation due its impact on productivity and human capital development.” (PEMANDU, 2010)

The relationship between human capital development and economic growth is well established (WHO, 2011). Poor education will lead to poor life and poor health in the future, as mentioned in a framework of social determinants of health (Solar & Irwin, 2010).

Most studies that examined the relationship between time spent on non-academic types of screen activities or social networking sites with academic performance have found a negative association between these factors (Esteban-Cornejo et al., 2015; Salomon & Kolikant, 2016; Wentworth & Middleton, 2014). A study about factors that may be associated with academic performance is relevant and important because it may be able to predict future outcomes for the young generation. Identifying the factors that are

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associated with good academic performance is a crucial step before we can successfully design interventions that empower adolescents to excel in their education.

1.4 RESEARCH GAP

Most of the published studies that have examined the relationship between sedentary time or screen time and its association with obesity have focused more on television viewing (Dietz & Gortmaker, 1985; Gortmaker et al., 1996; Ma, Li, Hu, Ma, & Wu, 2002). Some studies have looked into different types of sedentary time such as television viewing, use of the computer, and electronic gaming (Jackson et al., 2011; Kautiainen et al., 2005; Rey-Lopez et al., 2008; Schneider et al., 2007). Research about the relationship between time spent on interactive media with obesity that was done in California focused solely on female high-school adolescents (Schneider et al., 2007). Currently, no research has been published for Malaysia to study specifically Internet engagement among adolescents and its association with weight parameters, despite steady increased of the obesity prevalence in this country (IPH, 2011; IPH, 2015; IPH, 2017)

Most published studies that have looked at the relationship between time spent on the Internet and academic performances have focused on social network sites, particularly Facebook, since it is the most popular social networking site (Junco, 2012; Kirschner & Karpinski, 2010). Most studies have been conducted among young adults in college and universities (Ainin, Naqshbandi, Moghavvemi, & Jaafar, 2015; Alwagait, Shahzad, & Alim, 2015; Junco, 2012; Kirschner & Karpinski, 2010), and very few studies have examined the adolescent age group (Esteban-Cornejo et al., 2015; Salomon & Kolikant, 2016). Most of the published studies were actually looking into grade point average for adolescents in high school, especially from the United States, Europe, or even Saudi Arabia (Alwagait et al., 2015; Esteban-Cornejo et al., 2015; Junco, 2012; Kirschner & Karpinski, 2010).

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This study was also not based on self-reported academic performance (Salomon & Kolikant, 2016) but used the national standardized examination (PT3) results. Uniquely in this study, secondary school academic performance was measured according to the subjects. So far, there has been only one published paper for a study that measured academic performance by learning skill (Lee & Wu, 2013). So far, to our knowledge, no research about the association of Internet engagement and academic performance among school-aged adolescents in Malaysia has been published.

1.5 RESEARCH QUESTIONS

The research questions for this study were these:

1. What is the percentage of adolescents who engage in the Internet regularly?
2. Which gender, ethnicity, and schools' locality of adolescents is associated with regular engagement on the Internet?
3. Is regular or increased time engaging on the Internet associated with abnormality in any of the weight parameters (BMI, percentage of body fat, and waist circumference)?
4. Is regular or increased time engaging on the Internet associated with poor academic performance?

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1.6 RESEARCH OBJECTIVES

The research objectives were divided into general and specific objectives, as below.

1.6.1 General Objectives

The general objective was to study Internet engagement and its association with weight parameters (BMI, percentage of body fat, and waist circumference) and academic performance among adolescents in Malaysia.

1.6.2 Specific Objectives

1. Determine the prevalence of regular Internet engagement among Malaysian adolescents, and study the socio-demographic variation in relation to the regularity of Internet engagement.
2. Identify the association of Internet engagement (regularity and time spent) with weight parameters among adolescents in Malaysia.
3. Identify the association of Internet engagement (regularity and time spent) with academic performance among adolescents in Malaysia.

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CHAPTER 2: LITERATURE REVIEW

The Internet was invented by groups of scientists through a course of research efforts. Dramatic changes have taken place based on the evolution of the Internet since the idea initially emerged in the early 1960s. Economic growth, infrastructure improvement, the emergence of Internet providers and population growth have contributed to the increasing number of Internet users. Adolescents are among them. Thus, an increasing number of studies have been conducted to understand the relationship between Internet engagement and the lifestyles, health, education, and wellbeing of the younger generation.

2.1 SOCIO-DEMOGRAPHIC VARIANTS OF INTERNET USE AMONG ADOLESCENTS

The socio-demographic findings (age, gender, and ethnicity) of Internet use among adolescents vary in different parts of the world. A study in Europe found that more hours of Internet use for non-study purposes was observed among adolescents who are 15 years old and above compared to those who are less than 15 years old (Rey-López et al., 2010).

The Healthy Lifestyle in Europe by Nutrition in Adolescents (HELENA) study found that the percentage of Internet use for non-study reasons was higher for females on weekdays and weekends (Rey-López et al., 2010). The socio-demographic data reported by the Pew Research Centre's Internet & American Life Projects showed that boys and girls are equally likely to visit social networking sites (Lenhart et al., 2010). A study among young adults in China observed significant gender differences in the motivations for Internet use; boys use the Internet mainly for seeking fun, and girls use it for sociability, information seeking and school-related tasks (Wang et al., 2012).

A study in the United States found that among people of different ethnicities, whites (39%) are the most frequent users of the Internet followed by African Americans (33%) and Hispanics (26%) (Lenhart et al., 2010). The study also showed that social networking

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is more predominant in teens from lower income families (80%) compared to wealthier families (70%) (Lenhart et al., 2010). A study of Internet use among adolescents in Malaysia found that the most popular Internet activities were mainly entertainment and social networking (Tan et al., 2010). However, this study did not reflect the true ethnic composition of the Malaysian population as a majority of the participants were Chinese (76.8%), followed by Malays (13.5%), Indians (8.6%) and other ethnicities (1.1%) (Tan et al., 2010).

2.2 INTERNET ACCESS AND POSSESSION OF SCREENING DEVICES AMONG ADOLESCENTS

A study conducted in the United States by the Pew Research Centre in 2009 found that 93% of American teens (between the ages of 12 to 17 years old), 93% of young adults (from 18-29 years old) and 74% of adults use the Internet (Lenhart et al., 2010). Among the adolescents, only 88% aged 12-13 years old use the Internet compared to 95% of adolescents aged 14-17 years old (Lenhart et al., 2010). This study also found that 63% of the adolescents are online daily, 36% of them go online several times a day, and 27% reported being online only once per day. In addition, 39% of older adolescents (age 14-17 years old) are more likely to go online frequently than younger adolescents (only 28% are frequently online) (Lenhart et al., 2010).

Research conducted in the United States found that 76% of houses with adolescents had broadband Internet access, and only 10% of families have a dial-up Internet connection (Lenhart et al., 2010). Adolescents who live in houses with broadband (40%) are more likely to go online frequently than those with dial-up Internet access at home (21% online frequently) (Lenhart et al., 2010). A study in China found that 53.4% the adolescents and young adults access the Internet from home; however, boys mainly access

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the Internet from Internet bars, while girls access it mainly from home or the library (Wang et al., 2012).

The Pew Research Centre study found that 75% of American adolescents (aged 12-17 years old) have a cell phone, 83% of 17-year-olds own a cell phone, and 73% of 13-year-olds own one; however, younger adolescents (particularly 12-year-olds) are less likely than other adolescents to have cell phones (Lenhart et al., 2010). Of the adolescents aged 12-17 years old, 69% have a computer, and older adolescents (73% of 14-17 year-olds) are more likely to report owning a desktop or laptop compared to younger adolescents (60% of 12 to 13-year-olds) (Lenhart et al., 2010). Eight per cent of the families reported not having a computer at home, and 4% have a computer, but it is not connected to the Internet (Lenhart et al., 2010). A study conducted in China found that 70.2% of adolescents had computers at home, and 48.7% had their own computers (Wang et al., 2012).

A study about Internet use among adolescents in Malaysia reported that a majority of the participants accessed the Internet from home (46.7%), followed by Internet cafés (14.0%), someone else's house (10.8%), school (8.9%) and mobile phone (7.9%) (Tan et al., 2010). This study also reported that 9.5% of the participants did not have Internet access at all (Tan et al., 2010).

2.3 TIME SPENT ON THE INTERNET OR INTERACTIVE MEDIA AND OTHER SCREENING DEVICES AMONG ADOLESCENTS

A series of research projects about social media and mobile Internet use among teens and adults in the United States was conducted by the Pew Research Centre's Internet & American Life Projects. This study found that teens and young adults are the age groups that are online most frequently (Lenhart et al., 2010). There was an increasing trend of

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teen engagement on social network sites from 2006 (55%) to 2008 (65%) and 2010 (73%) (Lenhart et al., 2010).

The HELENA study, which was conducted in 10 European cities (Athens and Heraklion in Greece, Dortmund in Germany, Ghent in Belgium, Lille in France, Pecs in Hungary, Rome in Italy, Stockholm in Sweden, Vienna in Austria, and Zaragoza in Spain) in 2006 and 2007 divided the purposes of Internet use into study or non-study reasons (Rey-López et al., 2010). Twelve per cent of the adolescents used the Internet more than four hours for non-study purposes on the weekend compared to 7.5% on weekdays (Rey-López et al., 2010). On weekdays, most of the adolescents used the Internet for less than two hours for non-study reasons (Rey-López et al., 2010). A study conducted among 13 to 15 year old adolescents in a small New England city in 2008 found that the participants spent most of the time on television viewing (three hours and 21 minutes daily), followed by computer use (one hour and 10 minutes use daily) and video gaming (48 minutes use daily) (Bickham et al., 2013).

A study among Canadian children and youth showed that they spent an average of eight hours per day on screen time, including television viewing, recreational use of computers and video gaming (Leatherdale & Harvey, 2015). A study among youth between eight to 18 years old found that the total media exposure among youth averaged about 54 hours per week (Rideout, Foehr, & Roberts, 2010).

One study involving 13 to 24-year-old young adults in China revealed that 96.6% of the participants used the Internet, and 65.1% of them spent at least three hours per week online (Wang, Luo, Gao, & Kong, 2012). A study conducted among adolescents in Malaysia reported that the highest percentage, 39.2%, of the participants spent one to two hours on the Internet on a normal school day and spent more time on the weekends (Tan, Ng, & Saw, 2010). This study also recorded that the majority of the participants accessed

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the Internet at least once per day (48.2%), followed by those who accessed it a few times a week (29.9%) (Tan et al., 2010).

2.4 MECHANISM OF OBESITY IN RELATION TO THE INTERNET OR INTERACTIVE MEDIA AND OTHER SCREEN ACTIVITIES

The prevalence of overweight and obesity among children and adults worldwide is increasing. This problem has become a public health concern globally. Obesity increases type II diabetes, hypertension, hyperlipidemia, cardiovascular diseases and premature death (Franks et al., 2010). Current epidemiological trends in Malaysia indicate that the prevalence of childhood, adolescent and adult obesity reflect a consistent increasing trend (IPH, 2011, 2015). Despite the persistently increasing trend, not many of the interventions have been shown to be successful in solving this problem.

The technology of screen media has evolved from traditional consumption media (television and movies) to the new media, which are more interactive (such as Internet surfing, social networking and video gaming). These types of interactive media have gained popularity, especially among young adults and adolescents. The creation of smart phones became a way to facilitate the growth of interactive media. Thus, it has been placed with the reach of populations worldwide, especially the younger age groups.

Multiple studies have been conducted finding an association between television viewing and obesity (Dietz & Gortmaker, 1985; Elgar et al., 2005; Gortmaker et al., 1996; Ma et al., 2002). Most of them showed a positive relationship between the time spent on television viewing and obesity. Surprisingly, the findings of the traditional media do not apply to the new media. Studies about interactive media and the use of the Internet have shown very inconsistent results (Bickham et al., 2013; Kautiainen et al., 2005; Rey-Lopez et al., 2008; Schneider et al., 2007). To date, the relationship between the time spent on interactive media and weight-related parameters is still under debate.

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The mechanism of obesity in relation to screen activity is best explained by one or a combination of the following: 1) reduced energy expenditure and 2) increased energy intake. There are many hypotheses explaining both of these mechanisms. In relation to media viewing/usage, the mechanism of obesity is explained as: 1) a direct effect of sedentary activity, in which <1.5 metabolic equivalents of energy were spent during this activity (Bickham et al., 2013), 2) a result of increased time spent in media viewing/usage, which may reduce or replace time spent on moderate to vigorous levels of physical activity (Bickham et al., 2013; Elgar et al., 2005; Pearson & Biddle, 2011), 3) a result of increased energy intake in relation to media viewing/distracted eating during media use (Boulos, Vikre, Oppenheimer, Chang, & Kanarek, 2012; Cameron et al., 2016), 4) a result of exposure to food advertising in the media, which may increase the consumption of non-healthy food (high energy and non-nutritious food) (Dixon, Scully, Wakefield, White, & Crawford, 2007; Halford, Gillespie, Brown, Pontin, & Dovey, 2004).

This study mainly focusing on weight parameters in relation to the time spent on the Internet which may be sedentary in nature, therefore exploring point no 1 (a direct effect of sedentary activity). The level of physical activity in this study was a factor being controlled in the association of time spent on the Internet with weight parameters and academic performance. This study does not look deeper into the energy intake and food advertising in relation to the Internet use.

2.5 THE RELATIONSHIP BETWEEN TIME SPENT ON INTERACTIVE MEDIA OR SCREENING DEVICES WITH WEIGHT PARAMETERS

Many studies focused on the relationship of television use and BMI, with most reporting consistent results relating television viewing with overweight and obesity among children and adolescents (Dietz & Gortmaker, 1985; Gortmaker et al., 1996; Ma et al., 2002). Currently, studies are starting to shift to the use of interactive

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media/technology rather than focusing solely on television viewing (Kautiainen et al., 2005; Schneider et al., 2007; Vaterlaus, Jones, Patten, & Cook, 2015).

Studies about the association between time spent on the computer and BMI among adolescents have had inconsistent findings. Many studies have found no significant relationship between time spent on the computer and BMI (Bickham et al., 2013; Cameron et al., 2016; De Jong et al., 2013; Fletcher et al., 2015; Jackson et al., 2011; Wake, Hesketh, & Waters, 2003). However, some studies found a positive association between the amount of time spent on the computer and BMI (Arluk, Branch, Swain, & Dowling, 2003; Arora et al., 2013; Kautiainen et al., 2005; Schneider et al., 2007; Utter, Neumark-Sztainer, Jeffery, & Story, 2003). Some of the studies found a positive association among female adolescents, but not among male adolescents (Hume et al., 2009; Kautiainen et al., 2005).

A systematic review among female adolescents found strong evidence for a positive association between screen-based sedentary behaviour and weight parameters (Costigan et al., 2013). This study also found a negative association for screen time and physical activities (Costigan et al., 2013). The relationship between screen time and diet quality was inconclusive (Costigan et al., 2013). From 33 articles, only three were about the usage of the Internet as a sedentary screen activity, but none of the three articles studied weight parameters as an outcome (Costigan et al., 2013). Their concerns on Internet usage were mainly on mental issues and musculoskeletal aspect of health (Costigan et al., 2013). Most of the review articles that studied weight parameters as outcomes focused on overall sedentary activities, especially television viewing and computer usage (Costigan et al., 2013). Even though these articles included various types of screen-based activities, they did not look into the use of mobile phone or tablets. Only 18 articles examined the association of screen-based activities with weight parameters (Costigan et al., 2013).

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A randomised controlled trial demonstrated reductions in zBMI following an intervention to reduce television and computer use among overweight children (Epstein et al., 2008). This is a very good study using objectively measured time spent on technologies (television viewing and use of computers) and BMI (Epstein et al., 2008). The participants were children who were above the 75th BMI percentile. Therefore, the results cannot be generalised to the prevention of at-risk children who were less overweight.

A randomised controlled trial study on dose-response associations between screen time and overweight among Dutch adolescents found that girls who spend three or more hours/day in screen time are at increased risk of being classified as overweight by waist circumference, however there were no significant dose-response associations among boys (Hume et al., 2009). This relationship was independent of the time spent in organised sports, consumption of sugar-containing beverages, and high caloric snacks, and the likelihood increased substantially with increasing screen time for the association between dose-response screen time and waist circumference (Hume et al., 2009). This was an excellent study using the objective measurement of weight parameters (BMI, waist circumference and skinfold). However, this study does not look into the use of current technologies such as Internet engagement, use of mobile phones, and playing electronic games (Hume et al., 2009).

The Health Behaviour of School-Age Children Study in Wales recruited adolescents at Year 7 (ranging from 11-14 years old; a mean of 12.3 years old) and followed up four years later (at Year 11) to study the longitudinal relationship of total sedentary behaviour (involving watching television or video and playing computer games) and BMI (Elgar et al., 2005). This study found that the sedentary activity at Time 1 predicted body mass at Time 2. This influence was not mediated by physical activity (Elgar et al., 2005). This is a good study; however, it may not represent the current study as it measured the use of

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computer for playing games and although the BMI was objectively measured, however, the way it was measured by letting the shoes of the participants on may introduce the source of bias in measurement.

A cross-sectional study among adolescent girls in the United Kingdom (UK) was done to examine the independent associations between sleep duration, four technology types (computer use, mobile phones, television viewing and video gaming) and body mass index z-score (Arora et al., 2013). This study found positive and significant direct effects of association for those who watched TV, engaged in video gaming or used a computer on BMI z-score (Arora et al., 2013). All use of technology types (except for mobile telephones) was significantly associated with increased BMI z-score after adjustment (Arora et al., 2013). This study also found that the most significant positive association on BMI z-score was observed in those who watched TV or played video games at bedtime, and this association remained, although slightly attenuated after adjustment (Arora et al., 2013). This is one of the well-designed cross-sectional studies with 759 participants from multiple types of secondary schools in the Midlands region of the UK and good diversity of ethnicity distribution (Arora et al., 2013). The study can be strengthened further through longitudinal and experimental studies.

Interestingly, a study found that use of television and video as well as reading and doing homework positively associated with BMI in boys, while the use of television, video and computer were positively associated with BMI in girls (Utter et al., 2003). This study also found that physical activity was not associated with television or video viewing but positively associated with computer use and time spent reading or doing homework (Utter et al., 2003). This study also noted that high television and video use associated with poor diet behaviour and increased the consumption of soft drinks, fried food and snacks, but this association was not observed in computer use (Utter et al., 2003). This was a good quality cross-sectional study composed of a huge diverse samples of

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adolescents in the metropolitan area of the Upper Midwest of the United States of America. It also objectively measured BMI. However, it may not represent the current study as the focus was not on interactive media use, particularly the Internet.

A study from the University of California involving 194 female adolescents aged 14 to 17 years from the suburb area found that more time spent on interactive media (such as playing video games or surfing the Internet) was significantly associated with high BMI and a high percentage of body fat compared to zero hours spent on interactive media, even after controlling for fitness and physical activity (Schneider et al., 2007). The study also found that reading, doing homework, talking on the phone or watching television or movies were not significantly associated with BMI or body fat (Schneider et al., 2007). This is a cross-sectional study using convenience sampling, a self-reported three days activities and objectively measured BMI and body fat (Schneider et al., 2007). Although the findings of this study were interesting, in view of the sampling method and the place of study (in where the Internet was easily accessible), it was very unlikely that this study can be generalised to the general population.

A cross-sectional study about the relationship of time spent on information and communication technology (television viewing, playing digital games and using computers) to overweight Finnish adolescents was done as part of a nationwide survey and monitoring system of adolescents' health and health behaviours (Kautiainen et al., 2005). This study found a direct effect of increased time spent on viewing television and using computer associated with an increased prevalence of overweight and obesity among girls (Kautiainen et al., 2005). After adjustment, a statistically significant positive association remained between time spent on viewing television and using computers with overweight among girls but not in boys (Kautiainen et al., 2005). Time spent on playing digital games was not associated with overweight before and after the adjustment (Kautiainen et al., 2005). Although this study had a good national representative of

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adolescents, the data was collected through the mail, and the BMI was based on self-reported BMI and not objectively measured (Kautiainen et al., 2005).

A study on the information technology use (Internet use, videogame playing and cell phone) as predictors of children's body mass index (BMI), body weight and academic performance in southern Lower Peninsula of Michigan involved adolescents from 20 middle schools and after-school centre in Detroit, Michigan (Jackson et al., 2011). It found that none of the information technology use measures predicted BMI or body weight (Jackson et al., 2011). This study used the data collected through mail, and the BMI was not objectively measured because it was self-reported (Jackson et al., 2011).

A narrative review of children and adolescents concludes that excessive sedentary time, especially screen-based sedentary time, does associate with obesity and cardio-metabolic risk (Saunders, Chaput, & Tremblay, 2014). The review noted the shift of trends from television viewing to the usage of computers and video game playing. It also noted the lack of data using objectively measured sedentary time (Saunders et al., 2014). The published papers focused on television viewing, computer use and video game playing and not on interactive media like engagement on the Internet (Saunders et al., 2014).

2.6 THE RELATIONSHIP BETWEEN TIME SPENT ON THE INTERNET INTERACTIVE MEDIA OR SCREENING DEVICES WITH PYHSICAL ACTIVITY

One mechanism relating sedentary and obesity was a widespread belief that increased time spent in media viewing/usage might reduce or replace time spent on moderate to vigorous levels of physical activity (Bickham et al., 2013; Elgar et al., 2005; Pearson & Biddle, 2011). However, evidence from some studies was not supporting this popular

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theory, especially for interactive media viewing/usage (Ekelund et al., 2006; Robinson et al., 1999).

A cohort study in a large sample of adolescents in Northern Ireland found that even with high usage of television and computers among adolescents in a high socio-economic group, they were at lower risk of obesity because they compensated the usage with higher levels of physical activity and lower energy intake (Mutunga et al., 2005). This is a good study to demonstrate the causal relationships of the studied variables.

A cross-sectional study of female adolescents in California, United States, found that more physical activity and higher fitness were related to less time spent being sedentary (Schneider et al., 2007). It also found that adolescents who spent most time reading and doing homework were more likely to engage in vigorous physical activity than those who spent little time on homework and reading, and these studious children also had higher cardiovascular fitness (Schneider et al., 2007). From the findings in this study, interactive media or television viewing were not associated with physical activity or fitness (Schneider et al., 2007). This study had very interesting findings but used convenience sample (Schneider et al., 2007).

Interestingly, a cross-sectional study of adolescents in a metropolitan area of the Upper Midwest of United States of America found that physical activity was positively associated with computer use and time spent reading/doing homework (Utter et al., 2003). It also found that physical activity was not associated with television or video viewing among adolescents (Utter et al., 2003). This study was a good quality cross-sectional study with a large sample size of adolescents; however, it does not focus on interactive media use, particularly the Internet.

A cross-sectional study among adolescents in nine countries across Europe found that time spent on physical exercise was inversely correlated with television viewing in adolescents (Te Velde et al., 2007). It found that physical exercise was significantly

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positively associated with computer use in girls (Te Velde et al., 2007). This was a good study with large sample size involving adolescents from different countries. However, the non-respondents are quite high, ranging from 32.7 to 43.1% (Te Velde et al., 2007).

2.7 THE RELATIONSHIP BETWEEN TIME SPENT ON THE INTERNET AND/OR SOCIAL NETWORKING SITES WITH ACADEMIC PERFORMANCES

The World Health Organisation presented evidence that health and quality of life are socially determined by a combination of many factors (WHO, 2008). Among these factors are the social and economic environment (income, social status and social support networks), the physical environment (safe water, clean air and access to health services) and individual characteristics and behaviours (gender, genetics and educational level) (WHO, 2008). These factors are called the "Social Determinants of Health".

There are several pathways through which the level of education is linked with health (Braveman, Egerter, & Williams, 2011). A higher level of education can lead to improved health, as more educated individuals will most likely make better-informed health-related decisions and exercise self-control over health-related behaviours for themselves and their families (Leganger & Kraft, 2003; Sanders, Federico, Klass, Abrams, & Dreyer, 2009). A higher level of education also reduced the rate of unemployment, thus providing individuals and their families with higher incomes, which is linked to better health (Bartley & Plewis, 2002).

Most studies about the relationship between time spent on the Internet and academic performance have focused on the use of social networking sites (SNS) (Junco, 2012; Kirschner & Karpinski, 2010; Lambić, 2016; Michikyan, Subrahmanyam, & Dennis, 2015). Very few studies have addressed the time spent on different types of technologies (for example, the use of computers, mobile phones, the Internet and different types of

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Internet applications) and its relationship to academic performance (Lee & Wu, 2013; Salomon & Kolikant, 2016; Wentworth & Middleton, 2014). Most of these published studies have also been conducted mainly among the young adult age group, especially college or university students (Ainin et al., 2015; Alwagait et al., 2015; Junco, 2012; Kirschner & Karpinski, 2010; Wentworth & Middleton, 2014). Very few studies have investigated the adolescent secondary school age group (Esteban-Cornejo et al., 2015; Lee & Wu, 2013; Salomon & Kolikant, 2016).

A meta-analysis of the relationship between SNS use and academic performance among adolescents and young adults found a negative correlation between SNS use and grade point average (GPA), and the relationship was more strongly negatively correlated for females (compared to males) and college students (compared to adolescents) (Liu, Kirschner, & Karpinski, 2017). However, this meta-analysis also found a positive relationship between SNS use and language test results (Liu et al., 2017). This is a good meta-analysis study of SNS use and academic performance. However, most of the articles were cross-sectional studies, making the direction of effect difficult to determine (students who spent more time on SNS had lower GPA or students with lower GPAs spent more time in SNSs) (Liu et al., 2017). Furthermore, this study did not look at the time spent on the Internet as a whole and focused on SNSs.

A longitudinal study of 482 youth conducted in Michigan found that at Time 1, there was no association between Internet use and grades in school (Jackson et al., 2011). However, there was a significant positive correlation between the frequency of Internet use and reading skills only for below-average and average students (Jackson et al., 2011). The study also found that there is a significant positive correlation between videogame playing and visual-spatial skills only in youth who were initially low in visual-spatial skills (Jackson et al., 2011). A significant negative correlation was also found between videogame playing and GPA only in youth who had average GPAs (Jackson et al., 2011).

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This was a good study that studies different types of technology and examined them with different skills. This is similar to this present study. However, the data was self-reported and collected through mailed and not from the objectively measured academic results, which were obtained from respective schools (Jackson et al., 2011).

A study involving 87,735 15-year-old students across 15 regions in the Programme for International Student Assessment (PISA) 2009 Electronic Reading Assessment dataset found that more frequent information-seeking activities predicted better knowledge of metacognitive strategies, which, in turn, predicted better reading literacy (Lee & Wu, 2013). However, more frequent social entertainment activities predicted poorer knowledge of metacognitive strategies, which, in turn, led to poorer reading literacy (Lee & Wu, 2013). This study had high-quality data with a large number of participants involving adolescents from a different continent, mainly Europe and Asia. However, as there were too many participants with various backgrounds, there was no analysis for the socio-demographic distribution of the participants except for their socio-economic status. Furthermore, the significance results may be the effect of a large sample size.

A cross-sectional study of 533 public high school students conducted in Jerusalem, Israel found that there was a negative correlation between non-academic use of information and communication technology and academic performance (Salomon & Kolikant, 2016). Although the data about ICT use was high-quality data, the academic performance data were based on the self-reported participants' average score on their last annual certificate (Salomon & Kolikant, 2016). Academic performance was not taken from the standardised examination (from seven public high schools) and did not measure the different subjects tested in schools.

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2.8 THE FRAMEWORK OF THE STUDY

The framework of weight parameters and academic performance were identified as the current studies on the subject focus on Internet activity as a screening activity related to being sedentary. Since studies about the Internet are lacking, the factors in the framework were based on those that influence weight parameters or academic performance within being sedentary or screening activities.

The framework of the relationship between time spent on the Internet with weight parameters and academic performance among adolescents should not focus only on their attributes as students in school, but also consider their daily activities. This study's conceptual framework was adapted from a model of the reciprocal relationships between health, health behaviour and educational achievement used in a study of academic performance among university students in the United Kingdom (El Ansari, 2010).

In measuring the relationship between Internet use and academic performance among students, many studies considered multitasking as a mediating factor and thus included it in the study framework (Bellur, Nowak, & Hull, 2015; Lau, 2017; Wentworth & Middleton, 2014). However, in this study, the effect of multitasking may not be apparent in class, as secondary school students have been prohibited from bringing their mobile phones or devices into the class since 2012 (during the data collection period).

The framework used in this study does not focus on factors that have already been studied in other published papers about SNS use. Instead, we follow a different approach by investigating other factors that may influence academic performance concerning involvement in screening activities or being sedentary (Peiró-Velert et al., 2014; Syväoja et al., 2013). Below is the conceptual framework that the researcher used to study the relationship between Internet use and weight parameters as well as academic performance among adolescents in Malaysia.

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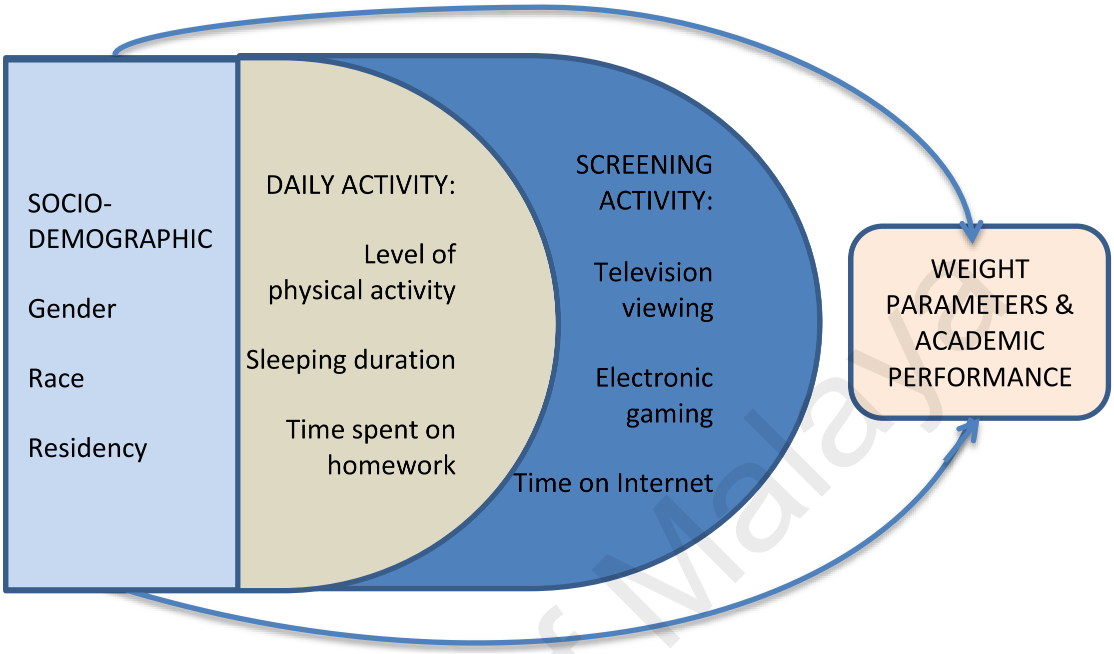

Figure 2.1: The study framework

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CHAPTER 3: METHODOLOGY

This chapter describes in detail the methodology used to obtain data and results for this study. The general objective of the present study was to examine Internet engagement and its association with weight parameters and academic performance among Malaysian adolescents. The study was separated into three domains: socio-demographic factors, weight parameters, and academic performance.

The socio-demographic domain objectives were to determine the prevalence of regular Internet engagement among Malaysian adolescents and to study the socio-demographic variation in relation to the regularity of Internet engagement. The main objective of the weight parameters domain was to identify the association of Internet engagement (regularity and time spent) with weight-related parameters (BMI, percentage of body fat, and waist circumference) among adolescents in Malaysia. The main objective of the academic performance domain was to identify the association of Internet engagement (regularity and time spent) with academic performances (aggregate and each subject). Data were obtained via primary and secondary data collection.

The majority of the data was secondary data from Malaysian Health and Adolescents Longitudinal Research Team (MyHeART) study. MyHeART study is a cohort study on risk factors for chronic non-communicable diseases among adolescents. The objectives of the MyHeART study are to identify trends of prevalence of non-communicable diseases' risk factors among adolescents and to determine how lifestyle factors in adolescence influence the development of chronic non-communicable diseases (Hazreen et al., 2014). MyHeART study completed its first and second waves of data collection in 2012 and 2014, respectively. Secondary data that were taken from MyHeART study included socio-demographic data, time spent on the Internet, and weight parameters.

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The primary data that was collected for the present study included the academic performance of participants and the schools' locality. The academic performance data were the results of standardized examinations (*Pentaksiran Tingkatan 3*, PT3) in Malaysia. All year three Malaysian public secondary school students in Malaysia sat for this examination in 2014. The results were collected in 2015. This chapter will explain the methodology of MyHeART and present study in detailed.

3.1 STUDY DESIGN, AREA AND POPULATION

This sub-topic will explain about the design, area and population of the MyHeART and present study.

3.1.1 Study Design, Area and Population of MyHeART Study

MyHeART study is a prospective cohort study. The study was conducted in the states of Selangor and Perak, as well as the Federal Territory of Kuala Lumpur. The study population consisted of adolescents who were attending public secondary schools. The first wave of data collection was taken when participants were in the first year of secondary school (13 years old). The same batch of students was followed up with a second wave of data collection in 2014, when the students were in the third year of secondary school (15 years old) (Hazreen et al., 2014).

3.1.2 Study Design, Area and Population of Present Study

This study was a cross-sectional study that used mainly secondary data from the second wave data of MyHeART study. The study area and population were similar to the MyHeART study. This present study area was in two states and one federal territory (Perak, Selangor, and Kuala Lumpur) within Peninsular Malaysia. The population was year three (fifteen years old) public secondary school students (excluding boarding and

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religious schools). Year three public secondary schools students were selected in view of the standardized examination (*Pentaksiran Tingkatan* 3, PT3) that they sit at the end of year 2014. This examination results were further being used for this present to measure their academic performances.

3.2 SAMPLING PROCEDURE OF MyHeART STUDY

The calculated sample size for the MyHeART study was 1,359 participants (Fadzlina et al., 2014; Hazreen et al., 2014). There were 1,361 participants in the first phase of the study. The study proceeded by selecting the schools and then selecting the participants from each school. The list of the schools in the study area was obtained from the Ministry of Education (MOE), Malaysia. Boarding and religious schools were excluded from the study because the population of students in these schools does not represent the true multiracial population in Malaysia, as these schools are attended mostly by Malay students. A very small percentage of adolescents from Perak, Selangor, and Kuala Lumpur were schooling in public boarding schools (1.8%) and public religious schools (0.7%) (MOE, 2012). A computerized random number generator was used to generate a random number list for selection of schools. Fifteen schools were selected to participate in the study, as shown in Table 3.1.

Table 3.1: Secondary schools selected for MyHeART study

NO	STATE / FEDERAL	NAME OF SCHOOL	SCHOOL'S LOCALITY
1.	Kuala Lumpur	SMK Desa Petaling	Urban
2.		SMK Seri Permaisuri	Urban
3.		SMK Datok Lokman	Urban

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Table 3.1 continued.

4.	Selangor	SMK Bagan Terap	Rural
5.		SMK Tasek Permai	Urban
6.		SMK Bukit Jelutong	Urban
7.		SMK Sultan Abdul Aziz Shah	Urban
8.		SMK Dato’ Abu Bakar Baginda	Urban
9.	Perak	SMK Pinji	Urban
10.		SMK Tapah	Rural
11.		SMK Sayong	Rural
12.		SMK Tun Perak	Rural
13.		SMK Mudzaffar Shah	Rural
14.		SMK Sultan Tajul Ariffin	Rural
15.		SMK Raja Lope Nor Rashid	Rural

*SMK = *Sekolah Menengah Kebangsaan* / Public Secondary School

In the second stage of sampling, participants were selected from each school. In 2012, all year one students who were able to speak, read, or write the Malay language were invited to join the study. In 2014, the same batch of students (who were then in year three) was invited to participate. The invitation was also opened to all year three students of the selected schools regardless of their participation in the first phase.

3.3 SAMPLE SIZE AND POWER OF THE STUDY CALCULATION OF THE PRESENT STUDY

This sub-topic will explain on the calculation of sample size and power of study for the present study.

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3.3.1 Sample Size

The sample size determines the weight of parameters and educational performance among adolescents as calculated using OpenEpi software, version 3. Similar studies on the association of Internet engagement and weight parameters and/or academic performance on adolescents have never been conducted in this region. Thus, the sample size was calculated based on the findings in studies conducted in Michigan, the United State of America (Jackson et al., 2011; Jackson et al., 2011)

The association between Internet engagement and weight parameters as well as the association between Internet engagement and academic performance are considered for when calculating the sample size. The statistical test of chi-square was selected to compute the required sample size as shown in the following table:

Table 3.2: Sample size calculation

Variables required for sample size calculation	The association of Internet engagement and weight parameters	The association of Internet engagement and academic performance
Two-sided confidence interval	95%	
Power of study	80%	
Ratio control to cases	1.0	
% control exposed	45%	15%
% cases with exposure	20%	50%
Odds ratio	0.59	1.76
Total sample size calculated	512	688

Based on the sample size calculation, the minimum sample size required for the study was 688. However, 720 subjects were selected as study participants to increase the precision of the study and the accuracy of the findings. The power of the study will be explained in results chapter section 4.1.3 of the thesis.

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3.4 ETHICAL CLEARANCE

Ethical clearance for this study was obtained from the University Malaya Medical Centre with the protocol number of 00011175 (refer to appendix C). Approval for academic data collection was obtained from the Ministry of Education Malaysia. Subsequently, approval was also received from the Education Department of Kuala Lumpur, Selangor, and Perak. Finally, approval was sought from all 15 schools involved in the study, prior to the collection of academic performance data. This data were collected only after all approvals had been obtained.

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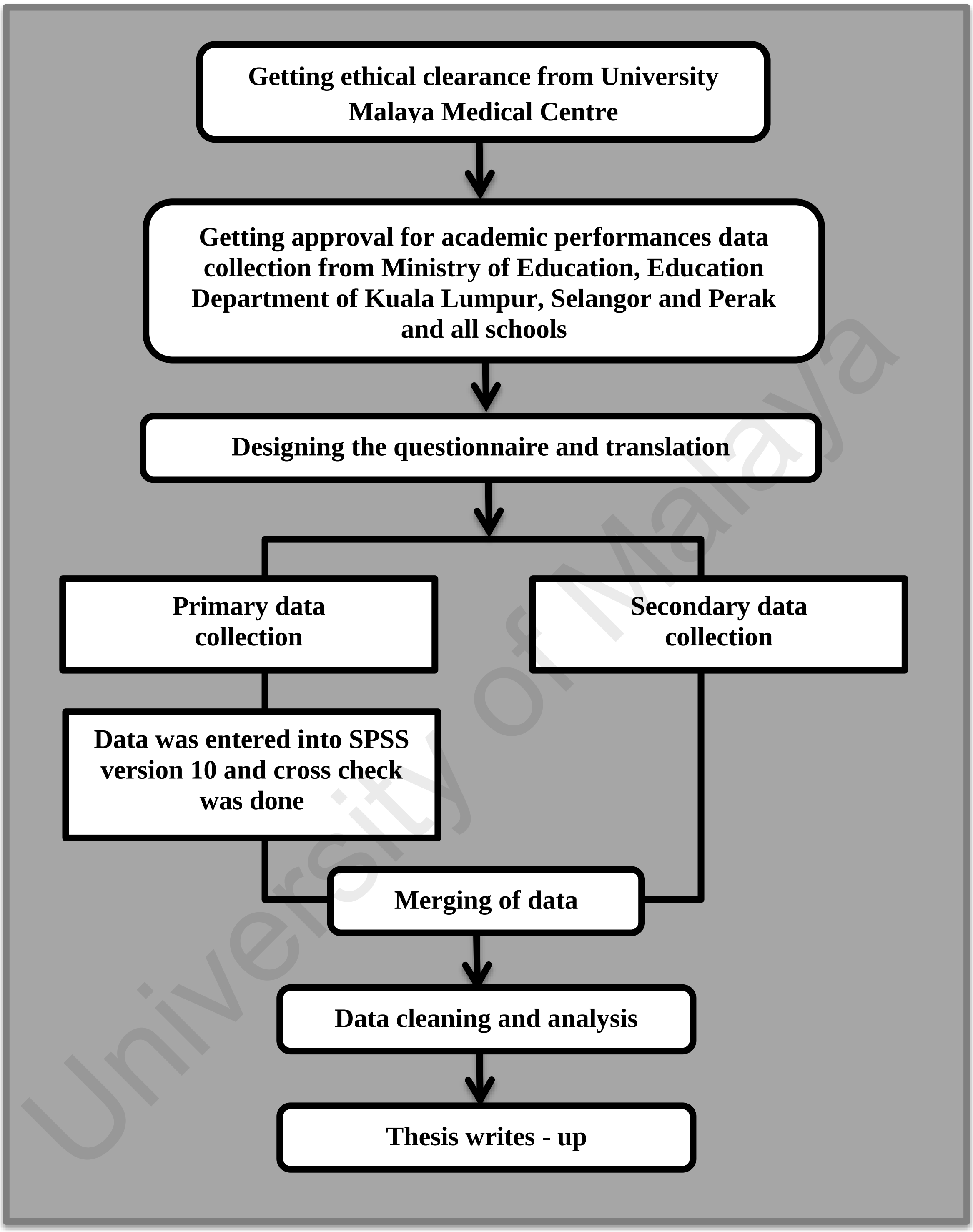

Figure 3.1: The study flow chart

3.5 SECONDARY DATA COLLECTION

Primary and secondary data were used in this study. Almost all data were secondary except for schools' locality and academic performance data (which were primarily collected from all schools). All secondary data were taken from the MyHeART study's second wave of data collection (in 2014).

3.5.1 The Recruitment and Protocol of MyHeART Study

A detailed training protocol was developed for all data collection tools. Prior to the start of data collection, training was organized for all enumerators who were involved in data collection at the selected schools. Each numerator received orientation and hands-on training on different and specific data collection tools.

Before conducting the MyHeART study, two feasibility studies (one each in an urban and a rural school) were conducted. Following each feasibility study, the research and field teams discussed the potential problems and tried to find solutions. Based on these findings, the data collection tools were finalized. Intensive monitoring of the data collection process by enumerators was done by the primary investigator (PI) and Co-PIs. Every effort was made to ensure collection of the highest quality data possible.

All students who were invited to join the study were given a consent form along with an information sheet. The information sheet included detailed information about the study to help the students and their parents decide whether to participate. Students who returned the consent form with parental agreement were allowed to participate.

For each participant in the MyHeART study, the data that were collected included anthropometric measurements (height, weight, waist circumference, hip circumference, and body fat analysis), blood pressure examination, blood investigations, and self-administered questionnaires. The questionnaire had many parts: socio-demographic background, lifestyle (including level of physical activity and sleeping practice), high-

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risk behaviours (smoking, alcohol, drugs, and Internet and electronic usage), and sexual reproductive health.

3.5.2 Study Instruments of MyHeART Study

Secondary data were collected first in 2014, followed by collection of primary data in 2015. Because the data collection began with secondary data, the tools used for secondary data collection will be explained first.

The secondary data from the MyHeART study were data from anthropometric measurements and the self-administered questionnaires. Anthropometric measurements captured height, weight, body fat percentage, and waist circumferences for this study's participants. The data from the self-administered questionnaires were related to socio-demographic background, lifestyle (including level of physical activity and sleeping practice), and high-risk behaviours (including Internet access, electronic devices, and time spent on Internet activities and other sedentary behaviours; activities included doing homework, television viewing, and playing electronic games).

The primary data were the academic performance data and the locality of the schools. Information below describes the anthropometric measurements, how the questions were asked in the self-administered questionnaire, and the primary data that had been collected.

3.5.2.1 Anthropometric measurements

The anthropometric measurements from participants were weight, height, body fat percentage, and waist circumference.

1. Weight: A calibrated digital electronic weighing scale (Seca 813, Seca, United Kingdom, UK) was used for measuring participants' weight. The scale was placed on a hard, flat surface and kept in "zero" position before each measurement.

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Participants were asked to remove shoes and socks, extra clothing, and items in their pockets. Then, participants were asked to stand straight on the scale with head looking forward, arms hanging freely by the sides of the body, and palms facing towards the thighs. The enumerator recorded the weight to the nearest 0.1 kilogram (kg).

2. Height: A calibrated, vertical stadiometer (Seca Portable 217, Seca, UK) was used to measure height. It is a standing height board with a movable headpiece (sliding horizontal rod that adjusts to rest on the head) that is perpendicular to the vertical backboard ruler. The stadiometer was placed on a hard floor, and during the measurement, the enumerator asked participants to remove their shoes, socks, and other heavy outer garments. Participants were then asked to stand straight (parallel to the stadiometer), on the footplate, with buttock, shoulder blades, the back of the head touching the flat upright surface of the stadiometer and the arms were hanging freely by the sides The participants were then asked to face forward with head parallel to the horizontal headpiece of the stadiometer. The headpiece of the stadiometer was brought down to the participants' uppermost point of the head until it firmly touched the head with sufficient pressure to compress the hair. The enumerator took the reading of the height from eye level and recorded the reading to the nearest 0.1 centimetre (cm). Using SPSS, the height was converted to meters (for BMI calculation) (Cole, Bellizzi, Flegal, & Dietz, 2000).

3. Body fat percentage: A portable body composition analyser (Tanita SC-240 MA, Body Composition Analyser, Tanita Europe B.V., The Netherlands) was used to

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measure participants' body fat composition. The analyser was placed on a hard, even floor, and participants were asked to remove shoes and socks, heavy or extra clothing, and items in their pockets. Participants' age, gender, and height were entered in the analyser before measurement. Then, participants were asked to stand straight on the analyser with head looking forward, arms straight 90 degrees from the body, and hand holding the analyser's electrode. The enumerator recorded the figure displayed on the analyser to the nearest 0.1%.

4. Waist circumference: Waist circumference was measured using ergonomic circumference measuring tape (Seca 201, Seca, UK). Privacy was maintained while taking the measurement because participants were asked to loosen their belts, slightly lower the pants and underclothing, and hold up their shirt during measurement. Waist circumference was measured at the midpoint between the lowest rib margin and the iliac crest. The reading was recorded to the nearest millimetre (mm).

3.5.2.2 Self-administered questionnaire

This sub-topic describes in detail the questions in the self-administered questionnaire that were asked of all study participants.

1. Socio-demographic background: age, date of birth (for accurate calculation of age), gender, and ethnicity. Participants were given a choice of answers for gender and race questions. For gender, participants were asked, 'What is your gender?' and given the choice of either male or female. As for race, participants were asked,

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'What is your race?' and options were given as Malay, Chinese, Indian, and Other. Participants who choose Other needed to specify the name of their race.

2. Level of physical activity: self-report by the Malay version of the Physical Activity Questionnaire for Older Children (PAQ-C). This version of the questionnaire had been validated in previous studies (Dan, Mohd, & Zalilah, 2011; Kowalski, Crocker, & Faulkner, 1997). The questionnaire assessed the level of physical activity in the last 7 days and consisted of 10 questions, as follows. 1) 'Have you done any of the following activities in the past seven days (last week) in your spare time? If yes, how many times per week?' Participants were given a list of recreational/sports activities (such as skipping, rollerblading/skating, hide and seek, walking, bicycling, etc.) and were asked to tick only one of the options, then expressing frequency using 'no', '1-2', '3-4', '5-6', and '7 or more'. 2) 'In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)?'. Answer options were 'I don't do PE', 'hardly ever', 'sometimes', 'quite often', and 'always'. 3) 'In the last 7 days, what did you do most of the time at recess?'. Options were 'sat down (talking, reading, doing schoolwork)', 'stood around or walked around', 'ran or played a little bit', 'ran around and played quite a bit', and 'run and played hard most of the time'. 4) 'In the last 7 days, what did you normally do at lunch (besides eating lunch)?'. Participants chose among 'sat down (talking, reading, doing schoolwork)', 'stood around or walked around', 'ran or played a little bit', 'ran around and played quite a bit' and 'run and played hard most of the time'. 5) 'In the last 7 days, on how many days right after school did you do sports, dance, or play games in which you were very active?'. Options were 'none', '1 time last week', '2 or 3 times last week', '4 times last week', and '5 times or more last week'. 6) 'In the

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last 7 days, on how many evenings did you do sports, dance, or play games in which you were very active?'. Participants chose among 'none', '1 time last week', '2 or 3 times last week', '4 times last week', and '5 times or more last week'. 7) 'During the last weekend, how many times did you do sports, dance, or play games in which you were very active?'. Choices were 'none', '1 time last week', '2 or 3 times last week', '4 times last week', and '5 times or more last week'. 8) 'Which one of the following describes you best for the last 7 days?'. Participants were asked to read these five statements and answer which best described them: 'all or most of my free time was spent doing things that involved little physical effort', 'I sometimes (1-2 times last week) did physical activities in my free time (for example: played sports, went running, swimming, bike riding, did aerobics)', 'I often (3-4 times last week) did physical activities in my free time', 'I quite often (5-6 times last week) did physical activities in my free time', and 'I very often (7 or more times last week) did physical activities in my free time'. 9) 'Mark how often you did physical activities (like playing sports, games, doing dance, or other physical activity) for each day last week?'. Participants were given a list of all days and asked to tick only one of the options for each, among 'none', 'little bit', 'medium', 'often', and 'very often'. 10) 'Were you sick last week, or did anything prevent you from doing your normal physical activities?'. Participants were asked to answer either 'yes' or 'no', and to provide detail if they answered 'yes'. The coding and categorization of the questions are further described in a further section.

3. Sleeping practice. Participants were asked four questions for sleeping practice to determine their sleep duration: 1) 'What time do you normally go to sleep when

the next day is a school day?' 2) 'What time do you normally go to sleep when the next day is not a school day?' 3) 'What time do you normally wake up on a school day?' 4) 'What time do you normally wake up on a non-school day?'

4. Internet access and electronic devices. Participants were asked; 'Do you have access to the Internet at home?' (yes/no) and 'How frequently do you use the Internet?' (every day, once/few days in a week, once/few days in a month, once/few days in a year). Participants were also asked, 'How do you usually access the Internet?' (no access at all, home, friend's or relative's home, school, cybercafe, public wi-fi, other). Participants who chose 'other' were asked to specify the place. Participants were also asked, 'Do you have your own smartphone or tablet with an Internet data plan?' (yes/no).

5. Internet usage and time spent on the Internet. Participants were asked, 'How many hours per day (during school days and/or during weekends) for each of the Internet activities below' and were given a list of Internet-related activities to tally. The activities included online gaming, chatting via online chatting applications, social networking sites, video streaming, info searching, email, blogging, and other activity (for which participants were asked to specify).

6. Other screening activities. Participants were asked, 'How many hours per day (during school days and/or during weekends) for each of the activity below' and were given a list of screen-related activities that included television viewing and playing electronic games.

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7. Time spent on homework. Participants were asked, 'How many hours per day (during school days and/or during weekends) for homework', which required a fill-in answer.

3.6 PRIMARY DATA COLLECTION

Primary data were the academic performance of all participants involved in the second wave of the MyHeART study (2014), and the school's location (from the Department of Statistic Malaysia).

1. Academic performance. Academic performance data were the results of the national standardized year three secondary public school examination in Malaysia (*Pentaksiran Tingkatan 3*, PT3). This examination is compulsory for all year three public secondary schools students in Malaysia. The results were grades A-F, with grade A as being the highest score and grade F as the lowest score for each subject. Among the subjects were the Malay language (oral and written), English language (oral and written), mathematics, science, history, geography, and skills of life. A few students had taken additional subjects such as Islamic study and other languages (Mandarin, Tamil, and Arabic). For the present study, Malay language (written), English language (written), mathematics and science subjects were taken for analysis. Malay and English languages were chosen to be part of the analysis in view of the findings of other studies that found relationship of Internet usage with language skills (Lee & Wu, 2013; Liu, Kirschner & Karpinski, 2017). Mathematics and science were chosen to be part of analysis in view of findings from studies that suggest use of interactive media strongly contributed to children's visual-spatial skills in which is believed to be the

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foundation for learning in science, mathematics, technology and engineering (Green & Bavelier, 2007; Subrahmanyam et al., 2000). Although the previous studies were focusing on playing of electronic game, however as the Internet is one of the interactive media, the researcher wants to know if there was any association of Internet engagement with any of these subjects. Other subjects were not taken for analysis. The oral component for the Malay and English language were evaluated by the different examiners for each school. Therefore, the oral part of the language subjects were not taken for analysis as the researchers felt it is not standardized because the outcomes may differ depending on several factors such as the mother tongue of the students, the schools' locality and the evaluators. The history and geography subjects had component of coursework which the marking were by own school teacher. Therefore both of these subjects were also not considered standardized for analysis purposed. While skills of life subject were further being sub divided into three different components (cooking, sewing and wood work) and each students was only required to choose one of the skill. In view of the differences of the skills that were examined in the examination for each student, therefore this subject was not considered standardized for analysis purposed too. Islamic study and other languages (such as Mandarin, Tamil, and Arabic) were not taken for analysis because these subjects were not compulsory and very few of the students took the subjects for examination purposed.

2. School's locality. The school's locality was the area (urban or rural) in which the school was located. In Malaysia, state educational departments usually allocate students close to their house. Therefore the students' house and the school were usually within the same area. The locality was obtained primarily from the Department of Statistic.

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3.7 DATA MANAGEMENT

The collected data underwent the processes of data entry, cleaning, coding, and categorization. The detail process were described as below.

3.7.1 Data Entry

Primary data (academic performance) were entered using SPSS version 20 by the researcher. After entry, data were double checked for errors and consistency. Participant and school names were double checked to be accurate with MyHeART data.

Collected data from the second-wave MyHeART study were entered into Staticticial Package for Social Science (SPSS) version 19 by a research assistant from the MyHeART team. Each data set was rechecked by an independent person. The data with requested variables were then provided to the researcher for cleaning and analysis.

The primary and secondary data were then merged by the researcher. The data were double check to ensure the merging process and each data of the participants were correct and no error was made. The merging data were then being treated for missing data, cleaned and followed by analysis.

3.7.2 Data Access and Security

All primary data were kept in a locked cabinet and accessible only to the researcher. The secondary data were requested from the MyHeART principle investigator and provided in soft copy. All other data were available only as soft copy and kept on the researcher's private laptop. All data were treated as strictly confidential.

3.7.3 Data Cleaning and Treating of Missing Data

Data were collected from 1231 participants who volunteered to participate in the study. Twelve of the participants answered only the socio-demographic section without

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answering the remaining questions and, therefore, were excluded from the data. The data were then analysed for the missing values. From the covariance table, $p>0.05$ indicates that the missing value was entirely at random. After that, the data were cleaned. The participants with incomplete information on the essential variables were removed from the data. Thus, 37 participants were removed from the dataset.

The data were then checked for outliers by running the descriptive analysis. Extreme values and outliers were deleted for each continuous variable. After excluding the incomplete data, removal of outliers, and data cleaning, the total number of participants remaining was 720. Once the researcher was satisfied with the distribution for all outcome parameters (explained in section 4.1.4), the data underwent the process of categorisation and coding. The data were then weighted before analysis was performed as per the study objectives.

3.7.4 Data Categorization and Coding

This sub-topic further explains data coding and categorization prior to analysis.

1. Gender. Male coded as (1) and female as (2).

2. Ethnicity. Coded as Malay (1), Chinese (2), Other (3), and Indian (4). "Other" were mainly Orang Asli (aborigine people).

3. Schools' locality. Urban coded as (1) and rural as (2).

4. Internet engagement. From the question 'How frequently do you use the Internet?', the answer was coded into everyday (1), once/few days in a week (2), once/few days in a month (3), and once/few days in a year (4). This categorization was then regrouped to collapse the variables into fewer categories for a meaningful

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analysis. The categories were regrouped and recoded as regularly engage (1) and rarely engage (2). The regularly engage group was a combination of every day and once/few days in a week categories, while the rarely engage was a combination of once/few days in a month and once/few days in a year categories.

5. Time spent on the Internet. Calculated only for participants who regularly engaged on the Internet. Participants reported durations for Internet activities that included online gaming, chatting via online chatting applications, social networking sites, video streaming, info searching, email, blogging, and other activity (specified by participant). All Internet activity time for weekdays and weekends was summed, and the hourly average was calculated using the formula below:

   $$\text{Average hour spent on Internet per day} = \frac{(\text{total time on weekdays x5}) + (\text{total time on weekends x2})}{7 \text{ days}}$$

   The hourly averages were then coded as more than or equal to 3 hours (1) and less than 3 hours (2).

6. Body mass index. BMI was calculated using weight (kg) divided by the square of height (m^2) and expressed as kg/m^2. Overweight and obesity was defined using the International Obesity Task Force criteria with extrapolation to adult BMI cut-offs of 25 kg/m^2 for overweight (with cut-off points of 23.28 kg/m^2 for males and 23.89 kg/m^2 for females) and 30 kg/m^2 for obesity (with cut-off points of 28.32 kg/m^2 for males and 29.01 kg/m^2 for females). Normal BMI ranges from 16.98%-23.27% for males and 17.43%-23.88% for females. Anything less than the normal range was considered as underweight (Cole et al., 2000). After all participants' BMIs were calculated, they were further categorized and coded into obese (1), overweight (2), underweight (3), and normal (4). This categorization was then

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regrouped to collapse the variables into fewer categories for a meaningful analysis. The categories were regrouped and recoded as overweight and obese (1) and non-obese (2). The overweight and obese group was a combination from obese and overweight groups, while the non-obese group was a combination of normal and underweight groups.

7. Body fat. The Tanita healthy body fat range for children (5-18 years old) chart was used as a reference for body fat percentage categories. Normal body fat percentage ranges from 10.4%-20.6% for males and 15.7%-29.8% for females. Anything less than the normal range was considered as having less body fat. Cut-off points for having high body fat were 20.7% for males and 29.9% for females. Cut-off points for being obese (extremely high body fat) were 25.0% for males and 33.8% for females (McCarthy, Cole, Fry, Jebb, & Prentice, 2006). All participants' body fat percentages were categorized and coded into obese (1), high body fat (2), less body fat (3), and normal (4). This categorization was then regrouped to collapse the variables into fewer categories for a meaningful analysis. The categories were regrouped and recoded as excess body fat (1) and healthy fat composition (2). The excess body fat group was a combination of obese and high body fat groups, while the health fat composition was a combination of normal and less body fat groups.

8. Waist circumference. Central obesity was defined by waist circumference ≥90th percentile according to waist circumference percentile curves for Malaysian children and adolescents. Cut-off points for having high waist circumference ≥90th percentile were 88.5 cm for males and 80.7 cm for females. Anything less than the cut-off point was considered to be normal (Poh et al., 2011). All

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participants' waist circumferences were categorized and coded into high (1) or normal (2).

9. Academic performance. The academic performances of the students were taken from the standardized national examination, PT3 (*Pentaksiran Tingkatan 3*). All year three Malaysian public secondary school students in Malaysia sat for this examination for the first time in 2014. The results were collected in 2015. The PT3 results that were given by the schools were in grade (grade A to F) for all subjects. Grade A being excellent, and grade F being not yet achieving the minimum standard. Therefore they were coded into grades A (1), B (2), C (3), D (4), E (5), and F (6). This categorization was then regrouped to collapse the variables into fewer categories for a meaningful analysis. The categories were regrouped and recoded as excellent (1), average (2), and failed (3) Excellent was a combination of grades A and B, average was a combination of grades C and D, and failed was a combination of grades E and F.

10. Aggregate. In an attempt to look at the overall academic performance, the grades for subjects (Malay and English language, mathematics, and science) were converted into a score-like figure: grade A = 1, grade B = 2, grade C = 3, grade D = 4, grade E = 5, and grade F = 6. The aggregate was achieved by calculating the score (grade) for each subject. Therefore, if the participants got A for all four subjects, the minimum aggregate was equal to four (1 x 4 = 4), and if the participants got F for all four subjects, the maximum aggregate was equal to 24 (6 x 4 = 24). The 4-24 score was then regrouped: above average (4-10), average (11-17), and below average (18-24). The categorization was coded as above average (1), average (2), and below average (3).

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11. Level of physical activity. Physical activity levels were self-reported by using the Malay version of the PAQ-C, which had been validated in previous studies (Dan, Mohd, & Zalilah, 2011; Kowalski, Crocker, & Faulkner, 1997). Before PAQ-C could be categorized and coded, the researcher needed to calculate the final PAQ-C score (the mean scores for items 1 to 9). The PAQ-C consists of 10 items (based on 10 questions), in which only items 1-9 were used for PAQ-C score calculation. The first item asked about the frequency of multiple types of sports or games that the participants did during spare time for the past 7 days. The answers came in five choices (participants had to choose one) ranging from 'no' (scored as 1) to '7 times or more' (5). The mean for all activities was calculated to form a composite score for item 1. Items 2-8 assessed activity during physical education (PE) classes, recess, lunch time, right after school, evenings, weekends, and leisure time. These answers came in five scales where choices ranged from 'the lowest activity response' (scored as 1) to 'the highest activity response' (5). Item 9 asked about the regularity of physical activities that the participants did for each day during the last week. The answers came in five scales for choices ranging from 'none' (1) to 'very often' (5). The mean scores of activity regularity for all days within the week were calculated to form a composite score for item 9. The last item on the PAQ-C was not used. Item 10 asked if the participants were sick or otherwise prevented from normal physical activity for the past seven days. The mean score of items 1-9 (in which items 1 and 9 were composite scores) was the final PAQ-C score. The mean score was further categorized into low (below 2.33), moderate (2.33-3.66), and high (above 3.66) physical activity (Crocker et.al., 1997). All participants' physical activity levels were then categorized and coded into low (1), moderate (2), and high (3). This categorization was then regrouped

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to collapse the variables into fewer categories for a meaningful analysis. The categories were regrouped and recoded as low (1) and moderate and high (2) (a combination of these two categories).

12. Sleeping duration. The sleeping duration on weekdays and weekends were calculated from four questions ('What time do you normally go to sleep when the next day is a school day?' 'What time do you normally wake up on a school day?' 'What time do you normally go to sleep when the next day is a not a school day?' 'What time do you normally wake up on a non-school day?'). The average daily hours of sleep were then calculated using the formula below:

$$\text{Average sleeping duration per day} = [\,(\text{sleep duration on weekdays} \times 5) + (\text{sleep duration on weekends} \times 2)\,] \div 7 \text{ days}$$

Average sleeping durations per day (in hours) were then coded as 3–6 (1), ≥ 9 (2), and 6–9 (3).

13. Time spent on television viewing. This was calculated from the question 'How many hours per day (during school days and/or during weekends) do you spend for television viewing?'. Daily averages were then calculated using the formula below:

$$\text{Average hour television viewing per day} = \frac{[\,(\text{television viewing on weekdays} \times 5) + (\text{television viewing on weekends} \times 2)\,]}{7 \text{ days}}$$

Average daily television viewing (in hours) was then coded as ≥ 2 (1) and < 2 (2).

14. Time spent on playing electronic games. This was calculated from the question 'How many hours per day (during school days and/or during weekends) do you spend for playing electronic games?'. Daily averages were then calculated using the formula below:

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$$\text{Average hour for electronic gaming per day} = \frac{[\,(\text{playing electronic games on weekdays} \times 5) + (\text{playing electronic games on weekends} \times 2)\,]}{7\ \text{days}}$$

Average daily television viewing (in hours) was then coded as ≥ 1 (1) and < 1 (2).

15. Time spent on homework. The question 'How many hours per day (during school days and/or during weekends) do you spend for homework?' was analysed using the formula below:

$$\text{Average hour doing homework per day} = \frac{[\,(\text{doing homework on weekdays} \times 5) + (\text{doing homework on weekends} \times 2)\,]}{7\ \text{days}}$$

Average daily hours of homework were then coded as ≥ 2 (1) and < 2 (2).

3.8 OPERATIONAL DEFINITION

The operational definitions that the researcher used in this study were these:

1. Socio-demographic. Term used to combine three socio-demographic components (gender, ethnicity, and schools' locality).

2. Weight parameters. One of the measured outcomes, and used to explain the three weight parameters that were actually being measured (BMI, body fat percentage, waist circumference).

3. Academic performance. One of the measured outcomes, and used to explain the two parameters that were actually being measured (aggregate and grades categorization for Malay language, English language, mathematics, and science

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subjects). The calculation, categorization, and coding of the aggregate are explained in detail under Data Coding and Categorization (3.4.4).

4. Internet engagement. Regularity of Internet engagement measured by frequency (every day, once/few days per week, once/few days per month, once/few days per year). Participants were considered to be regularly engaged when they chose everyday or once/few days per week. Those who not engaged on a weekly basis were considered as rarely engaged.

5. Time spent on other screening activities. Average time spent per day on other screening activities such as television viewing and electronic gaming.

3.9 STUDY VARIABLES

All variables and parameters are explained below under three domains; socio-demographic, weight parameters, and academic performance.

3.9.1 Socio-demographic variables

Socio-demographic domain variables were categorized into independent variables (gender, ethnicity, school locality) and a dependent variable (Internet engagement).

3.9.2 Weight parameters

Weight parameters domain variables were categorized into independent variables (‘Internet engagement’ and ‘average time spent on the Internet per day’), dependent variables (BMI, percentage of body fat, waist circumference) and confounders. Confounders comprised socio-demographic data (see above), level of physical activity

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(PAQ-C score), time spent on other screening activities (television viewing and playing electronic games), and sleep duration.

3.9.3 Academic performances

The independent variables were 'Internet engagement' and 'average time spent on the Internet per day'. The dependent variables were the aggregate (overall academic performance) and grade categorization for each subjects. Malay language, English languages, mathematics, and science subjects were analyzed in this study. The confounders were socio-demographic data (see above), level of physical activity (PAQ-C score), time spent on homework, time spent on other screening activities (television viewing, electronic gaming), and sleep duration.

3.10 WEIGHTAGE OF THE DATA

Due to the complex nature of sampling (multistage sampling), complex analysis was also used to analyse all data of this study (Farid et al., 2016). A weightage calculation is necessary before complex analysis can be carried out. This sub-topic describes the weightage calculation process in detail. The weightage of the schools was calculated based on the number of schools in the strata. The strata were divided into the school's area (Kuala Lumpur, Perak, Selangor) and the school's locality (urban or rural), as shown in Table 3.2.

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Table 3.3: School strata

School area	Kuala Lumpur	Perak		Selangor	
School locality	Urban	Urban	Rural	Urban	Rural
Total number of schools in the list	96	114	124	188	73
Schools that were excluded	4	6	25	18	16
Total number of schools in the strata	92	108	99	170	57
Selected schools	3	1	6	4	1

The sampling process involved the selection of the schools and students from the schools. Therefore the weightage was calculated based on the weightage of the schools and the study participants. The weightage of the schools was calculated based on the total number of the schools in the strata of the schools' area and locality, while the participants' weightage was measured by total number of form 3 students in each school and total number of respondents within each school. The final weightage was calculated for each school because each participant within the same school shared similar weightage. The weightage of schools was calculated as below:

$$\text{Weightage of schools} = \frac{\text{Total no of schools in the strata (within sample frame)}}{\text{Total no of selected schools in the strata}}$$

Based on this formula above, the calculated weightages are shown in Table 3.3.

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Table 3.4: School weightage

Schools	Total no of schools within sample frame	No of selected schools in the strata	School weightage
SMK Bagan Terap	57	1	57.0
SMK Bukit Jelutong	170	4	42.5
SMK Dato'Abu Bakar Baginda	170	4	42.5
SMK Datok Lokman	92	3	30.7
SMK Desa Petaling	92	3	30.7
SMK Mudzaffar Shah	99	6	16.5
SMK Pinji	108	1	108.0
SMK Raja Lope Nor Rashid	99	6	16.5
SMK Sayong	99	6	16.5
SMK Seri Permaisuri	92	3	30.7
SMK Sultan Abdul Aziz Shah	170	4	42.5
SMK Sultan Tajul Ariffin	99	6	16.5
SMK Tapah	99	6	16.5
SMK Tasek Permai	170	4	42.5
SMK Tun Perak	99	6	16.5

The weightage of the participants was calculated based on the total form 3 students in the selected schools over the total number of students who participated in the study:

$$\text{Weightage of participants} = \frac{\text{Total no of form 3 students in the schools}}{\text{Total no of respondents in the school}}$$

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Based on this formula, the calculated weightage of the participants is shown in Table 3.4.

Table 3.5: Participants' weightage

Schools	Total no. of form 3 students in the schools	Total no. of respondents in the schools	Participants' weightage
SMK Bagan Terap	150	99	1.51
SMK Bukit Jelutong	414	55	7.53
SMK Dato'Abu Bakar Baginda	258	83	3.11
SMK Datok Lokman	315	69	4.57
SMK Desa Petaling	236	95	2.48
SMK Mudzaffar Shah	175	63	2.78
SMK Pinji	224	69	3.25
SMK Raja Lope Nor Rashid	240	107	2.24
SMK Sayong	96	79	1.22
SMK Seri Permaisuri	252	76	3.32
SMK Sultan Abdul Aziz Shah	445	138	3.22
SMK Sultan Tajul Ariffin	116	91	1.27
SMK Tapah	49	43	1.14
SMK Tasek Permai	158	46	3.43
SMK Tun Perak	163	118	1.38

The final weightage was calculated using this formula:

Final weightage = weightage of the schools x weightage of the participants

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Table 3.5 summarizes the final weightage for each school (shared by the participants).

Table 3.6: Final weightage

Schools	Schools' weightage	Students' weightage	Final weightage
SMK Bagan Terap	57.0	1.51	86.1
SMK Bukit Jelutong	42.5	7.53	320.0
SMK Dato'Abu Bakar Baginda	42.5	3.11	132.2
SMK Datok Lokman	30.7	4.57	140.3
SMK Desa Petaling	30.7	2.48	76.1
SMK Mudzaffar Shah	16.5	2.78	45.9
SMK Pinji	108.0	3.25	351.0
SMK Raja Lope Nor Rashid	16.5	2.24	37.0
SMK Sayong	16.5	1.22	20.1
SMK Seri Permaisuri	30.7	3.32	101.9
SMK Sultan Abdul Aziz Shah	42.5	3.22	136.9
SMK Sultan Tajul Ariffin	16.5	1.27	21.0
SMK Tapah	16.5	1.14	18.8
SMK Tasek Permai	42.5	3.43	145.8
SMK Tun Perak	16.5	1.38	22.8

3.11 DATA ANALYSIS

Descriptive, bivariate, and multivariate analyses were used for this study. Each table in the results chapter shows unweightage and weightage part of the results. The weightage part of the results were described above, and the statistical tests are described below.

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3.11.1 Socio-demographic data

a) Descriptive analysis was used to determine the prevalence of Internet engagement among Malaysian adolescents. The descriptive analysis will be used to determine the socio-demographic distribution of the participants and its estimation in the population.

b) Bivariate analysis was used to examine the associations of socio-demographic distribution (gender, ethnicity, and schools' locality) with Internet engagement among the adolescents. Chi square tests were used for the association involving gender and schools' locality. Logistic regression tests were used for ethnicity.

3.11.2 Weight parameters

a) Descriptive analysis was used to determine the frequency and percentages of weight parameters of the study participants and its estimation in the population.

b) Bivariate analysis was used to determine the association of Internet engagement among the adolescents with each of the weight parameters. Bivariate analysis was also used to determine the crude association of the average daily time spent on the Internet with weight parameters (before and after separation of the association by gender). This analysis was also used to determine the crude association of the average daily time spent on the Internet with each component of body fat percentage.

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c) Multivariate analysis was used to determine the adjusted association of the average time daily spent on the Internet with weight parameters (controlling for socio-demographic data, level of physical activities, sleeping duration, and time spent on other screening activities), before and after the separation of the association by gender. This analysis was also used to determine the adjusted association of the average daily time spent on the Internet with each component of body fat percentage.

3.11.3 Academic performances

a) Descriptive analysis was used to determine the distribution of academic performance among the adolescents and its estimation in the population.

b) Non-parametric test (Kruskal-Wallis) was used to find the difference in aggregate based on the grouping of average daily time (in hours) spent on the Internet (0, <3, ≥ 3). A non-parametric test was chosen in view of the data being not normally distributed.

c) Bivariate analysis was used to determine the association of Internet engagement with academic performances. Bivariate analysis was also used to determine the crude association of the average time spent on the Internet per day with the academic performances.

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d) Multivariate analysis was used to determine the adjusted association of the average daily time spent on the Internet with academic performance (controlling for socio-demographic data, level of physical activities, sleeping duration, and time spent on homework and other screening activities).

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CHAPTER 4: RESULTS

The analysis and findings in this chapter are to fulfill the objectives of the study. The descriptive, bivariate and multivariate analyses were used to provide the results. Complex analyses were added to generate weightage results (estimation of the population) in view of the multistage sampling design used in this study. This chapter is divided into four subtopics; data of this study, socio-demographic, weight parameters and academic performance.

4.1 DATA OF THIS STUDY

In section 3.2, 15 schools were selected to participate in the study (as shown in Table 3.1). All students who studied in those schools were invited to join the study. They were given a consent form along with an information sheet. The information sheet included detailed information about the study to help the students and their parents decide whether to participate. Students who returned the consent form with the parental agreement were allowed to participate in the study. Below are the detailed calculations of the response rate, the measurement of the central tendency, socio-demographic distribution of non-respondents and power of the study.

4.1.1 Response Rate

The response rate for each school was calculated based on the formula:

$$\text{Response rate} = \frac{\text{Total no of respondents in the schools}}{\text{Total no of third-year students in the school}} \times 100\%$$

Based on the above formula, the calculated response rate for each school is shown in the Table 4.1 below:

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Table 4.1: Response rates for all schools

Schools	Total no. of third-year students in the school	Total no. of respondents in each school	Response rate (%)
SMK Bagan Terap	150	99	66.0%
SMK Bukit Jelutong	414	55	13.3%
SMK Dato'Abu Bakar Baginda	258	83	32.3%
SMK Datok Lokman	315	69	21.9%
SMK Desa Petaling	236	95	40.3%
SMK Mudzaffar Shah	175	63	36.0%
SMK Pinji	224	69	30.8%
SMK Raja Lope Nor Rashid	240	107	44.6%
SMK Sayong	96	79	82.3%
SMK Seri Permaisuri	252	76	30.2%
SMK Sultan Abdul Aziz Shah	445	138	31.0%
SMK Sultan Tajul Ariffin	116	91	78.4%
SMK Tapah	49	43	87.8%
SMK Tasek Permai	158	46	29.1%
SMK Tun Perak	163	118	72.4%

From the table above, the response rate by each school ranged from 13.3% to 87.8%. The average response rate for all schools was calculated based on the formula:

$$\text{Average response rate (for all selected schools)} = \frac{\text{Total \% of response rate in all schools}}{\text{15 schools}}$$

Based on the above formula, the calculated average response rate for all schools was 46.4%. The researcher did not explore the reasons for students' non-participation. The

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attrition rate was not being calculated in view of the cross-sectional study design of this study. Nevertheless, the attrition rate for MyHeART study could be obtained from Majid et al., 2016.

4.1.2 Socio-demographic Distribution of Non-Respondent

The relatively low response rate indicating that the number of non-respondents was high. The socio-demographic distribution of the non-respondents was calculated. The attrition rate was not calculated in view of the cross-sectional study design of this study. Nevertheless, the attrition rate for the MyHeART study could be obtained from Majid et al. (2016).

The percentage of non-respondents based on their socio-demographic details was calculated based on the formula:

$$\%\text{ of non-respondents} = \frac{\text{Total no of sample frame} - \text{study respondent}}{\text{Total no of the sample frame}} \times 100\%$$

Table 4.2: The frequency and percentage of socio-demographic distribution of non-respondents (n=3291)

		Total sample frame (n=3291)	Study respondent (n=1231)	Total number of non-respondents (n=2060)	The % of non-respondents
Gender	Male	1661	474	1187	71.5%
	Female	1630	757	873	53.6%
Schools' locality	Urban	2302	633	1669	72.5%
	Rural	989	598	391	39.5%
Ethnicity	Malay	2561	972	1589	62.0%
	Chinese	357	87	270	75.6%
	Indian	268	108	160	59.7%
	Other	105	64	41	39.0%

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The table above showed the percentage of non-respondents based on their socio-demographic distribution. From Table 4.2, the highest percentage of non-respondents was observed among Chinese students (75.6%), students who lived in the urban area (72.5%) and male students (71.5%). The lowest percentage of non-respondent was other ethnicity (39.0%) and students who lived in the rural area (39.5%).

4.1.3 Power of the Study

In view of the high percentage of non-respondents in this study, the power of the study was calculated backwards using OpenEpi software version 3. The calculation is based on the actual number of samples obtained in this study and the results of weight parameters (Table 4.9) and academic performance (aggregate) in Table 4.16. The following table presents a summary of the calculation:

Table 4.3: Power of study calculation

Variables	No of cases	No of controls	% of cases with exposure	% of control exposed	Approximate power* of study
BMI (n=614)	141	473	11.2%	42.7%	100.00%
Body fat percentage (n=614)	215	399	17.1%	36.8%	99.96%
Waist circumference (n=614)	88	526	7.3%	46.6%	100.00%
Aggregate (excellent), (n= 510)	108	402	11.2%	35.1%	99.98%
Aggregate (average), (n=612)	210	402	15.5%	29.2%	96.6%

*All calculated powers were based on 95% confidence interval

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Table 4.3 showed the power of this study ranged from 96.6% to 100.0%. This indicates that the study will detect an effect if it was present to be detected. The probability of making a Type II error is therefore very low.

4.1.4 The Measurement of the Central Tendency

The dataset consists of many outcomes which made it difficult to achieve normal distribution for all outcome parameters. In order to normalise the distribution of the outcome variables, the extreme values and outliers for each outcome variable were removed leaving some 720 participants. Although many attempts had been made to normalise the dataset, the normal distribution for all outcome parameters cannot be obtained in a single dataset. After achieving acceptable distribution for all measured parameters, the researcher decided to continue with the dataset which was not normally distributed and proceeded to analyze it as it was. Below is the table for measurement of the central tendency and its normality test results.

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Table 4.4: The central tendency of outcome variables of the dataset (n=720)

Outcome variables	Median	Mean (±SD)	Skewness	Kurtosis	Kolmogorov-Smirnov
Body mass index	19.840	21.022 (±4.711)	1.281	1.636	$p < 0.001$
Body fat percentage	24.050	24.207 (±11.516)	0.122	0.435	$p = 0.007$
Waist circumference	68.750	71.548 (±11.063)	1.082	0.930	$p < 0.001$
Aggregate (academic performances)	18.000	17.443 (±5.380)	-0.603	-0.681	$p < 0.001$

From Table 4.4, the median for BMI was 19.840 indicating that at least 50% of the participants were having a BMI of 19.84 (within the normal range BMI for both male and female). The mean BMI for the participants was 21.022 with a standard deviation of 4.711. The skewness of the BMI data were 1.282 which was >1, hence the data were slightly skewed to the right. The kurtosis of the BMI data were 1.636 which was >1, hence the data were leptokurtic. For the test of normality, since the sample size is 720, the Kolmogorov-Smirnov test was used. The normality test showed $p<0.001$, hence the BMI data were not distributed normally.

From Table 4.4, the median for body fat percentage was 24.050 indicating that at least 50% of the participants were having body fat percentage of 24.05% (within the normal range body fat percentage for female, but excess body fat percentage for male). The mean body fat percentage for the participants was 24.207, with a standard deviation of 11.516. The skewness of the body fat percentage data were 0.122, which was within ±1, hence the data can be assumed to be symmetrical. The kurtosis of the body fat percentage data were 0.435 which within ±1, hence the data can be assumed to be mesokurtic. For the test of normality, since the sample size is 720, the Kolmogorov-Smirnov test was used. The normality test showed that $p=0.007$, hence the body fat percentage data were not distributed normally.

From Table 4.4, the median for waist circumference was 68.75cm indicating that at least 50% of the participants were having a waist circumference of 68.75cm (within the normal range waist circumference for both male and female). The mean waist circumference for the participants was 71.548cm with a standard deviation of 11.063. The skewness of the waist circumference data were 1.082, which was >1, hence the data were slightly skewed to the right. The kurtosis of the waist circumference data were 0.930, which within ±1, hence the data can be assumed to be mesokurtic. For the test of normality, since the sample size is 720, the Kolmogorov-Smirnov test was used. The

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normality test showed that p<0.001, hence the waist circumference data were not distributed normally.

From Table 4.4, the median aggregate was 18.000, indicating that at least 50% of the participants were having an aggregate of 18.000 (within below average range of aggregate). The mean aggregate for the participants was 17.443, with a standard deviation of 5.380. The skewness of the aggregate was -0.603, which was within ±1, hence the data can be assumed to be symmetrical. The kurtosis of the aggregate was -0.681 which within ±1, hence the data can be assumed to be mesokurtic. For the test of normality, since the sample size is 720, the Kolmogorov-Smirnov test was used. The normality test showed that p<0.001, hence the aggregate data were not distributed normally.

Although the table above showed the median, mean and standard deviation of each outcome parameters, the median of the outcome variables were considered useable instead of mean, because the data were not normally distributed. The median of weight parameters were 19.84 kg/m2 for BMI, 24.05% for body fat percentage and 68.75cm for waist circumference. All outcomes in the academic performance were categorised except for aggregate for which the median was 18.00. All these parameters were then categorised according to the normal and abnormal cut-off points, in which some of the cut-off points differed for male and female adolescents (explained in the methodology chapter, section 3.7.4).

Even though the total participants suitable for analysis was 720, for the analysis of the association of time spent on the Internet with weight parameters and academic performance, only participants who engaged the Internet regularly were considered (n=614). Participants were considered to be regularly engaged the Internet if they engaged at least once or a few days in the week (usually on weekends) or daily. Those who engaged the Internet on a monthly or yearly basis (not weekly) were considered as rarely engaged the Internet (participants who spent 0 hours per day on the Internet). After removing those

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who rarely engaged the Internet, the total number of participants remaining for analysis was 614. Among those who regularly engaged the Internet, they were divided into the participants who spent an average of ≥3 hours per day on the Internet and the participants who spent an average of <3 hours per day on Internet. The detailed calculation of the time spent on the Internet had been mentioned in section 3.7.4.

In order to find the cut-off point for categorisation of each independent variable and confounder, the median for each variable was obtained after removing the participants who rarely engaged the Internet. The median for time spent on the Internet is 3.06 hours, median for time spent on television viewing is 1.79 hours and median for time spent in electronic gaming is 0.86 hours. All of the cut-off points categorised by the time spent on the Internet and other screening activities were based on the nearest hours to the median (three hours for time spent on the Internet, two hours for television viewing and one hour for electronic gaming).

4.2 SOCIO-DEMOGRAPHIC

This subtopic aimed to determine the prevalence of regular Internet engagement among Malaysian adolescents and to study the socio-demographic variation in relation to the Internet engagement among them. There are three important points to highlight in the socio-demographic subtopic of the results chapter.

4.2.1 Prevalence of the Regular Internet Engagement, Ownership of Mobile Phone/ Tablet and Distribution of Time Spent on the Internet

Frequency analysis was used to determine the prevalence of the adolescents who regularly engaged the Internet. The prevalence of adolescents who regularly engaged the Internet was 85.3% (n=614), while 14.7% (n=106) of the adolescents rarely engaged the Internet. Among those who regularly engaged the Internet, 53.9% (n=331) spent an

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average of ≥3 hours per day on the Internet while 46.1% (n=283) of them spent an average of <3 hours per day on the Internet. 71% (n=436) of the adolescents who engaged the Internet regularly had access to the Internet at home. 57.6% (n=415) of the participants admit having a mobile phone or tablet with a data plan, and 93.7% (n=389) of those who had mobile phones or tablets reported regularly engaging the Internet. 7.5% (n=54) of the adolescents admitted not having access to the Internet at all.

4.2.2 Socio-Demographic Distribution of Study Participants and Its Estimation in the Population

The frequency analysis was used to determine the number of participants and estimation in the population in relation to their socio-demographic distributions. The estimation in the population count was analysed using complex analyses. The frequency and percentages of socio-demographic distributions of the participants and estimation in the population are shown in Table 4.5.

Table 4.5: The frequency and percentage of the socio-demographic distribution of study participants and estimation in the population (n=720)

		No of study participants n (%)	Estimation in the population n (%)
		Non weightage count	Weightage count
Gender	Male	263 (36.5%)	27321 (35.7%)
	Female	457 (63.5%)	49253 (64.3%)
Schools' locality	Urban	376 (52.2%)	63560 (83.0%)
	Rural	344 (47.8%)	13014 (17.0%)

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Table 4.5 continued.

Ethnicity	Malay	554 (76.9%)	50246 (65.6%)
	Chinese	55 (7.6%)	6593 (8.6%)
	Indian	70 (9.7%)	15905 (20.8%)
	Other	41 (5.7%)	3830 (5.0%)

The table above showed the frequency and percentage of socio-demographic distribution of study participants and its estimation in the population. From the table, the percentage of socio-demographic distribution of study participants (non-weightage) was similar to the estimation in the population (weightage) except for schools' locality. Approximately 35.7% are male and 64.3% are female. Most of the adolescents were schooling in urban areas (83.0%) compared to rural areas (17.0%). The majority of the adolescents (65.6%) are Malay, followed by Indian (20.8%), Chinese (8.6%) and others ethnicity (5.0%).

4.2.3 The Association of the Socio-Demographic Characteristic with Internet Engagement among Adolescents

Binary analysis (chi-square and logistic regression) was used to compare the socio-demographic characteristics between adolescents who regularly or rarely engaged the Internet, as shown in Table 4.6.

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Table 4.6: The association of socio-demographic characteristic with regularity of Internet engagement among the adolescents (n=720)

		Regularly engaged on the Internet		Bivariate analysis OR (CI)	
		Yes	No	Non weightage	Weightage
Gender	Male	229 (37.3%)	34 (32.1%)	1.260 (0.812 – 1.955)	1.120 (0.582 – 2.152)
	Female	385 (62.7%)	72 (67.9%)	reference	reference
Schools' locality	Urban	342 (55.7%)	34 (32.1%)	2.663 (1.719 – 4.125)	2.175 (1.304 – 3.628)
	Rural	272 (44.3%)	72 (67.9%)	reference	reference
Ethnicity	Malay	479 (78.0%)	75 (70.8%)	2.379 (1.332 - 4.251)	3.634 (1.795 – 7.356)
	Chinese	53 (8.6%)	2 (1.9%)	9.873 (2.188 - 44.552)	12.666 (2.634 - 60.900)
	Other	31 (5.0%)	10 (9.4%)	1.155 (0.476 – 2.802)	1.721 (0.433 – 6.842)
	Indian	51 (8.3%)	19 (17.9%)	reference	reference

The table showed the association of socio-demographic characteristic with the regularity of Internet engagement among the adolescents. From Table 4.6, there is no significant difference in the regularity of Internet engagement among male and female adolescents. However, there is a significant difference in the regularity of Internet engagement among schools' locality and ethnicity of the adolescents. Adolescents schooling in urban areas were 2.663 times more likely to engage the Internet regularly compared to those who studied in rural areas (OR=2.663, CI=1.719-4.125). Chinese

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adolescents were 9.873 times more likely to engage regularly on the Internet compared to Indian adolescents (OR=9.873, CI=2.188-44.552). Malay adolescents were 2.379 times more likely to engage regularly on the Internet compared to Indian adolescents (OR=2.379, CI=1.332-4.251).

4.3 WEIGHT PARAMETERS

This subtopic aims to identify the association of Internet engagement and time spent on the Internet with weight parameters among adolescents in Malaysia. In this subtopic, the overall distribution of study participants' weight parameters was analysed (Table 4.7), followed by the answer to the study objective (Tables 4.8 – 4.9). The association of the time spent on the Internet with weight parameters was then divided into gender (Tables 4.10 – 4.11). This division was due to evidence shown in previous studies in which positive findings were seen in females rather than males (Hume et al., 2009; Kautiainen et al., 2005). Further detailed analysis of the positive findings that were obtained (in Tables 4.10 – 4.11) had also been carried, as shown in Table 4.12.

4.3.1 The Distribution of the Weight Parameters among the Adolescents

Frequency analysis was used to determine the number of participants and estimation in the population in relation to their weight parameters.

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Table 4.7: The frequency and percentages of weight parameters of the participants and estimation in the population (n=720)

		No of study participants n (%)	Estimation in the population n (%)
Body mass index	Overweight and obese	165 (22.9%)	17475 (22.8%)
	Non – obese	555 (77.1%)	59099 (77.2%)
Body fat percentage	Excess body fat	256 (35.6%)	26519 (34.6%)
	Healthy fat composition	464 (64.4%)	50055 (65.4%)
Waist circumference	High	105 (14.6%)	9918 (13.0%)
	Normal	615 (85.4%)	66656 (87.0%)

Table 4.7 showed the frequency and percentage of weight parameters distribution among study participants and its estimation in the population. From the table above, the percentage of weight parameters distribution and estimation in the population was about the same for all parameters. The prevalence of having overweight and obese BMI is more than one-fifth of the population. The prevalence of having excess body fat is about one-third of the population. The prevalence of having high waist circumference among adolescents is 13.0%.

4.3.2 The Association of the Adolescents' Internet Engagement with Weight Parameters

Binary analysis (chi-square) was used to determine the association of the adolescents' Internet engagement with weight parameters. The Internet engagement compared between adolescents who regularly and rarely engaged the Internet.

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Table 4.8: The association of the adolescents' Internet engagement with weight parameters (n=720)

		Regularly engaged the Internet		Bivariate analysis OR (CI)	
		Yes	No	Non weightage	Weightage
Body mass index	Overweight and obese	141 (85.5%)	24 (14.5%)	1.018 (0.623 – 1.666)	1.451 (0.712 – 2.959)
	Non – obese	473 (85.2%)	82 (14.8%)	reference	reference
Body fat percentage	Excess body fat	215 (84.0%)	41 (16.0%)	0.854 (0.559 – 1.306)	1.021 (0.545 – 1.915)
	Normal fat composition	399 (86.0%)	65 (14.0%)	reference	reference
Waist circumference	High	88 (83.8%)	17 (16.2%)	0.876 (0.497 – 1.542)	1.019 (0.442 – 2.349)
	Normal	526 (85.5%)	89 (14.5%)	reference	reference

Table 4.8 showed the association of the Internet engagement with weight parameters. From the table above, there was no significant difference in the body mass index, body fat percentage and waist circumference among adolescents who regularly and rarely engaged the Internet. From the table above, there was no association of adolescents who regularly engaged on the Internet with being overweight and obese on BMI, compared to adolescents who rarely engaged on the Internet (OR: 1.451, CI: 0.712-2.959). Participants who regularly engaged on the Internet were found to have no association with excess body fat compared to participants who rarely engaged on the Internet (OR: 1.021, CI: 0.545-1.915). There was no association found for high waist circumference among

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adolescents who regularly engaged on the Internet compared to the adolescents who rarely engaged on the Internet (OR: 1.019, CI: 0.442-2.349).

4.3.3 The Crude and Adjusted Association of the Time Spent on the Internet and Weight Parameters

Following the findings in Table 4.8, binary analysis using chi-square (for crude) and multivariate analysis using logistic regression (for adjusted) were used to determine the association of the adolescents' time spent on the Internet (≥3 hours per day and < 3 hours per day) with weight parameters.

Table 4.9: The association of the adolescents' time spent on the Internet (≥3 hours per day and < 3 hours per day) with weight parameters (n=614)

				Crude* OR (CI)		Adjusted# OR (CI)	
		≥ 3 hours per day n (%)	< 3 hours per day n (%)	Non weight age	Weight age	Non weight -age	Weight -age
Body mass index	Overweight and obese	69 (48.9%)	72 (51.1%)	0.772 (0.530 – 1.125)	0.710 (0.431 – 1.170)	0.747 (0.502 - 1.111)	0.677 (0.394 – 1.164)
	Non – obese	262 (55.4%)	211 (44.6%)	reference	reference	reference	reference
Body fat percentage	Excess body fat	105 (48.8%)	110 (51.2%)	0.731 (0.524 – 1.019)	0.764 (0.491 – 1.189)	0.701 (0.493 – 0.997)	0.699 (0.433 – 1.127)
	Normal fat composition	226 (56.6%)	173 (43.4%)	reference	reference	reference	reference
Waist circumference	High	45 (51.1%)	43 (48.9%)	0.878 (0.559 – 1.380)	0.673 (0.373 – 1.217)	0.842 (0.524 – 1.353)	0.644 (0.333 – 1.245)
	Normal	286 (54.4%)	240 (45.6%)	reference	reference	reference	reference

*Crude model consists of bivariate analysis of time spent on the Internet (using 3 hours cut-off points, with reference to < 3 hours group) with weight parameters.

#Adjusted model consists of multiple regression analysis between time spent on the Internet (using 3 hours cut-off points, with reference to < 3 hours group) with weight parameters, after controlling for socio-demographic data (gender, race and schools' locality), level of physical activity (PAQ-C score), time spent on television viewing and playing electronic game and sleeping duration.

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Table 4.9 showed the association of the adolescents' time spent on the Internet with weight parameters. There is no significant association of time spent on the Internet with all weight parameters, except for adjusted, non-weightage analysis of body fat percentage. Participants who spent an average of ≥3 hours per day on the Internet had less likelihood of having excess body fat compared to the participants who spent <3 hours daily on the Internet (OR=0.701, CI=0.493-0.997), after controlling for confounders. The confounders of this study are socio-demographic data (gender, race and schools' locality), level of physical activity (PAQ-C score), time spent on television viewing and playing electronic games and sleeping duration. This association was only significant only within the study participants and became not significant after the estimation in the population. However, the significance was weak and close to one. Even if the result was statistically significant, the difference was small and thus may not be significant clinically.

4.3.4 The Association of the Adolescents' Time Spent on the Internet with Weight Parameters between Male and Female Adolescents

Following the findings in Table 4.9, the same association by the separation of gender was examined. Results from this analysis are shown in Tables 4.10 and 4.11. Binary (chi-square test) and multivariate analyses (logistic regression) were used to determine the association.

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Table 4.10: The association of the adolescents' time spent on the Internet (≥3 hours per day and < 3 hours per day) with weight parameters among male adolescents (n=263)

				Crude* OR (CI)		Adjusted# OR (CI)	
		≥ 3 hours per day n (%)	< 3 hours per day n (%)	Non weight age	Weight age	Non weight -age	Weight -age
Body mass index	Overweight and obese	24 (45.3%)	29 (54.7%)	0.560 (0.301 – 1.039)	0.545 (0.233 – 1.276)	0.550 (0.285-1.063)	0.476 (0.197 – 1.150)
	Non – obese	105 (59.7%)	71 (40.3%)	reference	reference	reference	reference
Body fat percentage	Excess body fat	29 (43.3%)	38 (56.7%)	0.473 (0.265 – 0.843)	0.468 (0.211 – 1.039)	0.471 (0.254 – 0.871)	0.355 (0.150 – 0.839)
	Normal fat composition	100 (61.7%)	62 (38.3%)	reference	reference	reference	reference
Waist circumference	High	16 (47.1%)	18 (52.9%)	0.645 (0.311 – 1.340)	0.642 (0.235 – 1.755)	0.678 (0.312 – 1.477)	0.635 (0.227 – 1.777)
	Normal	113 (57.9%)	82 (42.1%)	reference	reference	reference	reference

*Crude model consists of bivariate analysis of time spent on the Internet (using 3 hours cut-off points, with reference to < 3 hours group) with weight parameters among male adolescents.

#Adjusted model consists of multiple regression analysis between time spent on the Internet (using 3 hours cut-off points, with reference to < 3 hours group) with weight parameters among male adolescents, after controlling for socio-demographic data (gender, race and schools' locality), level of physical activity (PAQ-C score), time spent on television viewing and playing electronic game and sleeping duration.

Table 4.10 showed the association of the adolescents' time spent on the Internet with weight parameters among male adolescents. There is no significant association of time spent on the Internet with body mass index and waist circumference among male adolescents. However, significant findings are observed in the association of time spent on the Internet with body fat percentage among male adolescents. Participants who spent an average of ≥3 hours per day on the Internet had less likelihood of having excess body fat compared to the participants who spent <3 hours daily on the Internet (OR=0.355,

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CI=0.150-0.839, p<0.01). This association was significant within the study participants and during estimation of population, after controlling for the confounders (socio-demographic data (gender, race and schools' locality), level of physical activity (PAQ-C score), time spent on television viewing and playing electronic games and sleeping duration). However, it became insignificant on the binary analysis (crude) within the population (OR: 0.468, CI=0.211-1.039).

Table 4.11: The association of the adolescents' time spent on the Internet (≥3 hours per day and < 3 hours per day) with weight parameters in female adolescents (n=457)

				Crude* OR (CI)		Adjusted# OR (CI)	
		≥ 3 hours per day n (%)	< 3 hours per day n (%)	Non weight age	Weight age	Non weight -age	Weight -age
Body mass index	Overweight and obese	45 (51.1%)	43 (48.9%)	0.933 (0.580 – 1.502)	0.803 (0.432 – 1.490)	0.858 (0.516 - 1.428)	0.716 (0.368 – 1.393)
	Non – obese	157 (52.9%)	140 (47.1%)	reference	reference	reference	reference
Body fat percentage	Excess body fat	76 (51.4%)	72 (48.6%)	0.930 (0.616 – 1.403)	0.939 (0.548 – 1.608)	0.828 (0.531 – 1.288)	0.808 (0.454 – 1.437)
	Normal fat composition	126 (53.2%)	111 (46.8%)	reference	reference	reference	reference
Waist circumfe-rence	High	29 (53.7%)	25 (46.3%)	1.059 (0.595 – 1.886)	0.685 (0.329 – 1.427)	0.896 (0.486 – 1.650)	0.623 (0.277 – 1.401)
	Normal	173 (52.3%)	158 (47.7%)	reference	reference	reference	reference

*Crude model consists of bivariate analysis of time spent on the Internet (using 3 hours cut-off points, with reference to < 3 hours group) with weight parameters among female adolescents.

#Adjusted model consists of multiple regression analysis between time spent on the Internet (using 3 hours cut-off points, with reference to < 3 hours group) with weight parameters among female adolescents, after controlling for socio-demographic data (gender, race and schools' locality), level of physical activity (PAQ-C score), time spent on television viewing and playing electronic game and sleeping duration.

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Table 4.11 showed the association of the adolescents' time spent on the Internet with weight parameters among female adolescents. There is no significant difference of body mass index, body fat percentage and waist circumference, observed among female adolescents who spent an average of ≥3 hours per day on the Internet compared to the participants who spent <3 hours per day on the Internet.

4.3.5 The Association of Time Spent on the Internet with All Components of Body Fat Percentage among Male Adolescents

Following the findings in Table 4.10, a detailed analysis of each component within the body fat percentage was carried out. Binary (chi-square test) and multivariate analyses (logistic regression) were used to determine this association.

Table 4.12: The association time spent on the Internet (using 3 hours cut-off point) with all components of body fat percentage among male adolescents (n=263)

				Crude* OR (CI)		Adjusted# OR (CI)	
		≥ 3 hours per day n (%)	< 3 hours per day n (%)	Non weight age	Weight age	Non weight - age	Weight-age
Body fat percentage	Obese	19 (14.7%)	20 (20.0%)	0.769 (0.355 – 1.667)	0.840 (0.365 – 1.931)	0.751 (0.267 – 2.112)	0.634 (0.212 – 1.898)
	Excess body fat	10 (7.8%)	18 (18.0%)	0.450 (0.184 – 1.101)	0.431 (0.158 – 1.174)	0.458 (0.134 – 1.572)	0.306 (0.076 – 1.227)
	Less body fat	58 (44.9%)	28 (28.0%)	1.677 (0.885 – 3.176)	1.892 (0.942 – 3.800)	1.550 (0.663 – 3.622)	1.523 (0.636 – 3.650)
	Normal	42 (32.6%)	34 (34.0%)	reference	reference	reference	reference

*Crude model consists of bivariate analysis of time spent on the Internet (using 3 hours cut-off points, with reference to < 3 hours group) with all components of body fat percentage among male adolescents.

#Adjusted model consists of multiple regression analysis between time spent on the Internet (using 3 hours cut-off points, with reference to < 3 hours group) with all components of body fat percentage among male adolescents, after controlling for socio-demographic data (gender, race and schools' locality), level of physical activity (PAQ-C score), time spent on television viewing and playing electronic game and sleeping duration.

Table 4.12 described the association of time spent on the Internet with all components of body fat percentage among male adolescents. There is no significant association of time spent on the Internet with all components of body fat percentage among male adolescents. Adolescents who spent an average of ≥3 hours per day on the Internet had no association with being obese compared to adolescents who spent an average of >3hours per day on the Internet per day. Adolescents who spent an average of ≥3 hours per day on the Internet were not associated with having excess body fat compared to adolescents who spent an average of >3hours per day on the Internet per day. Adolescents who spent an average of ≥3 hours per day on the Internet were also found to have no association with having less body fat compared to adolescents who spent an average of >3hours per day on the Internet per day.

However, from table 4.12, the majority of the participants who spent an average of ≥3 hours per day on the Internet were having less body fat (44.9%). This explained the significant findings of body fat percentage in Tables 4.9 and 4.10 (in which male adolescents who spent an average of >3 hours per day on the Internet seems to have less likelihood of having excess body fat compared to the participants who spent <3 hours daily on the Internet).

4.4 ACADEMIC PERFORMANCE

This subtopic identifies the association of Internet engagement and time spent on the Internet with academic performance among adolescents in Malaysia. In this subtopic, the overall distribution of study participants' academic performance were analysed (Table 4.13), followed by the non-parametric tests which tested the difference of aggregate in between adolescents who rarely engaged the Internet, the adolescents who spent an average <3 hours per day on the Internet and the adolescents who spent an average ≥3

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hours per day on the Internet (Table 4.14). Two tables that followed after that were to answer the research objective (Table 4.15 and Table 4.16).

4.4.1 The Distribution of the Adolescents' Academic Performance

Within the subtopic of academic performance, only one continuous variable is aggregate. Frequency analysis was used to determine the number and percentage of study participants and its estimation in the population in relation to their academic performance. The estimation in the population count was analysed using complex analysis. In view of the multistage sampling design, each participant's weightage was calculated (refer to section 3.10). Based on the weightage of each participant in the study, complex analysis was used to calculate the estimation of the indices in the population.

Table 4.13: The frequency and percentages of academic performance of the study participants and its estimation in the population (n=720)

Subjects	Grade	No of study participants n (%)	Estimation in the population n (%)
Malay language	Excellent	233 (32.4%)	28758 (37.6%)
	Average	269 (37.4%)	28009 (36.6%)
	Failed	218 (30.3%)	19807 (25.9%)
English language	Excellent	123 (17.1%)	18989 (24.8%)
	Average	229 (31.8)	25393 (33.2%)
	Failed	368 (51.1%)	32192 (42.0%)

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Table 4.13 continued.

Mathematics	Excellent	98 (13.6%)	15819 (20.7%)
	Average	164 (22.8%)	19242 (25.1%)
	Failed	458 (63.6%)	41514 (54.2%)
Science	Excellent	41 (5.7%)	8705 (11.4%)
	Average	165 (22.9%)	22626 (29.5%)
	Failed	514 (71.4%)	45243 (59.1%)
Aggregate	Above average	108 (15.0%)	18634 (24.3%)
	Average	210 (29.2%)	22188 (29.0%)
	Below average	402 (55.8%)	35752 (46.7%)

Generally, the percentages of the study participants' academic performance were not necessarily close to its estimation in the population. This is due to the fact that the estimation in the population count was weightage according to the sampling stages and further analysed using complex analysis to generate the estimation in the population. From Table 4.13, the academic performance of the study participants were generally poor. The majority failed all subjects except for Malay. The overall academic performance (aggregate) also showed that the majority were below average.

4.4.2 The Difference of Aggregate in between the Adolescents Who Spent an Average of ≥3 Hours, >0 - <3 Hours and 0 Hours Per Day on the Internet

Kruskal-Wallis test (non-parametric) was chosen to find the difference in aggregate in between adolescents' time spent on the Internet.

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Table 4.14: The difference in mean rank of total aggregate between adolescents who spent an average of ≥3 hours, >0hour-<3 hours and 0hours per day on the Internet (n=720)

	Time spent on the Internet	n	Mean Rank
Aggregate	≥3 hours	331	350.70
	>0- <3 hours	283	352.11
	0 hours	106	413.50

*p-value = 0.017

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The table above compared the mean ranks' of the aggregate (overall academic performance) between the adolescent who rarely engaged the Internet (0hours) and the adolescents who regularly engaged the Internet (either spent an average of ≥3 hours per day on the Internet or <3 hours per day on the Internet). A higher aggregate indicates poorer academic performance. The lower the value of aggregate means the better the academic performance of the adolescents. Table 4.14 showed a significant difference (p=0.017) of mean ranks' of aggregate (overall academic performance) in between the participants' time spent on the Internet. The highest mean rank of aggregate was observed in the participants who rarely engaged the Internet (time spent on the Internet daily was 0 hours). This indicates that participants who rarely engaged the Internet had poorest academic performance compared to the participants who regularly engaged the Internet. Among participants who regularly engaged the Internet, participants who spent an average of ≥3 hours per day on the Internet had lower mean aggregate of (350.70) compared to participants who spent an average of <3 hours per day on the Internet (352.11). However, the differences between these two groups were minimal.

4.4.3 The Association of the Adolescents' Internet Engagement with Academic Performance

Binary analysis was used to determine the association of the adolescents' Internet engagement with academic performance. Engagement in the Internet was compared between adolescents who regularly or rarely engaged the Internet (with rarely engaged the Internet as reference).

Table 4.15: The association of the adolescents' Internet engagement with academic performance (n=720)

		Bivariate analysis of study participants OR (CI)	Bivariate analysis of the estimation in the population OR (CI)
		Non weightage	Weightage
Malay language	Excellent	1.485 (0.880 – 2.506)	2.310 (1.061 – 5.028)
	Average	1.245 (0.765 – 2.027)	1.362 (0.653 – 2.842)
	Failed	reference	reference
English language	Excellent	2.184 (1.112 – 4.289)	2.168 (0.807 – 5.828)
	Average	1.423 (0.891 – 2.272)	1.228 (0.628 – 2.401)
	Failed	reference	reference
Mathematics	Excellent	2.093 (1.012 – 4.329)	2.833 (0.911 – 8.809)
	Average	1.830 (1.048 – 3.194)	1.529 (0.702 – 3.327)
	Failed	reference	reference

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Table 4.15 continued.

Science	Excellent	3.755 (0.889 – 15.854)	13.343 (2.435 – 73.102)
	Average	1.321 (0.789 – 2.209)	1.158 (0.567 – 2.366)
	Failed	reference	reference
Aggregate	Above average	2.319 (1.118 – 4.810)	3.060 (1.051 – 8.914)
	Average	1.429 (0.885 – 2.308)	1.350 (0.680 – 2.681)
	Below average	reference	reference

The table showed the association of Internet engagement with academic performance of the adolescents. There were few significant differences in academic performance between adolescents who regularly engaged the Internet compared to the adolescents who rarely engaged the Internet. From this table, adolescents who engaged regularly on the Internet were more likely to have a better aggregate (overall academic performance) compared to participants who rarely engaged the Internet. This association was significant with or without weightage. Participants who engaged the Internet regularly were more likely to get above average in total aggregate compared to the participants who rarely engaged the Internet (OR=2.319, CI=1.118-4.810). When the same analysis was estimated for the population, the adolescents who engaged the Internet regularly were more likely to get above average in aggregate compared to the participants who rarely engaged the Internet (OR=3.060, CI=1.051-8.914).

Within the study participants (when the association was tested without weightage), significant findings were found for English and mathematics subjects. Participants who engaged the Internet regularly were more likely to be excellent in English compared to the participants who rarely engaged the Internet (OR=2.184, CI=1.112-4.289). Participants who engaged the Internet regularly were more likely to be excellent

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(OR=2.093, CI=1.012-4.329) and average (OR=1.830, CI=1.048-3.194) in mathematics compared to the participants who rarely engaged the Internet. However, all of these findings became insignificant when estimated in the population.

Within the estimated population (when the association was tested with weightage), significant findings were recorded for Malay and science subjects. Participants who engaged the Internet regularly were more likely to be excellent in Malay compared to the participants who rarely engaged the Internet (OR=2.310, CI=1.061-5.028). Participants who engaged the Internet regularly also were more likely to be excellent in science compared to the participants who rarely engaged the Internet (OR=13.343, CI=2.435-73.102). All of these findings were initially insignificant when tested within the study participants. These significant findings after the estimation in the population were probably due to the effect of bigger samples rather than the true significant findings.

4.4.4 The Crude and Adjusted Association of the Time Spent on the Internet with Academic Performance

When analysing time spent on the Internet, only participants that engage in the Internet regularly will be analysed. Therefore, the total participants in the subsequent dataset will be 614. Following the findings in Table 4.15, binary and multivariate analysis (logistic regression) were used to determine the association of the adolescents' time spent on the Internet (by using 3 hours cut-off point) with academic performance.

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Table 4.16: The association of the adolescents' time spent on the Internet (≥3 hours per day and < 3 hours per day) with academic performance (n=614)

		Crude* OR (CI)		Adjusted# OR (CI)	
		Non weightage	Weightage	Non weightage	Weightage
Malay language	Excellent	1.030 (0.953 - 1.113)	1.049 (0.955 – 1.153)	0.970 (0.887 – 1.061)	0.988 (0.879 – 1.110)
	Average	0.984 (0.911 - 1.063)	1.030 (0.935 – 1.135)	0.951 (0.874 – 1.036)	0.998 (0.900 – 1.107)
	Failed	reference	reference	reference	reference
English language	Excellent	0.976 (0.895 – 1.066)	0.966 (0.869 – 1.073)	0.929 (0.842 – 1.025)	0.932 (0.824 – 1.055)
	Average	1.033 (0.964 – 1.106)	0.989 (0.905 – 1.081)	0.992 (0.920 - 1.070)	0.958 (0.869 – 1.056)
	Failed	reference	reference	reference	reference
Mathematics	Excellent	0.943 (0.857 – 1.037)	0.914 (0.827 – 1.010)	0.900 (0.806 – 1.005)	0.881 (0.783 – 0.990)
	Average	0.998 (0.927 – 1.075)	0.985 (0.889 – 1.092)	0.976 (0.901 – 1.058)	0.966 (0.861 – 1.085)
	Failed	reference	reference	reference	reference
Science	Excellent	0.981 (0.859 – 1.121)	0.927 (0.804 – 1.070)	0.935 (0.805 – 1.086)	0.901 (0.772 – 1.052)
	Average	1.049 (0.977 – 1.127)	1.027 (0.940 – 1.123)	1.027 (0.948 – 1.113)	1.022 (0.926 – 1.128)
	Failed	reference	reference	reference	reference

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Table 4.16 continued.

Aggregate	Above average	1.012 (0.928 – 1.103)	0.989 (0.893 – 1.095)	0.965 (0.874 – 1.066)	0.954 (0.847 – 1.074)
	Average	0.993 (0.925 – 1.066)	0.919 (0.840 – 1.007)	0.958 (0.886 – 1.036)	0.899 (0.811 – 0.996)
	Below average	reference	reference	reference	reference

*Crude model consists of bivariate analysis of time spent on the Internet (using 3 hours cut-off points, with reference to < 3hours group) with academic performances.
#Adjusted model consists of multiple regression analysis between time spent on the Internet (using 3 hours cut-off points, with reference to < 3 hours group) with academic performances, after controlling for socio-demographic data (gender, race and schools' locality), level of physical activity (PAQ-C score), time spent on doing homework, television viewing and playing electronic game and sleeping duration.

The table above showed the association of the time spent on the Internet with academic performance among adolescents. From Table 4.16, generally, the trend of less likelihood for scoring excellent and average scores on academic performance was observed among participants who spent an average of ≥3 hours per day on the Internet compared to participants who spent <3 hours daily on the Internet, even when it is non-significant.

The table showed that participants who spent an average of ≥3 hours per day on the Internet had less likelihood of getting excellent (grade A and B) in mathematics compared to the participants who spent an average of <3 hours per day on the Internet (OR=0.881, CI=0.783-0.990) after the association was controlled (adjusted) and the estimation of the population had been made. Similar findings were also observed in aggregate whereby the participants who spent an average of ≥3 hours per day on the Internet had less likelihood of getting average in aggregate (overall academic performance) compared to the participants who spent <3 hours daily on the Internet (OR=0.899, CI=0.811-0.996) after the association was controlled and the estimation of the population had been made. Both

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of these significant findings may be due to the effect of a bigger sample size (after being estimate in the population). This was perhaps due to inadequate sample size for this analysis. This issue is addressed in section 5.3. Furthermore, the confidence interval was so close to one. This indicates that the result may be statistically significant but with limited clinical significance in view of the minimal differences within each group.

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CHAPTER 5: DISCUSSION

This chapter discusses the findings from the results and compares them with those of previous studies. It also explains the strengths and limitations of this study.

5.1 SOCIO-DEMOGRAPHIC

In this study, the prevalence of adolescents who used the Internet regularly was 85.3%. This is comparable with the findings of a study conducted in Penang, Malaysia, which found that 86.0% of the participants (secondary school-aged adolescents) used the Internet at least once a week (Tan et al., 2010). The study showed a higher prevalence than this study. The differences probably arose because the study in Penang was conducted in five urban secondary schools which have better access to Internet facilities compared to this study, which was conducted in a mixture of urban and rural settings (Tan et al., 2010). NHMS 2017 indicates that the overall prevalence of Internet use among school-aged adolescents in Malaysia was 85.6% (IPH, 2017). However, NHMS does not examine the regularity of Internet engagement among the participants (IPH, 2017).

Almost 58% of the participants in this study admitted having a mobile phone or a tablet with a data plan. This is much lower than NHMS 2017, which found that 93.7% of adolescent Internet users used a smartphone to access the Internet. This marked difference was probably due to the fact that the data for this study were collected in 2012, while the data collection for NHMS 2017 occurred from March 2017 onwards (IPH, 2017). During this time, many changes took place in terms of better Internet facilities and connectivity. The Internet providers seem to be competing to provide better services to their customers, and some of the providers offer free smartphones to the users of their Internet data plans. This study's findings ere much lower compared to the Pew Research Centre study, which found that 73% of 13-year-olds in America owned a mobile phone in 2009 (Lenhart et

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al., 2010). This is perhaps because the United States is a developed country with has better facilities and connectivity to the Internet and access to smartphones, even among adolescents. This study also found that 7.5% (n=54) of the participants do not have access to the Internet at all. This finding is similar to the study in Penang, Malaysia, which found that 9.5% (n=51) of the students had no Internet access at home (Tan et al., 2010).

This study also found no significant difference in Internet engagement between the genders. NHMS 2017 recorded that female adolescents had a slightly higher prevalence of Internet use of 87.4% (CI: 85.83-88.81) compared to 83.8% among male adolescents (CI: 82.35-85.24) (IPH, 2017). Although female adolescents may use the Internet more than male adolescents, there was no significant difference in the gender distribution among those who used the Internet regularly. The Pew Research Centre's Internet & American Life Projects also recorded that male and female adolescents were equally likely to visit social networking sites (Lenhart, Purcell, Smith, & Zickuhr, 2010).

The present study found a significant difference in Internet engagement between different ethnicities. Malays and Chinese use the Internet more regularly compared to Indians. This finding was similar to those of the NHMS 2017, which found that Internet use among the Chinese is the highest (91.3%), followed by Malays (86.6%), others (78.6%) and Indians (78.3%) (IPH, 2017). This difference probably arose because the Chinese have a better socio-economic status compared to Malays and Indians, and thus, they are better equipped in terms of connectivity to the Internet at home or while mobile compared to other ethnicities in Malaysia.

This study found a significant difference in Internet engagement based on the schools' locality. Adolescents who attended school in an urban area used the Internet regularly compared to adolescents who attended school in a rural area. NHMS 2017 also recorded similar findings when measuring Internet use among Malaysian adolescents (IPH, 2017). Furthermore, NHMS 2017 found the highest prevalence of Internet use among

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adolescents in the two urban areas in Malaysia: Wilayah Kuala Lumpur (94.7%), followed by Wilayah Putrajaya (94.5%) (IPH, 2017). The lowest prevalence of Internet use was in two rural states in Malaysia: Sabah (75.9%) and Kelantan (72.5%) (IPH, 2017). These findings reflect that Internet accessibility and connections in the urban areas are much more efficient in terms of availability and speed compared to the rural areas.

It was interesting to note that NHMS 2017 also recorded a higher prevalence of Internet addiction among adolescents who attended school in urban areas (IPH, 2017). A paper published by MyHeART also found that adolescents who attended school in urban areas were more prone to engage in high-risk behaviours (Farid et al., 2016). The high prevalence of Internet users, regular engagement on the Internet, a higher prevalence of Internet addiction and a higher likelihood of engaging in risky behaviour are not a good combination among adolescents who attend school in urban areas. Therefore, parents and the government need to ensure that those adolescents are in a safe environment when using the Internet. CyberSecurity Malaysia should provide adolescents with safer platforms to explore the Internet and block websites containing materials that are inappropriate for them. The Malaysian government also needs to enact laws protecting adolescents' security during Internet use. The laws then need to be publicised and enforced to ensure the well-being of the adolescents even when they use the Internet regularly.

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5.2 WEIGHT PARAMETERS

The prevalence of overweight and obese adolescents in this study was 22.9%, which was lower than the combination of the prevalence of overweight (15.6%) and obesity (14.8%) in adolescents found in NHMS 2017 (IPH, 2017). The prevalence of non-obese adolescents in this study was 77.1%, which is higher than the combination of the prevalence of normal BMI (62.9%) and thin adolescents (6.6%) found in NHMS 2017

(IPH, 2017). The difference of the distribution was probably due to the difference in sampling design of both studies whereby this study was using two stages cluster sampling design in which may represent the adolescents in Peninsular Malaysia while NHMS 2017 represent the adolescents in Malaysia (including Sabah and Sarawak).

The initial analysis of the association between time spent on the Internet and weight parameters found that participants who spent an average of ≥3 hours per day on the Internet had a lower likelihood of having excess body fat compared to participants who spent <3 hours daily on the Internet. Further analysis comparing male and female adolescents found that this association was only significant among male adolescents; male adolescents who spent an average of ≥3 hours per day on the Internet had less likelihood of having excess body fat compared to the boys who spent <3 hours daily on the Internet. Further analysis of the association between time spent on the Internet and all components of the body fat percentage among male adolescents showed no significant results. This finding is consistent with other studies published about the association between time spent on interactive media and body composition, especially among male adolescents (Bickham et al., 2013; Hume et al., 2009; Jackson et al., 2011; Kautiainen et al., 2005). Thus, it can be concluded that there is no association between time spent on the Internet and weight parameters.

There were perhaps multiple factors contributing to the non-significant findings of the weight parameters component of this study. Comparing to the previous studies, significant findings of association with weight parameters were usually related to time spent on the computers (Aurora et al.,2013; Kautiainen et al., 2005; Utter et al., 2003). Some studies that showed significant results usually studied the combination of multiple screening activities, including television viewing, which is an established factor associated significantly to the increase in weight parameters (Elgar et a;l,. 2005; Hume et al., 2009). Study that focus on interactive media (by analysing them separately) had

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shown insignificant results for the association with weight parameters (Jackson et al., 2011). Non-significant results were also observed particularly in studies which involved the use of mobile phones (Aurora et al.,2013; Schneider et al., 2007).

In this study, although the participants were asked about the ownership of the mobile phone and tablet equipped with an Internet plan, the researcher did not explore, in-depth, the type of gadget (either with the mobile phone, tablet or the computer) used frequently to access the Internet. This is one of the limitations of this study. Perhaps a significant result could be achieved by analysing the association separately from participants who engaged the Internet by using the computer, rather than using the mobile phone, provided the sample size for both was adequate. The non-significant results could be due to the fact that the majority (58%) of the participants in this study perhaps accessed the Internet using a mobile phone or tablet, in view of owning these gadgets (equipped with data plan) at their home. However, the non-significant results of the association between use of mobile phone with weight parameters remains unclear.

Although it is a well-known fact that sedentary behaviour causes an increase in weight parameters as observed in multiple studies involving television viewing, the outcome with interactive media/computer use may not necessarily be similar (Dietz & Gortmaker, 1985; Gortmaker et al., 1996; Ma et al., 2002). Studies have shown that interactive media/computer use were not associated with weight parameters (Aurora et al.,2013; Jackson et al., 2011; Schneider et al., 2007). There were many reasons contributing to these findings. These findings should be discussed systematically using the mechanism of obesity development (in relation to media viewing or usage).

The mechanism of obesity in relation to media viewing is best explained by one or a combination of the following: 1) reduced energy expenditure a) as a direct effect of sedentary activity whereby <1.5 metabolic equivalents of energy were spent during the activity and/or b) from increased time spent in media viewing/usage, which may reduce

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or replace time spent on moderate to vigorous levels of physical activity) and/or 2) increased energy intake a) in relation to media viewing/distracted eating while using media and/or b) from exposure to food advertising in the media, which increases the consumption of non-healthy food (Bickham et al., 2013; Boulos et.at., 2012; Cameron et al., 2016; Dixon et al., 2007; Elgar et al., 2005; Halford et al., 2004; Pearson & Biddle, 2011).

Engagement on the Internet, especially via smart phone, may not be as sedentary as its engagement on the computer. This is due to the fact that the smart phone is mobilised and, therefore, the Internet can be engaged while also concurrently being active. This study only explored the time spent on the Internet without further exploring other activities occurring during adolescents' Internet use. We cannot discount the possibility that the participants may be involved in other activities not sedentary in nature (such as walking, commuting on transport or even running in the gym) during their Internet engagement.

Unlike television viewing, the engagement on the Internet may not reduce or replace time for moderate to vigorous levels of physical activity. A study found that physical activity was not associated with television or video viewing but positively associated with computer use and time spent reading or doing homework (Utter et al., 2003). Other studies also found no significant association between time spent on interactive media with and physical activity (Ekelund et al., 2006; Robinson et al., 1999, Te Velde et al.,2007).

Although there is evidence that media viewing leads to the consumption of high calories, non-nutritious food or sweet beverages, none of the relevant studies were focusing solely on the Internet engagement (Dixon et al., 2007; Elgar et al., 2005; Halford et al., 2004). Most previous studies primarily examined television viewing rather than Internet engagement (Dietz & Gortmaker, 1985; Gortmaker et al., 1996; Ma et al., 2002). A study found that high television and video use were associated with poor diet behaviour

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(increased consumption of soft drinks, fried food and snacks), but this association was not observed in computer use (Utter et al., 2003). This may be due to the interactive nature of the Internet which makes eating and drinking difficult. Accessing the Internet using mobile phones or tablets seems to make drinking or eating more unfavourable in view of the interactive and mobile nature of the device. Snacking, eating and drinking are more likely to occur during television viewing, in which the hands are not in use.

Studies showed that exposure to food advertising during viewing of the media could lead to increased consumption of non-healthy food (Dixon et al., 2007; Halford et al., 2004). Food advertising on the Internet was different compared to the advertisement on television. The advertisement on the television usually targeted mass markets (regardless of their age and background). Whereas the advertisement on the Internet is very focused on the background (gender and age) and the need of the users. For example, a middle-aged woman will usually get advertisements for handbags, clothing and shoes, but men will get advertisements more related to their hobbies and sports. Internet advertisements for adolescents may focus on entertainment (music and movies) rather than food. Therefore, the influence of food advertisements may be little or diminished among adolescents who engaged the Internet.

5.3 ACADEMIC PERFORMANCE

This study found that the academic performance of the participants was very poor, in which a high percentage of the participants failed in subjects like English, mathematics and science. The overall academic performance (aggregate) also showed that the majority performed below-average. The PT3 examination was the first held in Malaysia on the year of data collection. Teachers and students were unfamiliar with the examination format. Perhaps this contributed to the poor overall result of this examination.

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This study found that the academic performance of adolescents who regularly used the Internet was much better compared to adolescents who rarely used the Internet. These findings are relevant in view that the Internet can also be an educational tool for students. The Internet is full of educational information that can easily be accessed by adolescents. Furthermore, learning from the Internet is far more interesting than learning from books. The interactive features of the Internet make learning more enjoyable and easier. Thus, the significant positive association between Internet engagement and academic performance is relevant and justified.

A positive association between Internet engagement and academic performance was found for English, mathematics and aggregate (overall academic performance). This finding was consistent with previous studies; in which the use of Internet or social network sites found an improvement in language and/or reading skills (Jackson et al., 2011; Lee & Wu, 2013; Liu et al., 2017). The process of writing to update social media status, email writing and blogging may help to improve adolescents' written language. They can choose to use Malay or English, however, most of the commands or content on the websites were in English. Therefore, adolescents could indirectly learn English through their Internet use. Studies suggest that the use of interactive media strongly contributed to children's visual-spatial, which is believed to be the foundation for learning in science, mathematics, technology and engineering (Green & Bavelier, 2007; Subrahmanyam et al., 2000). However, to the knowledge of the researcher, this is the only study that has proven the positive association between Internet engagement and mathematics among adolescents.

This study found that the participants who spent an average of ≥3 hours per day on the Internet had less likelihood of improving their overall academic performance compared to participants who spent <3 hours daily on the Internet. However, this significant result was only appeared during the analysis in the population. The significant result was

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perhaps due to increasing effect size. The confidence interval that was close to 0 also indicates that, although it may be significant statistically, it may have minimal difference clinically. Other studies that examining the association between time spent on Internet / interactive media and academic performance (Liu et al., 2017; Paul et al., 2012; Salomon & Kolikant, 2016) found that more time spent on Internet / interactive media is associated with poor academic performance, however this study found no significant association between time spent on the Internet with academic performance.

This non-significant finding probably resulted from an inadequate sample. According to the sample calculation for academic performance, the sample size should be 688. However, after removing the participants who rarely engaged on the Internet, the sample size became 614 and thus inadequate for analysis of academic performance data, resulting in insignificant findings.

The other possibility of the non-significant finding was perhaps because the adolescents used the Internet partly for educational purposed. The Internet consists of multiple educational websites and educational platforms compared to social networking sites. Social networking sites are based on the content generated by the users, and users usually use them for social purposes rather than education. The non-significant results were probably also due to the fact that the researcher did not differentiate if the use of the Internet was educational or recreational. Therefore, the difference between these two groups cannot be detected in this study.

It is interesting to note that the Internet can be a medium for adolescents to improve their academic performance. However, monitoring by parents and guardians is still needed. The Ministry of Education should work hand-in-hand with the Cyber Security Department to educate the public, especially parents and adolescents on the “dos and don’ts” for Internet users to prevent them from misusing the Internet facilities or becoming a victim of cyber-security crimes.

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5.4 STRENGTH OF THE STUDY

Health is physical, mental and social well-being and not just absence of diseases. In a population with minimal physical diseases like adolescents, health is physical, mental and social well-being and not just the absence of disease. It is important to look into the other components that shape their well-being. This study touched on two such components: the physical component (weight parameters) and an aspect of the social components (academic performance).

The sample design of this study was similar to the sample design of NHMS. The results of this study reflect the population of adolescents in Peninsular Malaysia. The respondents attend a combination of urban and rural schools and mirror the multi-ethnic population of Malaysia. The total number of respondents was more than adequate for this study. Furthermore, due to the multistage sampling in the study, all the results were weighted accordingly. Thus, it provided a fairer picture of the estimation for the population at large.

This study also focused more on school-aged adolescents rather than young adults at colleges and universities, unlike most of the published studies (Ainin, Naqshbandi, Moghavvemi, & Jaafar, 2015; Alwagait, Shahzad, & Alim, 2015; Junco, 2012; Kirschner & Karpinski, 2010). To date, very few papers have studied the adolescent age group (Esteban-Cornejo et al., 2015; Salomon & Kolikant, 2016).

Most of the published papers studying the relationship of screen time with body composition have focused primarily on television viewing (Dietz & Gortmaker, 1985; Gortmaker et al., 1996; Ma, Li, Hu, Ma, & Wu, 2002). However, this study focused on Internet time and controlled for other screen activities (television viewing and playing electronic games) as confounders.

Furthermore, this study used an objectively measured calibrated tool to measure the participants' weight rather than self-reported weight. The proper method of the weight

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parameters measurements was implemented, so that the bias in measurement can be reduced.

Uniquely, this study measured academic performance based on the results of a standardised national examination of year three students in public secondary schools. Other studies used the GPA result from non-standardised examination (Jackson et al., 2011; Liu et al., 2017; Salomon & Kolikant, 2016). Furthermore, the reported academic performance was the results of the standardised national examination. The results were collected from all schools' administrations. This study did not use self-reported academic performance.

The academic performance was based on each subject in the examination. So far, only one study used international standardised measurements of specific learning outcomes (Lee & Wu, 2013). The present study also explored overall participants' Internet activity and did not focus exclusively on social networking sites (particularly Facebook), in contrast to most previously published studies (Junco, 2012; Kirschner & Karpinski, 2010).

This study found a positive association between Internet engagement and mathematics (which had been suggested in previous studies) but never proven (Jackson et al., 2011).

5.5 LIMITATIONS OF THE STUDY

Every study has its limitations. This is a cross-sectional study. Therefore, the pathway of causality cannot be determined. The power of the study may be affected by the high percentage of drop-out and non-responses of the study. However, when calculating the power of this study based on the sample and the results from this study, the power of this study ranged from 96.6% - 100.0% (refer to section 4.1.4).

This study did not explore other concurrent activities taking place during the participants' Internet use. These activities may affect the participants' weight parameters.

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The Internet can be used while commuting in public transport, being active in the gym or for exercising or dancing (via an exercise video on YouTube or music videos from similar or other platforms). These physical activities could further affect the weight parameters. This study also did not examine the mobility of the Internet usage of the participants. Perhaps the use of mobile devices to access the Internet (smartphone and tablet) could give rise to different outcomes from the non-mobile device (laptop and desktop) in the associations with weight parameters.

This study did not explore the participants' motives (educational or recreational) for their Internet use. These motives may differentiate the outcome of the relationship between time spent on the Internet and academic performance. The participants who used the Internet for educational purposes might show a positive association with their academic performance. Perhaps the negative association to academic performance could be observed in the participants who mainly used the Internet for recreational (non-educational) purposes. However, during the data collection in 2012, the use of the Internet for academic purposes was not as common as it is now. In fact, previously the Ministry of Education banned the use of mobile phones and tablets in class.

The PT3 examination was the first PT3 examination conducted in Malaysia, following the Ministry of Education's decision to change the previous examination, the Penilaian Menengah Rendah (PMR) to the PT3. Therefore, the participants and their teachers may have had trouble understanding the format of the exam, contributing to the inability of the study participants to perform well on this exam. Furthermore, the fact that it was an examination year may also induce stress and lead to the alteration of the participants' eating habits, which were not explored in this study.

On sample size calculation, the required sample size for academic performance analysis was supposed to be 688 (Table 3.2). However, the number of participants involved in the calculation for binary and multivariate analysis of the association of time

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spent on the Internet with academic performance (Table 4.16) was just 614. There was an inadequate sample size during this calculation, which could explain the inability to achieve significant results. However, the power calculated for academic performance was between 96.6% to 99.98%. Therefore, the chance of making Type II errors is very low.

This study was conducted in three states within Peninsular Malaysia. Therefore, it may not represent the entire adolescent population in Malaysia (particularly in East Malaysia like Labuan, Sabah and Sarawak).

The sample size considered only those schooling in public secondary schools. The adolescents who were not schooling or schooling in private schools were overlooked. Furthermore, the adolescents schooling in boarding or religious schools were excluded from the sampling frame. However, among the adolescents schooling in public schools in Perak, Selangor and Kuala Lumpur, only 1.8% were in boarding schools, and 0.7% were in public religious schools. These factors limit the generalisability of the findings to the entire adolescents' population in Malaysia.

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CHAPTER 6: CONCLUSION

The last chapter of this thesis highlights the main findings of this study, discusses the impact of this study upon public health and recommends future studies that will complement this research.

6.1 SUMMARY OF THE IMPORTANT POINTS

This study found the prevalence of adolescents who engaged on the Internet regularly was 85.3% (n=614), which was slightly lower than the 86.0% prevalence found in a study conducted in Penang (Tan et al., 2010). This difference was due to the fact that the previous study was conducted in schools within an urban area, which was better equipped with Internet facilities. From 614 adolescents who engaged on the Internet regularly, 53.9% spent an average of ≥3 hours per day on the Internet while 46.1% of them spent an average of <3hours per day on the Internet.

Almost 58% of the participants admitted to having mobile phones or tablets with data plans. This finding was much lower than the NHMS 2017, which showed that 93.7% of adolescents used smartphones to access the Internet (IPH, 2017). This difference was probably due to the fact that the data for this study were collected in 2012, while the data collection for NHMS 2017 took place from March 2017 onwards (IPH, 2017), when Internet access in Malaysia had improved, and smartphones were much cheaper.

This study also found no significant differences between the association of gender with Internet engagement. However, a significant difference in Internet engagement was found between ethnicities. The Chinese used the Internet more regularly, followed by Malays and other ethnicities, compared to Indians. Adolescents who attended school in urban areas used the Internet regularly compared to adolescents who attended school in rural areas. Both of these findings were similar to those concluded in NHMS 2017 (IPH, 2017).

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The prevalence of having overweight and obese BMI is 22.8%, while the prevalence of having excess body fat is 34.6%. The prevalence of having high waist circumference among adolescents is 13.0%. There was no significant difference in body mass index, body fat percentage and waist circumference among adolescents who regularly engaged on the Internet compared to the adolescents who rarely engaged on the Internet. There is no significant association of time spent on the Internet with all weight parameters, except for the adjusted, non-weightage analysis of body fat percentage. Participants who spent an average of ≥3 hours per day on the Internet had less likelihood of having excess body fat compared to the participants who spent <3hours daily on the Internet (OR=0.701, CI=0.493-0.997), after controlling for confounders. However, the significance was weak and close to one. Thus, even if the result was statistically significant, the difference was small and may not be significant clinically. A similar analysis conducted by separating gender found no significant association of time spent on the Internet with body mass index and waist circumference among male adolescents. However, significant findings were observed in the association of time spent on the Internet with body fat percentage among male adolescents. Male adolescents who spent an average of ≥3 hours per day on the Internet had less likelihood of having excess body fat compared to the participants who spent <3hours daily on the Internet (OR=0.355, CI=0.150-0.839, p<0.01). Surprisingly, there is no significant difference of body mass index, body fat percentage and waist circumference, being observed among female adolescents who spent an average of ≥3 hours per day on the Internet compared to the participants who spent <3hours per day on the Internet. Further analysis of the association of time spent on the Internet with all components of body fat among male adolescents was carried out. However, there is no significant association of time spent on the Internet with all components of body fat among male adolescents. Nevertheless, the majority of the participants who spent an average of ≥3 hours per day on the Internet were having less body fat (44.9%). This

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explains the significant findings of body fat in males. In summary, no significant association was found between Internet engagement or time spent on the Internet and weight parameters.

The non-significant results of this study were discussed in detail in section 5.2. The main contribution of this finding was the inadequacy of detailed questions on the device used to access the Internet by the participants, and the analysis that focused solely on Internet activity rather than the combination of overall sedentary behaviour or screen time. Furthermore, four mechanisms of obesity in relation to media viewing (studied earlier as part of television viewing) may not necessarily fit the Internet or smartphone usage.

The academic performance of the study participants was generally poor. The majority failed all subjects except for Malay. The overall academic performance (aggregate) also showed that the majority performed below-average. This is addressed in limitations whereby the change of format from PMR to PT3 occurred during the data collection period which may have caused teachers and students to become non-familiar with the exam thereby contributing to their overall failure. Participants who rarely engaged on the Internet had the poorest academic performance compared to the participants who regularly engaged on the Internet. Among participants who regularly engaged on the Internet, the differences between participants who spent an average of ≥3hours per day on the Internet and participants who spent an average of <3hours per day on the Internet (352.11) was small and, therefore, might not be clinically significant. This is perhaps because the Internet was being used by adolescents for education instead of recreation. A positive association between Internet engagement and academic performance was found for English, mathematics and aggregate (overall academic performance). This finding was consistent with previous studies in which the use of the Internet or social network sites led to improvements in language and/or reading skills (Jackson et al., 2011; Lee &

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Wu, 2013; Liu et al., 2017). The positive association between Internet engagement and mathematics among adolescents was the strength in this study, as previous studies had suggested that the use of interactive media strongly contributed to children's visual-spatial skills, which is believed to be the foundation for learning in science, mathematics, technology and engineering (Green & Bavelier, 2007; Subrahmanyam et al., 2000). However, no study had found a positive association of the use of the Internet with mathematics and science-related subjects (Jackson et al., 2011). The significant findings recorded for the association between Internet engagement with Malay and science subjects were probably due to the effect of bigger samples rather than actual significant findings. Although generally, the trend of less likelihood on getting excellent and average on academic performance was observed among participants who spent an average of $\geq$3 hours per day on the Internet compared to participants who spent <3hours daily on the Internet, it is non-significant. The significant findings of the association between time spent on the Internet with mathematics and aggregate were perhaps the effect of a bigger sample size. Furthermore, the confidence interval that was close to one indicated that the result may be statistically significant but not clinically significant in view of the minimal differences within each group. These findings were perhaps due to inadequate sample size for this analysis, or because the adolescents used the Internet partly for educational purposes. The Internet consists of multiple educational websites and platforms that act as an educational tool for students to improve their academic performance. Furthermore, learning from the Internet is far more fun and enjoyable compared to books. The interactive features of the Internet make learning more interesting.

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6.2 STUDY IMPACT ON PUBLIC HEALTH

This study identifies the group of adolescents that use the Internet regularly. Although engaging on the Internet is considered a screening activity, Internet engagement may not be as sedentary as television viewing. Therefore, the Internet can be used as an effective tool to combat overweight and obesity problems. It is also interesting to note that the adolescents engaging on the Internet regularly associated positively with better academic performance. Thus, the use of the Internet may enhance adolescents' academic skills.

From this study, the researcher learnt that not all Internet usage is bad for adolescents. It is the misused, uncontrolled, and non-educational use of the Internet that can be harmful to the adolescents' well-being. However, with close monitoring and educational use of the Internet, the adolescents will gain more benefit from this technology. Therefore, parents and guardians need to play an active role in monitoring the Internet use of adolescents.

Collaboration between the Ministry of Education, the Cyber Security Department and the Ministry of Health is essential to enable them to play an active role in educating adolescents and their parents about how to use the Internet more efficiently and thus benefit the future generation. They also need to be educated about the dangers of the Internet and how they can identify and avoid those dangers. This education is important, particularly for the younger generation, as they are currently on track to not just use this technology, but also to fully utilise it in almost every part of their lives.

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6.3 RECOMMENDATIONS OF FUTURE RESEARCH

Future research should be more detailed than this study in order to gain a deeper understanding of the topic. A full cohort to study the causal relationship between Internet engagement or time spent on the Internet with weight parameters and academic performance should be carried out. This is important because the causal relationship is stronger than the association relationship.

The study which incorporated the socio-economic status of the participants could be enhanced by including diet data. The association between mental health and Internet engagement was also worthy of study. It should cover a wide range of topics, including Internet addiction, stress, aggressiveness, depression, suicide and many other issues. A study of the relationship between mental health and Internet use could be extensive, as it could address not only Internet addiction but also the prevalence of disorders and other mental health problems associated with Internet use.

In addition, following this research, intervention studies related to the use of the Internet in reducing excessive weight and enhancing the academic skills of school-aged adolescents should be designed and implemented.

Qualitative studies also need to be carried out in order to understand the details surrounding adolescents' Internet engagement. Qualitative studies can examine the motives for Internet use, the activities associated with Internet engagement, the patterns of technology usage among adolescents and the risks involved in Internet use. Such studies can also explore whether adolescents are aware of the risks associated with being online.

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LIST OF PUBLICATIONS AND PAPERS PRESENTED

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2. Poster presentation at 6th International Public Health Conference in Kuala Terengganu, 31st May – 1st June 2016.

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