EFFECT OF ELETROMAGNETIC FIELDS DEVICES USE ON SLEEP QUALITY AND ACADEMIC PERFORMANCE AMONG HIGH SCHOOL STUDENTS IN BANGKOK THAILAND

Mrs. Nuchanad Hounnaklang

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ผลของอุปกรณ์สื่อสารอิเล็กทรอนิกส์ต่อคุณภาพการนอนหลับ และผลการศึกษาในนักเรียนมัธยมศึกษาตอนปลาย กรุงเทพมหานคร ประเทศไทย

นางนุชนาฏ หวนนากลาง

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรดุษฎีบัณฑิต
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Thesis Title	EFFECT OF ELETROMAGNETIC FIELDS DEVICES USE ON SLEEP QUALITY AND ACADEMIC PERFORMANCE AMONG HIGH SCHOOL STUDENTS IN BANGKOK THAILAND
By	Mrs. Nuchanad Hounnaklang
Field of Study	Public Health Sciences
Thesis Advisor	Associate Professor Somrat Lertmaharit, M.Sc., M. Med. Stat.
Thesis Co-Advisor	Associate Professor Vitool Lohsoonthorn, M.D., Ph.D.

Accepted by the College of Public Health Sciences, Chulalongkorn University in Partial Fulfillment of the Requirements for the Doctoral Degree

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....Thesis Co-Advisor
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....Examiner
(Associate Professor Ratana Somrongthong, Ph.D.)

....Examiner
(Professor Karl j. Neeser, Ph.D.)

....External Examiner
(Nanta Auamkul, M.D, M.P.H)

นุชนาฏ หวนนากลาง : ผลของอุปกรณ์สื่อสารอิเล็กทรอนิกส์ต่อคุณภาพการนอนหลับ และผลการศึกษาในนักเรียนมัธยมศึกษาตอนปลาย กรุงเทพมหานคร ประเทศไทย (EFFECT OF ELETROMAGNETIC FIELDS DEVICES USE ON SLEEP QUALITY AND ACADEMIC PERFORMANCE AMONG HIGH SCHOOL STUDENTS IN BANGKOK THAILAND) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: รศ. สมรัตน์ เลิศมหาฤทธิ์M.Sc., M. Med. Stat., อ.ที่ปรึกษาวิทยานิพนธ์ร่วม: รศ. ดร. นพ. วิฑูรย์ โล่ห์สุนทรM.D., Ph.D., 141 หน้า.

การวิจัยนี้เป็นการศึกษาแบบภาคตัดขวาง โดยมีวัตถุประสงค์เพื่อศึกษาความสัมพันธ์ระหว่างอุปกรณ์สื่อสารอิเล็กทรอนิกส์กับคุณภาพการนอนหลับ และผลการศึกษาในนักเรียนมัธยมศึกษาตอนปลาย กรุงเทพมหานคร ประเทศไทย มีผู้เข้าร่วมการวิจัยจำนวน 1,080 คน ทั้งนี้ผู้วิจัยได้ใช้เครื่องมือวิจัยที่ประกอบด้วยแบบสอบถามเศรษฐานะและข้อมูลทางคลินิก ข้อมูลการใช้อุปกรณ์สื่อสารอิเล็กทรอนิกส์ คุณภาพการนอนหลับ สุขภาพทั่วไป และการบริโภคแอลกอฮอล์และการสูบบุหรี่ โดยใช้สถิติ univariate และ multivariable logistic regression ในการวัดความสัมพันธ์

ผลการศึกษาพบว่ากลุ่มตัวอย่างร้อยละ 96.9 ใช้โทรศัพท์มือถือและหรือสมาร์ทโฟน ในจำนวนผู้ที่ใช้ในวันที่ไปโรงเรียนมีค่าเฉลี่ยในการใช้ 3.50 (ส่วนเบี่ยงเบนมาตรฐาน = 2.47) และในวันที่ไม่ได้ไปโรงเรียนมีค่าเฉลี่ยในการใช้ 4.93 (ส่วนเบี่ยงเบนมาตรฐาน = 3.56) ส่วนเหตุผลสำคัญ 3 ลำดับแรกในการใช้โทรศัพท์มือถือและหรือสมาร์ทโฟน คือ ใช้แอพพลิเคชั่นในเครือข่ายสังคมออนไลน์ ใช้เพื่อการติดต่อสื่อสาร และใช้ดูหนังฟังเพลงแบบออนไลน์ นอกจากนี้ยังพบว่าความชุกของคุณภาพการนอนหลับแย่ในนักเรียนมัธยมศึกษาตอนปลายเท่ากับร้อยละ 32.0 [95% CI=29.26-34.91] สำหรับความสัมพันธ์ระหว่างอุปกรณ์สื่อสารอิเล็กทรอนิกส์กับคุณภาพการนอนหลับนั้น เมื่อควบคุมตัวแปร ระดับการศึกษาของบิดา เงินที่ได้รับจากพ่อแม่ ผู้ปกครอง การบริโภคแอลกอฮอล์ และการสูบบุหรี่แล้ว พบว่าเมื่อเปรียบเทียบกับนักเรียนที่ใช้โทรศัพท์มือถือและหรือสมาร์ทโฟน < 1.93 ชั่วโมง (< 25 เปอร์เซ็นไทล์) นักเรียนที่ใช้ 1.93-3.57 ชั่วโมง (26-50 เปอร์เซ็นไทล์) มีความเสี่ยงต่อการมีคุณภาพการนอนหลับแย่เป็น 1.47 เท่า (adjusted OR=1.47 [95% CI=0.99-2.18]) นักเรียนที่ใช้เวลา >3.57-5.57 ชั่วโมง (51-75 เปอร์เซ็นไทล์) มีความเสี่ยงต่อการมีคุณภาพการนอนหลับแย่เป็น 1.08 เท่า (adjusted OR=1.08 [95% CI=0.73-1.60]) และนักเรียนที่ใช้เวลา > 5.57 ชั่วโมง (> 75เปอร์เซ็นไทล์) มีความเสี่ยงต่อการมีคุณภาพการนอนหลับแย่เป็น 1.52 เท่า (adjusted OR=1.52 [95% CI=1.04-2.23]) ส่วนความสัมพันธ์ระหว่างอุปกรณ์สื่อสารอิเล็กทรอนิกส์กับผลการศึกษา เมื่อควบคุมตัวแปร ระดับการศึกษาของบิดา ระดับการศึกษาของมารดา อาชีพมารดา รายได้ของครอบครัว สุขภาพจิต การบริโภคแอลกอฮอล์และการสูบบุหรี่ พบว่าไม่มีความสัมพันธ์ระหว่างอุปกรณ์สื่อสารอิเล็กทรอนิกส์กับผลการศึกษา

ผลการศึกษาสรุปว่า นักเรียนมัธยมศึกษาตอนปลายที่ใช้โทรศัพท์มือถือและหรือสมาร์ทโฟนมากกว่า 5.57 ชั่วโมง มีความเสี่ยงต่อการมีคุณภาพการนอนหลับแย่เป็น 1.52 เท่า เมื่อเปรียบเทียบกับกลุ่มที่ใช้น้อยกว่า 1.93 ชั่วโมง ดังนั้นองค์กรภาครัฐและเอกชนที่เกี่ยวข้อง สถาบันการศึกษาโดยเฉพาะอย่างยิ่งพ่อแม่ ผู้ปกครองควรจะต้องร่วมมือกันในการรณรงค์ให้ความรู้และแนวทางในการใช้อุปกรณ์สื่อสารอิเล็กทรอนิกส์ในด้านที่ก่อให้เกิดประโยชน์แก่นักเรียน นักศึกษาและบุคคลทั่วไปอย่างจริงจัง

สาขาวิชา วิทยาศาสตร์สาธารณสุข	ลายมือชื่อนิสิต ....
ปีการศึกษา 2558	ลายมือชื่อ อ.ที่ปรึกษาหลัก ....
	ลายมือชื่อ อ.ที่ปรึกษาร่วม ....

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KEYWORDS: EMF DEVICES USE/ SLEEP QUALITY/ ACADEMIC PERFORMANCE/ HIGH SCHOOL STUDENT

NUCHANAD HOUNNAKLANG: EFFECT OF ELETROMAGNETIC FIELDS DEVICES USE ON SLEEP QUALITY AND ACADEMIC PERFORMANCE AMONG HIGH SCHOOL STUDENTS IN BANGKOK THAILAND. ADVISOR: ASSOC. PROF. SOMRAT LERTMAHARIT, M.Sc., M. Med. Stat., CO-ADVISOR: ASSOC. PROF. VITOOL LOHSOONTHORN, M.D., Ph.D., 141 pp.

This cross-sectional study aims to investigate the association between EMF devices use and sleep quality and academic performance among high school students in Bangkok. The study samples covered 1,080 high school students, in Bangkok. The researcher employed socio-economic and clinical characteristic, EMF communications devices used, Pittsburgh Sleep Quality Index (PSQI), General Health Questionnaire 28 (GHQ-28), and stimulant use questionnaire. The univariate and multivariable logistic regression were employed to control for potential confounders.

The study found that 96.9% of the participants used mobile/smart phone and mean time spent on school days and non-school days constituted 3.50 (SD = 2.47) hrs. and 4.93 (SD = 3.56) hrs, respectively. The first 3 main reasons for using smartphone among participants included the following: for social networks, for communicating with friends and for watching films & listening to music. Besides, the prevalence of poor sleep quality among the participants constituted 32.0% [95% CI=29.26-34.91]. Given the related confounding factors of an association between EMF devices use and sleep quality among high school students based on socio-economic and clinical characteristics and stimulant use, the findings showed that confounding variables constituted father's occupation, weekly allowance, alcohol consumption and smoking. After controlling for the confounding variables (father's occupation, weekly allowance, alcohol consumption and smoking), it was found that when comparing with the students using mobile/smartphone < 1.93 hour (≤ 25 percentiles), those using 1.93-3.57 hours (26-50 percentiles) were likely to have 1.47 times poorer sleep quality (adjusted OR=1.47 [95% CI=0.99-2.18]); those using > 3.57-5.57 hours (51-75 percentiles) were likely to have 1.08 times poorer sleep quality (adjusted OR=1.08 [95% CI=0.73-1.60]); those using > 5.57 hours (> 75percentiles) were likely to have 1.52 times poorer sleep quality (adjusted OR=1.52 [95% CI=1.04-2.23]). The findings of an association between EMF devices use and academic performance, after adjusting for the confounding variables (father's education, mother's education, family income, psychological disturbance, alcohol consumption and smoking), indicated that there was no association between EMF devices use and academic performance

Conclusively, our findings indicated that participants using > 5.57 hours were at 1.52 times higher risk than those using mobile/smart phone < 1.93 hours in comparison. So, it is recommended that such individuals and parties concerned as government and private organizations, educational institutions, parents/guardians in particular, are required to establish guidelines for constructive use of electromagnetic communications equipment, in addition to consistently cooperate in launching projects on awareness, positive and negative impacts of EMF devices use to students and the public in general.

Field of Study: Public Health Sciences	Student's Signature ....
Academic Year: 2015	Advisor's Signature ....
	Co-Advisor's Signature ....

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I wish to express my sincere gratitude to many other resourceful individuals and parties concerned, for example, to name just a few, participating high schools and students in Bangkok, who have kindly facilitated and co-operated during my fieldworks. Besides, my sincere thanks also go to my supportive colleagues, particularly, Onuma Zongram, who has always cheered me up.

My dissertation could not have been possibly completed had it not been for the dedication and morale support from my husband, Dr. Suwanchai, for looking after me without fail; and my son, Paul, only 5 years old then, for his admirable patience and understanding while I was mentally and physically tired and, last but not least, my mom for her tremendous morale support.

CONTENTS

Page

LIST OF TABLE

LIST OF FIGURE

CHAPTER I

INTRODUCTION

1.1 Background and Rationale:

Due to technological advancement, mobile/smart phones are more efficient and cost effective, thus can be had and easier accessed by adolescents for their daily use than before. According to Pew Internet and American Life project 2005, it was found that 45% of adolescents own a mobile phone. 10 years later in 2015, the study by Pew Internet and American Life project reported that 88% of adolescents in America have or have access to mobile phones; whereas 73% of them have smart phones. Worth pointing that nearly 100% of American adolescents have or have access to mobile phone. Adolescents with higher income are most likely to have mobile/smart phones. Interestingly, in year 2005, it was reported that, comparing between girls and boys in terms of mobile phone ownership, the number was 49% and 40%, respectively. Whereas in 2015, it was, compared girl to boy in terms of ownership and accessibility, 88% and 87%, respectively (1).

Use of electromagnetic field (EMF) devices has been increasingly popular among adolescents all over the world. A number of studies found that access to and use of media by adolescents has increased over the years as new technologies are developed (2). Undoubtedly, adolescents are often early adopters of new media and communication technologies (3). It was discovered that the number of American adolescents having personal mobile phones has increased from 45% in the year 2004 to 75% in the year 2010: a total of 30% increase across the 6-year period (4). It is reported that the number of Asian youths (in 11 countries: China, Hong Kong, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan, Vietnam and Thailand) having owned mobile phones has also increased from 60% in the year 2008 to 64% in the year 2010. The survey indicated that adolescents in Thailand were the top chatterboxes across Asia by spending 1.7 hours a day talking on their mobile phones (5, 6)

The study revealed that Thai adolescents' use of mobile phones has increased significantly in the region of 2-300% in just one year with 75.7% of the samples engaging regularly with social networks; 20% used their mobile phones regularly in class; 35% checked social networks through their mobile phones prior to going to bed. Given that the seemingly over-indulgence in playing computer games and engaging with social network activities for about 8 hours a day, it is not surprising that they would have less sleep duration, less time for family, for doing assignments and studies and, more importantly, for examination preparation (7).

A recent survey showed that internet surfing among Thai adolescents aging between 15–24 years increased from 39.7% (2007) to 51.9% (2011). Comparing to other Asian adolescents, Thais spent 3.1 hrs/day playing online games through computers, smart phones and portable electronic gadgets (i.e., X-box); thus being regarded as the highest total time spenders. Notably, average playing time for adolescents from Thailand : Singapore : Hong Kong : China : Korea were reported as follows: 60.7 min/day: 59.4 min/day: 56.0 min/day: 46.0 min/day: 43.2 min/day, respectively (8).

To access to internet has never been easier by today's digital technology development. EMF devices like smart phones, tablets, notebook computers are both efficient and cost effective, in terms of speed, mobility and price. Undoubtedly, adolescents can easily possess the above-mentioned gadgets and get indulged online with various activities. Having been developed and very advanced, today's social networks can greatly impact internet users, particularly adolescents. It was discovered that, in several Asian countries, Thai adolescents spent most time in using internet, and becoming top users playing online games through (8).

Admittedly, internet has played key roles in enhancing people's knowledge and experience, particularly adolescents' education. Thus, most governments and educational institutions launched internet-based learning campaigns aiming to well equip their kids and adolescents with more effective learning approach. However, a study on adolescents and internet found that 65.4% using internet for games playing and downloading purposes. More interestingly, 42.4% of adolescents used one of communications devices, smartphone, as their media (8).

Though some studies indicated that technological advancement can have negative impacts on adolescents if they are overused, others argued that technology can have positive impacts if it is not been overused (9, 10). Likewise, the proliferation of EMF device has been implicated in the poor sleep of adolescents, like going to bed late; shorter sleep duration; day time sleepiness; waking time tiredness and sleep deprivation (11-15).

Previous studies indicated that exposure to EMF devices, to a greater extent, had impacts on human in different aspects, i.e., effects on DNA (16); impacts on stress response (17); effects on immune system (18); impacts on blood pressure (19); increased risk of brain tumours (20); cause of sleep disruption; and impacts on sleep patterns (21).

A number of studies of the use of EMF media on students' academic performance showed mixed results: some indicated that the media use had little or no impacts, whereas others showed that it had negative effects on academic performance. A number of findings reported negative impacts of EMF devices on performance as Taiwanese students reported sleep deprivation due to heavy internet use which, in turn, was correlated with poor academic performance (22). Likewise, Chen and Peng (2008) found that students regarded as internet heavy users (identified by>34 hrs/week) had poorer academic performance than those non-heavy users (23).

With the rapid advanced technology and development, the EMF devices have been greatly popular among adolescents all over the world, particularly among Thai adolescents ranked the highest number of mobile phone users in Asia. Extensive investigations have been made on various effects derived from single specific device, i.e., mobile phone exposure (24). It is important to find out as to what extent the EMF devices have effects on the users. Moreover, very few, if any, researches in Thailand have focused on effects of EMF devices exposure. So, it is necessary to study the effects of EMF devices exposure relating to sleep quality and academic performance among high school students in Bangkok, Thailand. The findings can be beneficial to the following: adolescents, parents, educators, health-care practitioners and policy makers, in terms better awareness of negative impacts of EMF devises, as well as effective measures to address the issues relating to EMF devices.

1.2 Research Questions:

1.2.1 What are the frequencies of EMF devices usage among high school students in Bangkok?

1.2.2 What is the prevalence of poor sleep quality among high school students in Bangkok?

1.2.3 What is the association between EMF devices use and sleep quality among high school students in Bangkok?

1.2.4 What is the association between EMF devices use and academic performance among high school students in Bangkok?

1.3 Objectives:

1.3.1 General objectives:

To investigate the association between EMF devices use and sleep quality and academic performance among high school students in Bangkok.

1.3.1 Specific objectives:

1.3.1.1 To discover the frequencies of EMF devices usage, on school day and non-school day, among high school students in Bangkok.

1.3.1.2 To identify the prevalence of poor sleep quality among high school students in Bangkok.

1.3.1.3 To investigate the association between EMF devices use and sleep quality among high school students in Bangkok.

1.3.1.4 To investigate the association between EMF devices use and academic performance among high school students in Bangkok.

1.4 Research Hypothesis:

1.3.2 There is association between EMF devices usage and sleep quality among high school students in Bangkok

1.3.3 There is association between EMF devices usage and academic performance among high school students in Bangkok

1.5 Expected Outcomes:

1.5.1 To obtain the frequencies of EMF devices usage, on school day and non-school day, among high school students in Bangkok.

1.5.2 To obtain the prevalence of poor sleep quality among high school students in Bangkok.

1.5.3 To achieve the association between EMF devices usage and sleep quality among high school students in Bangkok.

1.5.4 To be a stepping stone for future studies to explore in-depth issues associating with adolescents.

1.5.5 To create awareness among health educators/public health professionals to be able to tackle this issue.

1.6 Conceptual Framework

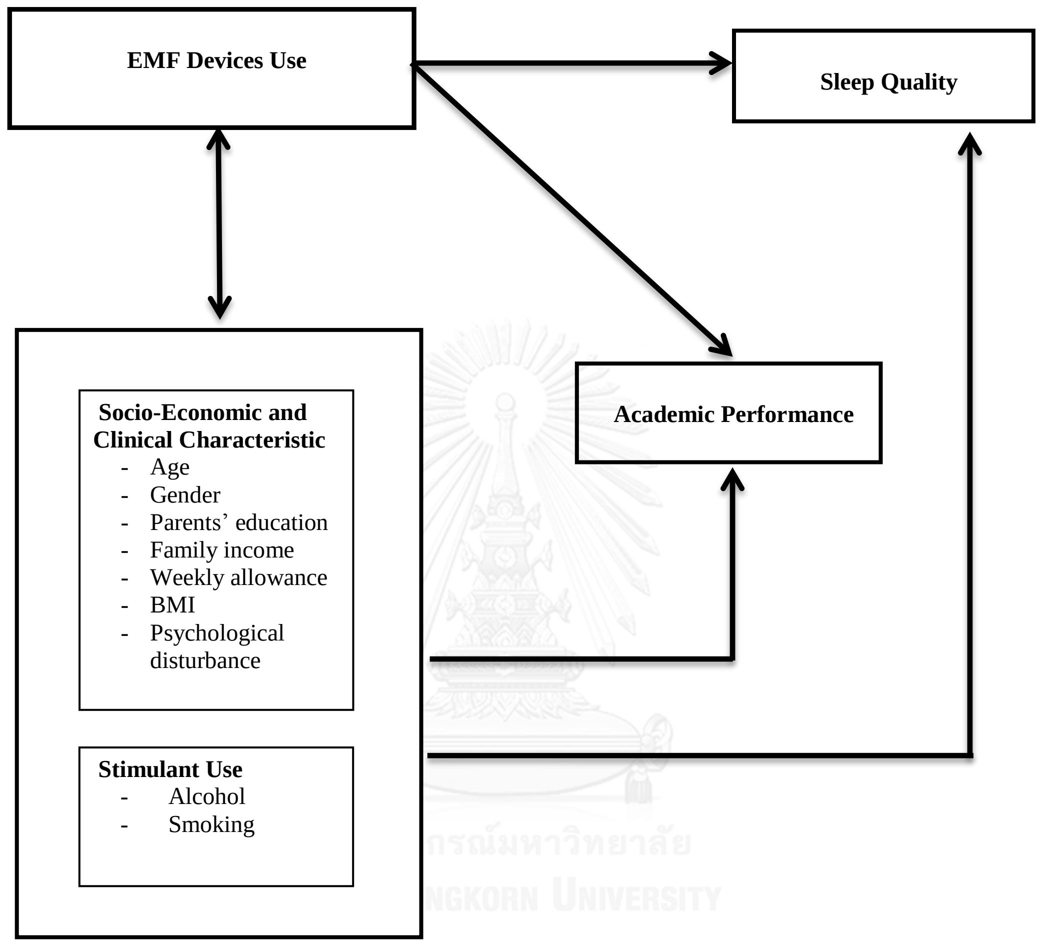

Figure 1 Conceptual Framework

1.7 Operational definitions:

The following definitions of terms will be used for this study:

1.7.1 High school students: High school students refers to the students of grade 10-12 studying in High School, for academic year 2013, in Bangkok area, under the supervision of the Office of the Basic Education Commission, Ministry of Education.

1.7.2 EMF devices: EMF devices are those having spectral region of microwave wireless communications frequency including: mobile phones, smartphones, personal computers, notebooks, tablets interfaces among devices equipped for wireless communications, devices used through wireless local area networks (WLAN) including wireless fidelity (Wi-Fi), worldwide interoperability for microwave access (WiMAX) and long-term evolution (LTE) for 3-G networks.

1.7.3 Sleep quality: This term refers to an individual's sleep quality. It can be measured by using Pittsburgh Sleep Quality Index (PSQI) encompassing seven categories, namely: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction.

1.7.4 Academic performance: This refers to high school students' grade point average (GPA) in their last semester.

1.7.5 Body mass index (BMI): The index was calculated as self-reported weight (in kilograms) and height (in meters), based on WHO's criteria describing BMI-for-age (5-19 years) (25).

CHAPTER II

LITERATURE REVIEWS

After careful analysis and synthesis of relevant and related literatures from such sources as academic articles and journals, conference proceedings and research papers, books and reports, as well as online materials from various libraries, the researcher has divided this chapter into 8 parts: Electromagnetic fields (EMF), EMF and Related Health Factors, EMS Used and Sleep, EMF Devises Used and Academic Performance, Sleep, Sleep and related factors, Sleep and Health:

2.1 Electromagnetic field (EMF):

2.1.1 What is Electromagnetic field (EMF):

Described as a physical influence that travels through space, electromagnetic field (EMF) occurring in nature and present on earth, originates from electrically charged objects. All EMFs are force fields equipped with energy that can generate an action at a distance (24, 26). Owing to an increasing demand in electricity usage and advanced wireless technology, it is obvious that most citizen of the 21st century are unavoidably exposed to a complex mix of electric and magnetic fields at various frequencies (27).

EMF stems from two sources, i.e., nature and man-made as a brief description following: a) Natural sources of EMF: Despite its invisibility, EMF is actually present in an environment and everywhere. EMFs are generated by the local build-up of electric charges in the atmosphere associated with thunderstorms; b) Human-made sources of EMF: this includes X-rays used to diagnose a broken limb and the frequency used to transmit information like mobile phone base station. Generally, wavelength and frequency can be classified into ionizing and non-ionizing radiation: ionizing radiation is a property carried by ultraviolet, x-ray and gamma ray given off by radioactive materials. As for non-ionize radiation covering light, infrared, radiofrequency radiation which has a wavelength between 0 – 300 GHz that can be subdivided into four categories: static field, extremely low frequency field (ELF), intermediate frequency (IF), and radiofrequency/microwaves (28, 29).

Ionizing radiation contains so much energy in its individual quanta of energy that it is able to expel electrons from their orbits in the atom shells. This creates free radicals in living matter increasing the risk of chromosomal damage and fatal abnormalities, which may lead to cancer. However, non-ionizing radiation is still debatable whether it has any possible health hazards on human being (28, 29).

Technically, electric field consists of various voltages; whereas the level of voltage will determine the fields' strength: the higher the voltage, the stronger the electric current. When electric current flows, the magnetic fields will be created; if the current is higher, the magnetic fields will be stronger, too. Though there is no current flows, an electric field does still exist. Suffice to say that whiles the electric field's strength depends on the power usage, the electric field strength still remains constant. The classification of EMF spectrum can be illustrated below:

Table 1 EMF spectrum

Frequency range	Frequency	Field source
Static	0Hz	• Natural • VDU (Video displays) • MRI and other diagnostic/ Scientific instrumentation • Industrial electrolysis
Extremely low frequency (ELF)	0 – 300 Hz	• Powerlines • Domestic distribution • Electric energies in cars, train and tramway
Intermediate frequency (IF)	300 Hz – 100 kHz	• Typical example are: VUD, anti-theft devices in shops, hand free access control systems, card readers and mental detectors
Radiofrequency (RF)	100 kHz – 300 GHz	• Broadcasting and TV
Microwaves	300 Hz – 300 GHz	• Mobile telephone • Microwave oven • Radar, portable and stationary radio transceivers • Personal mobile radio
Infrared	300 GHz – 405THz	• Magic eyes in security lighting • Remote control (e.g. TV)
Light	405 THz –790THz	• Seeing • Photography
Ultra-violet (UV)	790 THz – 30PHz	• Sun-tan lamp
X-rays	30 PHz – 33ETHz	• Imaging defects in bones
Gamma rays	More than 10 EHz	• Medical tracers • Killing cancer cells • Sterilization • Imaging defects in metal

Source: Scientific Committee on Emerging and Newly Identified Health Risks (29)

2.1.2 Electromagnetic field devices (EMF devices):

Regarding the level exposure, the fields' frequencies generated to be used for electrical power and broadcasting are much lower than those produced by man-made sources. Since the past decades, electrical energy has been widely used for telecommunication purposes. It is evident that people's exposure to EMF has been on the rise. Notable, everybody can be exposed to low level of EMF from transmitters used for broadcast television and radio, as well as for mobile communications. Besides, a number of people can be exposed to low level fields from microwave communications links, radar, televisions and display screen equipment. Greater exposures can arise if people come close to, though short period of time, sources like mobile phone handsets, portable radio antennas and RF security equipment, especially, the devices/gadgets based on wireless communications technology (30). Adolescents tend to report using different kinds of information and communication technology in their daily life. Some of the most popular wireless communication devices include mobile/smart phones; Bluetooth devices; and devices used through Wireless local area networks (WLAN).

As for mobile/smart phones, it has been well recognized that mobile/smart phones are increasingly popular for people in the 21st century. In 1980s, the 1st generation of mobile phones arrived using analogue radio systems that worked at 450 MHz. or 800/900 MHz. Late in 1990s, the 2nd generation (2G) appeared on the market before a digital mobile communications systems started to develop. The evidence pointed out that, in many countries around the world, the Global System for Mobile Communication (GSM) is the key player. The GSM is operating at 900 and 1800 MHz (whiles a frequency of 850 and 1900 MHz was used in America) (31).

Since the 2G system was created to serve the voice application purpose, the development of the next generation of mobile phones (2.5G and 3G) started right after that. The 3G (third generation) which operates at 1900-2200 MHz provides users with various applications, including internet browsing, email access, high speed downloading of music and videos. Despite the fact that 3G is the latest mobile communications technology, attempts have been made to further develop higher data rates and establish mobile broadband operations. In the very near future, the 4G will operate at a higher frequency bands of 2 GHz (31) .

By the year 2010, smartphone has been widely used and continued growing, particularly among adolescents all over the world. Apart from using smartphone to make calls, adolescents use it to surf internet, send and receive e-mails, chatting via a variety of social networks application and watching movies through YouTube, and many others (32).

Regarding Bluetooth devices, the devices equipped with Bluetooth element, operating at 2.45 GHz, can provide short distance wireless connectivity between mobile communication devices. Today, it is common for most computers, mobile/smart phones and other peripheral accessories to have Bluetooth ability (31). Besides, the devices being used through wireless local area networks (WLAN) equipped with technologies that operate in frequency band between 2.4 and 5 GHz are 'licence exempt", and bandwidth is divided among users. The technical standards most popular are established by the institute of Electrical and Electronic Engineers (IEEE). Generally, this kind of technology is recognized as Wi-Fi. The computers and devices using this technology are connected to the local area network (LAN) wirelessly. So it is not necessary to have Ethernet wired: all devices must have required antennas to be able to transmit and receive radio waves and wireless connection is then operational.

Owing to the above literature reviews of EMF exposure, aside from the wavelengths and the following EMF sources: mobile phone handsets, cordless phones, digital data communications, Bluetooth interfaces (among devices equipped for wireless communications), wireless local area networks (WLAN), wireless fidelity (Wi-Fi), worldwide interoperability for microwave access (WiMAX), and long-term evolution (LTE) for 3-G networks, the researcher intends to focus on RF fields communications devices used, since most, if not all, adolescents have more opportunity to get exposed to the related wavelengths. In addition, the RF fields communications devices used could have association with their sleep quality and academic performance (31).

2.2 EMF devices Use and Sleep:

A number of findings indicated the EMFs can have effect on serum melatonin and pineal gland function (33). It is discovered that EMF devices exposure can result in the suppressed generation of melatonin (hormone produced by the pineal gland located deep near the center the brain). The melatonin is generated mainly during the night, thus releasing into the blood stream and dispersed through the whole body. More importantly, the melatonin regulates sleep, mood and behavior (24). Melatonin regulates organ function appropriate to circadian (time-of-day) rhythms. Serum levels of melatonin change with the time-of-day depending on the amount of light reaching the retina, lower levels in the daytime and higher levels in the night, with the exposure to light causing a depression in melatonin production (34). According to Burch et al. (2002)'s investigation on the effects of cellular phones, the evidence suggested that cellular phone use of longer than 25 minutes per day resulted in a drop of melatonin levels. Nonetheless, the effect was discovered only after the 3rd day of the study. The data also pointed that prolonged use of cellular phone can lead to reduced melatonin production (35).

It has been well recognized that wireless technologies, i.e. mobile or smart phones are key players in causing an increase exposure to electromagnetic fields in the users' daily life. Several reports have attempted to address such issues as the extent of which short-term EMF exposure can impact sleep measures like brain activity recorded by electroencephalography (36-39). It is arguably, however, that though EMF exists almost everywhere in the environment, a double-blinded cohort study on whether sleep quality is affected by mobile phone use or by other EMF sources in the everyday environment, found that only those using EMF devices appeared to have sleep deprivation and daytime sleepiness. Besides, exposure to environmental EMF did not affect self-reported sleep quality (40). From this study, it can be summarized that EMF devices use can affect those using mobile or smart phones in terms of sleep-related issues, i.e., sleep quality and sleep deprivation.

As far as adolescents' sleep quality is concerned, it was discovered that adolescents' exposure to EMF devices can have impacts on their sleep-related behaviors. So, it can be concluded that EMF devices can play key roles in adults' sleep deprivation owing to being overindulged themselves in heavy use of such EMF devices as internet, mobile/smart phones, computer and video games which lead to a reduced time in bed, and increased sleep disturbances (41-43).

2.3 EMF Used and Academic Performance:

A number of literature reviews have been focusing on the effects of EMF exposure on biological system and suggested that EMF can affect blood brain barrier (44). According to an experiment on memory performance of EMF-exposed rats, it was found that the tested rats have showed a memory performance deficit. The findings from this study provide us with new insight into the nonthermal effects of long-term high-frequency EMF exposure on memory (45). Therefore, an increasing use of mobile phones has raised the concern over the effects of daily EMF exposure on people's health.

Interestingly, numerous studies investigating the effects of mobile phones on cognitive function found that exposure to EMF has an effect on attention and vigilance: reaction time and vigilance tasks were speeded up when subjects were under exposure to EMF (46, 47). Besides, another study conducted on teenagers, entitled "Effect on human attention of exposure to the electromagnetic field emitted by mobile phones" indicated that exposure to EMF emitted by mobile phones may have mild effect on attention function deficit (48). However, one study, examining the effects of daily exposure to GSM900 type mobile phone on cognitive function, suggested that a daily mobile phone use has no effect on cognitive function after a 13-hour rest period. (49).

Based on previous studies, those adolescents spending most of their time overindulging in current technology experienced both physical and emotional negative impacts. Nowadays, adolescents' increased use of mobile phones or tablets, particularly in the bedroom, has raised public concerns regarding their attachments to social media so that their emotional needs can be fulfilled. Besides, overuse of EMF devices can alter sleeping and waking patterns (14), and thus undermines adolescents' performance at school (50).

The more adolescents multitask with a variety of technological devices (texting, talking on the phone, using the Internet, listening to an iPod), the fewer hours of sleep required, which can cause an increase daytime sleepiness. So, researchers suggested that multitasking could make those adolescents unable to sustain educational achievement (51). Though none of empirical findings available, adolescents who were much attached to social networks felt tired during the day and found it hard to meet the cognitive demands of study (52).

Students who are tired and sleepy in class found it difficult to achieve performing tasks related to academic performance, i.e., effective time management, and sustaining effort, interest, and attention. So, they do poorly at school, and tired students feel less satisfied with their school experience (53, 54).

2.4 EMF and Health Related Factors:

Due to advanced technology and widespread use of wireless communications devices among people globally, the greater risks of frequency exposure have significantly increased. Besides, various agencies have been concerned about the EMF exposure. In the past decade, studies of EMF exposure impacts have been seriously conducted, especially the adverse health impacts on both human and animals (55). Besides, Heinrich et al.(2010) suggested that, based on their findings, there have been grave concerns for those exposed to EMF that they may experience adverse health effects, especially in children and adolescents, since there is a significant increase in mobile phone usage all over the world (56). The outcomes of adverse health-related EMF exposure can be summarized as follows:

2.4.1 EMF and Brain Tumors:

Based on the findings from researches worldwide, the risk of brain tumors caused by increased use of mobile/smartphone was discussed among those conducting the survey on the possible relations between brain tumors and phone used;

and it was found that over 25 papers have indicated a possible link between brain tumors and use of mobile/smartphone. Interestingly, the largest increase was associated with longest use (57). Likewise, a number of researchers also raised the issue of the potential harm owing to increased use and cumulative effect of RF (58, 59).

2.4.2 EMF and Cancer:

EMF can be regarded as discrete quanta which are absorbed by matter. The quantum energies of EM waves are too low to break chemical bonds. Nevertheless, there are structures in biological materials that can be affected by very low energy like hydrogen bonded structures in which very low energy may cause displacement of protons. It is, however, debatable as to the potential health risks of EM energy, particularly from the mobile/smart phone. One of the key issues discussed covers the possible cancer-enhancing effects. It is unlikely that any cancer-related effects of EM can be based on direct genotoxic effects, because the energy level is not high enough to damage DNA. Instead, a study was carried out whether EMF is cocarcinogenic, i.e., whether they enhance the effects of other carcinogenic factors. So, it is necessary to find out some characteristics of cells, tissues, enzymes, and proteins in human body to better understand the associated interaction mechanisms (24, 60).

2.4.3 EMF and Cardiovascular Disease:

It is still uncertain whether the use of EMF devices can have any impacts on cardiovascular system. Previous studies reported mixed findings on cardiovascular disease: whiles some found no acute effect on blood pressure, heart rate or ECG waveform; others reported subtle effects on heart rate. Braune et al. (2002) concluded in their study that exposure of human volunteers to EMF of mobile phones increased the sympathetic efferent activity, with an increase in the resting blood pressure (61). Several studies (62-64) found no significant changes on cardiovascular functions due to EMF exposure. Moreover, it was indicated that the risk analysis of human exposure to EMF reported insufficient evidence regarding the association between cardiovascular disease and exposure to RF fields.

2.4.4 EMF and Cataracts:

Cataracts are believed to be caused by exposure to strong radiation derived from microwave having frequencies ranging between 300 MHz and 300 GHz. Advanced devices emitting microwaves like mobile/smart phone, radars and computers are prevalent in most people's daily life (65). While George et al. (2008) stated that non-thermal effects in the microwave induced unfolding of proteins observed by chaperone binding, de la Hoz and Díaz-Ortiz (2005) pointed that the formation of cataracts directly related to the power of the microwaves and the duration of exposure, and the magnitudes of microwave radiation including thermal and non-thermal effects (66, 67).

Owing to a popular use of EMF devices, the concern of health effects caused by exposure to microwave radiation seems to spread far and wide globally. Though well recognized that strong microwave radiation can induce cataracts through its thermal effects, it is still debatable if low-power microwave radiation or the radiation levels below the current exposure limits, can be cataractogenic (68).

2.4.5 EMF and Mental Health:

It has been discovered that EMF can affect neurotransmitter metabolism and the concentration of receptors in many parts of the brain that can contribute to stress and anxiety response (69). One of the studies found that there was likely association between high information and high frequency of mobile phone use, thus reporting mental health symptoms among teenage users (70). The study was followed by a qualitative interview with participants having high frequency use of computer or mobile phone, who had reported mental health symptoms at 1-year follow-up. (71). Key factors appear to contribute to mental health symptoms including personal dependency, demands for achievement and availability which arise from domains of work, study, social network and user's aspirations. It seems that a key stressor was to not be available. Likewise, concerns about possible hazards associated with exposure to electromagnetic fields also exist. It can be concluded that there are several factors in different domains contributing to mental health symptoms; one of them happens to be an over use of mobile phone (71). More interestingly, it was also found that overuse of mobile phone can lead to depression as reported by a study on possible negative health effects of mobile phone exposure. The findings concluded that high frequency of mobile phone use was a risk factor for depression after a 1-year follow-up among the young adults (72).

2.4.5 EMF and weight gain:

Sitting idle in front of computer, note book, mobile/smart phones can result in sedentary behavior (73-75), consequently, physical activity unavoidably decreased and reducing total energy expenditure. Beside, such food intakes as soft drinks and snacks increased causing overweight and obesity. Previous cross-sectional study found that girls using computer and internet were more likely to be over weight (76). Likewise, a longitudinal cohort study of females aging 14-21 years discovered that those spending more time on the internet contributed to an increase of BMI (77).

2.4.5 EMF and Socio-economic Characteristics:

EMF devices use and social networking differ according socio-economic status, for example, age, school grade, gender, residential area, household income, parents' educational level were considered as key factors related to mobile phone use in adolescents (78). Gaps of the above-mentioned factors were accounted for inequality in media access (79, 80).

Previous study indicated that the rate of mobile phone owner was increasing with age (81). Though each user has different motives for possessing mobile phones, particularly parents feeling much concerned over their children's safety and security; so they feel necessary to purchase mobile phones for their growing children for emergency purpose (82). For adolescents, mobile phones play important roles in different activities, i.e., for social networking, communicating and hanging round with their friends outside of home. Even further, some findings found that the phones can be key instrument in creating and maintaining peer groups among children (83, 84). According to a survey in Korean high school students, it was found that, in comparing between the high and low level students, the ownership rate and use frequency of mobile phone by high level students surpassed that of low level students (78).

According to some researches, it was found that different genders in adolescents use mobile phones differently. Female tended to use more phones than male; due to parents' attitudes and the way they have been raised by Asian parents. Nevertheless, the previous study of mobile phones use between boy and girl suggested that there was no gender difference in mobile phone use (85). Notably, it was also reported by a finding on Korean high school students that the number of female using mobile phones was higher that that of male users (78); this was consistent with a study that girls were more likely to own and use mobile phone than boys (86). However, a study by Ji, P. (2013) discovered that, out of research samples aging 18-65 years, males used mobile phones for social network and for professional connections more often than female, but use of social networks or mobile phones to contact friends did not differ between genders (87).

2.4.6 EMF devices use and alcohol consumption and smoking:

Access to EMF devices, particularly mobile phone, has been recognized as the most important requirement for today's adolescents (88); owing to mobile/smart phones' various benefits like calling friends and relatives, social networking, listening to music, watching films and, particularly, playing games online. Early studies found excessive mobile phone use and smoking coincided in the same individuals (89). Additionally, research evidences indicated that smoking and drinking were closely related (90). Most notably, a study entitled "Intensity of mobile phone use and health compromising behaviours-how is information and communication technology connected to health-related lifestyle in adolescence?" discovered that there was as association between smoking and alcohol and mobile phone use (88).

2.5 Sleep:

Based on behavioral definition, sleep can be described as a reversible behavioral state of perceptual disengagement from and unresponsiveness to the environment. Besides, sleep is a complex combination of physiologic and behavioral processes. Typically though not necessarily, sleep is accompanied by postural recumbence, behavioral quiescence, closed eyes, and indicators commonly associates with sleeping. Under unusual circumstance, such behaviors as sleepwalking, sleep talking, teeth grinding, and other physical activities, can occur during sleep. Anomalies involving sleep processes also include intrusions of sleep—sleep itself, dream imagery, or muscle weakness—into wakefulness (91). Sleep and its processes can be empirically measured using a variety of metrics, ranging from such objective variables as sleep duration, sleep latency, sleep efficiency, and sleep fragmentation to subjective sleep variables such as sleepiness and sleep quality.

2.5.1 Sleep mechanism:

Regarded as an unchanged inactivity, sleep is deemed one of the most complex activities by most researchers due largely to the fact that it was difficult to access through medical examination. To have a better understanding of sleep, the scientists use sensitive electrodes on the scalp of the sleepers and record the electrical signals generated by activity in their brain. By this, the scientist started to identify different stages of sleep from monitoring the sleepers' eye movements, muscle tone, and brain-wave patterns. As a result, the researchers of today have learnt how the sleep stages are able to maintain health, growth and functioning. Theoretically, human's normal sleep consists of two states: rapid eye movement (REM) and non–REM (NREM) sleep. These two states will alternately occur cyclically across a sleep episode. Both types of non-REM and REM sleeps can be described as follows (91, 92).

2.5.1.1 Non-REM (quiet sleep):

Though the term suggests that this is a quiet sleep, the sleepers can sometimes move or change positions during their sleeping period. It is also described as "an idling brain in a moveable body" which indicates the slowing down of most physiological activities of the sleepers. The sleepers having the non-REM sleep are those experiencing the following three stages of quiet sleep:

The stage N1: In this stage, the transition from wakefulness into light sleep starts; this stage takes the sleepers about 5 minutes. The predominant brain waves slow at the rate of four to seven cycles per second called theta waves pattern. During this stage, the sleepers' temperature begins falling, muscles relaxing, eyes moving slowly from side to side, and losing awareness of surroundings; meanwhile, they can also easily have jarred awakening. If awakened, some sleepers may say they are being drowsy; while others may just say they have been asleep. It can be said that during this stage 1, sleep can be discontinued by softly calling their name, touching them lightly, quietly closing a door, etc. conclusively, stage 1 sleep is associated with a low arousal threshold.

The stage N2: In this stage, the sleepers have an actual sleep for about 10-25 minutes; their eyes are remaining still, with heart rate and breathing moving, unlike when awake, slower. The EEG illustrates a so-called K-complex pattern which can be roused by some internal or external stimuli, i.e., sounds. This stage lasts the sleepers approximately half the night.

The stage N3: This is called a deep sleep or slow-wave sleep. In this stage, the sleepers will have a more regular breathing. Besides, the blood pressure falls; the rate of the pulse gets slower than the waking rate ranging between 20-30 per cent. The Delta waves, in other words, large and slow brain waves are key features on the EEG. During this stage, to wake the sleepers are difficult since their brains are not well responsive to external stimuli.

2.5.1.2 REM (rapid eye movement) sleep:

In general, the sleepers with dreaming (REM) sleep will experience some kinds of dreaming. The dreams during REM sleep can be called an "active brain in a paralyzed body". The scientists believe that REM can restore the sleepers' mind; just as the slow-wave sleep restores the sleepers' body. It was found that students having sufficient sleep can solve problems better than those having less sleep.

The average length of the first NREM-REM sleep cycle is approximately 70 - 100 minutes, while the average length of the second and later cycles is about 90 - 120 minutes; whereas the average time of the NREM-REM cycle constitutes roughly 90 - 110 minutes, across the night.

2.5.2 Sleep throughout life:

It is believed that, to some degree, heredity plays an important role in people's sleep in that how and when to sleep all through their life. Clear evidence has suggested that identical twins have more similar sleep patterns than those non-identical twins or other sibling pairs. Though sleep and waking patterns appear to be inborn and the genetic evidence is still unable to be fully comprehended, certain factors can also affect people's sleep patterns, one of which is the sleepers' age which has been playing the most significant part in how people's sleep. People with 20 years of age onwards will spend longer time than when younger to fall asleep. The classification of sleep patterns, based on sleepers' age, can be described as follows (93):

Childhood: For newborn babies, they may be sleeping eight times a day, totaling 18 hours of sleep and spending about 9 hours in REM sleep, during which occurs often, generally less than an hour apart. When newborn infants get to the age of 4 weeks, they will get a longer sleeping period, especially by 6 months, they sleep longer and more regular periods in non-REM sleep. When they are at preschool, they gradually have daytime naps shortened until they reach the age of six, most of them keep waking up all day and will have an average of 10 hour-sleep per night. However, from 7 years old to puberty period, their generation of nocturnal melatonin is highest making them to have a deep and restorative sleep.

Adolescence: Regarded as the period for rapid body growth and development, adolescence can also cause easy daytime drowsiness for teenagers. Based on a study suggesting that some adolescents have a so-called delay sleep phase syndrome making them not feeling sleepy until well after usual bedtime and unable to get up and arrive at school late. Some other studies have pointed out that one of the causes of sleep loss among adolescents is due to an early start time of their schools, contributing to their behavioral issues, mood swings, as well as learning and concentration problems.

Adulthood: During this period, though sleep patterns look stable but they are gradually evolving and, by the age of 20-30 years old, the quantity of slow-wave sleep falls about 50 per cent, and nighttime awakenings double. Until they are 40 years old, slow-wave sleep is dramatically decreased.

Middle age: When both men and women reach their middle age, their sleep will gradually decrease while waking up at nighttime more often and last longer. It is very common for the middle age to wake up after three hours of sleep. For menopause women, many of them may experience hot flashes that can interrupt their sleep; whereas obese people, at their middle age, tend to have nocturnal breathing problems. However, middle age people with sound body can sleep better than those with unfit body.

Elder: In general, older people have had sleep problems, namely, inability to sleep throughout the night; often waking up at nighttime and, after waking ups, usually takes them longer to go to sleep again. Though doctors once used to advice their elder patients that it is not necessary to have long sleep to function well, sleep experts have argued that it is not true: they explain that older people need approximately 7 ½ - 8 hours of sleep to function well.

2.5.3 Sleep quality:

Despite the word "sleep quality" has been used in sleep medicine, the accepted definition of this term has not yet been established. Sometimes the term "Sleep quality" refers to a collection of sleep measures encompassing total sleep time, sleep onset latency, degree of fragmentation, total wake time, sleep efficiency, and sometimes sleep disruptive events like spontaneous arousals or apnea. The Pittsburgh Sleep Quality Index (PSQI) provides a measure of global sleep quality based on a respondent's retrospective appraisal (past month) of an array of sleep measures, including sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction (94).

Besides, an issue of measuring sleep quality remains debatable. Some stated that the "gold standard" for examining sleep is the polysomnogram (95). Sleep quality is inferred from a collection of objective indices taken from polysomnography (PSG). Of the objective, indices are measures like sleep onset latency, total sleep time, wake time after sleep onset, sleep efficiency, and number of awakenings derived from different self-report instruments (96).

2.5.4 Prevalence of sleep quality:

The prevalence of poor sleep quality (see Table 2) among adolescents has covered the range from 34.3% to 62.4% (97-102). The findings indicated that the prevalence of sleep quality among undergraduate students equals 48.1-62.4%; whereas that of third-year high school and pre-university students falls at 52.9%; and that of senior and junior high school students equals 34.3 %. Nevertheless, worth pointing out is that the findings found in Thailand among Thai college students, the prevalence of sleep quality constitutes 48.1%, slightly lower than that of among college students in other countries.

Table 2 Prevalence of poor sleep quality

Sources	Participants	Prevalence	Measurement
Suen, et al. (2008)	University students in Hong Kong (n=400)	57.5%	Pittsburgh Sleep Quality Index (PSQI)
Cheng, et al. (2012)	Incoming university students in Taiwan (n=4,318)	54.7%	Pittsburgh Sleep Quality Index (PSQI)
Rocha, et al. (2010)	Third-year high school and pre-university students in São Paulo, Brazil (n=529)	52.9%	Pittsburgh Sleep Quality Index (PSQI)
Lashkaripour, et al. (2012)	Medical students and specialist assistants in Zahedan University of Medical Science, Iran	62.4%	Pittsburgh Sleep Quality Index (PSQI)
Lohsoonthorn, et al. (2012)	College students in Thailand (n=2,854)	48.1%	Pittsburgh Sleep Quality Index (PSQI)
Zhou et al. (2012)	Senior high schools (grades 10–12) and junior middle schools (grades 7–9) in	34.3%	Subjective Sleep Quality Questionnaire

2.5.5 Sleep duration:

It is generally agreed that sleep is necessary for physical and mental health, particularly important during adolescence, a phase of rapid biologic growth and development (103). Most adults reported sleeping about 7.5 hours per night on weekday nights and little longer, 8.5 hours, on weekend nights. Though the figures' variability is rather high from night to night and person to person, the length of sleep can also depends on genetic determinants (104). While adolescents going through developmental changes, physically, emotionally and psychosocially, it was found that sleep patterns of adolescents have gained serious attention lately. Despite the onset of adolescence, teenagers require 9.2 hour of sleep, a number of research findings have indicated that they have less sleep duration (53). Although no established sleep guidelines available, the National Sleep Foundation's national survey of adolescents found that adolescents in high school reported spending an average of 7.5 hours in bed and getting an average of 7.2 hours of sleep per night. The Foundation's definition on sleep hours for adolescents to be insufficient if <8 hr. per night, borderline if 8 hr. per night, and optimal if 9 hr. per night. According to the 2006 Sleep in America poll , more than half of adolescents are getting insufficient sleep on school nights; therefore, many adolescents are at risk for negative consequences of insufficient sleep (105). Likewise, the study on sleep and sleep need in a group of 10–14-year-old adolescents for a 10-year period with surveys every second year has pointed out that, 14.5% needed more sleep consistently during adolescence and only 3.3% slept adequately across the years (106).

However, several studies have indicated that adolescents' sleep duration to be significantly less (107). While the literatures reviewed above may have different results, it is undeniable that to specify exactly how much sleep adolescents require is an impossible task, since it is still unclear and varies between studies and specific ages. Sleep habits reflect cultural differences and considerable variation is found between countries, for instance, in the time of going to bed and the amount of sleep time in children and adolescents (108).

2.5.6 Sleep on non/school day:

Based on meta-analysis specifically compared between time in bed on school and non-school days, several studies reported average time in bed across the seven day week. The findings indicated that differences exist in sleep patterns between school and non-school days, during school vacations and on weekends. It is obvious that this enhanced the understanding of time in bed among this age group, since bedtime distribution seems more important than their average weekly time in bed. So, the significance of sleep patterns of school and non-school times reflects a better understanding of developmental sleep/wake behavior changes, especially that of the sleep patterns of young people (109).

Correspondingly, time difference in bed during the school week when cognitive performance is at its greatest can generate pivotal effects. It was discovered that adolescents slept more on non-school days than on school days. Additionally, the difference has increased from 25 minutes at age nine to 86 minutes at age 18, This has illustrated a different rate of age-related decline on school days – 13.6 (boys) 14.4 (girls) min/night per year of age compared to non-school days – 6.6 (boys) 8.0 (girls) min/night (110).

Moreover, the findings of a research on "Socio-demographic and Behavioral Predictors of Bed Time and Wake Time among US Adolescents Aged 15 to 17 Years" using time diaries to find out whether adolescent sleep has changed in recent years and what factors determine bed times and wake times, found that average time in bed on school days was approximately 8 hours, and was 1 to 2 hours longer on non-school days. On school days, school start time was the key predictor of wake time. Every hour earlier that school started, wake time was about 25 minutes earlier, but this cannot be support evidence showing that this is a recent change in bed times and wake times. Though several factors influencing bed time exist, school start time seems to be a major determinant of wake time on school days. That aside, earlier school days and increased use of computer can also lead to adolescents' sleep loss (111).

2.6 Sleep and related factors:

It is well recognized that good quality sleep is necessary for healthy development (112). Socio-economic, cultural, and racial elements have been found to be sleep related factors (113-116). Parental bedtime behaviors were found to be related with child sleep (117). Age and gender have also been reported to be associated with sleep quality (118, 119). Besides, adolescents engaging in school or community-related activities were at greater risk from sleepiness (120). Some stated that the use of stimulant like caffeine, generally found in coffee, tea, soft drinks and energy drink, resulted in poor sleep and daytime drowsiness (99, 121). Cigarette smoking was also associated with a higher chance of poor sleep owing to the fact that a stimulant substance has pharmacological effects on sleep quality (122); whereas previous studies found that there was a strong relationship between poor sleep quality and alcohol consumption (123). Key sleep-related factors can be summarized as follows:

2.6.1 Parents:

Parents would normally set bedtimes for younger adolescents and help wake up older adolescents. In general practice, the younger adolescents tend to wake up more spontaneously on school mornings than older adolescents (120). Based on the study of Zhang, J., Li, A.M., Fok, T.F., Wing, Y.K. (2010) about children model bedtime, the findings discovered that one of the predictors for bedtime is maternal bedtime. For example, the care-taking role of young children in Hong Kong Chinese people is largely carried out by mothers, who would probably have stronger impacts on children's sleep/wake habit and behaviors (124).

Interestingly, a study on "Longitudinal Associations Between the Quality of Parent-Child Interactions and Children's Sleep at Preschool Age" reported that the quality of parents-infant interactions was in a positive manner associated with children's percentage of night-time sleep at preschool age (125). However, it is worth pointing out that as children age, parental supervision of bedtimes would also be reduced with a potential permissiveness around the enforcement of regular bedtimes and a societal increase in young people's choices around sleep routines (110, 126).

2.6.2 Age:

The sleep reduction during adolescence can be described as a biological process of delayed melatonin secretion associated with puberty. Melatonin, a hormone secreted from the pituitary gland in the brain, forms part of the system that regulates the sleep/wake cycle. During adolescence, the secretion of melatonin is delayed compared to pre-adolescent pubescent levels (91, 127).

As reported by a research study titled: "The relationships between sex, age, geography and time in bed in adolescents: A meta-analysis of data from 23 countries", the sleep duration has been found to be different across regions; for instance, on school days, the differences between the rates of age-related decline were greater for Asia and the USA (17-18 min/year of age) than for Europe or

Australia (12 min/year of age); while on non-school days, Europe had a larger rate of age-related decline (8.4 min per year of age) than Australia, Asia or the USA (4.2–5.8 min per year of age). The findings indicated that there were large differences in reported sleep time across regions as the following summary: on school days, adolescents from the USA have approximately 20–60 min/day of sleep time less than those from Europe and Australia; whereas adolescents in Asia have approximately 60–120 min/day of sleep time less than those from Europe and Australia. On non-school days, adolescents from the USA have about 30 min/day of sleep time less than those from Europe and Australia, while adolescents from Asia have approximately 70–90 min/night sleep time less than those from Europe and Australia (110).

Though the National Survey Foundation's definition on sleep hours for adolescents to be insufficient if <8 hr. per night, borderline if 8 hr. per night, and optimal if 9 hr. per night (105). It is arguable, however, that the requirement for sleep duration can vary depending on ages: children younger than 5 years old require at least 11 hours of sleep per day; while those aged 5 to 10 years need at least 10 hours (128); whereas children and adolescents over 10 years of age need 9 or more hours of sleep per day (129). Despite the onset of adolescence and teenagers require 9.2 hour of sleep, a number of research findings have indicated that they have less sleep duration (53).

2.6.3 Gender:

As reported by a research study titled: "The relationships between sex, age, geography and time in bed in adolescents: A meta-analysis of data from 23 countries", Overall girls slept more than boys on both school days and non-school days. Likewise, girls slept more than boys in general on both school days and non-school days. For example, on school days, girls slept 11.1 minutes per night more than boys; whereas on non-school days girls slept 28.7 minutes per night more than boys (Olds, T., et al., 2010).

It has been pointed out also that boys normally have longer screen times than girls, for example, watching television, playing videogames and engaging in social networks activities. Especially on non-school days, they generally have later bedtimes and less sleep owing to the above-mentioned activities (130, 131). Nonetheless, according to earlier studies, it was discovered that females reported having poorer sleep quality than males, reflecting a significant association between poor sleep quality and gender (97, 132), which well corresponds with another study indicating that gender has been reported to be associated with sleep quality (118).

2.6.4 Socioeconomic status:

Over the past decade, socioeconomic, cultural, and racial factors have been found to have important impacts on sleep problems (115, 133). As previous study found that highly family income is strongly associated with insufficient sleep (134). Similarly, there was also evidence indicating that an association between socioeconomic indicators and quality of sleep in adolescents exists, in that low socioeconomic status reflects a worse subjective perception of sleep quality, shorter duration, and greater daytime sleepiness. (135). However, the different roles played by socio-demographic and lifestyle variables have proven to be factors that intervene with nocturnal sleep duration. The variables related to the sleep-wake cycle-naps and night awakenings-proved to be associated with a slight reduction in night-time sleep, while regularity in sleep and wake-up schedules was shown to be associated with more extended sleep duration, with a distinct expression along the week and the weekend. Having to attend school and work, coupled with other socio-demographic and lifestyle factors, creates an unfavorable scenario for satisfactory sleep duration (136).

2.6.5 Sleep and academic performance:

It is generally agreed that sleep is necessary for children and adolescents' learning, memory processes and school performance. Several researches illustrate that poor sleep, increased sleep fragmentation, late bedtimes and early awakenings have impacts on learning ability, school performance, as well as neurobehavioral functioning (54, 137). The physiological process of reduced sleep duration with age is worsen by activities, both-academically and recreationally (138)

The studies on adolescents have shown that one of the factors affecting their sleep patterns is academic obligations, i.e., trying to finish their homework; preparing lessons for their tests, etc. The findings from Taipei, Taiwan pointed out that the students in more academic challenging programs reported less sleep and lower level of alertness than those in the less challenging programs (139); whereas in America, the students on the academic fast track are likely to sleep less, although supportive data are still unavailable (120). In addition, it was found that not only homework demand, but academic stress and pressure have shortened children's time in bed and sleep duration (140).

Insufficient sleep, poor sleep quality and sleepiness are common problems in children and adolescents associated with learning, memory and school performance. The association between sleep quality, sleep duration, sleepiness and school performance were examined in three separate meta-analyses including influential factors (e.g., gender, age, parameter assessment) as moderators. All three sleep variables were significantly but modestly related to school performance. Sleepiness showed the strongest relation to school performance, followed by sleep quality and sleep duration (141).

The high school students with academic problems and those getting C's or lower in school report are people having had sleep lost, later bedtimes and more irregular sleep schedules than students reporting higher grades. (Note: A causal relationship has not yet been established.). Whereas the findings, established by some researchers administering the School Sleep Habits Survey to approximately 3,120 high school students from 4 high schools which represent 3 school districts in southern New England, discovered that adolescents with self-reported higher grades reported longer and more regular sleep/wake schedules. In addition, the study indicated that they had more total sleep and earlier bedtimes on school nights than those with lower grades (53).

In fact, the differences have differentiated students reporting mostly Bs or better from those reporting Cs and worse. By the same token, the weekend sleep habits of those students also varied in accordance with self-reported grades.

Particularly, A and B students reported earlier bedtimes and earlier rise times than those with poorer grades. Students with worse grades reported greater weekend delays of sleep schedule than those with better grades (53).

Besides, the recent analysis on academic performance and sleep by the above researching team has suggested that adolescents' shortened total sleep and irregular sleep schedules are greatly related to poor school performance. Their study examined student grades and attendance through district records and administered the School Sleep Habits Survey to 50,962 students in 7 high schools (grades 9–12). The results have found that daily attendance rates were higher in the 1999–2000 academic year than in 1995–1996; the percentage of high school students continuously enrolled in the district or in the same school increased in 1999–2000, relative to the percentage in 1995–1996; and with the later start time, the dropout rate decreased (54).

The School Sleep Habits Survey has indicated that there is no change in average school-night bedtimes or weekend bedtimes and rise times. Nevertheless, owing to later rise times on weekdays, Minneapolis students reported that they obtained, on average, 60 more minutes of sleep on school nights than those in high schools with start times 1 hour earlier (54). In addition, earlier research compared young adolescents commencing school at 7:15 AM or earlier at least 2 times a week with those starting at 8:00 AM. The outcomes indicated that early risers have complained more of daytime fatigue and sleepiness throughout the school day, greater tendency to doze off in class, and attention/concentration difficulties in school (142).

Also, some studies have correspondingly examined the relationship between sleep/wake patterns and academic performance in college students by interviewing 185 randomly selected first-year college students regarding sleep/wake habits, exercise, eating, mood, perceived stress, social support, religious habits, and semester grade point averages (GPAs). The results of the studies have suggested that sleep habits, particularly rise times, was accounted for the largest amount of variance in GPAs. More notably, the outcomes indicated that, later weekday and weekend wake times and increased number of work hours (paid/volunteer) were associated with lower GPAs; whereas eating habits, mood, stress, time management, and social support were not related to these students' grades (143).

Likewise, other investigations also found that short-sleepers reported significantly lower overall GPAs than did long-sleepers. Although there were no age or gender differences, long-sleepers (≥9 hours per night) reported significantly higher GPAs than did short-sleepers (≤6 hours per night; mean GPA: 3.24 vs 2.74, respectively). Nevertheless, the findings have unveiled that average-sleepers (7–8 hours per night) were not significantly different from long- or short-sleepers (144).

2.6.6 Sleep related private tutoring:

Private tutoring has become a mega-trend which affects most parts of the world but does so with different emphases and dynamics. Elsewhere they may be lower; but they appear to be growing in all regions of the world (145). Having private tutoring after the regular school day is perceived to be a common phenomenon among several East Asian countries, i.e., Japan, Singapore, Korea, Macau and Hong Kong (146), as well as Thailand which boast of its approximately 2,000 tutoring establishments (147).

Private tuition may have both positive and negative dimensions. It is believed that private tutoring can help slow learners to keep up with their peers, and can stretch further the competence of high achievers. Private tutoring also has social functions as a ground where young people can meet in a structured atmosphere (145). Under tutoring system, the students are taught techniques for passing school examinations and for reaching the academic standard required for promotion to the next class up the school, or are prepared for entrance examinations to prestigious tertiary institutions (146).

According to previous findings, Korean parents place great emphasis on education, and adolescents often take extra classes or private lessons, contributing to chronic sleep deprivation. In particular, the 11-12 th graders in Korea have an average nighttime sleep duration of 4.9-5.5 hours, much less than students in Japan, where parents also place great emphasis on education. This severe chronic nighttime sleep deprivation can lead to excessive daytime sleepiness and lack of attention in class (140, 148).

2.6.7 Extra-curricular club activities and sports:

Based on Carskadon, M.A. (2002), the sleep patterns of adolescents can be affected by extra-curricular club activities and school sports, namely, music band, choir, badminton and tennis. Based on a high school survey, it was revealed that approximately 25% of them join the club activities during the preceding week; while 90% of the surveyed students spent less than 12 hours per week in the above-mentioned activities. For most students, though the extra-curricular club activities and after school sports can, to a certain extent, impact their sleep patterns, they are not key factors contributing to students' sleep patterns.

2.6.8 Employment:

It has been discovered that, in the majority of high schools in America, one of the main influences impacting most students' sleep patterns is the number of working hours they spend to get paid. For those students working for pay, according to the study, if they work 20 or more hours per week (approx. 28% of samples), then they will have later bedtime, sleeping fewer hours per night, and falling asleep in school and oversleeping more often than do those not working or working fewer than 20 hours per week (Carskadon M.A., 1990).

2.7 Sleep and Health:

2.7.1 Body Mass Index (BMI):

A few studies on children and adults found that body mass index (BMI) was related to complaints of sleep problems, sleepiness, and decreased sleep time (149, 150), But it was also discovered that childhood obesity can be the cause of negative impacts on the children's health and, thus can last to adulthood and influence their future health. As indicated by an investigation that insufficient and poor sleep for children and adolescents can become risk factors in the future (151-153).

Further, short sleep is associated with impaired glucose tolerance and insulin resistance (154), and other hormone systems are affected as well. The studies of sleep deprivation have also examined the hormones leptin which regulates appetite and energy metabolism, and ghrelin which stimulates appetite. These hormones regulate hunger and satiety (155). Many studies discovered that sleep deprivation is associated with cravings for more calorie-dense foods (156) and habitual shorter sleep is related to greater fat intake (133). Besides, it has been summarized that, according to a systematic review of 31 cross-sectional studies, a short sleep duration seems independently associated with weight gain, especially in young age groups (157).

Causal-pathways linking short sleep duration with obesity, developed by Patel & Hu (2007), indicated that sleep deprivation might predispose to weight gain caused by increasing calorie intake. Besides, these increases were particularly notable for high fat and high carbohydrate foods. These changes corresponded with elevations in ghrelin and reductions in leptin, suggesting that sleep deprivation may impact peripheral regulators of hunger, as can be seen in Figure 2.

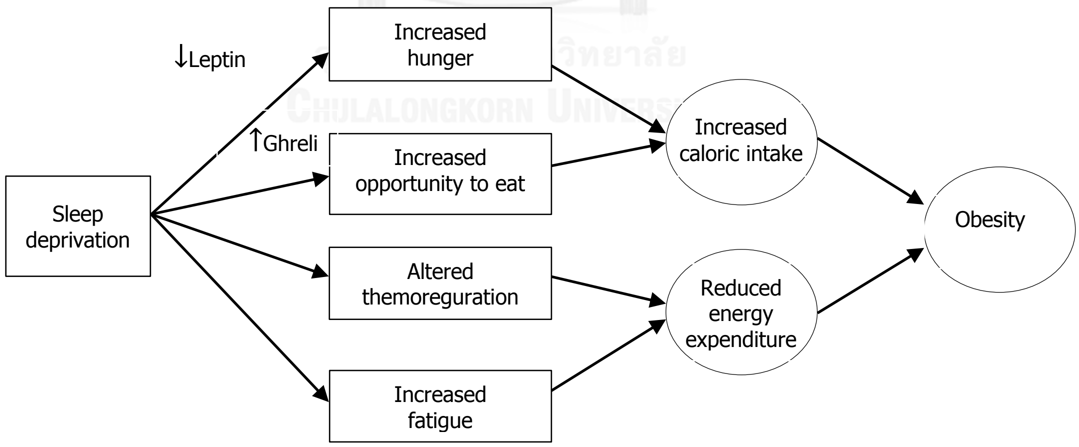

Figure 2 Potential mechanisms by which sleep deprivation may predispose to obesity (157)

2.7.2 Blood Pressure/Cardiovascular Disease:

It has been found that in epidemiologic studies, the issues of sleep duration and sleep quality have been associated with blood pressure. Also, the cross-sectional examinations have suggested that self-reported short sleep durations or subjectively poor sleep quality are related to higher blood pressure or higher prevalence of hypertension (11, 158-160).

More interestingly, the previously-mentioned findings, a longitudinal study Whitehall II, covering the tracking of workers' health from 20 departments of the British civil service across 15 years, has further pointed that, despite both sleep duration and sleep disturbance were associated with increased coronary heart disease risk, only sleep disturbance remained significant after adjustment for covariates. It has been concluded that the combination of sleep duration and sleep disturbance was a better predictor of coronary heart disease risk rather than simply sleep duration (161).

2.7.3 Hypertension:

Experimental and clinical studies have recently reported an association between sleep deprivation and higher incidence of arterial hypertension. Sleep has important homeostatic functions in human. Sleep deprivation has been associated with impairments in sympathetic nervous system activation and stress system function. (162, 163).

2.7.4 Diabetes Mellitus:

It has been reported that some potential path ways by which sleep and circadian disruption can cause obesity and diabetes (164). Also, sleep duration has generally been related to obesity risk, and short sleepers are at increased risk of large weight gain over time (157). However, these epidemiological observations do not infer a causal role of short sleep duration on obesity. Explanations were clarified regarding the role of short sleep duration on obesity risk. One involves a decrease in physical activity due to increased fatigue; whereas the other involves an increases in food intake, either because of increased time spent awake (opportunity to eat) or as a result of hormonal changes that trigger increased appetite/hunger (165) . All scenarios propose a positive energy balance, either via reduced energy expenditure or increased energy intake, which would explain the association with obesity and large weight gain.

2.7.5 Thyroid:

Thyroid hormone acts on virtually every organ system in humans. Thyroid hormone increases the basal metabolic rate, heat production, and oxygen consumption. It also alters cardiovascular and respiratory functions. Many of these actions are vital in sleep deprivation. (166). Though it is time to sleep but that person cannot sleep for some reason, the hypothalamus drives the pituitary to release more TSH and, consequently, the thyroid gland to release thyroid hormone. Increased TH release increases the strength of sensory system signalling, allowing these signals to reach the cortex and thereby overcoming sleepiness (166). It is known that hyperthyroid patients are often short sleepers and hypothyroid patients are long sleepers; and euthyroid patients can improves excessive daytime somnolence and prolonged nocturnal sleep time (167).

2.7.6 Obstructive Sleep apnea (OSA):

Obstructive sleep apnea is a common sleep disorder characterized by the repetitive obstruction of the upper airway during sleep (168). Poor sleep quality is common in people with OSA, (169). Symptoms of OSA include daytime sleepiness, poor sleep quality, and co-morbidities with depression and anxiety. According to previous research, patients with OSA has abnormally high levels of daytime sleepiness, depression, and anxiety, as well as poor sleep quality. Patients without an assessment for OSA, but showing the following symptoms: sleepiness, depression, and complaints of poor sleep, can possibly be suspected. However, the level of symptoms should not be assumed to relate to the severity of the sleep disorder (170).

2.7.7 Sleep and Mental Health:

It is well established that sleep is very sensitive to transient and chronic aspects of emotional status and psychopathology. Sleep disruptions are found in many psychiatric disorders, and sleep-related problems (171). For example, Attention

Deficit/Hyperactivity Disorder (ADHD), anxiety, stress and depression, as well as sleep deprivation (172).

The term Attention Deficit/Hyperactivity Disorder (ADHD), characterized by inattention, hyperactivity, is one of the most common psychiatric disorders of childhood (171). Sleep disorders or dysfunction have been implicated in ADHD for both children and adults. The diagnosis of ADHD is valid and sleep dysfunction is either a product of the ADHD or simply comorbid with it (173). The ADHD patients with sleep problems have often wakings at night. Though daytime sleepiness is commonly found among ADHD patients, they perform excessive hyperactivity during the day to keep themselves awake, instead. Sleep problems covering difficulty initiating and maintaining sleep have been found among children and adolescents having ADHD. The findings have reported a high prevalence of mild to severe sleep problems in children with ADHD. It is also found that there is a higher prevalence of sleep problems in children with ADHD than in those with other psychopathologies (174).

Greater recognition of the associations between sleep quality and psychiatric disorders is an important consideration. The associations between sleep quality and symptoms of anxiety and depression are well established within the field of psychiatry, to the extent that sleep disturbance is listed as a symptom of certain anxiety and depressive disorders in DSM IV(171). It is acknowledged that sleep disturbance may precede symptoms of anxiety and depression(175). Sleep disturbance may also predict depression relapse (176).

In terms of sleep-related issues studied over the last decade, one of the findings found that high school students getting to sleep on the weekend two or more hours later than their usual weeknight bedtime reported feeling more depressed than those who did not stay up late on the weekends. The findings indicated that insufficient sleep can be related to a reduction in ability to control, inhibit or change emotional responses (177).

A good example, for instance, adolescents having late-night, irregular schedules, apart from early school commencing times can significantly experience sleep deprivation. This, in turn, can erode their mood and motivation; in other words, those having difficulties with mood, motivation, and school performance are most likely to suffer from serious stress and affective problems. As a consequence, the negative affective experiences further interfere with sleep and arousal regulation and circadian effects resulting in difficulty falling asleep, more erratic schedules, and deterioration across these systems (121).

2.7.8 Sleep and Stimulants use:

Evidence has indicated that adolescents engaged in school or community activities would be at greater risk from impacts of either sleepiness or stimulant use (caffeine, nicotine, alcohol) than those not engaged (178). The use of stimulant like caffeine generally found in coffee, tea, chocolate, and soft drinks can result in insomnia or subconscious sleep disruption and daytime drowsiness which, in turn, lead to an increasing more consumption the next day. More importantly, despite the use of stimulants like caffeine or nicotine under sleepy conditions can provide short-term benefits, the long-term negative impacts on sleep and circadian health are, nevertheless, unavoidable (121).

Based on current investigation and other corresponding findings, cigarette smoking was associated with an increased chances of poor sleep quality. The mechanism through which smoking causes poor sleep quality could involve nicotine (179), a stimulant found in cigarettes that has pharmacological effects on sleep (122). Regarding alcohol, a potent short-term sedating substance, though it may induce sleep, the consumer can develop acute rebound insomnia immediately the blood alcohol concentrations have dropped low enough. Furthermore, alcohol can result in pharyngeal dilator muscle relaxation, precipitates snoring and, in some cases, sleep apnea in susceptible individuals (127).

A previous research has indicated that stimulant use was found to be statistically significant and positively associated with poor sleep quality. Alcohol consumption and cigarette smoking also reported having significant association with increased daytime dysfunction caused by sleepiness (180). The stimulant use generally found among Thai college students, is found to be related with several other poor sleep quality indices. Likewise, the sleep quality and sleep patterns have also been found to be associated with consumption of energy drinks, caffeinated beverages and some other stimulants use among Thai college students (99).

More interestingly, smoking has been reported to be associated with poor sleep quality, including a longer initial sleep latency and less total sleep duration (181). The poor sleep quality among smokers are caused by the pharmacological effect of nicotine, a potent stimulant which inhibits sleep promoting systems (182). Besides, nicotine cravings during the night can induce arousal and interfere with sleep quality(122, 179). As far as alcohol-related sleep quality is concerned, some studies suggested that alcohol has been used as a self-treatment for insomnia among general population (183). However, alcohol consumption is one of the causes of insomnia since it increases fragmentation and decreases quality of sleep (184). Indeed, a number of studies confirmed the negative relationship between alcohol consumption and sleep quality (185, 186), and problem drinkers frequently reported poor sleep quality and sleep difficulties (187).

2.8 Academic performance and related factors:

In determining academic performance, several factors have to be put into consideration; besides, a number of literature reviews consisted of debate and discussion as to academic achievement related variables. Academic related factors have long been in focus among academicians, educational policy planners, educational institutions worldwide since these factors can predict educational quality (188). Given their academic-related importance, the variables covered the following: teachers' experience, school size, classroom size, students' ability, etc. However, in our research, attempts have been made to focus on confounding factors relating to academic performance, as well as to EMF device use. Details of academic performance and related factors can be illustrated below:

2.8.1 Academic performance and socio-economic factors (SES):

It has been recognized that socio-economic status (SES) is the most widely used contextual variable in education research as indicated by a number of studies examining educational processes, together with academic achievement, in relation to socio-economic history (189). Previous study on the first meta-analysis focusing on studies published before 1980 examining the relation between SES and academic performance, which found that the relation differed with such factors as SES categories (190). More interestingly, another meta-analytic study investigating journal articles published between 1990-2000 found shat there was a medium to strong relation between SES and academic achievement (191). As far as family SES is concerned, past researchers found that this factor significantly affected academic performance; students from family with better SES background had better learning experience (192, 193). Some findings suggested that family's educational resources influenced learning ability gaps in different family socio-economic status the most (194, 195).

2.8.2 Academic performance and psychological factors:

Various findings discovered important association between psychological factors and academic achievement (196). Correspondingly, previous study also found that a significant relation between mental health and academic performance did exist (197). Worth pointing out is that a study result based on meta-analysis discovered that students having emotional disturbances performing significantly below their peers (198). This was pertinent to a survey that higher level of anxiety was associated with lower GPA and test scores (199). Likewise, previous findings indicated that there was a significant relationship between anxiety and academic achievement among early adolescent students (200).

2.8.3 Academic performance and alcohol consumption and smoking:

Recognized as a classic theory of deviant behavior and, it was, therefore, often used to explain why adolescents' academic experience might be related to alcohol consumption and smoking. Given this theory, adolescents with good academic achievement would develop a greater stake in school as a social institution and, consequently, have more to lose in engaging in such behavior as drinking and smoking that could jeopardize their standing in school (201). A number of studies confirmed accordingly that alcohol consumption was associated with academic performance (202-204). Additionally, academic achievement was found to be related with smoking in that good academic students were less likely to smoke (205, 206)).

CHAPTER III

METHODOLOGY

This research has employed a cross-sectional study with the objective of investigating the association between EMF devices and sleep quality and academic performance among high school students in Bangkok. The research details cover the following items:

3.1 Research design:

This cross-sectional study was designed to investigate the association between EMF devices and sleep quality and academic performance among high school students in Bangkok

3.2 Population:

The population of this research consists of high school students of grade 10-12 studying in high schools in Bangkok area, under the supervision of the Office of the Basic Education Commission, Ministry of Education.

3.3 Sample; Sample Size; Sampling Technique:

Sample:

The samples cover 1,080 high school students of grade 10-12 for academic year of 2013, derived from 10 high schools in Bangkok area, under the supervision of the Office of the Basic Education Commission, Ministry of Education. Eligible criteria for selecting samples to participate in this research project can be detailed as follows:

Inclusion criteria:

- The required samples will be obtained from high schools in Bangkok, under the supervision of the Office of the Basic Education Commission, Ministry of Education. The subjects must be high school students (males and females) in grade 10-12, willing to participate in the project and, at the same time, get permission from their parents or guardians through consent form.

Exclusion criteria: None

Sample size:

The sample size used in this research has been calculated as follows (207):

$$n = \frac{Z_{\alpha/2}^{\ 2}\, PQ}{d^2}$$

Where

n = sample size,

$Z_{\alpha/2}$ = $Z_{\alpha/2}$ statistic for level of confidence,

P = proportion of success (expected prevalence or true proportion)

Q = proportion of failure (1 – P)

d = error

For the level of confidence:

$Z_{\alpha/2}$ = 1.96

P = 0.48 (prevalence of poor sleep quality derived from the study of Lohsoonthorn et al., 2013)

d = 0.03 (we expect to see 3% difference of proportion)

A sample size calculated was based on the prevalence of poor sleep quality with the rate of 48% from a study of Lohsoonthorn et al. (99) with 95% CI, and 3% of poor sleep quality rate for minimum error. The formula for one sample proportion estimation derived from Lemeshow et al. (208) gives rounded up a minimum sample size of 1,065 participants. The total 1,080 participants completed the questionnaire.

Sampling Technique:

This research, based on multi-stage sampling method, covered the following process as follows:

Step 1: Since Bangkok has a total of 2 educational service areas, the researcher employed simple random technique in both educational areas in Bangkok. Each area included 5 schools; totalling 10 schools altogether.

Step 2: Each school employed simple random technique to obtain a total of 3 levels (Grade 10, 11, 12) of classrooms: likewise, one classroom from each level, totalling 30 classrooms.

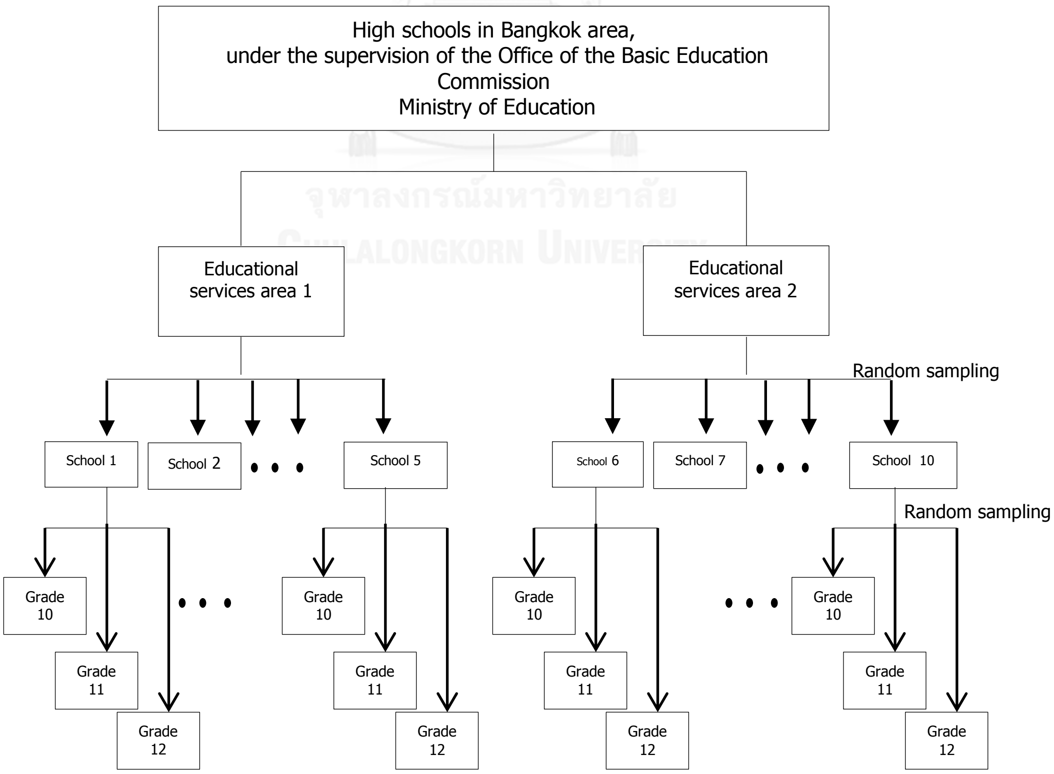

Figure 3 Sampling technique

3.4 Research Instruments:

3.4.1 Research instrument used:

The questionnaires employed for this research is Effect of Electromagnetic Field Devices Used on Sleep Quality and Academic Performance among High School Students in Bangkok, Thailand, covering 6 parts (Appendix). The details are as follows:

Part 1: Socio-Economic and Clinical Characteristic Information: this questionnaire covers the following items: age; gender; GPA; socioeconomic status, etc., totaling 22 items.

Part 2: EMF Communications Devices Used: this covers the various communications devices used, usage frequency, reasons to use, etc., totaling 27 items.

Part 3: Sleep Patterns: This part includes the following behaviors, i.e., bed/rise time and number of sleep hours; reasons for going to bed; time and how to go to school, etc. This questionnaire is developed from the sleep quality among Thai college students (99), totaling 22 items.

Part 4: Pittsburgh Sleep Quality Index (PSQI): The PSQI was designed to evaluate overall a one-month period of sleep quality. Each item of the total 19 self-reported items of the questionnaire belongs to one of seven categories: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Five additional questions related by respondent's roommate or bed partner are included for clinical purposes and are not scored, totaling 10 items. The total PSQI scores can range from 0-21 with high scores reflecting poor sleep quality. A score above 5 is generally considered poor sleep. The internal reliability of the questionnaire with a Cronbach's alpha of 0.83; a test-retest reliability being = 0.85; a sensitivity being = 89.6%; a specification being = 86.5% (94). In terms of reliability and validity of the Thai version of PSQI, the internal reliability of the questionnaire with a Cronbach's alpha of 0.84; a test-retest reliability being = 0.89; a sensitivity being = 77.78%; a specification being = 93.33% (209).

Part 5: General Health Questionnaire 28 (GHQ-28): The GHQ-28 items for mental health screening test developed from Goldberg's original GHQ transcript is one of the most widely recognized questionnaires, and has been translated into more than 36 languages. Though this GHQ Thai version, through its' effectiveness, can clearly identify the psychological disturbance, it cannot diagnose as to the type of mental illness. The GHQ-28 has been divided into four subscales, for instance, somatic symptoms (items 1–7); anxiety/insomnia (items 8–14); social dysfunction (items 15–21), and severe depression (items 22–28), respectively (210). Each and every item covers four answers and has to be filled out by the respondent according to their mental health over the last two weeks. This research questionnaire has scored 0, 0, 1, 1, according to the increased severity of the symptom. If the questionnaire scored $\geq$ 6 is identified as having psychological disturbances (211).

Part 6: Alcohol and Caffeine Consumption: This questionnaire is developed from the sleep quality among Thai college students (99), totaling 8 items.

3.4.2 Research instrument development:

To develop the instruments for this research study, the development process can be illustrated as follows:

3.4.2.1 Development of Part 1 and Part 2 of the questionnaire: Part 1: Socio-Economic and Clinical Characteristic Information; Part 2: EMF Communications Devices Used. The development process can be described as follows:

- Conduct literature reviews on EMF devices use towards sleep quality and academic performance.
- Develop the questionnaire's related items based on literature reviews required.
- Ensure content validity by related field experts.

- Revise questionnaire items according to experts' comments and suggestion.
- Try out the questionnaires and revise accordingly.

3.4.2.2 Development of Part 3 and Part 6 of the questionnaire: Part 3: Sleep Patterns and Part 6: Alcohol and Caffeine Consumption.

The development process can be described as follows:

- Conduct literature reviews on sleep patterns and alcohol consumption among adolescents.
- Get permission to develop the questionnaire used in the research entitled "Sleep quality and sleep patterns in relation to consumption of energy drinks, caffeinated beverages, and other stimulants among Thai college students" (99).
- Develop the questionnaire's related items based on literature reviews and the questionnaire approved above.
- Ensure content validity by related field experts.
- Revise questionnaire items according to experts' comments and suggestion.
- Try out the questionnaires and revise accordingly.

3.4.2.3 Development of Part 4: Pittsburgh Sleep Quality Index (PSQI)

The development process can be described as follows:

- Get permission to use and translate the PSQI into Thai language by the researcher.
- Ensure content validity by related field experts.
- Revise questionnaire items according to experts' comments and suggestion.
- Back translate from Thai language to English by English expert who are well verse with Thai language and having no knowledge of the PSQI.

- Try out the questionnaires with high school students, rather than samples from 10 selected schools, in Bangkok, under the supervision of the Office of the Basic Education Commission, Ministry of Education. The reliability of PSQI found yielding a Cronbach's α = 0.77.

3.4.2.3 Development of Part 5: General Health Questionnaire 28 (GHQ-28)

The development process can be described as follows:

- Get permission to use the GHQ-28 from Nilchaikovit, et al., (1996) who had developed the GHQ-28 Thai version.
- Try out the questionnaires with high school students, rather than samples from 10 selected schools, in Bangkok, under the supervision of the Office of the Basic Education Commission, Ministry of Education. The reliability of the GHQ-28 found yielding a Cronbach's α = 0.91.

3.5 Data accessibility and collection:

In order to obtain the data required, the following steps have been performed:

- Contact the directors of 10 high schools via telephone to explain about research project in details and ask for permission to collect data.
- Send invitation letters to the above directors.
- Explain to the sampled teachers and students about the research project and ask them to take part in the project.
- For students willing to take part in this project, they are given 3 documents for their parents/guardians to approve: a) Informed Consent b) Consent Form c) Questionnaire.
- After receiving the consent form, the researcher, in classroom, explains in details about questionnaire completion. The participants spend approximately 45 minutes to complete the questionnaires in their

classroom by themselves. More importantly, they are assured of the data’s confidentiality.

3.6 Statistical Analysis:

In statistical analysis, the researcher has focused on the following areas:

3.6.1 To describe the general information, descriptive statistical analysis was used as follows:

- Descriptive statistics, i.e., frequency, per cent, mean, standard deviation, percentile, range, were employed to analyze such variables as EMF devices use, socio-economic and clinical characteristic, stimulant use, sleep quality and academic performance.

3.6.2 To discover the frequencies of EMF devices use, on school day and non-school day, among high school students in Bangkok. The statistics used included:

- Descriptive statistics, for example, frequency, per cent, mean, standard deviation, range, were employed.

3.6.3 To identify the prevalence of poor sleep quality among high school students in Bangkok. The following statistics were used:

- Descriptive statistics like frequency, per cent, Chi-square test. They were employed to analyze the sleep quality and its components.

3.6.4 To investigate the association between EMF devices use and sleep quality among high school students in Bangkok. The following statistics were used:

- Logistic regression analysis was used to study the association between EMF device use and sleep quality. The univariate association between poor sleep quality and EMF devices use, socio-economic and clinical characteristic (age, gender, parents’ education, family income, weekly allowance and BMI), as well as stimulant use (alcohol consumption and smoking) was calculated. Logistic regression modeling procedures were used to calculate unadjusted odds ratio (unadjusted OR) with 95% confidence intervals (CI). Upon completion of the univariate analyses, the variables which were related to sleep quality (p-value < 0.05) were selected for multivariable analysis to calculate adjusted odds ratio (adjusted OR) with 95% confidence intervals (CI) by using enter method.

3.6.5 To investigate the association between EMF devices use and academic performance among high school students in Bangkok. The following statistics were used:

- Logistic regression analysis was used to study the association between EMF device use and academic performance. The univariate association between academic performance and EMF devices use, socio-economic and clinical characteristic (parents' education, family income, weekly allowance, and psychological disturbance), as well as stimulant use (alcohol consumption and smoking) was calculated. Logistic regression modeling procedures were used to calculate unadjusted odds ratio (unadjusted OR) with 95% confidence intervals (CI). Upon completion of the univariate analyses, the variables which were related to academic performance (p-value < 0.05) were selected for multivariable analysis to calculate adjusted odds ratio (adjusted OR) with 95% confidence intervals (CI) by using enter method.

- The above analyses were accomplished by using statistical software: The Statistical Package for Social Sciences (SPSS 22.0 for Windows).

3.7 Ethical Considerations:

Protection of participants and procedure for data collection, approved code: COA No. 016/2014, were approved by the Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University (ECCU).The participants had to get permission from their parents/guardians prior to participate in this research project, and willingly agree to take part by signing an informed consent form. Information collected was kept confidential.

CHAPTER IV

RESULTS

This research has employed a cross-sectional study with the objective of investigating the association between EMF devices use and sleep quality and academic performance among high school students in Bangkok. The research details cover the following items:

4.1 Socio-Economic and Clinical Characteristic:

In this research, the researcher has collected the required data consisting of high school students (grade 10-12) of academic year 2013, in Bangkok area, under the supervision of the Office of the Basic Education Commission, Ministry of Education. The total number of samples being collected were 1,080 participants, mean age was 16.8 (SD = .94) years, 483 (44.7%) were male and 597 (55.3 %) were female. In terms of students' educational level, 31.4% studying at grade 10; whereas 34.5% and 34.1% studying at grade 11 and 12, respectively. In terms of Grade Point Average (GPA), mean GPA was accounted for3.06 (SD=0.56); quartile was used to divide the participants into groups as follows: < 2.70 (25 percentiles) 25.1%; 2.71-3.12 (26-50 percentiles) 26.0%; 3.13-3.50 (51-75 percentiles) 24.0%; >3.50(>75 percentiles) 24.9%.

Regarding father's educational level, 25.3% completed ≤elementary school; 41.1% completed secondary school through junior vocational school/ associate degree; whereas 33.6% completed bachelor degree through post graduate degree. Regarding mother's educational level, 31.2% completed ≤ elementary school; 38.5% completed secondary school through junior vocational school/associate degree, whereas 28.7% completed bachelor degree through post graduate degree. In terms of father's occupation: 3.7% being unemployed; 10.7% being government officials; 38.1% having their own business; 16.4% being company employees; 26.1% being general laborers; whereas 5.0% being others (nun, death, don't know). As for mother's occupation: 22.2% being housewife/unemployed 9.1% being government officials; 34.2% having their own business; 14.1% being company employees; 18.4% being general laborers; whereas 2% being others (monk, death, don't' know).

Regarding family income: 7.3% earns $\leq$10,000 baht/month; 47.9% earns 10,001 - 30,000 baht/month; 24.1 % earns 30,001 - 50,000 baht/month; whereas 20.7% earns > 50,000 baht/month. As for weekly allowance: the findings found that 59.4% earns $\leq$ 600 (baht/ week); while 40.6% earns >600 (baht/ week).

In terms of body mass index (BMI), those being underweight constitute 31.3%; whereas those being Normal and Overweight/Obese constitute 52.4% and 16.3%, respectively; also those having psychological disturbance constitute 22.5%. Regarding part-time job, it was found that those working part-time job constitutes 10.4%. Concerning physical activity, it was found that those having physical activity ($\geq$150 min./week) constitutes 47.3%. As for school activity: it was discovered that those saying no constitutes 46.3%; whiles those having school activity (1-5 hrs/week) constitutes 42.4%; whiles those having school activity ($\geq$ 6hrs/week) constitutes 11.3%. As far as private tutoring is concerned: It was indicated that those saying no constitutes 19.4%; while those having Private tutoring (1-5 hrs/week) constitutes 41.6%; whiles those having Private tutoring (6-10 hrs/week) constitutes 24.4%; and those having private tutoring ($\geq$10 hrs/week) constitutes 14.6%. As for alcohol consumption, it was discovered that those saying "never" constitutes 47.1%; while those saying "none over last 12 months" constitutes 10.0%; those having < once a month and $\geq$ once a month constitutes 34.7% and 8.2%, respectively. Concerning smoking, the findings indicated that those saying "yes" constitute 13.4%. Concerning sleep quality, the prevalence of poor sleep quality accounted for 32.0% [95% CI=29.26-34.91] (See Table 3).

Table 3 Socio-economic and Clinical characteristic (n=1,080)

Characteristics	n	(%)
Gender		
Male	483	(44.7)
Female	597	(55.3)
Age (Years)		
15	90	(8.3)
16	333	(30.8)
17	376	(34.8)
18 and over	281	(26.0)
Mean (SD)	16.80	(0.94)
Range	15.0 - 19.0	
Education level		
Grade 10	339	(31.4)
Grade 11	373	(34.5)
Grade 12	368	(34.1)
Grade Point Average (GPA)		
≤ 2.70 (25 percentiles)	261	(25.1)
2.71-3.12 (26-50 percentiles)	271	(26.0)
3.13-3.50 (51-75 percentiles)	250	(24.0)
>3.50 (>75 percentiles)	259	(24.9)
Mean (SD)	3.06	(0.56)
Range	1.0 - 4.0	
Father's education		
≤Elementary school	266	(25.3)
Secondary school through Junior vocational school/ Associate degree	433	(41.1)
Bachelor degree through Post graduate	354	(33.6)
Mother's education		
≤Elementary school	337	(31.2)
Secondary school through Junior vocational school/ Associate degree	416	(38.5)
Bachelor degree through Post graduate	310	(28.7)
Father's occupation		
unemployed	40	(3.7)
Government officials	115	(10.7)
Own business	411	(38.1)
Company employees	177	(16.4)
General laborers	281	(26.1)
Others (monk, death, don't know)	54	(5.0)

Table 3 Socio-demographic characteristic of participants (n=1,080) (Con.)

Characteristics	n	(%)
Mother's occupation		
Housewives/unemployed	240	(22.2)
Government officials	98	(9.1)
Own business	369	(34.2)
Company employees	152	(14.1)
General laborers	199	(18.4)
Others (nun, death, don't know)	22	(2.0)
Family income: (baht/month) [a]		
$\leq$ 10,000	79	(7.3)
10,001 - 30,000	516	(47.9)
30,001 - 50,000	260	(24.1)
>50,000	223	(20.7)
Weekly allowance (baht/week) [a]		
$\leq$ 600(50 percentiles)	633	(59.4)
>600 (>50 percentiles)	432	(40.6)
Mean (SD)	658.92	(312.56)
Range	100.0 - 3,000.0	
Psychological disturbance (GHQ-28)		
No	837	(77.5)
Yes	243	(22.5)
Body mass index (BMI)		
Underweight	337	(31.3)
Normal	564	(52.4)
Overweight/Obese	176	(16.3)
Part-time job		
No	968	(89.6)
Yes	112	(10.4)
Physical activity		
No	569	(52.7)
Yes($\geq$150 min./week)	511	(47.3)

Table 3 Socio-demographic characteristic of participants (n=1,080) (Con.)

Characteristics	n	(%)
School activity		
No	500	(46.3)
1-5 hrs/week	458	(42.4)
≥6 hrs/week	122	(11.3)
Private tutoring		
No	210	(19.4)
1-5 hrs/week	449	(41.6)
6-10 hrs/week	263	(24.4)
≥ 10 hrs/week	158	(14.6)
Alcohol consumption		
Never	508	(47.1)
None over last 12 months	108	(10.0)
< Once a month	374	(34.7)
≥ Once a month	89	(8.2)
Smoking		
No	928	(86.6)
Yes	177	(13.4)
Sleep quality		
Poor sleep quality	346	(32.0)
Good sleep quality	734	(68.0)
Prevalence of poor sleep quality (95%) CI)	32.0	(29.26-34.91)

[a] $1 US = 35 Baht (Approx.)

4.2 EMF Devices Use:

4.2.1 Type of EMF Devices Use:

According to Table 4, the findings suggested that EMF devices used by the participants can be classified as follows: As for mobile/smartphone, it was found that the figure of participants using them constitutes 96.9%; whereas those using desktop/notebook equipped with wireless internet and, tablet equipped with wireless internet constitutes 74.1% and 24.3%, respectively.

Regarding the number of devices use, owing to the proliferation of EMF devices usage, a number of adolescents at present could have used more than one device in their daily life. Likewise, those using mobile/smartphone and desktop/notebook computer equipped with wireless internet accounted 53.1%; Our result showed that the participants using only mobile/smartphone constituted 20.1%, those using mobile/smartphone and Desktop/notebook computer and tablet equipped with wireless internet constituted 18.5%., those using mobile/smartphone and tablet equipped with wireless internet constituted 5.1%, those using only desktop/notebook computer equipped with wireless internet constituted 1.8 %., whereas those using desktop/notebook computer and tablet equipped with wireless internet accounted only 0.6%.

Table 4 Type of EMF devices use (n=1,080)

Type of EMF devices use	n	(%)
Type of devices use		
Mobile/smartphone	1,046	(96.9)
Desktop/notebook equipped with wireless internet	800	(74.1)
Tablet equipped with wireless internet	262	(24.3)
Number of devices use		
Mobile/smartphone and Desktop/notebook equipped with wireless internet	574	(53.1)
Mobile/smartphone	217	(20.1)
Mobile/smartphone and Desktop/notebook and Tablet equipped with wireless internet	200	(18.5)
Mobile/smartphone and Tablet equipped with wireless internet	55	(5.1)
Desktop/notebook equipped with wireless internet	19	(1.8)
Desktop/notebook and Tablet equipped with wireless internet	7	(0.6)

4.2.2 Mobile/smartphone use:

Table 5 shows the distribution of mobile/smartphone use across gender of students. It was found that, among all the mobile/smartphone users, totaling 1,074 (96.9%), 75.4% of them using mobile/smartphone without small talk/Bluetooth; whereas only 21.4% using mobile/smartphone with small talk/Bluetooth. Moreover, on school days, among those using mobile/smartphone, the participants' total time spent per day were illustrated as follows: mean time spent of both genders was accounted for 3.50 (SD = 2.47) hrs., range = 0.00 – 12.7 hrs.; while male spending 2.96 (SD=2.27) hrs.; female spending time was accounted for 3.92 (SD=2.54) hrs.; those spending ≤ 1 hour was accounted for 21.4%; whiles those spending > 1-3 hours constituted 30.6%; those spending > 3-5 hrs. was accounted for 28.3%; whereas those spending > 5 hrs. was accounted for 19.7%.

On non-school days, the findings indicated that, among those using mobile/smartphone, the total time spent per day were illustrated as follows: mean time spent of both genders was accounted for 4.93 (SD = 3.56) hrs., range = 0.00 – 14.0 hrs.; male spending time constituted 4.05 (SD=3.30) hrs; whiles female spending time was accounted for 5.63 (SD=3.60) hrs; those spending ≤ 1 hour constituted 18.4%; whereas those spending > 1-3 hours constituted 20.2%; those spending > 3-5 hrs. constituted 21.3%; while those spending > 5 hrs. was accounted for 40.1%.

As regards with "Used over 30 min./day without small talk/bluetooth", mean times of both genders was accounted for 2.50 (SD = 2.01) hrs., range = 0 – 10 times; it was found that those answering "Never" constituted 17.7%; while those answering "1-2 times per day" constituted 38.5%; whereas those answering " 3-4 times per day" constituted 25.1%; those saying ≥ 5 times per day was accounted for 18.8%.

As far as "used mobile phone in the classroom/time/day" is concerned, the outcomes suggested that mean times of both genders was accounted for 2.41 (SD = 2.68) hrs., range = 0 – 20 times; it was discovered that those answering "Never" constituted 28.5%; while those answering "1-2 times per day" was accounted for33.1%; whereas those answering " 3-4 times per day" constituted 21.2%; those answering ≥ 5 times per day was accounted for 17.2%.

Regarding Internet used through smartphone, the findings found that those using smartphone with online internet when needed constitutes 55.3%; while those using Internet offline before bedtime constitutes 12.9%; and those using Internet online all the time constitutes 31.8%.

In terms of location of smartphone at bedtime, it was indicated that those placing their smartphone beside pillow constitutes 18.9%; whereas those placing their smartphone on bed constitutes 52.4%; and placing their smartphone in bedroom constitutes 22.2%; whiles placing their smartphone outside bedroom constitutes 6.5%.

Table 5 Mobile/smartphone use (n=1,080)

Mobile/smartphone Use	All (n=1,074)		Gender			
			Male (n=483)		Female (n=597)	
	n	(%)	n	(%)	n	(%)
Mobile/smartphone use (n=1,074)						
None	34	(3.2)	27	(5.6)	7	(1.2)
Yes, without small talk/Bluetooth	810	(75.4)	375	(78.1)	435	(73.2)
Yes, with small talk/Bluetooth	230	(21.4)	78	(16.2)	152	(25.6)
Mobile/smartphone use (n=1,080)						
No	34	(3.1)	27	(5.6)	7	(1.2)
Yes	1,046	(96.9)	456	(94.4)	590	(98.8)
Total time spent per day (school day) (n=1,040)						
≤ 1 hour	223	(21.4)	123	(27.2)	100	(17.0)
>1-3 hours	318	(30.6)	159	(35.1)	159	(27.1)
>3-5 hours	294	(28.3)	111	(24.5)	183	(31.2)
> 5 hours	205	(19.7)	60	(13.2)	145	(24.7)
Mean (SD)	3.50	(2.47)	2.96	(2.27)	3.92	(2.54)
Range	0.00 - 12.17		0.00 - 11.00		0.00 - 12.17	

Table 5 Mobile/smartphone use (n=1,080) (Con.)

Mobile/smartphone Use	All (n=1,080)		Gender			
			Male (n=483)		Female (n=597)	
	n	(%)	n	(%)	n	(%)
Total time spent per day (non-school day) (n=1,040)						
≤ 1 hour	191	(18.4)	118	(26.0)	73	(12.4)
>1.0-3 hours	210	(20.2)	102	(22.5)	108	(18.4)
>3.0-5 hours	222	(21.3)	99	(21.9)	123	(21.0)
> 5 hours	417	(40.1)	134	(29.6)	283	(48.2)
Mean (SD)	4.93	(3.56)	4.05	(3.30)	5.63	(3.60)
Range	0.00 - 14.00		0.00 - 14.00		0.00 – 14.00	
Used over 30 min./day without small talk/Bluetooth (n=810)						
Never	143	(17.7)	89	(23.7)	54	(12.4)
1-2 per day	312	(38.5)	159	(42.4)	153	(35.2)
3-4 per day	203	(25.1)	80	(21.3)	123	(28.3)
≥ 5 per day	152	(18.8)	47	(12.5)	105	(24.1)
Mean (SD)	2.50	(2.01)	2.10	(1.97)	2.84	(2.00)
Range	0 - 10		0 - 10		0 - 9	
Used mobile/smartphone in the classroom (n=1,040)						
Never	296	(28.5)	157	(34.7)	139	(23.7)
1-2 per day	344	(33.1)	148	(32.7)	196	(33.4)
3-4 per day	221	(21.2)	72	(15.9)	149	(25.4)
≥ 5 per day	179	(17.2)	76	(16.8)	103	(17.5)
Mean (SD)	2.41	(2.68)	2.24	(2.92)	2.54	(2.46)
Range	0 - 20		0 - 20		0 - 20	
Internet use thru smartphone (n=674)						
Use smartphone with online internet when needed	373	(55.3)	166	(57.0)	207	(54.0)
Internet offline before bedtime	87	(12.9)	30	(10.3)	57	(14.9)
Internet online all the time	214	(31.8)	95	(32.6)	119	(31.1)
Location of smartphone at bedtime (n=811)						
Beside pillow	128	(18.9)	39	(13.4)	89	(23.2)
On bed	354	(52.4)	162	(55.5)	192	(50.0)
In bedroom	150	(22.2)	70	(24.0)	80	(20.8)
Outside bedroom	44	(6.5)	21	(7.2)	23	(6.0)

Based on Table 6, the first 3 main reasons for using smartphone among participants are: 1) For social networks, i.e. FB/Twitter/Line/IG (77.2%); and it appeared that the number of male using social networks was less than that of female participants (61.2% vs. 80.8%); 2) For communication purpose which accounts for 61.4%; it appeared that the number of male and female using social networks was quite close (60.7% vs. 61.9%); 3) For watching films & listening to music which accounts for 48.3%, and it appeared that the number of male and female watching films & listening to music was quite close (49.6% vs. 47.4%).

Table 6 Reason for using smartphone (n=896)

Reasons	All (n=896)		Male (n=369)		Female (n=527)	
	n	(%)	n	(%)	n	(%)
Social networks (FB/Twitter/Line/IG)	692	(77.2)	226	(61.2)	426	(80.8)
For communication by phone	550	(61.4)	224	(60.7)	326	(61.9)
Watching film & listen to music online	433	(48.3)	183	(49.6)	250	(47.4)
Search for academic information	389	(43.4)	136	(36.9)	253	(48.0)
Search for non-academic information	304	(33.9)	131	(35.5)	173	(32.8)
For playing games online	218	(24.3)	119	(32.2)	99	(18.8)
Share assignment solution online	192	(21.4)	67	(18.2)	125	(23.7)
Downloading film and music	189	(21.1)	81	(22.0)	108	(20.5)
Download / upload to YouTube	167	(18.6)	69	(18.7)	98	(18.6)
Watching TV online	76	(8.5)	35	(9.5)	41	(7.8)
For sending-receiving E-mail	60	(6.7)	30	(8.1)	30	(5.7)
Send text messages	59	(6.6)	25	(6.8)	34	(6.5)
Doing E-business online	54	(6.0)	27	(7.3)	27	(5.1)

4.2.3 Desktop/notebook equipped with wireless internet use:

Based on Table 7, given the use of desktop/notebook equipped with wireless internet, it was discovered that the number of male users was accounted for 67.7%; whereas that of female users being 79.2%. On school days, the findings indicated that, among those using desktop/notebook via wireless internet, the total time spent per day were classified as follows: mean time spent for both genders was accounted for 2.61 (SD = 1.88) hrs., range = 0.00 – 8.00 hrs.; while male spending time constituted 2.41 (SD=1.79) hrs.; female spending time was accounted for 2.79 (SD=1.94) hrs.; those spending $\leq$ 1 hour constituted 28.2%; whereas those spending > 1-3 hours constituted 40.2%; those spending > 3-5 hrs. was accounted for 23.1%; while those spending > 5 hrs. constituted 8.4%.

As far as using desktop/notebook equipped with wireless internet on non-school days is concerned, the findings indicated that the total time spent per day can be described as follows: mean time spent for both genders was 5.02 (SD = 3.28) hrs., range = 0.17 – 15.00 hrs.; whiles male spending time constituted 5.55 (SD=3.33) hrs.; female spending time was accounted for 4.56 (SD=3.17) hrs.; those spending $\leq$ 1 hour constituted 12.0%; whereas those spending > 1-3 hours was accounted for 24.4%; those spending > 3-5 hrs. constituted 27.8%; while those spending > 5 hrs. was accounted for 35.9%.

Table 7 Desktop/notebook equipped with wireless internet use (n=1,080)

Desktop/notebook equipped with wireless internet	All (n=1,080)		Gender: Male (n=483)		Gender: Female (n=597)	
	n	(%)	n	(%)	n	(%)
Desktop/notebook equipped with wireless internet use						
No	280	(25.9)	156	(32.3)	124	(20.8)
Yes	800	(74.1)	327	(67.7)	473	(79.2)
Total time spent per day (school day) (n=800)						
≤ 1 hour	226	(28.2)	114	(30.2)	112	(26.5)
>1-3 hours	322	(40.2)	160	(42.4)	162	(38.3)
>3-5 hours	185	(23.1)	83	(22.0)	102	(24.1)
> 5 hours	67	(8.4)	20	(5.3)	47	(11.1)
Mean (SD)	2.61	(1.88)	2.41	(1.79)	2.79	(1.94)
Range	0.00 - 8.00		0.00 - 8.00		0.25 - 8.00	
Total time spent per day (non-school day) (n=800)						
≤ 1 hour	96	(12.0)	35	(9.3)	61	(14.4)
>1-3 hours	195	(24.4)	76	(20.2)	119	(28.1)
>3-5 hours	222	(27.8)	98	(26.0)	124	(29.3)
> 5 hours	287	(35.9)	168	(44.6)	119	(28.1)
Mean (SD)	5.02	(3.28)	5.55	(3.33)	4.56	(3.17)
Range	0.00 - 15.00		0.00 - 15.00		0.00 - 14.00	

Based on Table 8, the first 3 main reasons for using desktop/notebook equipped with wireless internet can be summarized as follows: 1) For social networks interaction, i.e. FB/Twitter/Line/IG (59.4%); and it appeared that the percentage of male users was close to that of female users (59.2% vs. 59.6%); 2) For searching academic information (57.9%); and the findings showed that the percentage of female users was two times higher than that of male users (67.6% vs. 31.0%); 3) For playing games online (46.3%), it was found that the percentage of male users was two times higher than that of female users (67.9% vs. 27.0%).

Table 8 Reason for using Desktop/notebook equipped with internet use (n=800)

Reasons	All (n=800)		Male (n=377)		Female (n=423)	
	n	(%)	n	(%)	n	(%)
Social networks (FB/Twitter/Line/IG)	475	(59.4)	223	(59.2)	252	(59.6)
Search for academic information	463	(57.9)	117	(31.0)	286	(67.6)
Watching film & listen to music online	417	(52.1)	235	(62.3)	236	(55.8)
For playing games online	370	(46.3)	256	(67.9)	114	(27.0)
Search for non-academic information	283	(35.4)	142	(37.7)	141	(33.3)
Downloading film and music	213	(26.6)	106	(28.1)	107	(25.3)
Download / upload to YouTube	178	(22.3)	80	(21.2)	98	(23.2)
Share assignment solution online	177	(22.1)	80	(21.2)	98	(23.2)
Watching TV online	114	(14.3)	56	(14.9)	58	(13.7)
For sending-receiving E-mail	97	(12.1)	39	(10.3)	58	(13.7)
Doing E-business online	50	(6.3)	22	(5.8)	28	(6.6)

4.2.4 Tablet equipped with wireless internet use:

Based on Table 9, the findings illustrated that the number of male using tablet equipped with wireless internet was accounted for 21.1%; whereas that of female users was accounted for 26.8%. As for the total time spent per day, on school day, the findings indicated as follows: mean time spent for both genders was 1.97 (SD = 1.63) hrs., range = 0.00 – 8.00 hrs.; while male spending time constituted 1.99 (SD=1.80) hrs.; female spending time constituted 1.96 (SD=1.51) hrs.; those spending ≤ 1 hour per day constituted 46.9%; whereas those spending > 1-2 hours per day constituted 22.1%; and those spending >2 hours constituted 30.9%.

As far as on non-school days is concerned, the findings indicated that mean time spent for both genders constituted 2.91 (SD = 2.60) hrs., range = 0.00 – 12.00 hrs.; while male spending time constituted 2.54 (SD=2.41) hrs.; female spending time constituted 3.14 (SD=2.70) hrs.; those spending ≤ 1 hour per day constituted 33.2%; whereas those spending > 1-2 hours per day constituted 22.1%; those spending > 2 hours per day constituted 44.7%

Table 9 Tablet equipped with wireless internet use (n=1,080)

Tablet equipped with wireless internet usage	All (n=1,080)		Gender: Male (n=483)		Gender: Female (n=597)	
	n	(%)	n	(%)	n	(%)
Tablet use						
No	818	(75.7)	381	(78.9)	437	(73.2)
Yes	262	(24.3)	102	(21.1)	160	(26.8)
Total time spent per day (school day) (n=262)						
≤ 1 hour	123	(46.9)	48	(47.1)	75	(46.9)
> 1- 2 hours	58	(22.1)	24	(23.5)	34	(21.2)
> 2 hours	81	(30.9)	30	(29.4)	51	(31.9)
Mean (SD)	1.97	(1.63)	1.99	(1.80)	1.96	(1.51)
Range	0.00 - 8.00		0.00 - 8.00		0.00 - 7.00	
Total time spent per day (non-school day) (n=262)						
≤ 1 hour	87	(33.2)	38	(37.3)	49	(30.6)
>1- 2 hours	58	(22.1)	24	(23.5)	34	(21.2)
> 2 hours	117	(44.7)	40	(39.2)	77	(48.1)
Mean (SD)	2.91	(2.60)	2.54	(2.41)	3.14	(2.70)
Range	0.00 - 12.00		0.00 - 12.00		0.00 - 12.00	

Based on Table 10, the first 3 main reasons for using tablet via wireless internet by Gender among participants are: 1) Social networks, i.e. FB/Twitter/Line/IG (55.3%); and it appeared that the percentage of female participants was close to that of male participants (53.8% vs. 57.8%); 2) Watching film & listen to music online (54.6%); and it showed that the percentage of female participants was close to that of male participants (58.8% vs. 48.0%); 3) Search for academic information (39.3%); and it was found that the percentage of female is slightly higher than that of male participants (45.0% vs. 30.4%).

Table 10 Reason for using tablet equipped with wireless internet (n=262)

Reasons	All (n=262)		Male (n=102)		Female (n=160)	
	n	(%)	n	(%)	n	(%)
Social networks (FB/Twitter/Line/IG)	145	(55.3)	59	(57.8)	86	(53.8)
Watching film & listen to music online	143	(54.6)	49	(48.0)	94	(58.8)
Search for academic information	103	(39.3)	31	(30.4)	72	(45.0)
For playing games online	100	(38.2)	45	(44.1)	55	(34.4)
Search for non-academic information	82	(31.3)	37	(36.3)	45	(28.1)
Download / upload to YouTube	62	(23.7)	29	(28.4)	33	(20.6)
Downloading film and music	61	(23.3)	21	(20.6)	40	(25.0)
Watching TV online	55	(21.0)	23	(22.5)	32	(20.0)
Share assignment solution online	28	(10.7)	11	(10.8)	17	(10.6)
Doing E-business online	15	(5.7)	3	(2.9)	12	(7.5)
For sending-receiving E-mail	14	(5.3)	5	(4.9)	9	(5.6)

4.3 EMF Devices on Sleep Quality:

Based on table 11, according to socio-economic and clinical characteristics, when comparing between good and poor sleep quality, the findings indicated that father's occupation and weekly allowance were associated with sleep quality. Those students whose fathers working as company employees having poor sleep quality constituted 70 (20.2%), whiles those having good sleep quality constituted 107 (14.6%). As for weekly allowance, those students with > 600 baht/week having poor sleep quality constituted 141 (47.1%); whiles those having good sleep quality constituted 271 (37.5%).

Table 11 Comparison between good and poor sleep quality by Socio-Economic and Clinical Characteristics

Characteristics	All (n=1,080)		Poor sleep quality (n=346)		Good sleep quality (n=734)		p-value
	n	(%)	n	(%)	n	(%)	
Gender							0.053
Male	483	(44.7)	140	(40.5)	343	(46.7)	
Female	597	(55.3)	206	(59.5)	391	(53.3)	
Age (Years)							0.561
15	90	(8.3)	25	(7.2)	65	(8.9)	
16	333	(30.8)	107	(30.9)	226	(30.8)	
17	376	(34.8)	129	(37.3)	247	(33.7)	
18 and over	281	(26.0)	85	(24.6)	196	(26.7)	
Father's education							0.642
≤Elementary school	266	(25.3)	84	(24.7)	182	(25.5)	
Secondary school through Junior vocational school/ Associate degree	433	(41.1)	135	(39.7)	298	(41.8)	
Bachelor degree through Post graduate degree	354	(33.6)	121	(35.6)	233	(32.7)	
Mother's education							0.185
≤Elementary school	337	(31.7)	106	(31.0)	231	(32.0)	
Secondary school through Junior vocational school/ Associate degree	416	(39.1)	124	(36.3)	292	(40.5)	
Bachelor degree through Post graduate degree	310	(29.2)	112	(32.7)	198	(27.5)	
Father's occupation							0.037
Unemployed /Others (monk, death, don't know)	94	(8.7)	27	(7.8)	67	(9.2)	
Government officials	115	(10.7)	45	(13.0)	70	(9.6)	
Own business	411	(38.1)	125	(36.1)	286	(39.1)	
Company employees	177	(16.4)	70	(20.2)	107	(14.6)	
General laborers	281	(26.1)	79	(22.8)	202	(27.6)	
Mother's occupation							0.266
Housewives/unemployed / Others (nun, death, don't know)	262	(24.3)	73	(21.1)	189	(25.7)	
Government officials	98	(9.1)	35	(10.1)	63	(8.6)	
Own business	369	(34.2)	121	(35.0)	248	(33.8)	
Company employees	152	(14.1)	57	(16.5)	95	(12.9)	
General laborers	199	(18.4)	60	(17.3)	139	(18.9)	

Table 11 Comparison between good and poor sleep quality by Socio-Economic and Clinical Characteristics (Con.)

Characteristics	All (n=1,080)		Poor sleep quality (n=346)		Good sleep quality (n=734)		p-value
	n	(%)	n	(%)	n	(%)	
Family income: (baht/month) [a]							0.827
≤ 10,000	79	(7.3)	25	(7.2)	54	(7.4)	
10,001 - 30,000	516	(47.9)	160	(46.4)	356	(48.6)	
30,001 - 50,000	260	(24.1)	83	(24.1)	177	(24.1)	
>50,000	223	(20.7)	77	(22.3)	146	(19.9)	
Weekly allowance (baht/week) [a]							0.003
≤ 600(50 percentiles)	633	(59.4)	181	(52.9)	452	(62.5)	
>600 (>50 percentiles)	432	(40.6)	161	(47.1)	271	(37.5)	
Body mass index (BMI)							0.160
Underweight	337	(31.3)	120	(34.7)	217	(29.7)	
Normal	564	(52.4)	167	(48.3)	397	(54.3)	
Overweight/Obese	176	(16.3)	59	(17.1)	117	(16.0)	

P-value from Chi-square test. [a] $1 US = 35 Baht (Approx.)

Based on table 12, according to stimulant use, when comparing between good and poor sleep quality, the findings indicated that those answering “None over last 12 months” having poor sleep quality constituted 178 (51.4%); whiles those having good sleep quality constituted 438 (59.8%). Regarding smoking, it was found that those smoking with poor sleep quality constituted 61 (17.7%); whiles those with good sleep quality constituted 83 (11.4%).

Table 12 Comparison between good and poor sleep quality by stimulant use

Characteristics	All (n=1,080)		Poor sleep quality (n=346)		Good sleep quality (n=734)		p-value
	n	(%)	n	(%)	n	(%)	
Alcohol consumption							0.006
None over last 12 months	616	(57.1)	178	(51.4)	438	(59.8)	
≥ Once a year	463	(42.9)	168	(46.6)	295	(40.2)	
Smoking							0.003
No	928	(86.6)	283	(82.3)	645	(88.6)	
Yes	144	(13.4)	61	(17.7)	83	(11.4)	

P-value from Chi-square test

As per table 13, given an association between EMF devices use and sleep quality among high school students; when comparing with those students using mobile/smartphone < 1.93 hour (≤ 25 percentiles), the findings discovered that those using 1.93-3.57 hours (26-50 percentiles) were likely to have 1.45 times poorer sleep quality (unadjusted OR=1.45 [95% CI=0.98-2.12]); those using > 3.57-5.57 hours (51-75 percentiles) were likely to have 1.20 times poorer sleep quality (unadjusted OR=1.20 [95% CI=0.82-1.74]); those using > 5.57 hours (> 75percentiles) were likely to have 1.59 times poorer sleep quality (unadjusted OR=1.59 [95% CI=1.10-2.29]).

Given the related confounding factors of an association between EMF devices use and sleep quality among high school students based on socio-economic and clinical characteristics and stimulant use, the findings showed that confounding variables constituted father's occupation, weekly allowance, alcohol consumption and smoking. After controlling for the confounding variables (father's occupation, weekly allowance, alcohol consumption and smoking), it was found that when comparing with those students using mobile/smartphone < 1.93 hour (≤ 25 percentiles), those using 1.93-3.57 hours (26-50 percentiles) were likely to have 1.47 times poorer sleep quality (adjusted OR=1.47 [95% CI=0.99-2.18]); those using > 3.57-5.57 hours (51-75 percentiles) were likely to have 1.08 times poorer sleep quality (adjusted OR=1.08

[95% CI=0.73-1.60]); those using > 5.57 hours (> 75percentiles) were likely to have 1.52 times poorer sleep quality (adjusted OR=1.52 [95% CI=1.04-2.23]).

Table 13 Unadjusted Odds Ratio, Adjusted Odds Ratio and 95% CI of association between EMF devices use and sleep quality

Mobile/ smart phone use	Poor sleep quality (n=332)		Good sleep Quality (n=708)		Unadjusted OR (95% CI)		Adjusted OR[b] (95% CI)	
	n	(%)	n	(%)				
< 1.93 hour (≤ 25 percentiles)	71	(21.4)	195	(27.5)	Ref.		Ref.	
1.93-3.57 hours (26-50 percentiles)	80	(24.1)	152	(21.5)	1.45	(0.98-2.12)	1.47	(0.99-2.18)
>3.57-5.57 hours (51-75 percentiles)	84	(25.3)	193	(27.3)	1.20	(0.82-1.74)	1.08	(0.73-1.60)
> 5.57 hours (> 75percentiles)	97	(29.2)	168	(23.7)	1.59	(1.10-2.29)	1.52	(1.04-2.23)

[b]Each odds ratio is adjusted for father's occupation, weekly allowance, alcohol consumption, and smoking

4.4 EMF Devices on Academic performance:

Based on table 14, according to stimulant use, when comparing between GPA ≤ 2.70 (25 percentiles) and GPA > 2.70 (> 25 percentiles) by socio-economic and clinical characteristic, the findings indicated that father's education, mother's education, mother's occupation, family income, and psychological disturbance were associated with academic performance. Those students whose fathers completing bachelor degree through postgraduate having GPA ≤ 2.70 (25 percentiles) constituted 55 (22.0%), whiles GPA > 2.70 (> 25 percentiles) constituted 288 (37.5%). As for those students whose mothers completing bachelor degree through postgraduate having GPA ≤ 2.70 (25 percentiles) constituted 48 (19.0%), whiles GPA > 2.70 (> 25 percentiles) constituted 254 (32.9%). As for those students whose mothers being general laborers having GPA ≤ 2.70 (25 percentiles) constituted 78 (30.1%), whiles GPA > 2.70 (> 25 percentiles) constituted 193 (24.7%). As for those students' family income > 50,000 baht/month having GPA ≤ 2.70 (25 percentiles) constituted 31

(11.9%), whiles GPA > 2.70 (>25 percentiles) constituted 187 (24.0%). Also, those students with psychological disturbance having GPA ≤ 2.70 (25 percentiles) constituted 70 (26.8%), whiles GPA > 2.70 (> 25 percentiles) constituted 166 (21.3%).

Table 14 Comparison between GPA ≤ 2.70 (25 percentiles and GPA>2.70 (>25 percentiles) by socio-economic and clinical characteristic

Characteristics	All (n=1,002)		GPA≤2.70 (25 percentiles) (n=245)		GPA>2.70 (>25 percentiles) (n=754)		p-value
	n	(%)	n	(%)	n	(%)	
Father's education							<0.001
≤Elementary school	259	(25.5)	85	(34.0)	174	(22.7)	
Secondary school through Junior vocational school/ Associate degree	415	(40.8)	110	(44.0)	305	(39.8)	
Bachelor degree through Post graduate degree	343	(33.7)	55	(22.0)	288	(37.5)	
Mother's education							<0.001
≤Elementary school	324	(31.6)	104	(41.1)	220	(28.5)	
Secondary school through Junior vocational school/ Associate degree	400	(39.0)	101	(39.9)	299	(38.7)	
Bachelor degree through Post graduate degree	302	(29.4)	48	(19.0)	254	(32.9)	
Father's occupation							0.210
Unemployed/ Others (monk, death, don't know)	92	(8.9)	26	(10.0)	66	(8.5)	
Government officials	109	(10.5)	21	(8.1)	88	(11.3)	
Own business	397	(38.2)	98	(37.8)	299	(38.3)	
Company employees	170	(16.4)	36	(13.9)	134	(17.2)	
General laborers	271	(26.1)	78	(30.1)	193	(24.7)	
Mother's occupation							0.005
Housewives/unemployed / Others (nun, death, don't know)	256	(24.6)	55	(21.1)	201	(25.8)	
Government officials	94	(9.0)	20	(7.7)	74	(9.5)	
Own business	352	(33.8)	88	(33.7)	264	(33.8)	
Company employees	146	(14.0)	30	(11.5)	116	(14.9)	
General laborers	193	(18.5)	68	(26.1)	125	(16.0)	

Table 14 Comparison between GPA ≤ 2.70 (≤ 25 percentiles and GPA>2.70 (> 25 percentiles) by socio-economic and clinical characteristic (Con.)

Characteristics	All (n=1,002)		GPA ≤ 2.70 (≤ 25 percentiles) (n=245)		GPA > 2.70 (> 25 percentiles) (n=754)		p-value
	n	(%)	n	(%)	n	(%)	
Family income: (baht/month) [a]							<0.001
≤ 10,000	74	(7.1)	28	(10.7)	46	(5.9)	
10,001 - 30,000	494	(47.5)	145	(55.6)	349	(44.8)	
30,001 - 50,000	254	(24.4)	57	(21.8)	197	(25.3)	
>50,000	218	(21.0)	31	(11.9)	187	(24.0)	
Weekly allowance (baht/month) [a]							0.481
≤ 600(50 percentiles)	615	(59.8)	151	(59.4)	464	(59.9)	
>600 (>50 percentiles)	414	(40.2)	103	(40.6)	311	(40.1)	
Psychological disturbance (GHQ-28)							0.040
No	805	(77.3)	191	(73.2)	614	(78.7)	
Yes	236	(22.7)	70	(26.8)	166	(21.3)	

P-value from Chi-square test. [a] $1 US = 35 Baht (Approx.)

Based on table 15, according to stimulant use, when comparing between GPA ≤ 2.70 (≤ 25 percentiles) and GPA > 2.70 (> 25 percentiles) by stimulant use, the findings indicated that those answering “None over the last 12 months” having GPA ≤ 2.70 (≤ 25 percentiles) constituted 119 (45.8%); whiles those having GPA > 2.70 (> 25 percentiles) constituted 477 (61.2%). Regarding smoking, it was found that those smoking with GPA ≤ 2.70 (≤ 25 percentiles) constituted 68 (26.5%); whiles those with GPA > 2.70 (> 25 percentiles) accounted for 69 (8.9%).

Table 15 Comparison between GPA ≤ 2.70 (25 percentiles and GPA>2.70 (>25 percentiles) by stimulant use

Characteristics	All (n=1,002)		GPA≤2.70 (25 percentiles) (n=245)		GPA>2.70 (>25 percentiles) (n=754)		p-value
	n	(%)	n	(%)	n	(%)	
Alcohol consumption							<.001
None over last 12 months	596	(57.3)	119	(45.8)	477	(61.2)	
≥ Once a month	444	(42.7)	141	(54.2)	303	(38.8)	
Smoking							<.001
No	896	(86.7)	189	(73.5)	707	(91.1)	
Yes	137	(13.3)	68	(26.5)	69	(8.9)	

P-value from Chi-square test.

As per table 16, given an association between EMF devices use and academic performance among high school students; when comparing with those students using mobile/smartphone < 1.93 hour (≤ 25 percentiles), the findings discovered that those using 1.93-3.57 hours (26-50 percentiles) were likely to have 1.30 times poorer academic performance (GPA ≤ 2.70 (≤ 25 percentiles)) (unadjusted OR=1.30 [95% CI=0.86-1.96]); those using > 3.57-5.57 hours (51-75 percentiles) were likely to have 1.15 times poorer academic performance (unadjusted OR=1.15 [95% CI=0.77-1.71]); those using > 5.57 hours (> 75percentiles) were likely to have 0.92 times poorer academic performance (unadjusted OR=0.92 [95% CI=0.61-1.39]).

Given the related confounding factors of an association between EMF devices use and academic performance among high school students based on socio-economic and clinical characteristic and stimulant use, the findings found that confounding variables constituted father’s education, mother’s education, mother’s occupation, family income, psychological disturbance, alcohol consumption and smoking. After controlling for the confounding variables (father’s education, mother’s education, mother’s occupation, family income, psychological disturbance, alcohol consumption and smoking), the findings discovered that when comparing with those students using mobile/smartphone < 1.93 hour (≤ 25 percentiles), those using 1.93-3.57 hours (26-50 percentiles) were likely to have 1.06 times poorer academic performance (GPA ≤ 2.70 (25 ≤ percentiles)) (adjusted OR=1.06 [95% CI=0.69-1.63]); those using >3.57-5.57 hours (51-75 percentiles) were likely to have 0.93 times poorer academic performance (adjusted OR=0.93 [95% CI=0.61-1.42]); those using > 5.57 hours (> 75percentiles) were likely to have 0.79 times poorer academic performance (adjusted OR=0.79 [95% CI=0.52-1.22]).

Table 16 Unadjusted Odds Ratio, Adjusted Odds Ratio and 95% CI of association between EMF devices use and academic performance

Mobile/smart phone use	GPA ≤ 2.70 (25 percentiles) (n=245)		GPA > 2.70 (>25 percentiles) (n=757)		Unadjusted OR (95% CI)		Adjusted OR[b] (95% CI)	
	n	(%)	n	(%)				
< 1.93 hour (≤ 25 percentiles)	59	(24.1)	197	(26.0)	Ref.		Ref.	
1.93-3.57 hours (26-50 percentiles)	63	(25.7)	162	(21.4)	1.30	(0.86-1.96)	1.06	(0.69-1.63)
>3.57-5.57 hours (51-75 percentiles)	68	(27.8)	198	(26.2)	1.15	(0.77-1.71)	0.93	(0.61-1.42)
> 5.57 hours (> 75percentiles)	55	(22.4)	200	(26.4)	0.92	(0.61-1.39)	0.79	(0.52-1.22)

[b]Each odds ratio is adjusted father’s education, mother’s education, mother’s occupation, family income, psychological disturbance, alcohol consumption and smoking

CHAPTER V

DISCUSSIONS, CONCLUSION & RECOMMENDATIONS

This cross-sectional research's objective was to investigate the association between EMF devices use and sleep quality and academic performance among high school students in Bangkok. The researcher employed random sampling technique covering 1,080 samples consisting of students of $10\text{-}12^{th}$ grade of 10 high schools in Bangkok area for academic year 2013. This quantitative study's questionnaires included 6 parts: socio-Economic and clinical characteristic Information; communications devices use; Sleep Patterns; Pittsburgh Sleep Quality Index (PSQI); General Health Questionnaire 28 (GHQ-28); alcohol and caffeine consumption;

5.1 General information of participant:

In this research, the researcher has collected the required data consisting of high school students (grade 10-12) of academic year 2013, in Bangkok area, under the supervision of the Office of the Basic Education Commission, Ministry of Education. The total number of samples being collected were 1,080 participants, mean age was 16.8 (SD = 0.94) years, 483 (44.7%) were male and 597 (55.3 %) were female. In terms of students' educational level, 31.4% completed grade 10; whereas 34.5% and 34.1% completed grade 11 and 12, respectively. Also, the majority of their parents completed a minimum of secondary school level, i.e., father constitutes 74.7% whiles mother constitutes 72.1%.

As for psychological disturbance, those having history disease related sleep problems constitutes 22.5%. Overweight/Obese ($\geq$25) constitute 13.7%, respectively. Regarding part-time job, it was found that those working part-time job constitutes 10.4%. Concerning physical activity, it was found that those having physical activity ($\geq$ 150 min./week) constitutes 43.7%.

Regarding school activity, it was discovered those engaging in school activity constitute 53.7% As far as private tutoring is concerned, the findings indicated that those saying yes constitutes 80.6%; likewise, those drinking alcohol ≥ once a month constitute 42.9%. Concerning smoking, the findings indicated that those saying yes constitute 13.4%. As for caffeine consumption, those consuming caffeine constitutes 90.6%.

The issue of mental health among adolescents has been increasingly recognized as globalized problem (212), as adolescents to date are deemed potentially high-risk prospects owing to various kinds of stressors they are facing (213). Therefore, it has undoubtedly appeared to be one of the main public health concerns, as a number of studies attempted to investigate the impacts of mental health on adolescents, particularly those in the western countries (214, 215). According to our study, it was found that nearly 25% of participants had psychological disturbances; this well corresponded with previous study conducting in Thailand on grade 10^{th} -12^{th} students showing that about 20-21% experienced depression (216). Furthermore, some other evidences found that internet overuse resulted in psychological symptoms (217, 218).

Thus, it is most likely that, based on our results, one of the key factors contributes to adolescent` psychological disturbances is the over-exposure to EMF device use; our participants used smart/mobile phones approximately 3.5 hrs./day on school days; and 5 hrs./day on non-school days.

5.2 EMF Devices Use:

Based on our research findings, an exploration of EMF devices use among high school students in Bangkok, we want to illustrate the students' behavior and objectives in using EMF devices on school days and non-school days. The main outcomes of the study are to be discussed below:

5.2.1 Overall EMF use:

Our study found that nearly 100% of respondents (96.9%) in Bangkok have widely used mobile/smart phone on a regular basis. This corresponds with a study in that 88% of American teenagers, aged 13-18 years old, have accessed to their mobile/smart phones; besides, sub-group wise, aged 15-17 years old, accountings for 92%, have accessed mobile/smart phones (219). Additionally, the findings of a research entitled "Ownership and Use of Mobile Phone – a Population Based Study Physical Education and Sport College Students in Turkey" found that the participants, aged 17-22 years old, accounting for 98.5% have used mobile phones (220). Therefore, we can conclude that teenagers all over the world can conveniently and easily access to mobile/smart phones. This well corresponded with a survey on Thailand Internet User Profile 2015" which suggested that the smartphone users constituted 82.1% (221).

In terms of desktop/notebook computer used via wireless internet, our findings discovered that the respondents accounting for 74.1% have accessed to desktop/notebook computers via wireless internet on a regular basis. this well corresponded with a survey on "Thailand Internet User Profile 2015" suggesting that 54.7% and 45.2% of users had access to desktop and notebook computers, respectively (221). Interestingly, our findings seemed to well correspond with a study on teenagers in America that 87% of them had access to their desktop/notebook computers regularly (219).

Regarding the use of tablet equipped with wireless internet, our findings discovered that the respondents accounting for 24.3% used their tablet on a regular basis; this well corresponded with a survey on Thailand Internet User Profile 2015" which suggested that the tablet users constituted 21.1% (221). However, other study in America found that 58% of teenagers can access to their tablet regularly (219).

According to our study, mobile/smart phones are the most popular EMF devices among Thai teenagers accounting for over 80%; which corresponds well with other findings showing that over 92% of American teenagers used mobile/smart phones. The reasons for such popular usage can be explained that mobile/smart phones are vital instrument for surviving in their society, they are very portable and innovative in various situation like social networks engagement, searching for required information, shopping/doing business online, and for a variety of entertainment like watching films, listening to music.

Given a number of devices use, it is necessary to mention that, owing to the proliferation of EMF devices usage, today's adolescents may have used or accessed to more than one devise on a regular basis. Earlier study on "Adolescent Sleep Patterns and Night-Time Technology Use: Results of the Australian Broadcasting Corporation's Big Sleep Survey" found that over 70% of adolescents reported having 2 or more electronic devices in their bedroom at night (222), which corresponded with our findings that approximately 80% of the participants reported using 2 or more EMF devices in their daily life. By the same token, due to the fact that the use of electronic devices is increasing by leaps and bounds, such devices as computers, tablets, mobile/smartphones have been implicated in adolescents' sleep quality, for example, a number of studies linked the mere presence of those devices in the bedroom with later bedtimes, less time in bed, shorter sleep duration and daytime sleepiness (12, 42, 222, 223).

5.2.2 Mobile/smartphone use:

It has been evident that, currently, the use of EMF devices has been rapidly growing and widespread by leaps and bounds all over the world. Those exposed to EMF devices nowadays are clearly younger in age but longer in time usage. Over-exposure to EMF devices can result in different forms of negative impacts (224). Within the realm of academic interest, we hope that the study of EMF devices usage patterns and behavior among high school students, especially in Bangkok area, can contribute to a better understanding of teenagers' general usage of mobile/smart phone in their daily life, apart from raising awareness of all concerned regarding the effect of EMF devices use on sleep quality and academic performance that could arise among those students.

Our evidence indicated that 810 (75.4%) of the participants using mobile/smart phone without small talk/Bluetooth. Of this figures, it was discovered that 667 (82.3%) participants used their mobile/smart phone over 30 min./period, at least once a day. Some studies suggested that using EMF devices for 35 min/period can lead to acute effects on blood pressure (225); other indicated that EMF can cause heating and thermal changes in the user's body, as well as cataract, auditory effects, headache, depression, sleeplessness. However, it is advisable that the microwave exposure limit for occupational and general users should be on the average 6 min./period and 30 min/period, respectively (226). Interestingly, our findings found that "Used over 30 min/period/day without small talk/Bluetooth", mean times for both genders was 2.50 (SD = 2.01) hrs., range = 0 – 10 times. Thus, from the result above, it was obvious that the participants exposed to EMF radiation averagingly 2.5 times per day. Besides, those participants would have greater chance of being affected by more exposure to EMF devices since, based on our results; most users (71.1%) placed their smart/mobile phones beside pillows/on bed at bedtime.

Also, our evidence discovered that the total time spent per day on school days and non-school days was accounted for 3.50 (SD = 2.47) hrs., and 4.93 (SD = 3.56) hrs., respectively. The findings corresponded to the survey outcome on adolescents' use of microwave communication wireless device, which found that Thai adolescents spent 3.1 hrs./day, including computer/mobile for online games and, when comparing to other Asian adolescents, it was regarded as the highest total time spent on microwave communication wireless device (8). Worth mentioning is that an evidence based on internet survey regarding "Thailand Internet User Profile 2015" found that, among 10,434 respondents, 80% of them using smartphone approximately 5.7 hrs./day (221).

Based on our evidence, approximately 70% of participants placed their mobile/smartphones on the bed while sleep, rather close to their body, which can lead to adverse health effects, given that effects of electromagnetic wave can be based on direct genotoxic effects, though the energy level is not high enough to damage DNA. Instead, a study was carried out whether EMF is cocarcinogenic (24, 60).

Earlier study convincingly elaborated key reasons resulting in a rapid growing of mobile/smartphone users, i.e. fast technological developments in the last decade leading to devices transmitting electromagnetic waves such as videophone and different options becoming part of our daily life (220, 227). Nevertheless, our study (See Table 6) found that the first 3 main objectives for the participants to use mobile/smartphone include: 1) For social networks engagement, i.e. FB/Twitter/Line/IG (77.2%); 2) For communication purposes (61.4%); and 3) For watching films & listening to music (48.3%). It is notable that a previous internet survey in Thailand recently indicated that the top 3 main reasons for the public in general to use smartphone were: 1) For social media networking (82.7%); 2) For searching online information (56.6%); and 3) For updated news and events follow-up/e-book reading (52.2%) (221). At the same time, it was discovered that American teenagers were as enthusiastic as social media users (76%) (219). Briefly, fast development of internet and social networks have exerted great impacts on most, if not all, teenagers of our globalized society, as has been reported that, for example, Facebook had at least 1 billion active users reaping numerous benefits as free access, facilitating communication, apart from sharing information (228, 229).

5.3 Prevalence of poor sleep quality among high school students in Bangkok:

The prevalence of poor sleep quality among high school students, based on this study, is 32.0% when comparing with other studies using the PSQI to evaluate. However, evidences from previous studies on poor sleep quality among students in colleges showed that the prevalence of poor sleep quality was between 48.1% to 62.4% (97-102). As far as the study on the prevalence of poor sleep quality conducted in Thailand is concerned, the result of this study is found to be consistent with the research findings of Lohsoonthorn et al. (99) derived from a survey conducted among college students in Thailand (32.0% vs. 48.1%). Nevertheless, for results discovered so far in other Asian countries, particularly in Hong Kong and Korea, it was found that the prevalence of poor sleep quality among college students are likely to be higher than that of college students in Thailand.

5.4 Association between EMF devices use and sleep quality among high school students in Bangkok:

Our study found that there is association between EMF devices use and sleep quality among high school students in Bangkok after adjusting for the following variables: father's occupation, weekly allowance, alcohol consumption, and smoking. Our results showed that when comparing with those students using mobile/smartphone < 1.93 hour (≤ 25 percentiles), those using > 5.57 hours (> 75 percentiles) were likely to have 1.52 times poorer sleep quality (adjusted OR=1.52 [95% CI=1.04-2.23]). This corresponded with other two studies conducted in Peru and Turkey: "Association between Facebook Dependence and Poor Sleep Quality: A Study in a Sample of Undergraduate Students in Peru" that indicated a significant association between Facebook dependence and poor sleep quality (PR=1.31; 95% CI: 1.04, 1.67), after controlling for age, sex, and years in the faculty (230); also, a study conducted in Turkey on "Evaluation of mobile phone addiction level and sleep quality in university students", aiming to compare mean of sleep quality between those using mobile phone < 1 hr/day and those use ≥5 hrs/day, found that those using ≥5 hrs/day experienced poorer sleep quality than those use <1 hr/day (231).

5.5 Association between EMF devices use and academic performance among high school students in Bangkok:

Our study discovered that EMF devices use is not associated with academic performance among high school students in Bangkok after adjusting for the following variables: father's education, mother's education, mother's occupation, family income, psychological disturbance, alcohol consumption and smoking.

Generally, academic achievement can be attributable to a number of factors, for example, working while attending school, ethnicity, family obligations, distance from home, family or personal finances, and engagement with the institution (232, 233). Previous studies discovered that family socioeconomic status played key role in students' academic achievement, because those with good socioeconomic background had better opportunity and able to learn better (191, 234). Also, many findings suggested that students' learning achievement was based on their engagement in learning activities (235). Given a classic case study for instance, in Taiwan, only those from well off family had better chance taking summer learning activities; whereas those unable to afford financially were experiencing learning achievement gaps (235).

More interestingly, most students in Thailand shared the so-called after-school tutoring as those in Taiwan and several countries in Asia. Clearly, those high school students' study patterns are somewhat different from those in Western countries in that after-school tutoring requires additional fees not subsidized by the government. Since tuition fees for such programs are more expensive than regular school activities, students coming from poor families would miss such opportunity.

In summary, since there are a number of factors affecting academic performance as mentioned above, it is then not surprising that, in our research findings, there is no association between EMF devices use and academic performance. On the contrary, the findings discovered that such variables as father's education, part-time job, school activity, private tutoring, alcohol consumption and smoking, are associated with academic performance.

Conclusion:

In broader term, this cross-sectional study aimed to investigate the association between EMF devices use and sleep quality and academic performance among high school students in Bangkok. In conducting this research, we used random sampling method including 1,080 samples studying at 10-12th grade from 10 high schools in Bangkok area, academic year 2013, under the supervision of the Office of the Basic

Education Commission, Ministry of Education.. The study questionnaires focused on 6 important areas, for instance, socio-economic and clinical characteristic information, communications devices use; sleep patterns, Pittsburgh Sleep Quality Index (PSQI), General Health Questionnaire 28 (GHQ-28), alcohol and caffeine consumption.

In specific term, out of 1,080 samples being collected, our findings found that mean age was 16.8 (SD = 0.94) years, 483 (44.7%) were male and 597 (55.3 %) were female. In terms of students' educational level, 31.4% studying at grade 10; whereas 34.5% and 34.1% at grade 11 and 12, respectively. The majority of their parents completed a minimum of secondary school level: the number of father and mother's educational level was accounted for 74.7% and 72.1%, respectively.

As for psychological disturbance, those having history disease related sleep problems constituted 22.5%. Overweight/Obese (BMI $\geq$25) constituted 13.7%. Regarding part-time job, those working part-time job constituted 10.4%. Concerning physical activity, it was found that those having physical activity ($\geq$150 min./week) constituted 43.7%.

Given school activity, those engaging in school activity constituted 53.7%; whereas those having private tutoring constituted 80.6%. Likewise, those drinking alcohol $\geq$ once a month constituted 42.9%; while those smoking constituted 13.4%; and those consuming caffeine constituted 90.6%. The students' behavior and objectives in using EMF devices on school days and non-school days can be illustrated below: In terms of EMF devices use, our findings indicated that 96.9% of respondents used mobile/smart phone regularly; while 74.1% used desktop/notebook computer equipped with wireless internet on a regular basis. Nevertheless, only 24.3% of them use tablet equipped with wireless internet regularly. Interestingly, 75.4% of them used mobile/smart phone without small talk/Bluetooth. Of this figure, it was discovered that 82.3% used mobile/smart phone over 30 min/period at least once a day. It is necessary to point out that, those users would experienced acute effects on blood pressure if using EMF devices for 35 min/period (225); whiles others indicated that EMF can cause heating and thermal changes in the user's body, as well as cataract, auditory effects, headache, depression, sleeplessness.

However, it is advisable that the microwave exposure limit for occupational and public should be about 6 min./period and 30 min/period, respectively (226). Also, our findings found that the users having "used over 30 min/period/day without small talk/Bluetooth", mean times of both genders was 2.50 (SD = 2.01) hrs., range = 0 – 10 times. Thus, it is evident from our study that, the participants exposed approximately to EMF radiation 2.5 times per day and, consequently were at greater chance of being affected by more exposure to EMF devices, given that 71.1% of them placed their smart/mobile phones beside their pillows/on bed at bedtime. The total time spent per day on school day and non-school day accounted for 3.50 (SD = 2.47) hrs, and 4.93 (SD = 3.56) hrs., respectively. We found that the first 3 main reasons for using smartphone included the following: 1) For social networks, i.e. FB/Twitter/Line/IG (77.2%); 2) For communication purposes which was accounted for 61.4%; and 3) For watching films & listening to music which constituted for 48.3%.

Given the prevalence of poor sleep quality, the findings indicated that the prevalence of poor sleep quality constituted 32.0% when comparing with other studies using the PSQI to evaluate. Regarding an association between EMF devices use and sleep quality, when adjusting for confounding variables (father's occupation, weekly allowance, alcohol consumption and smoking), it was found that when comparing with those students using mobile/smartphone < 1.93 hour (≤ 25 percentiles), those using > 5.57 hours (> 75percentiles) were likely to have 1.52 times poorer sleep quality (adjusted OR=1.52 [95% CI=1.04-2.23]). Our study found that EMF devices use was not associated with academic performance among high school students in Bangkok after adjusting for the following variables: father's education, mother's education, mother's occupation, family income, psychological disturbance, alcohol consumption and smoking.

Generally, academic achievement can be attributable to a number of factors, for example, working while attending school, ethnicity, family obligations, distance from home, family or personal finances, and engagement with the institution (232, 233). Previous studies discovered that family socioeconomic status played key role in students' academic achievement, because those with good socioeconomic backgrounds had better opportunity and able to learn better (191, 234). Also, many findings suggested that students' learning achievement was based on their engagement in learning activities (235). Given a classic case study, for instance, in Taiwan, only those from well off family had better opportunity taking summer learning activities; whereas those unable to afford financially were experiencing learning achievement gaps (235). More interestingly, most students in Thailand shared the so-called after-school tutoring as those in Taiwan and several other countries in Asia. Nonetheless, the study patterns of Asian high school students are somewhat different from that of Western countries as after-school tutoring requires additional fees not subsidized by the government. Thus, since tuition fees for such programs are more expensive than regular school activities, students coming from poor families would miss such opportunity.

Recommendations:

It is not surprising that, based on an increasing use and exposure to the EMF devises, especially among the youngsters, the magnitude of negative impacts towards the EMF devices users would be unavoidable and beyond imagination and expectation. Therefore, the researcher would like to advise and recommend that in the future, it is necessary and imperative that…

- As problematic issue over exposure EMF devices use has taken momentum globally, in terms of psychological health concern, it is one of the high priorities for educational institutions, government and private organizations to initiate campaigns educating both parents and students of all ages to be aware of the consequences of EMF devices exposure.

- Given the health concerns and the majority of adolescents today reported having/using 2 or more electronic devices in their daily life, apart from placing mobile/smartphones on bed or nearby their body during sleep, attempts should be made in developing evidence-based guidelines for EMF devices users and concerned parties, in order to enhance their understanding of how and when to use their devices properly.

- Attempts should be made by researchers to build more subjective and reliable instrument, i.e., the scale and extent of exposure to EMF devices use; this would certainly lead to fruitful area for inter-disciplinary research and development. Also, a co-operation and efforts between electronic engineering fields and public health agencies are required to come up with innovative software specifically designed for mobile/smart phone users.

- In addition to sleep quality-based questionnaire, and to get more reliable results, laboratory confirmation on sleep should be established. Therefore, further studies should take into consideration the measurement of melatonin levels in the urine, saliva or blood.

- Study samples should specifically cover more various age groups and different careers and behavior, i.e., toddlers and babies, young children, pregnant women, business and professional workers, etc. so that a better understanding of the effects of EMF devices use among those samples, apart from an association between certain variables can be successfully established.

- Concerned parties and individuals such as government's related agencies, private/business organizations, educational institutions, especially parents and EMF devices users, should be educated and equipped with practical guidelines and knowledge of how and when to use EMF devices in a safe and sound manner.

Limitations:

In conducting this cross-sectional study, the issues and limitations of this research can be described as follows:

- Causal relationship issue: Given causal relationship, it is necessary to mention that, based on the study designed, these findings were unable to explain the causal relationship; instead, they could present only the association.

- Study questionnaires limitation: This study used self-administered questionnaires to collect required information; it was possible that certain extent of error could be generated owing to some subjective questionnaire items, for instance, students self-report could have been positively or negatively biased, due to memory error and lack of awareness of their exposure to EMF devices and actual time spent.

- Sensitive issue: Some items like the respondents' weekly allowance and GPA were presumably highly sensitive and, thus, it was most likely that certain questions would get distorted answers resulting in certain extent of erroneous information. Therefore, we resorted to anonymous questionnaires to address this issue and were confident that the issue can be reduced, to a greater degree.

- Generalisability: Size alone cannot guarantee generalization, despite having a large sample size, since 1,080 participants were all drawn from high school students of grade 10-12 studying in high schools in Bangkok area, under the supervision of the Office of the Basic Education Commission, Ministry of Education. To address this limitation, future research should include more and varied samples (i.e., include private high schools, rural area settings).

REFERENCES

1. Smith A. U.S. Smartphone Use in 2015 2015 [cited 2015 25 September]. Available from: http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/.

2. Rideout VJ, Foehr UG, Roberts DF. Generation M2: media in the lives of 8-18 year-olds. Kaiser Family Foundation, 2010.

3. Madden M, Lenhart A, Cortesi S, Gasser U, Duggan M, Smith A, et al. Teens, Social Media, and Privacy. PewResearchCenter, 2013 May 21, 2013. Report No.

4. Lenhart A, Purcell K, Smith A, Zickuhr K. Social media & mobile Internet use among teens and young adults. Pew Internet & American Life Project2010 [cited 2013 13 August]. Available from: http://pewinternet.org/Reports/2010/.

5. Asian Pacific Post. Asian youth see mobile phones as an extension of themselve 2010 [cited 2014 14 March]. Available from: http://www.asianpacificpost.com/article/4072-asian-youth-see-mobile-phones-extension-themselves.html.

6. The Nation. Thailand youth are top users in all that mobile phones offer 2010 [cited 2014 10 January]. Available from: http://www.nationmultimedia.com/home/Thailand-youth-are-top-users-in-all-that-mobile-ph-30137366.html.

7. Naewna. Telephone Addiction in Thai Adolescents 2013 [cited 2014 7 June]. Available from: http://www.naewna.com/local/54682.

8. Office for National Statistics. Internet Access – Households and Individuals 2014. Office for National Statistics, Thailand,, 2014 07 August 2014. Report No.

9. Anderson CA, Funk J, Griffiths MD. Contemporary issues in adolescent videogame playing: Brief overview and introduction to the special issue. Journal of Adolescence. J Adolescence. 2004;27:1-3.

10. Schmidt ME, Vandewater EA. Media and attention, cognition, and school achievement. Future Child. 2008;18(1):63-85.

11. Choi KM, Lee JS, Park HS, Baik SH, Choi DS, Kim SM. Relationship between sleep duration and the metabolic syndrome: Korean National Health and Nutrition Survey 2001. Int J Obesity. 2008;32(7):1091-7.

12. Mindell JA, Telofski LS, Wiegand B, Kurtz ES. A Nightly Bedtime Routine: Impact on Sleep in Young Children and Maternal Mood. Sleep. 2009;32(5):599-606.

13. Munezawa T, Kaneita Y, Osaki Y, Kanda H, Minowa M, Suzuki K, et al. The Association between Use of Mobile Phones after Lights Out and Sleep Disturbances among Japanese Adolescents: A Nationwide Cross-Sectional Survey. Sleep. 2011;34(8):1013-20.

14. Punamaki RL, Wallenius M, Nygard CH, Saarni L, Rimpela A. Use of information and communication technology (ICT) and perceived health in adolescence: The role of sleeping habits and waking-time tiredness. J Adolescence. 2007;30(4):569-85.

15. Thomée S, Eklöf M, Gustafsson E, Nilsson R, Hagberg M. Prevalence of Perceived Stress, Symptoms of Depression and Sleep Distubances in Relation to

Information and Communication Technology (Ict) Use among Young Adults- an Explorative Prospective Study. Computers in Human Behavior. 2007;23:1300-21.
16. Lai H, Singh NP. Acute low-intensity microwave exposure increases DNA single-strand breaks in rat brain cells - Reply. Bioelectromagnetics. 1996;17(2):166-.
17. Daniells C, Duce I, Thomas D, Sewell P, Tattersall J, de Pomerai D. Transgenic nematodes as biomonitors of microwave-induced stress. Mutat Res-Fund Mol M. 1998;399(1):55-64.
18. Veyret B, Bouthet C, Deschaux P, de Seze R, Geffard M, Joussot-Dubien J, et al. Antibody responses of mice exposed to low-power microwaves under combined, pulse-and-amplitude modulation. Bioelectromagnetics. 1991;12(1):47-56.
19. Lu ST, Mathur SP, Akyel Y, Lee JC. Ultrawide-band electromagnetic pulses induced hypotension in rats. Physiol Behav. 1999;65(4-5):753-61.
20. Hardell L, Nasman A, Pahlson A, Hallquist A, Mild KH. Use of cellular telephones and the risk for brain tumours: A case-control study. Int J Oncol. 1999;15(1):113-6.
21. Borbely AA, Huber R, Graf T, Fuchs B, Gallmann E, Achermann P. Pulsed high-frequency electromagnetic field affects human sleep and sleep electroencephalogram. Neurosci Lett. 1999;275(3):207-10.
22. Chou C. Internet heavy use and addiction among Taiwanese college students: An online interview study. Cyberpsychol Behav. 2001;4(5):573-85.
23. Chen YF, Peng SS. University students' Internet use and its relationships with academic performance, interpersonal relationships, psychosocial adjustment, and self-evaluation. Cyberpsychol Behav. 2008;11(4):467-9.
24. SSM:s Independent Expert Group on Electromagnetic Fields. Recent Research on EMF and Health Risks. Sixth annual report from SSM:s independent Expert Group on Electromagnetic Fields 2009. 2009.
25. de Onis M, Martorell R, Garza C, Lartey A, Reference WMG. WHO Child Growth Standards based on length/height, weight and age. Acta Paediatr. 2006;95:76-85.
26. SSM:s Independent Expert Group on Electromagnetic Fields. Recent Research on EMF and Health Risks,. 2009 2009:36.
27. WHO. Establishing a dialogue on risks from electromagnetic fie. Switzerland: World Health Organization; 2002.
28. Roosli M. Epidemiology of Electromagnetic Fields. US: CRC Press; 2014.
29. SCENIHR. Opinion on Potential health effects of exposure to electromagnetic fields. Luxembourg2015.
30. Heymann D. Health Protection Agency London: 2013.
31. Golio M. Microwave and RF Product applications. London: CRC Press; 2003.
32. Tamura T, Masuda I. Device Connectivity Technologies Using Short-distance Wireless Communications. Fujitsu Sci Tech J. 2013;49(2):213-9.
33. Wilson BW, Chess EK, Anderson LE. 60-Hz electric-field effects on pineal melatonin rhythms: time course for onset and recovery. Bioelectromagnetics. 1986;7(2):239-42.

34. Moore-Ede MC, Campbell SS, Reiter RJ. Electromagnetic Fields and Circadian Rhythmicity. Boston, MA: Birkhauser; 1991.
35. Burch JB, Reif JS, Noonan CW, Ichinose T, Bachand AM, Koleber TL, et al. Melatonin metabolite excretion among cellular telephone users. Int J Radiat Biol. 2002;78(11):1029-36.
36. Frei P, Mohler E, Neubauer G, Theis G, Burgi A, Frohlich J, et al. Temporal and spatial variability of personal exposure to radio frequency electromagnetic fields. Environ Res. 2009;109(6):779-85.
37. Hinrichs H, Heinze H, Rotte M. Human sleep under the influence of a GSM 1800 electromagnetic far field. Somnologie. 2005;9:185-91.
38. Huber R, Treyer V, Borbély AA, Schuderer J, Gottselig JM, Landolt HP, et al. Electromagnetic fields, such as those from mobile phones, alter regional cerebral blood flow and sleep and waking EEG. J Sleep Res. 2002;11(4):289-95.
39. Lowden A, Akerstedt T, Ingre M, Wiholm C, Hillert L, Kuster N, et al. Sleep After Mobile Phone Exposure in Subjects With Mobile Phone-Related Symptoms. Bioelectromagnetics. 2011;32(1):4-14.
40. Mohler E, Frei P, Frolich J, Braun-Fahrlander C, Roosli M, Qualifex-Team. Exposure to Radiofrequency Electromagnetic Fields and Sleep Quality: A Prospective Cohort Study. Plos One. 2012;7(5).
41. Johnson JG, Cohen, P., Kasen, S., First, M.B., Brook, J.S. Association between television viewing and sleep problems during adolescence and early adulthood. Arch Pediatr Adolesc Med. 2004;158(6):562-268.
42. Van den Bulck J. Television viewing, computer game playing, and Internet use and self-reported time to bed and time out of bed in secondary-school children. Sleep. 2004;27(1):101-4.
43. Van den Bulck J. Adolescent use of mobile phones for calling and for sending text messages after lights out: Results from a prospective cohort study with a one-year follow-up. Sleep. 2007;30(9):1220-3.
44. Salford LG, Brun AE, Eberhardt JL, Malmgren L, Persson BRR. Nerve cell damage in mammalian brain after exposure to microwaves from GSM mobile phones. Environ Health Persp. 2003;111(7):881-3.
45. Schneider J, Stangassinger M. Nonthermal Effects of Lifelong High-Frequency Electromagnetic Field Exposure on Social Memory Performance in Rats. Behavioral Neuroscience. 2014;128(5):633- 7.
46. Edelstyn N, Oldershaw A. The acute effects of exposure to the electromagnetic field emitted by mobile phones on human attention. Neuroreport. 2002;13(1):119-21.
47. Koivisto M, Krause CM, Revonsuo A, Laine M, Hamalainen H. The effects of electromagnetic field emitted by GSM phones on working memory. Neuroreport. 2000;11(8):1641-3.
48. Lee TM, Ho SM, Tsang LY, Yang SH, Li LS, Chan CC, et al. Effect on human attention of exposure to the electro-magnetic field emitted by mobile phones. Neuroreport. 2001;26( ):729-31.
49. Besset A, Espa F, Dauvilliers Y, Billiard M, de Seze R. No effect on cognitive function from daily mobile phone use. Bioelectromagnetics. 2005;26(2):102-8.

50. Shapiro LAS, Margolin G. Growing Up Wired: Social Networking Sites and Adolescent Psychosocial Development. Clin Child Fam Psych. 2014;17(1):1-18.
51. Calamaro CJ, Mason TBA, Ratcliffe SJ. Adolescents Living the 24/7 Lifestyle: Effects of Caffeine and Technology on Sleep Duration and Daytime Functioning. Pediatrics. 2009;123(6):E1005-E10.
52. Vernon V, Barber BL, Modec KL. Adolescent Problematic Social Networking and School Experiences: The Mediating Effects of Sleep Disruptions and Sleep Quality. CYBERPSYCHOLOGY, BEHAVIOR, AND SOCIALNETWORKING. 2015;18:386-92.
53. Wolfson AR, Carskadon MA. Sleep schedules and daytime functioning in adolescents. Child Dev. 1998;69:875- 87.
54. Wolfson AR, Carskadon MA. Understanding adolescent's sleep patterns and school performance: a critical appraisal. Sleep Med Rev. 2003;7(6):491-506.
55. Krewski D, Glickman BW, Habash RWY, Habbick B, Lotz WG, Mandeville R, et al. Recent advances in research on radiofrequency fields and health: 2001-2003. J Toxicol Env Heal B. 2007;10(4):287-318.
56. Heinrich S, Thomas S, Heumann C, von Kries R, Radon K. Association between exposure to radiofrequency electromagnetic fields assessed by dosimetry and acute symptoms in children and adolescents: a population based cross-sectional study. Environ Health-Glob. 2010;9.
57. Kjell HM, Lennart H, Michael C. Pooled Analysis of Two Swedish Case-Control Studies on the Use of Mobile and Cordless Telephones and the Risk of Brain Tumours Diagnosed During 1997–2003 International Journal of Occupational Safety and Ergonomics. 2007;13(1):63-71.
58. Hardell L, Carberg M. Mobile phones, cordless phones and the risk for brain tumours. Int J Oncol. 2009;35:5-17.
59. Hardell L, Carlberg M, Mild K. Use of mobile phones and cordless phones is associated with increased risk for glioma and acoustic neuroma. Pathophysiology 2013;20:85-110.
60. WHO. IARC Classifies Radiofrequency Electromagnetic Fields as Possibly Carcinogenic to Human France2011 [cited 2015 28 June]. Available from: http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf.
61. Braune S, Riedel A, Schulte-Moning J, Raczek J. Influence of a radiofrequency electromagnetic field on cardiovascular and hormonal parameters of the autonomic nervous system in healthy individuals. Radiat Res. 2002;158:352 - 6.
62. Barker AT, Jackson PR, Parry H, Coulton LA, Cook GG, Wood SM. The effect of GSM and TETRA mobile handset signals on blood pressure, catechol levels and heart rate variability. Bioelectromagnetics. 2007;28(6):433 - 8.
63. Barutcu I, Esen AM, Kaya D, Turkmen M, Karakaya O, Saglam M, et al. Do mobile phones pose a potential risk to autonomic modulation of the heart? . Pacing Clin Electrophysiol. 2011;34(11):1511 - 4.
64. Parazzini M, Ravazzani P, Thuroczy G, Molnar F, Ardesi G, Sacchettini A, et al. Nonlinear heart rate variability measures under electromagnetic fields produced by GSM cellular phones. Electromagnetic Biology and Medicine. 2007;32(2):173-81.

65. Elder JA. Ocular effects of radiofrequency energy. Bioelectromagnetics. 2003:S148-S61.
66. George DF, Bilek MM, McKenzie DR. Non-thermal effects in the microwave induced unfolding of proteins observed by chaperone binding. Bioelectromagnetics. 2008;29:324 -30.
67. de la Hoz A, Díaz-Ortiz A, Moreno A. Microwaves in organic synthesis: Thermal and non-thermal microwave effects. Chem Soc Rev. 2005;34:164-78.
68. Yu Y, Yao K. Non-thermal Cellular Effects of Low-power Microwave Radiation on the Lens and Lens Epithelial Cells. J Int Med Res. 2010;38(3):729-36.
69. Mausset AL, de Seze R, Montpeyroux F, Privat A. Effects of radiofrequency exposure on the GABAergic system in the rat cerebellum: clues from semi-quantitative immunohistochemistry. Brain Res. 2001;912(1):33-46.
70. Thomee S, Eklof M, Gustafsson E, Nilsson R, Hagberg M. Prevalence of perceived stress, symptoms of depression and sleep disturbances in relation to information and communication technology (ICT) use among young adults - an explorative prospective study. Computers in Human Behavior. 2007;23(3):1300-21.
71. Thomee S, Dellve L, Harenstam A, Hagberg M. Perceived connections between information and communication technology use and mental symptoms among young adults - a qualitative study. Bmc Public Health. 2010;10.
72. Thomee S, Harenstam A, Hagberg M. Mobile phone use and stress, sleep disturbances, and symptoms of depression among young adults - a prospective cohort study. Bmc Public Health. 2011;11.
73. Bevelander KE, Anschutz DJ, Creemers DHM, Kleinjan M, Engels RCME. The Role of Explicit and Implicit Self-Esteem in Peer Modeling of Palatable Food Intake: A Study on Social Media Interaction among Youngsters. Plos One. 2013;8(8).
74. Epstein LH, Roemmich JN, Robinson JL, Paluch RA, Winiewicz DD, Fuerch JH, et al. A randomized trial of the effects of reducing television viewing and computer use on body mass index in young children. Arch Pediat Adol Med. 2008;162(3):239-45.
75. Utter J, Neumark-Sztainer D, Jeffery R, Story M. Couch potatoes or french fries: Are sedentary behaviors associated with body mass index, physical activity, and dietary behaviors among adolescents? J Am Diet Assoc. 2003;103(10):1298-305.
76. Kautiainen S, Koivusilta L, Lintonen T, Virtanen SM, Rimpela A. Use of information and communication technology and prevalence of overweight and obesity among adolescents. Int J Obesity. 2005;29(8):925-33.
77. Berkey CS, Rockett HRH, Colditz GA. Weight Gain in Older Adolescent Females: The Internet, Sleep, Coffee, and Alcohol. J Pediatr-Us. 2008;153(5):635-9.
78. Byun Y-H, Ha M, Kwon H-J, Choi K-H, Burm E, Choi Y, et al. Epidemiological Characteristics of Mobile Phone Ownership and Use in Korean Children and Adolescents. Environmental Health and Toxicology. 2013;28(2013):1-8.

79. DiMaggio P, Hargittai E, Neuman WR, Robinson JP. Social implications of the Internet. Annu Rev Sociol. 2001;27:307-36.
80. Parayil G. The digital divide and increasing returns: Contradictions of informational capitalism. Inform Soc. 2005;21(1):41-51.
81. Bohler E, Schuz J. Cellular telephone use among primary school children in Germany. Eur J Epidemiol. 2004;19(11):1043-50.
82. Sanchez-Martinez M, Otero A. Factors Associated with Cell Phone Use in Adolescents in the Community of Madrid (Spain). Cyberpsychol Behav. 2009;12(2):131-7.
83. Kaare BH, Brandtzeg PB, Heim J, Endestad T. In the borderland between family orientation and peer culture: the use of communication technologies among Norwegian tweens. New Media Soc. 2007;9(4):603-24.
84. Oksman V, Rautiainen P. Extension of the hand: children's and teenagers' relationship with the mobile phone in Finland. Mahwah, NJ: Lawrence Erlbaum Associates Publishers; 2003.
85. Song EJ. The relationship between the using mobile phone and mental health state of high school students. J Korean Acad Psych Mental Health Nurs. 2006;15(3):325-33.
86. Mezei G, Benyi M, Muller A. Mobile phone ownership and use among school children in three Hungarian cities. Bioelectromagnetics. 2007;28(4):309-15.
87. Ji P, Skorica MM. Gender and social resources: digital divides of social network sites and mobile phone use in Singapore. Chinese Journal of Communication. 2013;6(2):221-39.
88. Koivusilta L, Lintonen T, Rimpelä A. Intensity of mobile phone use and health compromising behaviours--how is information and communication technology connected to health-related lifestyle in adolescence? J Adolesc. 2005;28(1):35-47.
89. Koivusilta L, Lintonen T, Rimpela A. Mobile phone use has not replaced smoking in adolescence. Brit Med J. 2003;326(7381):161-.
90. Aarø LE, Laberg JC, Wold B. Health behaviours among adolescents: towards a hypothesis of two dimensions. HEALTHEDUCATION RESEARCH. 1995;10(1):83-9 3.
91. Carskadon MA, Dement WC. Monitoring and staging human sleep. In M.H. Kryger, T. Roth, & W.C. Dement (Eds.), Principles and practice of sleep medicine, 5th edition. St. Louis: Elsevier Saunders; 2011.
92. Corliss J. A Harvard Medical School Special Health Report on Improving Sleep: A guide to a good night's rest. Boston: Harvard university; 2013.
93. Corliss J. A Harvard Medical School Special Health Report on Improving Sleep: A guide to a good night's rest. Boston: Harvard university, 2013.
94. Buysse DJ, Reynolds CFr, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989;28(2):193-213.
95. Krystal AD, Edinger JD. Measuring sleep quality. Sleep Med. 2008;9:S10-S7.

96. Buysse DJ, Ancoli-Israel S, Edinger JD. Recommendations for a standard research assessment of insomnia. (vol 29, pg 1155, 2006). Sleep. 2006;29(11):1380-.
97. Cheng SH, Shih, C., Lee, H., Hou, Y., Chen, K.C., Chen, K., Yang, Y.K., Yang, Y.C. A study on the sleep quality of incoming university students. Psychiatry Research 2012;197:270–4.
98. Lashkaripour K, Bakhshani, N.M., and Mafi, S. Sleep Quality Assessment of Medicine Students and Physician (Medical) Assistants. Interdisciplinary Journal of Contemporary Research in Business. 2012;4(8):443 - 50.
99. Lohsoonthorn V, Khidir H, Casillas G, Lertmaharit S, Tadesse MG, Pensuksan WC, et al. Sleep quality and sleep patterns in relation to consumption of energy drinks, caffeinated beverages, and other stimulants among Thai college students. Sleep Breath [Internet]. 2013 [cited 2012 14 December 2012].
100. Rocha CR, Rossini, S. and Reimão, R. Sleep disorders in high school and pre-university students. Arq Neuro-Psiquiat. 2010;68:903-7.
101. Suen LK, Hon, K.L. and Tam, W.W. Association Between Sleep Behavior and Sleep-related Factors among University Students in Hong Kong. Chronobiol Int. 2008;25(5):760-75.
102. Zhou HQ, Shi WB, Wang XF, Yao M, Cheng GY, Chen PY, et al. An epidemiological study of sleep quality in adolescents in South China: a school-based study. Child Care Hlth Dev. 2012;38(4):581-7.
103. Stein MB, Enns, M. W., & Kryger, M. H. . Sleep impairment in patients with panic disorder: II. Polysomnographic assessment of sleep architecture and sleep continuity J Affect Disorders. 1993;28(1):1-6.
104. Karacan I, Moore CA. Genetics and human sleep. Psychiatr Ann. 1979;9:11-23.
105. National Sleep Foundation. Sleep in America Poll: Summary Findings Washington, DC: National Sleep Foundation; 2006 [cited 2012 20 Novemver]. Available from: http://www.sleepfoundation.org.
106. Strauch I, Meier, B. Sleep need in adolescents: a longitudinal approach. Sleep. 1988;11(4):378-86.
107. Loessl B, Valerius, G., Kopasz, M., Hornyak, M., Riemann, D., Voderholzer, U. Are adolescents chronically sleep-deprived? An investigation of sleep habits of adolescents in the Southwest of Germany. Child Care Health Dev. 2008;34(5):549-56.
108. Tynjälä J, Kannas, L., Välimaa, R. How young Europeans sleep. Health Educ Res. 1993;8(1):69-80.
109. Sadeh A, Gruber, R., Raviv, A. The effects of sleep restriction and extension on school-age children: what a difference an hour makes. Child Dev. 2003;74(2):444-55.
110. Olds T, Blunden S, Petkov J, Forchino F. The relationships between sex, age, geography and time in bed in adolescents: A meta-analysis of data from 23 countries. Sleep Med Rev. 2010;14:371-8.
111. Knutson KL, Lauderdale AS. Sociodemographic and Behavioral Predictors of Bed Time and Wake Time among US Adolescents Aged 15 to 17 Years. The Journal of Pediatrics. 2009;154(3):426-30.

112. WHO. WHO technical meeting on sleep and health. Bonn: Germany: WHO Regional Office for Europe, 2004.

113. Grandner MA, Kripke, D.F. Self-reported sleep complaints with long and short sleep: a nationally representative sample. Psychosom Med. 2004;66:239-41.

114. Gureje O, Makanjuola, V.A., Kola, L. Insomnia and role impairment in the community : results from the Nigerian survey of mental health and wellbeing. Social Psychiatry and Psychiatric Epidemiology. 2007;42(6):495-501.

115. Heslop P, Smith GD, Metcalfe C, Macleod J, Hart C. Sleep duration and mortality: the effect of short or long sleep duration on cardiovascular and all-cause mortality in working men and women. Sleep Med Rev. 2002;3:305–14.

116. Ohayon MM, Smirne, S. Prevalence and consequences of insomnia disorders in the general population of Italy. Sleep Med Rev. 2002;3(2):115-20.

117. Hayes MJ, Parker KG, Sallinen B, Davare AA. Bedsharing, temperament, and sleep disturbance in early childhood. Sleep. 2001;24(6):657-62.

118. Lemma S, Gelaye B, Berhane Y, Worku A, Williams MA. Sleep quality and its psychological correlates among university students in Ethiopia: a cross-sectional study. Bmc Psychiatry. 2012;12.

119. Luo JF, Zhu GX, Zhao QH, Guo QH, Meng HJ, Hong Z, et al. Prevalence and Risk Factors of Poor Sleep Quality among Chinese Elderly in an Urban Community: Results from the Shanghai Aging Study. Plos One. 2013;8(11).

120. Carskadon MA. Factors influencing sleep patterns of adolescents. In: Adolescent Sleep Patterns: Biological, Social, and Psychological Influences. Cambridge, United Kingdom: Cambridge University Press; 2002. 4-26 p.

121. Millman RP, Working Group on Sleepiness in Adolescents/Young Adults, AAP Committee on Adolescence. Excessive Sleepiness in Adolescents and Young Adults: Causes, Consequences, and Treatment Strategies. Pediatrics. 2005;115(6):1774 -86.

122. Phillips BA, Danner FJ. Cigarette smoking and sleep disturbance. Arch Intern Med. 1995;155(7):734-7.

123. Kenney SR, Paves AP, Grimaldi EM, LaBrie JW. Sleep Quality and Alcohol Risk in College Students: Examining the Moderating Effects of Drinking Motives. J Am Coll Health. 2014;62(5):301-8.

124. Zhang J, Li, A.M., Fok, T.F., Wing, Y.K. Roles of Parental Sleep/Wake Patterns, Socioeconomic Status, and Daytime Activities in the Sleep/Wake Patterns of Children. The journal of pediatrics. 2010;156(4):606-12.

125. Bordeleau S, Bernier A, Carrier J. Longitudinal Associations Between the Quality of Parent-Child Interactions and Children's Sleep at Preschool Age. J Fam Psychol. 2012;26(2):254-62.

126. Iglowstein I, Jenni OG, Molinari L, Largo RH. Sleep duration from infancy to adolescence: reference values and generational trends. Pediatrics. 2003;111(2):302-7.

127. Carskadon MA, Wolfson AR, Acebo C, Tzischinsky O, Seifer R. Adolescent sleep patterns, circadian timing, and sleepiness at a transition to early school days. Sleep. 1998;21(8):871-81.

128. Gulliford MC, Price CE, Rona RJ, Chinn S. Sleep habits and height at ages 5 to 11. Arch Dis Child. 1990;65:119-22

129. Lumeng JC, Somashekar D, Appugliese D, Kaciroti N, Corwyn RF, Bradley RH. Shorter Sleep Duration Is Associated With Increased Risk for Being Overweight at Ages 9 to 12 Years. Pediatrics. 2007;120(5):1020 -9.
130. Dollman J, Ridley K, Olds T, Lowe E. Trends in the duration of school-day sleep among 10- to 15-year-old South Australians between 1985 and 2004. Acta Paediatr. 2007;96(7):1011-4.
131. Marshalla SJ, Gorelyb T, Biddle SJ. A descriptive epidemiology of screen-based media use in youth: A review and critique. J Adolescence. 2006;29(3):333-49.
132. Snel J, Lorist MM. Effects of caffeine on sleep and cognition. Prog Brain Res. 2011;190:105-17.
133. Grandner MA, Kripke DF, Langer RD. Correlations among dietary nutrient variables and subjective and objective sleep. Sleep. 2005;28:148–9.
134. Hoefelmann LP, Lopes AD, da Silva KS, Moritz P, Nahas MV. Sociodemographic factors associated with sleep quality and sleep duration in adolescents from Santa Catarina, Brazil: what changed between 2001 and 2011? Sleep Med. 2013;14(10):1017-23.
135. Felden ÉP, Leite CR, Rebelatto CF, Andrade RD, Beltrame TS. Sleep in adolescents of different socioeconomic status: a systematic review. Revista Paulista de Pediatria. 2015.
136. Fischer FM, Nagai R, Teixeira LR. Explaining sleep duration in adolescents: The impact of socio-demographic and lifestyle factors and working status. Chronobiol Int. 2008;25(2-3):359-72.
137. Curcio G, Ferrara M, De Gennaro L. Sleep loss, learning capacity and academic performance. Sleep Med Rev. 2006;10(5):323-37.
138. Liu X, Zhao, Z., Jia, C., Buysse, D.J. Sleep patterns and problems among chinese adolescents. Pediatrics. 2008;121(6):1165-73.
139. Gau SF, Soong WT. Sleep problems of junior high school students in Taipei. Sleep. 1995;18(8):667-73.
140. Yang CK, Kim JK, Patel SR, Lee JH. Age-related changes in sleep/wake patterns among Korean teenagers. Pediatrics. 2005;115(1):250-6.
141. Dewald JF, Meijer AM, Oort FJ, Kerkhof GA, Bo¨gels SM. The influence of sleep quality, sleep duration and sleepiness on school performance in children and adolescents: A meta-analytic review. Sleep Med Rev. 2010;14:179-89.
142. Epstein R, Chillag, N., Lavie, P. Starting times of school: Effects of daytime functioning of fifth-grade children in Israel. Sleep. 1998;21(3):250-6.
143. Trockel MT, Barnes MD, Egget DL. Health-related variables and academic performance among first-year college students: Implications for sleep and other behaviors. J Am Coll Health. 2000;49(3):125-31.
144. Kelly WE, Kelly KE, Clanton RC. The relationship between sleep length and grade-point average among college students. College Student Journal. 2001;35(1):84-6.
145. Doriana B, Samuel L. Education in a hidden marketplace: monitoring of private tuition; Private supplementary tutoring in Central Asia: new opportunities and burdens; Confronting the shadow education system: what government policies for what private tutoring? A Journal of Comparative and International Education. 2011;41(1):153-5.

146. Tse SK. To what extent does Hong Kong primary school students' Chinese reading comprehension benefit from after-school private tuition? Asia Pacific Educ Rev 2014;15:283-97.
147. ThaiPBS. Unlock Tutoring from Thailand's Educational system 2014 [cited 2015 28 August]. Available from: http://news.thaipbs.or.th/content/.
148. Shin C, Kim J, Lee S, Ahn Y, Joo S. Sleep habits, excessive daytime sleepiness and school performance in high school students. Psychiat Clin Neuros. 2003;57(4):451-3.
149. Chaput J, Brunet M, Tremblay A. Relationship between short sleeping hours and childhood overweight/obesity: results from the 'Quebec en Forme'' project. Int J Obes. 2006;30(7):1080–5.
150. Hasler G, Buysse DJ, Klaghofer R, Gamma A, Ajdacic V, Eich D, et al. The association between short sleep duration and obesity in young adults: a 13-year prospective study. Sleep. 2004;27(4):661–6.
151. Al-Hazzaa HM, Musaiger AO, Abahussain NA, Al-Sobayel HI, Qahwaji DM. Prevalence of short sleep duration and its association with obesity among adolescents 15- to 19-year olds: A cross-sectional study from three major cities in Saudi Arabia. Ann Thorac Med. 2012;7(3):133-9.
152. Reilly JJ, Armstrong J, Dorosty AR, Emmett PM, Ness A, Rogers I, et al. Early life risk factors for obesity in childhood: cohort study. BMJ. 2005;330:1357-63.
153. von Kries R, Toschke AM, Wurmser H, Sauerwald T, Koletzko B. Reduced risk for overweight and obesity in 5- and 6-year-old children by duration of sleep-a cross-sectional study. Int J Obes. 2002;26(5):710-6.
154. Spiegel K, Leproult R, van Cauter E. Impact of sleep debt on metabolic and endocrine function. Lancet. 1999;354(9188):1435-9.
155. Gale SM, Castracane VD, Mantzoros CS. Energy homeostasis, obesity and eating disorders: recent advances in endocrinology. J Nutr Health Aging. 2004;134(2):295–8.
156. Spiegel K, Tasali E, Penev P, van Cauter E. Brief communication: sleep curtailment in healthy young men is associated with decreased leptin levels, elevated ghrelin levels, and increased hunger and appetite. Ann Intern Med 2004;141(11):846–50.
157. Patel SR, Hu FB. Short Sleep Duration and Weight Gain: A Systematic Review. Obesity. 2008;16(3):643-53.
158. How sleep apnea affects the heart. Poor-quality sleep and heart disease are connected. . Harvard Heart Letter: From Harvard Medical School. 2013;23(6):5.
159. Gottlieb JD, Redline D, J.F. J, Baldwin MC, Newman BA, Resnick EH, et al. Association of Usual Sleep Duration With Hypertension: The Sleep Heart Health Study. Sleep. 2006;29 (8):1009-14.
160. Stang A, Moebus, S., Möhlenkamp, S., Jöckel, K.H. Gender-Specific Associations of Short Sleep Duration With Prevalent Hypertension. Hypertention. 2008;51:e15-e6.
161. Marmot M, Brunner E. Cohort profile: The Whitehall II study. Int J Epidemiol. 2005;34(2):251-6.
162. Copyright. In: Watson RR, editor. Modulation of Sleep by Obesity, Diabetes, Age, and Diet. San Diego: Academic Press; 2015. p. iv.

163. Palagini L, Bruno RM, Gemignani A, Baglioni C, Ghiadoni L, Riemann D. Sleep Loss and Hypertension: A Systematic Review. Curr Pharm Design. 2013;19(13):2409-19.

164. Leslie M. Sleep Study Suggests Triggers for Diabetes and Obesity. Sci Technol Weld Joi. 2012;336(6078):143-

165. Penev PD. Association between sleep and morning testosterone levels in older men. Sleep. 2007;30(4):427-32.

166. Pereira JC, Andersen ML. The role of thyroid hormone in sleep deprivation. Med Hypotheses. 2014;82(3):350-5.

167. Shinno H, Inami Y, Inagaki T, Kawamukai T, Utani E, Nakamura Y, et al. Successful treatment with levothyroxine for idiopathic hypersomnia patients with subclinical hypothyroidism. Gen Hosp Psychiat. 2009;31(2):190-3.

168. Kang K, Seo JG, Seo SH, Park KS, Lee HW. Prevalence and Related Factors for High-Risk of Obstructive Sleep Apnea in a Large Korean Population: Results of a Questionnaire-Based Study. J Clin Neurol. 2014;10(1):42-9.

169. Kezirian EJ, Harrison SL, Ancoli-Israel S, Redline S, Ensrud K, Goldberg AN, et al. Behavioral Correlates of Sleep-Disordered Breathing in Older Men. Sleep. 2009;32(2):253-61.

170. Macey PM, Woo MA, Kumar R, Cross RL, Harper RM. Relationship between Obstructive Sleep Apnea Severity and Sleep, Depression and Anxiety Symptoms in Newly-Diagnosed Patients. Plos One. 2010;5(4).

171. American Psychiatric Association. Diagnostic and statistical manual of mental disorders, 4th edition, text revision (DSM-IV-TR) (4th ed). Washington, DC: American Psychiatric Association; 1997.

172. Adams C. Natural Sleep Solution for Insomnia: The Science of Sleep, Dreaming, and Nature's Sleep Remedies. Wilmington, Delaware: USA: Sacred Earth Publishing; 2010.

173. Cassels TG. ADHD, Sleep Problems, and Bed Sharing: Future Considerations. Am J Fam Ther. 2013;41(1):13-25.

174. Yürümez E, Kılıç BG. Relationship Between Sleep Problems and Quality of Life in Children With ADHD. Journal of Attention Disorders. 2013:1-7.

175. Ford DE, Kamerow DB. Epidemiologic study of sleep disturbances and psychiatric disorders. An opportunity for prevention? JAMA. 1989;262(11):1479-84.

176. Perlis ML, Giles DE, Buysse DJ, Tu X, Kupfer DJ. Self-reported sleep disturbance as a prodromal symptom in recurrent depression. J Affect Disord. 1997;42(2-3):209-12.

177. Dahl RE. The Consequences of Insufficient Sleep for Adolescents: Links Between Sleep and Emotional Regulation. Phi Delta Kappan. 1999;8(5):354-9

178. Carskadon MA. Patterns of sleep and sleepiness in adolescents. Pediatrician. 1990;17:5-12.

179. Wetter DW, Young TB, Bidwell TR, Badr MS, Palta M. Smoking as a risk factor for sleep-disordered breathing. Arch Intern Med. 1994;154(19):2219–24.

180. Matricciani LA, Olds T, Williams M, Blunden S, Rigney G. Sleep Recommendations for Children: A Need for More Data Reply. Pediatrics. 2012;129(5):989-91.

181. Zhang L, Samet J, Caffo B, Punjabi NM. Cigarette smoking and nocturnal sleep architecture. Am J Epidemiol. 2006;164(6):529-37.
182. Mair RG, Onos KD, Hembrook JR. Cognitive Activation by Central Thalamic Stimulation: The Yerkes-Dodson Law Revisited. Dose-Response. 2011;9(3):313-31.
183. Roehrs T, Papineau K, Rosenthal L, Roth T. Ethanol as a hypnotic in insomniacs: Self administration and effects on sleep and mood. Neuropsychopharmacol. 1999;20(3):279-86.
184. Deatherage JR, Roden RD, Zouhary K. Normal Sleep Architecture. Seminars in Orthodontics. 2009;15(2):86-7.
185. Chueh KH, Yang MS, Chen CS, Chiou SM. Poor sleep quality and alcohol use problems among elderly Taiwanese aboriginal women. Int Psychogeriatr. 2009;21(3):593-9.
186. Ehlers CL, Gilder DA, Criado JR, Caetano R. Sleep Quality and Alcohol-Use Disorders in a Select Population of Young-Adult Mexican Americans. J Stud Alcohol Drugs. 2010;71(6):879-84.
187. Brower KJ. Alcohol's effects on sleep in alcoholics. Alcohol Res Health. 2001;25(2):110-+.
188. Gibbs G. Dimensions of quality. York: Charlesworth Group; 2002.
189. Bornstein MC, Bradley RH. Socioeconmic status, parenting, and child development. Mahwah, NJ: Lawrence Erlbaum; 2003.
190. White KR. The relation between socioeconomic status and academic achievement. Psychological Bulletin. 1982;91(3):461-81.
191. Sirin SR. Socioeconomic status and academic achievement: A meta-analytic review of research. Rev Educ Res. 2005;75(3):417-53.
192. Jaeger MM, Holm A. Does parents' economic, cultural, and social capital explain the social class effect on educational attainment in the Scandinavian mobility regime? Soc Sci Res. 2007;36(2):719-44.
193. Sandefur GD, Meier AM, Campbell ME. Family resources, social capital, and college attendance. Soc Sci Res. 2006;35(2):525-53.
194. Kuan PY. Effects of Cram Schooling on Mathematics Performance: Evidence from Junior High Students in Taiwan. Comp Educ Rev. 2011;55(3):342-68.
195. Tsai M-H, Liu F-Y. Multigroup Structural Equation Approach: Examing the Relationship among Family Socioeconomic Status, Parent-Child Interaction, and Academic Achievement Using TASA Samples. International Journal of Intelligent Technologies & Applied Stat. 2013;6(4):353-73.
196. Muijs RD. Predictors of academic achievement and academic self-concept: a longitudinal perspective. Brit J Educ Psychol. 1997;67:263-77.
197. Bostani M, Nadri A, Nasab AR. A Study of the Relation between Mental health and Academic Performance of Students of the Islamic Azad University Ahvaz Branch. Social and Behavioral Sciences 2014;116:163 - 5.
198. Reid R, Gonzalez JE, Nordness PD, Trout A, Epstein MH. A meta-analysis of the academic status of students with emotional/behavioral disturbance. J Spec Educ. 2004;38(3):130-43.
199. Seipp B. Anxiety and academic performance:A meta-analysis of findings. Anxiety Research. 1991;4(1):27-41

200. Owens M, Stevenson J, Hadwin JA, Norgate R. Anxiety and depression in academic performance: An exploration of the mediating factors of worry and working memory. School Psychol Int. 2012;33(4):433-49.
201. Hirschi T. Causes of Delinquency. Berkeley: Universy of California Press; 1969.
202. Benner AD, Kretsch N, Harden KP, Crosnoe R. Academic Achievement as a Moderator of Genetic Influences on Alcohol Use in Adolescence. Dev Psychol. 2014;50(4):1170-8.
203. Deliens T, Clarys P, De Bourdeaudhuij I, Deforche B. Weight, socio-demographics, and health behaviour related correlates of academic performance in first year university students. Nutr J. 2013;12.
204. Singleton RA, Wolfson AR. Alcohol Consumption, Sleep, and Academic Performance Among College Students. J Stud Alcohol Drugs. 2009;70(3):355-63.
205. Audrain-McGovern J, Rodriguez D, Tercyak KP, Cuevas J, Rodgers K, Patterson F. Identifying and characterizing adolescent smoking trajectories. Cancer Epidem Biomar. 2004;13(12):2023-34.
206. Morin AJS, Rodriguez D, Fallu JS, Maiano C, Janosz M. Academic achievement and smoking initiation in adolescence: a general growth mixture analysis. Addiction. 2012;107(4):819-28.
207. Daniel WW. Biostatistics: A Foundation for Analysis in the Health Sciences. 7th edition New York: John Wiley & Sons; 1999.
208. Lemeshow S, Hosmer DW, Klar J, Lwanga SK, World Health Organization. Adequacy of sample size in health studies: Chichester : Wiley; 1990.
209. Sitasuwan T, Bussaratid S, Ruttanaumpawan P, Chotinaiwattarakul W. Reliability and validity of the Thai version of the Pittsburgh Sleep Quality Index. J Med Assoc Thai. 2014;3:S57-67.
210. Goldberg D, Hillier V. A scaled version of the General Health Questionnaire. Psychol Med 1979;9:139-45.
211. Nilchaikovit T, Sukying C, Silpakit C. Reliability and validity of the Thai version of the General Health Questionaire Journal of the Psychiatrist Association of Thailand. 1996;41(1):2-17.
212. Sheeber L, Hops H, Davis B. Family processes in adolescent depression. Clin Child Fam Psych. 2001;4(1):19-35.
213. Romeo RD. Adolescence: A Central Event in Shaping Stress Reactivity. Dev Psychobiol. 2010;52(3):244-53.
214. Byrne B. Relationships between anxiety, fear, self-esteem, and coping strategies in adolescence. Adolescence. 2000;35(137):201-15.
215. Trzesniewski KH, Donnellan MB, Moffitt TE, Robins RW, Poulton R, Caspi A. Low self-esteem during adolescence predicts poor health, criminal behavior, and limited economic prospects during adulthood. Dev Psychol. 2006;42(2):381-90.
216. Charoensuk S. Negative thinking: a key factor in depressive symptoms in Thai adolescents. Issues Ment Health Nurs. 2007;28(1):55-74.
217. An J, Sun Y, Wan YH, Chen J, Wang X, Tao FB. Associations Between Problematic Internet Use and Adolescents' Physical and Psychological Symptoms: Possible Role of Sleep Quality. J Addict Med. 2014;8(4):282-7.

218. Shapira NA, Lessig MC, Goldsmith TD, Szabo ST, Lazoritz M, Gold MS, et al. Problematic Internet use: Proposed classification and diagnostic criteria. Depress Anxiety. 2003;17(4):207-16.
219. Lenhart A. Teens, Social Media & Technology Overview 2015. 2015.
220. Tutkun E, Akarb A, Canbazc S, Çekind R, Özden HY. Ownership and Use of Mobile Phone – A Population based Study Physical Education and Sport College Students in Turkey. Social and Behavioral Sciences. 2014;116 5215-22.
221. Electronic Transactions Development Agency (Public Organization). Thailand Internet User Profile 2015. 2015.
222. Gamble AL, D'Rozario AL, Bartlett DJ, Williams S, Bin YS, Grunstein RR, et al. Adolescent Sleep Patterns and Night-Time Technology Use: Results of the Australian Broadcasting Corporation's Big Sleep Survey. Plos One. 2014;9(11).
223. Li S, Jin, X., Wu, S., Jiang, F., Yan, C., Shen, X. The impact of media use on sleep patterns and sleep disorders among school-aged children in China. Sleep. 2007;30(3):361-7.
224. Movvahedi MM, Tavakkoli-Golpayegani A, Mortazavi SA, Haghani M, Razi Z, Shojaie-Fard MB, et al. Does exposure to GSM 900 MHz mobile phone radiation affect short-term memory of elementary school students? J Pediatr Neurosci. 2014;9(2):121-4.
225. Braune S, Wrocklage C, Raczek J, Gailus T, Lucking CH. Resting blood pressure increase during exposure to a radio-frequency electromagnetic field. Lancet. 1998;351(9119):1857-8.
226. Environmental Health and Safety Cornell University. RF & Microwave Safety Program 2009 [cited 2015 7 November]. Available from: http://www.ehs.cornell.edu/File/RF_Microwave_Safety_Program_Guide%282%29.pdf.
227. Otto M, von Muhlendahl KE. Electromagnetic fields (EMF): Do they play a role in children's environmental health (CEH)? Int J Hyg Envir Heal. 2007;210(5):635-44.
228. Griffiths MD. Facebook Addiction: Concerns, Criticism, and Recommendations-a Response to Andreassen and Colleagues. Psychol Rep. 2012;110(2):518-20.
229. Mesquita G, Reimao R. Nightly use of computer by adolescents - Its effect on quality of sleep. Arq Neuro-Psiquiat. 2007;65(2b):428-32.
230. Wolniczak I, Caceres-DelAguila JA, Palma-Ardiles G, Arroyo KJ, Solis-Visscher R, Paredes-Yauri S, et al. Association between Facebook Dependence and Poor Sleep Quality: A Study in a Sample of Undergraduate Students in Peru. Plos One. 2013;8(3).
231. Sahin S, Ozdemir K, Unsal A, Temiz N. Evaluation of mobile phone addiction level and sleep quality in university students. Pak J Med Sci. 2013;29(4):913-8.
232. Berger JB, Milem JF. The role of student involvement and perceptions of integration in a causal model of student persistence. Res High Educ. 1999;40(6):641-64.
233. Murtaugh PA, Burns LD, Schuster J. Predicting the retention of university students. Res High Educ. 1999;40(3):355-71.

234. Tomul E, Polat G. The Effects of Socioeconomic Characteristics of Students on Their Academic Achievement in Higher Education. American Journal of Educational Research. 2013;1(10):449-55.
235. Lin CY, Hsieh YH, Chen CH. Use of latent growth curve modeling for assessing the effects of summer and after-school learning on adolescent students' achievement gap. Asia Pac Educ Rev. 2015;16(1):49-61.

APPENDIX

AF 02-12

The Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University
Institute Building 2, 4 Floor, Soi Chulalongkorn 62, Phyat hai Rd., Bangkok 10330, Thailand, Tel: 0-2218-8147 Fax: 0-2218-8147 E-mail: eccu@chula.ac.th

COA No. 016/2014

Certificate of Approval

Study Title No.164.1/56 : *EFFECT OF ELECTROMAGNETIC FIELD DEVICES USED SLEEP QUALITY AND ACADEMIC PERFORMANCE AMONG HIGH SCHOOL STUDENTS IN BANGKOK, THAILAND*

Principal Investigator : MRS. NUCHANAD HOUNNAKLANG

Place of Proposed Study/Institution : College of Public Health Sciences, Chulalongkorn University

The Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University, Thailand, has approved constituted in accordance with the International Conference on Harmonization – Good Clinical Practice (ICH-GCP) and/or Code of Conduct in Animal Use of NRCT version 2000.

Signature: Prida Tasanapradit

(Associate Professor Prida Tasanapradit, M.D.)
Chairman

Signature: Nuntaree Chaichanawongsaroj

(Assistant Professor Dr. Nuntaree Chaichanawongsaroj)
Secretary

Date of Approval : 27 January 2014 Approval Expire date : 26 January 2015

The approval documents including

1) Research proposal
2) Patient/Participant Information Sheet and Informed Consent Form
3) Researcher
4) Questionnaire

Protocol No. 164.1/56

Date of Approval 27 JAN 2014

Approval Expire Date 26 JAN 2015

The approved investigator must comply with the following conditions:

1. *The research/project activities must end on the approved expired date of the Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University (ECCU). In case the research/project is unable to complete within that date, the project extension can be applied one month prior to the ECCU approval expired date.*
2. *Strictly conduct the research/project activities as written in the proposal.*
3. *Using only the documents that bearing the ECCU's seal of approval with the subjects/volunteers (including subject information sheet, consent form, invitation letter for project/research participation (if available).*
4. *Report to the ECCU for any serious adverse events within 5 working days.*
5. *Report to the ECCU for any change of the research/project activities prior to conduct the activities.*
6. *Final report (AF 03-12) and abstract is required for a one year (or less) research/project and report within*

AF 04-07

ข้อมูลสำหรับกลุ่มประชากรหรือผู้มีส่วนร่วมในการวิจัย

ชื่อโครงการวิจัย ผลของอุปกรณ์สื่อสารอิเล็กทรอนิกส์ต่อคุณภาพการนอนหลับ และผลการศึกษาในนักเรียนมัธยมศึกษาตอนปลาย กรุงเทพมหานคร ประเทศไทย

ชื่อผู้วิจัย [illegible]

สถานที่ติดต่อผู้วิจัย (ที่ทำงาน) วิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย อาคารสถาบัน 2 ซอยจุฬาลงกรณ์ 62 ถนนพญาไท แขวงวังใหม่ เขตปทุมวัน กรุงเทพฯ 10330

(ที่บ้าน) 11/25 ตำบลบางคูวัด อำเภอเมือง จังหวัดปทุมธานี 12000

โทรศัพท์ (ที่ทำงาน) 02-2188156 โทรศัพท์มือถือ 087-341-9882 E-mail: [illegible]@yahoo.com

1. ขอเรียนเชิญท่านเข้าร่วมในการวิจัยก่อนที่ท่านจะตัดสินใจเข้าร่วมในการวิจัย มีความจำเป็นที่ท่านควรทำความเข้าใจว่างานวิจัยนี้ทำเพราะเหตุใด และเกี่ยวข้องกับอะไร กรุณาใช้เวลาในการอ่านข้อมูลต่อไปนี้อย่างละเอียดรอบคอบ และสอบถามข้อมูลเพิ่มเติมหรือข้อมูลที่ไม่ชัดเจนได้ตลอดเวลา

2. โครงการนี้เกี่ยวข้องกับการศึกษาผลของอุปกรณ์สื่อสารอิเล็กทรอนิกส์ที่มีต่อคุณภาพการนอนหลับ และผลการเรียนของนักเรียนมัธยมศึกษาตอนปลาย ในเขตกรุงเทพมหานคร

3. วัตถุประสงค์ของการวิจัยเพื่อศึกษาความสัมพันธ์ระหว่างอุปกรณ์สื่อสารอิเล็กทรอนิกส์กับคุณภาพการนอนหลับ และผลการเรียนของนักเรียนมัธยมศึกษาตอนปลาย ในเขตกรุงเทพมหานคร

4. ประชากรศึกษาคือ นักเรียนมัธยมศึกษาตอนปลายทั้งชายและหญิง โรงเรียนมัธยมศึกษาในสังกัดสำนักงานคณะกรรมการการศึกษาขั้นพื้นฐาน (สพฐ) ระดับชั้นมัธยมศึกษาปีที่ 4 – 6 ในเขตกรุงเทพมหานคร โดยใช้วิธีการสุ่มอย่างง่ายสุ่มตัวอย่างโรงเรียนจากเขตการศึกษาที่ 1 และ 2 จำนวนเขตการศึกษาละ 4 โรงเรียน รวม 8 โรงเรียน และสุ่มห้องเรียนในระดับชั้นมัธยมศึกษาปีที่ 4 – 6 ระดับชั้นละ 1 ห้องเรียน รวม 24 ห้องเรียน ซึ่งคาดว่าจะมีนักเรียนจากการสุ่มทั้งหมดประมาณ 900 คน

5. ผู้วิจัยจากวิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย จะทำการชี้แจงรายละเอียดเกี่ยวกับโครงการ ตอบคำถามที่ท่านสงสัย และ [illegible] หากท่านสมัครใจจะมอบให้ท่านนำเอกสาร 4 ฉบับ คือ 1) ข้อมูลสำหรับกลุ่มประชากรหรือผู้มีส่วนร่วมในการวิจัย 2) ข้อมูลสำหรับผู้ปกครองในการวิจัย 3) แบบสอบถาม และ 4) ใบยินยอมเข้าร่วมการวิจัย เพื่อขอความยินยอมจากผู้ปกครองในการเข้าร่วมโครงการ จากนั้นให้ท่านนำแบบสอบถามและใบยินยอมมาให้ผู้ช่วยนักวิจัย และนักวิจัยจะอธิบายรายละเอียดเกี่ยวกับการตอบแบบสอบถาม แล้วจึงให้ท่านตอบแบบสอบถามด้วยตนเอง โดยในการตอบแบบสอบถามนี้จะใช้เวลาประมาณ 45 นาที ข้อมูลที่ได้จะถูกเก็บไว้เป็นความลับ หากข้อคำถามหรือประเด็นใดที่ท่านรู้สึกไม่สะดวกใจที่จะตอบ ท่านสามารถเลือกที่จะไม่ตอบคำถามนั้นได้ สถานที่ที่ทำการตอบแบบสอบถามคือห้องเรียนในโรงเรียนที่ท่านกำลังศึกษาอยู่

6. งานวิจัยนี้ไม่มีความเสี่ยงใดๆ จากตัวงานวิจัย เนื่องจากเป็นการตอบแบบสอบถามเท่านั้น ในการอ่าน [illegible] ที่เกี่ยวข้องกับปัญหา การนอนหลับและปัญหาด้านสุขภาพอื่นๆ ในระหว่างการตอบแบบสอบถาม สามารถติดต่อ [illegible] ผู้วิจัยในโครงการได้ที่ โทร [illegible] และ 087-341-9882 เพื่อสอบถามข้อมูลหรือปรึกษา [illegible] หน่วยงานทางด้านสาธารณสุขที่เกี่ยวข้อง [illegible]

เลขที่โครงการวิจัย 164.1/56

วันที่รับรอง 27 มิ.ค. 2557

วันหมดอายุใบรับรอง 26 มิ.ค. 2558

* คำเอียง หมายถึง คำอธิบาย ไม่ต้องระบุในเอกสาร

AF 04-07

7. ข้อมูลที่ได้จากการ [illegible] ในการศึกษา [illegible] จะเป็นข้อมูลที่จะสามารถนำไปใช้ในการดูแลสุขภาพของนักเรียน [illegible] ต่อไป

8. การเข้าร่วมในการวิจัยของท่านเป็นโดยสมัครใจ และสามารถปฏิเสธที่จะเข้าร่วมหรือถอนตัวจากการวิจัยได้ทุกขณะ โดยไม่ต้องให้เหตุผลและไม่สูญเสียประโยชน์ที่พึงได้รับ

9. ข้อมูลที่เกี่ยวข้องกับท่านจะเก็บเป็นความลับ หากมีการเสนอผลการวิจัยจะเสนอเป็นภาพรวม ข้อมูลใดที่สามารถระบุถึงตัวท่านได้จะไม่ปรากฏในรายงาน

10. หากท่านไม่ได้รับการปฏิบัติตามข้อมูลดังกล่าว สามารถร้องเรียนได้ที่ คณะกรรมการพิจารณาจริยธรรมการวิจัยในคน กลุ่มสหสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย ชั้น 4 อาคารสถาบัน 2 ซอยจุฬาลงกรณ์ 62 ถนนพญาไท เขตปทุมวัน กรุงเทพฯ 10330 โทรศัพท์ 0-2218-8147 หรือ 0-2218-8141 โทรสาร 0-2218-8147 E-mail: eccu@chula.ac.th

รหัสโครงการวิจัย 144.1/56
วันที่รับรอง 27 มิ.ย. 2556
วันหมดอายุ 26 มิ.ย. 2557

AF 04-07

ข้อมูลสำหรับผู้ปกครอง

ชื่อโครงการวิจัย	ผลของอุปกรณ์สื่อสารอิเล็กทรอนิกส์ต่อคุณภาพการนอนหลับ และผลการศึกษาใน นักเรียนมัธยมศึกษาตอนปลาย กรุงเทพมหานคร ประเทศไทย
ชื่อผู้วิจัย	นางบุษนาฏ หวานมากลาง ตำแหน่ง หัวหน้าโครงการ
สถานที่ติดต่อผู้วิจัย (ที่ทำงาน)	วิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย อาคารสถาบัน 2 ซอยจุฬาลงกรณ์ 62 ถนนพญาไท แขวงวังใหม่ เขตปทุมวัน กรุงเทพ 10330
(ที่บ้าน)	119/28 ตำบลบางพูด อำเภอเมือง จังหวัดปทุมธานี 12000
โทรศัพท์ (ที่ทำงาน)	02-2188156 โทรศัพท์มือถือ 087 341-9882 E-mail: pboonmaklang@yahoo.com

1. ขออนุญาตให้ผู้ที่อยู่ในปกครอง/ในความดูแลของท่านเข้าร่วมในการวิจัย ก่อนที่ท่านจะตัดสินใจให้ผู้ที่อยู่ในปกครอง/ในความดูแลของท่านเข้าร่วมในการวิจัย มีความจำเป็นที่ท่านควรทำความเข้าใจว่างานวิจัยนี้ทำเพราะเหตุใด และเกี่ยวข้องกับอะไร กรุณาใช้เวลาในการอ่านข้อมูลต่อไปนี้อย่างละเอียดรอบคอบ และสอบถามข้อมูลเพิ่มเติมหรือข้อมูลที่ไม่ชัดเจนได้ตลอดเวลา

2. โครงการนี้เกี่ยวข้องกับการศึกษาผลของอุปกรณ์สื่อสารอิเล็กทรอนิกส์ที่มีต่อคุณภาพการนอนหลับ และผลการเรียนของนักเรียนมัธยมศึกษาตอนปลาย ในเขตกรุงเทพมหานคร

3. วัตถุประสงค์ของการวิจัยเพื่อศึกษาความสัมพันธ์ระหว่างอุปกรณ์สื่อสารอิเล็กทรอนิกส์กับคุณภาพการนอนหลับและผลการเรียนของนักเรียนมัธยมศึกษาตอนปลาย ในเขตกรุงเทพมหานคร

4. ประชากรตัวอย่างคือนักเรียนมัธยมศึกษาตอนปลายทั้งชายและหญิง โรงเรียนมัธยมศึกษาในสังกัดสำนักงานคณะกรรมการการศึกษาขั้นพื้นฐาน (สพฐ) ระดับมัธยมศึกษาปีที่ 4 – 6 ในเขตกรุงเทพมหานคร โดยใช้วิธีการสุ่มอย่างง่ายสุ่มตัวอย่างโรงเรียนจากเขตการศึกษาที่ 1 และ 2 จำนวนเขตการศึกษาละ 4 โรงเรียน รวม 8 โรงเรียน และสุ่มห้องเรียนในระดับชั้นมัธยมศึกษาปีที่ 4 – 6 ระดับชั้นละ 1 ห้องเรียน รวม 24 ห้องเรียน ซึ่งคาดว่าจะมีนักเรียนจากการสุ่มทั้งหมดประมาณ 900 คน

5. นักวิจัยจากวิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย จะทำการอธิบายรายละเอียดเกี่ยวกับโครงการให้ผู้ที่อยู่ในปกครอง/ในความดูแลของท่าน ตอบคำถามที่สงสัย และ พร้อมทั้งถามความสมัครใจ หากผู้ที่อยู่ในปกครอง/ในความดูแลของท่านสมัครใจเข้าร่วมโครงการวิจัย ผู้วิจัยจะมอบนำเอกสารให้แก่นักเรียน 4 ฉบับ คือ 1) ข้อมูลสำหรับกลุ่มประชากรหรือผู้มีส่วนร่วมในการวิจัย 2) ข้อมูลสำหรับผู้ปกครอง 3) แบบสอบถาม และ 4)ใบยินยอมเข้าร่วมการวิจัย เพื่อขออนุญาตจากท่านในการเข้าร่วมโครงการ จากนั้นจะให้ผู้ที่อยู่ในปกครอง/ในความดูแลของท่านนำแบบสอบถามและใบยินยอมเข้าร่วมการวิจัยกลับมา นักวิจัยจะอธิบายรายละเอียดเกี่ยวกับการตอบแบบสอบถาม และให้ผู้ที่อยู่ในปกครอง/ในความดูแลของท่านตอบแบบสอบถามด้วยตนเอง โดยในการตอบแบบสอบถามนี้จะใช้เวลาประมาณ 45 นาที ข้อมูลที่ได้จะถูกเก็บไว้เป็นความลับ หากข้อคำถามหรือประเด็นใดที่ผู้ที่อยู่ในปกครอง/ในความดูแลของท่านรู้สึกไม่สะดวกใจที่จะตอบ สามารถเลือกที่จะไม่ตอบคำถามได้ สถานที่ที่ทำการตอบแบบสอบถามคือภายในโรงเรียนที่ผู้ที่อยู่ในปกครอง/ในความดูแลของท่านกำลังศึกษาอยู่

เลขที่โครงการวิจัย 164.1/56

วันที่รับรอง 27 ม.ค. 2557

วันหมดอายุ 26 ม.ค. 2558

* หัวเรื่อง หมายถึง คำอธิบาย ไม่ต้องระบุในเอกสาร

ปรับปรุงเมื่อ ... 2554

[illegible]

AF 06-07

ข้าพเจ้าได้รับคำรับรองว่า ผู้วิจัยจะปฏิบัติต่อข้าพเจ้าตามข้อมูลที่ระบุไว้ในเอกสารชี้แจงผู้มีส่วนร่วมในการวิจัย และข้อมูลใดๆ ที่เกี่ยวข้องกับข้าพเจ้า ผู้วิจัยจะเก็บรักษาเป็นความลับ โดยจะนำเสนอข้อมูลการวิจัยเป็นภาพรวมเท่านั้น ไม่มีข้อมูลใดในการรายงานที่จะนำไปสู่การระบุตัวข้าพเจ้า [illegible]

หากข้าพเจ้าไม่ได้รับการปฏิบัติตรงตามที่ได้ระบุไว้ในเอกสารชี้แจงผู้มีส่วนร่วมในการวิจัย ข้าพเจ้าสามารถร้องเรียนได้ที่ คณะกรรมการพิจารณาจริยธรรมการวิจัยในคน กลุ่มสหสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย ชั้น 4 อาคารสถาบัน 2 ซอยจุฬาลงกรณ์ 62 ถนนพญาไท เขตปทุมวัน กรุงเทพฯ 10330 โทรศัพท์ 0-2218-8147, 0-2218-8141 โทรสาร 0-2218-8147 E-mail: eccu@chula.ac.th

ข้าพเจ้าและผู้ปกครอง [illegible] ได้ลงลายมือชื่อไว้เป็นสำคัญต่อหน้าพยาน ทั้งนี้ข้าพเจ้าได้รับสำเนาเอกสารชี้แจงผู้มีส่วนร่วมในการวิจัย และสำเนาหนังสือแสดงความยินยอมไว้แล้ว

ลงชื่อ...
(นางสาวชุติมา [illegible])
ผู้วิจัยหลัก

ลงชื่อ...
(...)
ผู้มีส่วนร่วมในการวิจัย

ลงชื่อ...
(...)
พยาน

ลงชื่อ...
(...)
พ่อแม่/ผู้ปกครอง [illegible]

โครงการวิจัยที่ 164.1/56
วันที่รับรอง 27 ส.ค. 2557
วันหมดอายุ 26 ส.ค. 2558

* ในกรณีผู้มีส่วนร่วมในการวิจัยเป็นผู้เยาว์ [illegible]

ฉบับปรับปรุงเมื่อ 25 พฤศจิกายน 2554

1

ID.............................

school.............................

แบบสอบถาม

เรื่อง

ผลของอุปกรณ์สื่อสารอิเล็กทรอนิกส์ต่อคุณภาพการนอนหลับ และผลการศึกษาในนักเรียนมัธยมศึกษาตอนปลาย กรุงเทพมหานคร ประเทศไทย

คำชี้แจงแบบสอบถาม

แบบสอบถามฉบับนี้ เป็นแบบสอบถามเกี่ยวกับสุขภาพการนอนหลับในนักเรียนระดับมัธยมศึกษาตอนปลาย มีวัตถุประสงค์เพื่อศึกษาข้อมูลการใช้อุปกรณ์สื่อสารอิเล็กทรอนิกส์ ที่มีความสัมพันธ์กับคุณภาพการนอนหลับ และผลการศึกษาในนักเรียนมัธยมศึกษาตอนปลายในเขตกรุงเทพมหานคร

แบบสอบถามชุดนี้ประกอบด้วย 6 ส่วน รวม 117 ข้อ 14 หน้า ใช้เวลาในการทำแบบสอบถามประมาณ 30 นาที ดังนี้

ส่วนที่ 1	ข้อมูลส่วนบุคคล	จำนวน	22	ข้อ
ส่วนที่ 2	ข้อมูลการใช้อุปกรณ์สื่อสารอิเล็กทรอนิกส์ไร้สาย	จำนวน	27	ข้อ
ส่วนที่ 3	พฤติกรรมการนอน	จำนวน	22	ข้อ
ส่วนที่ 4	แบบประเมินคุณภาพการนอนหลับในระยะ 1 เดือนที่ผ่านมา (Pittsburgh Sleep Quality Index)	จำนวน	10	ข้อ
ส่วนที่ 5	แบบสอบถามสุขภาพทั่วไป (General Health Questionnaire)	จำนวน	28	ข้อ
ส่วนที่ 6	แบบประเมินการบริโภคแอลกอฮอล์และคาเฟอีน	จำนวน	8	ข้อ

ข้อมูลจากแบบสอบถามจะถูกนำไปวิเคราะห์ในเชิงภาพรวม และข้อมูลที่ได้จะเป็นประโยชน์อย่างยิ่งในการวางแผนป้องกันและดูแลสุขภาพของนักเรียนระดับมัธยมศึกษาตอนปลาย หากท่านมีข้อสงสัยประการใดเกี่ยวข้องกับปัญหาด้านจริยธรรม ท่านสามารถติดต่อสอบถามได้ที่ คณะกรรมการจริยธรรมการวิจัย วิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย หากท่านมีข้อสงสัยใดๆ เกี่ยวกับข้อคำถาม โปรดติดต่อ นางสุชญา คงนาคกลาง ได้ที่วิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย หมายเลขโทรศัพท์ 02-218-8156

โปรดตอบแบบสอบถามทุกข้อเรียงตามลำดับ และโปรดอ่านคำชี้แจงของแบบสอบถามแต่ละส่วนก่อนเริ่มทำ เมื่อทำเสร็จ กรุณาให้ผู้วิจัยทำการวัด ชั่งน้ำหนัก และวัดส่วนสูง

ขอบพระคุณที่ให้ความร่วมมือมา ณ โอกาสนี้

นางสุชญา คงนาคกลาง

นิสิตวิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย

เลขที่โครงการวิจัย 164.1/56

วันที่รับรอง 27 มี.ค. 2557

วันหมดอายุ 26 มี.ค. 2558

คำชี้แจง โปรดทำเครื่องหมาย ✔ ลงในช่อง ☐ ท้ายคำตอบและเติมคำในช่องว่าง..........หน้าข้อความให้ตรงกับความเป็นจริง

ส่วนที่ 1 ข้อมูลส่วนบุคคล

1. เพศ ☐ 1. ชาย ☐ 2. หญิง
2. อายุ................................ ปี
3. ระดับชั้นที่ศึกษาอยู่ในระดับชั้น
   ☐ 1. มัธยมศึกษาปีที่ 4 ☐ 2. มัธยมศึกษาปีที่ 5 ☐ 3. มัธยมศึกษาปีที่ 6
4. แผนการเรียนที่ท่านกำลังศึกษาอยู่
   ☐ 1. วิทย์ – คณิต ☐ 2. อังกฤษ – คณิต ☐ 3. อังกฤษ – ภาษาต่างประเทศที่ 2
   ☐ 4. อังกฤษ – ไทย – สังคม ☐ 5. อื่นๆ (ระบุ)..
5. ในเทอมที่ผ่านมาท่านได้เกรดเฉลี่ย (ระบุ)
   ....
6. ระดับการศึกษาของบิดา
   ☐ 1. ไม่ได้ศึกษา ☐ 2. ประถมศึกษา
   ☐ 3. มัธยมศึกษาตอนต้น ☐ 4. มัธยมศึกษาตอนปลาย / ปวช.
   ☐ 5. ปวส./อนุปริญญา ☐ 6. ปริญญาตรี
   ☐ 7. สูงกว่าปริญญาตรี ☐ 8. อื่นๆ (ระบุ)..
7. ระดับการศึกษาของมารดา
   ☐ 1. ไม่ได้ศึกษา ☐ 2. ประถมศึกษา
   ☐ 3. มัธยมศึกษาตอนต้น ☐ 4. มัธยมศึกษาตอนปลาย / ปวช.
   ☐ 5. ปวส./อนุปริญญา ☐ 6. ปริญญาตรี
   ☐ 7. สูงกว่าปริญญาตรี ☐ 8. อื่นๆ (ระบุ)..
8. อาชีพบิดา
   ☐ 1. ไม่ได้ประกอบอาชีพใดๆ/พ่อบ้าน ☐ 2. ข้าราชการ/พนักงานของรัฐ
   ☐ 3. ธุรกิจส่วนตัว/ค้าขาย ☐ 4 พนักงานบริษัทเอกชน
   ☐ 5.พนักงานรัฐวิสาหกิจ ☐ 5. ผู้ใช้แรงงานรับจ้างทั่วไป
   ☐ 6. อื่นๆ(ระบุ)..
9. อาชีพมารดา
   ☐ 1. ไม่ได้ประกอบอาชีพใดๆ/แม่บ้าน ☐ 2. ข้าราชการ/พนักงานของรัฐ
   ☐ 3. ธุรกิจส่วนตัว/ค้าขาย ☐ 4.พนักงานบริษัทเอกชน
   ☐ 5.พนักงานรัฐวิสาหกิจ ☐ 6. ผู้ใช้แรงงานรับจ้างทั่วไป
   ☐ 6. อื่นๆ(ระบุ)..

10. [illegible] รายได้ [illegible] ต่อเดือน [illegible]

☐ 1. น้อยกว่าหรือเท่ากับ 10,000 บาท/เดือน ☐ 2. 10,001-20,000 บาท/เดือน

☐ 3. 20,001-30,000 บาท/เดือน ☐ 4. 30,001-40,000 บาท/เดือน

☐ 5. 40,001-50,000 บาท/เดือน ☐ 6. 50,000 บาท/เดือน ขึ้นไป

11. ท่านมี [illegible] ต่อไปนี้ [illegible] (ตอบทุกข้อ)

11.1 [illegible]	☐ 1. ไม่เคย	☐ 2. เคย
11.2 [illegible]	☐ 1. ไม่เคย	☐ 2. เคย
11.3 [illegible]	☐ 1. ไม่เคย	☐ 2. เคย
11.4 [illegible]	☐ 1. ไม่เคย	☐ 2. เคย
11.5 [illegible]	☐ 1. ไม่เคย	☐ 2. เคย
11.6 [illegible]	☐ 1. ไม่เคย	☐ 2. เคย
11.7 อื่นๆ (ระบุ)............	☐ 1. ไม่เคย	☐ 2. เคย

12. ท่านได้รับเงินจากพ่อแม่หรือผู้ปกครอง....................................บาท/สัปดาห์

13. ในช่วงเวลาที่ผ่านมา ท่าน [illegible] หรือไม่

☐ 1. ไม่เคย (ข้ามไปข้อ 15) ☐ 2. เคย (ระบุ)..

14. ท่านใช้เวลา [illegible] เฉลี่ยต่อสัปดาห์

ในวันที่ไปโรงเรียน..............................ชั่วโมง/สัปดาห์

ในวันหยุดสุดสัปดาห์..............................ชั่วโมง/สัปดาห์

15. ในช่วงเวลาที่ผ่านมา ท่าน [illegible] นอกเหนือจากในชั่วโมงพลศึกษา [illegible] หรือไม่

☐ 1. ไม่เคย (ข้ามไปข้อ 17) ☐ 2. เคย

16. ท่านใช้เวลาออกกำลังกายหรือเล่นกีฬานอกเหนือจากในชั่วโมงพลศึกษาเฉลี่ยต่อสัปดาห์

ในวันที่ไปโรงเรียน..............................ชั่วโมง/สัปดาห์

ในวันหยุดสุดสัปดาห์..............................ชั่วโมง/สัปดาห์

17. ในช่วงเวลาที่ผ่านมา ท่านได้เข้าร่วม [illegible] หรือไม่

☐ 1. ไม่เคย (ข้ามไปข้อ 19) ☐ 2. เคย

18. ท่าน [illegible] เฉลี่ยต่อสัปดาห์ ([illegible])

ในวันที่ไปโรงเรียน..............................ชั่วโมง/สัปดาห์

ในวันหยุดสุดสัปดาห์..............................ชั่วโมง/สัปดาห์

19. ในช่วงเวลาที่ผ่านมา ท่าน [illegible] หรือไม่

☐ 1. ไม่เคย (ข้ามไปข้อ 20) ☐ 2. ใช่

20. ท่านใช้เวลา [illegible] เฉลี่ยต่อสัปดาห์

ในวันที่ไปโรงเรียน..............................ชั่วโมง/สัปดาห์

ในวันหยุดสุดสัปดาห์..............................ชั่วโมง/สัปดาห์

เลขที่โครงการวิจัย........ [illegible] /56

วันที่รับรอง........27 พ.ค. 2557

วันหมดอายุ........26 พ.ค. 2558

21. น้ำหนัก..............................กิโลกรัม

22. ส่วนสูง..............................เซนติเมตร

ส่วนที่ 2 ข้อมูลการใช้อุปกรณ์สื่อสารอิเล็กทรอนิกส์ไร้สาย

1. ในช่วง 1 เดือนที่ผ่านมาท่านใช้อุปกรณ์สื่อสารอิเล็กทรอนิกส์ไร้สายใดต่อไปนี้ (ตอบได้มากกว่า 1 ข้อ)
   - □ 1. โทรศัพท์มือถือ (รุ่นที่ใช้อินเทอร์เน็ตไม่ได้)
   - □ 2. สมาร์ทโฟน
   - □ 3. คอมพิวเตอร์ตั้งโต๊ะ (Desktop PC) เชื่อมต่ออินเทอร์เน็ตไร้สาย
   - □ 4. โน้ตบุ๊ก (Notebook PC) ที่เชื่อมต่ออินเทอร์เน็ตไร้สาย
   - □ 5. แท็บเล็ตที่เชื่อมต่ออินเทอร์เน็ต (ไอแพด, ซัมซุงกาแล็กซี่ เป็นต้น)
   - □ 6. อุปกรณ์เชื่อมต่อโดยบลูทูธ (เมาส์ แป้นพิมพ์ หูฟัง แบบไร้สาย เป็นต้น)
   - □ 7. อุปกรณ์เชื่อมต่อโดยอินฟราเรด (เมาส์ แป้นพิมพ์ หูฟัง แบบไร้สาย เป็นต้น)
   - □ 8. อุปกรณ์ไร้สายอิเล็กทรอนิกส์ชนิดอื่น ๆ (ระบุ)..
2. ท่านเริ่มใช้อุปกรณ์สื่อสารอิเล็กทรอนิกส์ไร้สายใน (ข้อ 1.) ตั้งแต่อายุ..............ปี
3. ส่วนใหญ่ท่านใช้โทรศัพท์มือถือโดย
   - □ 1. ใช้โดยตรง (แนบหู)
   - □ 2. ใช้ผ่านสมอลทอร์ค (Smalltalk)
   - □ 3. ใช้ผ่านบลูทูธ (Bluetooth)
   - □ 4. ไม่ได้ใช้โทรศัพท์มือถือ
4. ในวันจันทร์-ศุกร์ โดยเฉลี่ยท่านใช้โทรศัพท์มือถือ (ใช้โทรศัพท์หรือส่งข้อความ)
   ใช้วันละ..................ชั่วโมง..............นาที
   - □ ไม่เคยใช้
5. ในวันเสาร์-อาทิตย์ โดยเฉลี่ย ท่านใช้โทรศัพท์มือถือ (ใช้โทรศัพท์หรือส่งข้อความ)
   ใช้วันละ..................ชั่วโมง..............นาที
   - □ ไม่เคยใช้
6. โดยเฉลี่ยใน 1 วัน ท่านใช้โทรศัพท์มือถือติดต่อกันเกินครั้งละ 30 นาที ขึ้นไป กี่ครั้ง
   - □ 1. ไม่เคยเลย หรือ หรือแทบจะไม่เคย
   - □ 2. ใช้ 1 ครั้งต่อวัน
   - □ 3. ใช้ 2 ครั้งต่อวัน
   - □ 4. ใช้ 3 ครั้งต่อวัน
   - □ 5. ใช้ 4 ครั้งต่อวัน
   - □ 6. ใช้ 5 ครั้งต่อวัน
   - □ 7. ใช้ตั้งแต่ 6 ครั้งต่อวันขึ้นไป (ระบุ).............ครั้ง
7. โดยเฉลี่ยท่านใช้โทรศัพท์มือถือในเวลาเรียนบ่อยเพียงใด
   - □ 1. ไม่เคยเลย หรือ แทบจะไม่เคยเลย
   - □ 2. ใช้ 1 ครั้งต่อวัน
   - □ 3. ใช้ 2 ครั้งต่อวัน
   - □ 4. ใช้ 3 ครั้งต่อวัน
   - □ 5. ใช้ 4 ครั้งต่อวัน
   - □ 6. ใช้ 5 ครั้งต่อวัน
   - □ 7. ใช้ตั้งแต่ 6 ครั้งต่อวันขึ้นไป (ระบุ).............ครั้ง

8. **ส่วนใหญ่**ท่านใช้สมาร์ทโฟนโดย

□ 1. ใช้โดยตรง (แนบหู) □ 2. ใช้ผ่านลำโพงสมอลทอล์ค (Smalltalk)

□ 3. ใช้ผ่านบลูทูธ (Bluetooth) □ 4. ไม่ได้ใช้สมาร์ทโฟน

9. ใน**วันจันทร์-ศุกร์** โดยเฉลี่ยท่านใช้**สมาร์ทโฟน** (ใช้โทรศัพท์ สืบค้นข้อมูล ไลน์ ฯ)

ใช้วันละ.........................ชั่วโมง...........นาที

□ ไม่เคยใช้

10. ใน**วันเสาร์-อาทิตย์** โดยเฉลี่ยท่านใช้ **สมาร์ทโฟน** (ใช้โทรศัพท์ อินเทอร์เน็ต ไลน์ ฯ)

ใช้วันละ.........................ชั่วโมง...........นาที

□ ไม่เคยใช้

11. **โดยเฉลี่ยใน 1 วัน** ท่านใช้ **สมาร์ทโฟนติดต่อกันเกินครั้งละ 30 นาที ขึ้นไป** กี่ครั้ง

□ 1. ไม่เคยเลย หรือ แทบจะไม่เคย □ 2. ใช้ 1 ครั้งต่อวัน

□ 3. ใช้ 2 ครั้งต่อวัน □ 4. ใช้ 3 ครั้งต่อวัน

□ 5. ใช้ 4 ครั้งต่อวัน □ 6. ใช้ 5 ครั้งต่อวัน

□ 7. ใช้ตั้งแต่ 6 ครั้งต่อวันขึ้นไป (ระบุ).........ครั้ง

12. โดยเฉลี่ยท่านใช้สมาร์ทโฟน**ในเวลาเรียน**บ่อยแค่ไหน

□ 1. ไม่เคยเลย หรือ แทบจะไม่เคย □ 2. ใช้ 1 ครั้งต่อวัน

□ 3. ใช้ 2 ครั้งต่อวัน □ 4. ใช้ 3 ครั้งต่อวัน

□ 5. ใช้ 4 ครั้งต่อวัน □ 6. ใช้ 5 ครั้งต่อวัน

□ 7. ใช้ตั้งแต่ 6 ครั้งต่อวันขึ้นไป (ระบุ).........ครั้ง

13. เหตุผล**ส่วนใหญ่**ในการที่ท่านใช้ **สมาร์ทโฟน** (**เลือกตอบได้ไม่เกิน 3 ข้อ**)

□ 1. โทรศัพท์เพื่อการติดต่อสื่อสาร □ 2. สืบค้นข้อมูลเพื่อการศึกษา

□ 3. สืบค้นข้อมูลสิ่งต่างๆที่ไม่เกี่ยวข้องกับการศึกษา □ 4. เล่นเกมส์ แบบ**ออนไลน์**

□ 5. ดูหนังฟังเพลงแบบ**ออนไลน์** □ 5. ส่งข้อความ (SMS)

□ 6. ดูทีวีแบบ**ออนไลน์** □ 7. ดาวน์โหลดเพลง/หนัง

□ 8. ดาวน์โหลด/อัพโหลดยูทูป (YouTube) □ 9. อีเมล (e-mail)

□ 10. ทำการบ้านกับเพื่อนออนไลน์ □ 11. ซื้อขายออนไลน์

□ 12. ใช้แอพพลิเคชั่นในเครือข่ายสังคมออนไลน์ เช่น เฟสบุ๊ค ทวิตเตอร์ ไลน์ อินสตาแกรม สไกป์ แชท [illegible]

□ 13. ไม่เคยใช้ □ 14. อื่นๆ (ระบุ)...

14. **ส่วนใหญ่**ในการใช้สมาร์ทโฟน ท่านจะ**เปิด และ ปิดสัญญาณเชื่อมต่ออิ**นเทอร์เน็ต ในเวลาใด

□ 1. เปิดสัญญาณตลอดเวลา □ 2. เปิดสัญญาณเฉพาะเวลาที่ใช้งาน

□ 3. เปิดสัญญาณระหว่างวันและปิดสัญญาณตอนกลางคืน □ 4. ไม่เคยใช้

□ 5. อื่นๆ (ระบุ)...

เลขที่โครงการวิจัย 164.1/56

วันที่รับรอง 27 มี.ค. 2557

วันหมดอายุ 26 มี.ค. 2558

15. **<u>เมื่อเข้านอน</u>** ท่านวางสมาร์ทโฟน ไว้ที่ใด

☐ 1. ใต้หมอน หรือใกล้หมอน ☐ 2. บริเวณหัวเตียง หรือ ข้างเตียง

☐ 3. ในห้องนอน ☐ 4. นอกห้องนอน

☐ 5. ไม่เคยใช้ ☐ 6. อื่นๆ (ระบุ).......................................

16. ใน<u>วันจันทร์-ศุกร์</u> โดยเฉลี่ยท่านใช้คอมพิวเตอร์ตั้งโต๊ะ (Desktop PC) และหรือ โน้ตบุ๊ก (Notebook PC) **<u>เชื่อมต่ออินเทอร์เน็ตไร้สาย</u>**

ใช้วันละ.....................ชั่วโมง...........นาที

☐ ไม่เคยใช้

17. ใน<u>วันเสาร์-อาทิตย์</u> โดยเฉลี่ย ท่านใช้คอมพิวเตอร์ตั้งโต๊ะ (Desktop PC) และหรือ โน้ตบุ๊ก (Notebook PC) **<u>เชื่อมต่ออินเทอร์เน็ตไร้สาย</u>**

ใช้วันละ.........................ชั่วโมง...........นาที

☐ ไม่เคยใช้

18. **<u>โดยเฉลี่ยใน 1 วัน</u>** ท่านใช้คอมพิวเตอร์ตั้งโต๊ะ (Desktop PC) และหรือ โน้ตบุ๊ก (Notebook PC) **<u>เชื่อมต่ออินเทอร์เน็ตไร้สายติดต่อกัน</u>**เกินครั้งละ 30 **<u>นาที ขึ้นไป</u>** กี่ครั้ง

☐ 1. ไม่เคยใช้ หรือ แทบจะไม่ใช้เลย ☐ 2. ใช้ 1 ครั้งต่อวัน

☐ 3. ใช้ 2 ครั้งต่อวัน ☐ 4. ใช้ 3 ครั้งต่อวัน

☐ 5. ใช้ 4 ครั้งต่อวัน ☐ 6. ใช้ 5 ครั้งต่อวัน

☐ 7. ใช้ตั้งแต่ 6 ครั้งต่อวันขึ้นไป (ระบุ)............ครั้ง

19. เหตุผลส่วนใหญ่ในการที่ท่านใช้คอมพิวเตอร์ตั้งโต๊ะ (Desktop PC) **<u>เชื่อมต่ออินเทอร์เน็ตไร้สาย</u>** (เลือกตอบได้ไม่เกิน 3 ข้อ)

☐ 1. เล่นเกมส์แบบ<u>ออนไลน์</u> ☐ 2. ค้นคว้าข้อมูลเพื่อการศึกษา

☐ 3. ค้นหาข้อมูลเรื่องที่ไม่เกี่ยวข้องกับการศึกษา ☐ 4. ดูหนังฟังเพลงแบบ<u>ออนไลน์</u>

☐ 5. ดูทีวีแบบ<u>ออนไลน์</u> ☐ 6. ดาวน์โหลดเพลงหนัง

☐ 7. ดาวน์โหลดหรืออัพโหลดยูทูป (YouTube) ☐ 8. อีเมล (e-mail)

☐ 9. ทำการซื้อขายสินค้าออนไลน์ ☐ 10. ซื้อสลากดิจิตอล

☐ 11. ใช้แอพพลิเคชั่นในเครือข่ายสังคมออนไลน์ เช่น เฟสบุ๊ค ทวิตเตอร์ ไลน์ อินสตาแกรม สไกป์ แชท เป็นต้น

☐ 12. ไม่เคยใช้ ☐ 13. อื่นๆ (ระบุ)...................................

20. ใน<u>วันจันทร์-ศุกร์</u> โดยเฉลี่ยท่านใช้แท็บเล็ตที่เชื่อมต่ออินเทอร์เน็ต (ไอแพด, ซัมซุงกาแล็กซี่ เป็นต้น)

ใช้วันละ........................ชั่วโมง...........นาที

☐ ไม่เคยใช้

21. ใน<u>วันเสาร์-อาทิตย์</u> โดยเฉลี่ย ท่านใช้แท็บเล็ตที่เชื่อมต่ออินเทอร์เน็ต (ไอแพด, ซัมซุงกาแล็กซี่ เป็นต้น)

ใช้วันละ.......................ชั่วโมง...........นาที

☐ ไม่เคยใช้

22. โดยเฉลี่ยใน 1 วัน ท่านใช้โทรศัพท์เคลื่อนที่เชื่อมต่ออินเทอร์เน็ต (โน้ตบุ๊ค คอมพิวเตอร์ เป็นต้น) ครั้งละ 30 นาทีขึ้นไป กี่ครั้ง

☐ 1. ไม่เคยเลย หรือ แทบจะไม่เคยเลย ☐ 2. ใช้ 1 ครั้งต่อวัน

☐ 3. ใช้ 2 ครั้งต่อวัน ☐ 4. ใช้ 3 ครั้งต่อวัน

☐ 5. ใช้ 4 ครั้งต่อวัน ☐ 6. ใช้ 5 ครั้งต่อวัน

☐ 7. ใช้ตั้งแต่ 6 ครั้งต่อวันขึ้นไป (ระบุ)............ครั้ง

23. โดยเฉลี่ยท่านใช้โทรศัพท์เคลื่อนที่เชื่อมต่ออินเทอร์เน็ต (โน้ตบุ๊ค คอมพิวเตอร์ เป็นต้น) บ่อยเพียงใด

☐ 1. ไม่เคยเลย หรือ แทบจะไม่เคยเลย ☐ 2. ใช้ 1 ครั้งต่อวัน

☐ 3. ใช้ 2 ครั้งต่อวัน ☐ 4. ใช้ 3 ครั้งต่อวัน

☐ 5. ใช้ 4 ครั้งต่อวัน ☐ 6. ใช้ 5 ครั้งต่อวัน

☐ 7. ใช้ตั้งแต่ 6 ครั้งต่อวันขึ้นไป (ระบุ)............ครั้ง

24. เหตุผลส่วนใหญ่ที่ท่านใช้โทรศัพท์เคลื่อนที่เชื่อมต่ออินเทอร์เน็ต (โน้ตบุ๊ค คอมพิวเตอร์ เป็นต้น) เชื่อมต่ออินเทอร์เน็ตไร้สาย (เลือกตอบได้ไม่เกิน 3 ข้อ)

☐ 1. เล่นเกมส์แบบออนไลน์ ☐ 2. ค้นหาข้อมูลเพื่อการศึกษา

☐ 3. ค้นหาข้อมูลอื่นๆ ที่ไม่เกี่ยวกับการศึกษา ☐ 4. ดูหนังฟังเพลงแบบออนไลน์

☐ 5. ดูทีวีแบบออนไลน์ ☐ 6. ดาวน์โหลดเพลง/หนัง

☐ 7. ดาวน์โหลดคลิปวิดีโอจากยูทูป (YouTube) ☐ 8. อีเมล (e-mail)

☐ 9. ทำการบ้านกับเพื่อนออนไลน์ ☐ 10. ซื้อขายสินค้า

☐ 11. ใช้แอพพลิเคชั่นในเครือข่ายสังคมออนไลน์ เช่น เฟสบุ๊ค ทวิตเตอร์ ไลน์ อินสตาแกรม ฯลฯ เป็นต้น

☐ 12. ไม่เคยใช้ ☐ 13. อื่นๆ (ระบุ).............................

24. ที่บ้านท่านติดตั้งอินเทอร์เน็ตไร้สาย หรือที่เรียกว่า ไวไฟ (WiFi) หรือไม่

☐ 1. ติดตั้ง ☐ 2. ไม่ได้ติดตั้ง (ข้ามไปทำข้อ 27)

25. ที่บ้านท่านติดตั้งเครื่องทวนสัญญาณหรือเสาสัญญาณหรือไม่

☐ 1. ติดตั้ง ☐ 2. ไม่ได้ติดตั้ง (ข้ามไปทำข้อ 27)

26. ที่บ้านท่านติดตั้งเครื่องทวนสัญญาณหรือเสาสัญญาณไว้บริเวณห้องนอนของท่านหรือไม่

☐ 1. ติดตั้ง ☐ 2. ไม่ได้ติดตั้ง

27. ท่านคิดว่าอุปกรณ์สื่อสารอิเล็กทรอนิกส์ที่ใช้สายหรือไร้สายทำให้ท่าน

27.1 ทำให้ติดยาเสพติดเพิ่มขึ้น	☐ 1. ไม่ใช่	☐ 2. ใช่
27.2 ทำให้มีความสุขมากขึ้น	☐ 1. ไม่ใช่	☐ 2. ใช่
27.3 ทำให้เครียด	☐ 1. ไม่ใช่	☐ 2. ใช่
27.4 ทำให้วิตกกังวลมากขึ้น	☐ 1. ไม่ใช่	☐ 2. ใช่
27.5 ทำให้ความสัมพันธ์กับครอบครัวลดลง	☐ 1. ไม่ใช่	☐ 2. ใช่
27.6 ทำให้มีคุณภาพในการดำเนินชีวิตดีขึ้น	☐ 1. ไม่ใช่	☐ 2. ใช่

เอกสารรับรองเลขที่ 164.1/56

วันที่รับรอง 27 มิ.ย. 2557

วันหมดอายุ 26 มิ.ย. 2558

8

ส่วนที่ 3 พฤติกรรมการนอน

1. ปัจจุบันท่านนอนห้องเดียวกับใคร (กรุณาตอบทุกข้อ)

1.1 พ่อแม่หรือพี่เลี้ยง	☐ 1. ไม่ใช่	☐ 2. ใช่
1.2 สัตว์เลี้ยง	☐ 1. ไม่ใช่	☐ 2. ใช่
1.3 [illegible]	☐ 1. ไม่ใช่	☐ 2. ใช่
1.4 [illegible]	☐ 1. ไม่ใช่	☐ 2. ใช่
1.5 สมาชิกอื่นในครอบครัว	☐ 1. ไม่ใช่	☐ 2. ใช่

1.6 อื่นๆ (ระบุ) ....

2. ในช่วง 3 เดือนที่ผ่านมา [illegible] หรือไม่

☐ 1. ไม่ ☐ 2. ใช่

3. โดยปกติในวันที่ไปโรงเรียนท่านเข้านอนเวลา .... น.

4. ในวันที่ไปโรงเรียนอะไรคือเหตุผลหลักที่ทำให้ท่านเข้านอน (เลือกตอบเพียง 1 ข้อ ที่ตรงกับท่านมากที่สุด)

☐ 1. พ่อแม่เป็นผู้กำหนดเวลาในการเข้านอน ☐ 2. รู้สึกง่วง

☐ 3. ท่านทำการบ้านเสร็จแล้ว ☐ 4. รายการโทรทัศน์ที่ท่านดูจบแล้ว

☐ 5. พี่น้องบอกท่านเข้านอน ☐ 6. ท่านคุยหรือส่งข้อความกับเพื่อนเสร็จแล้ว

☐ 7. [illegible] ☐ 8. อื่นๆ (ระบุ) ....

5. โดยปกติในวันที่ไปโรงเรียนท่านตื่นนอนเวลา .... น.

6. ในวันที่ไปโรงเรียนอะไรคือเหตุผลหลักที่ทำให้ท่านตื่นนอน (เลือกตอบเพียง 1 ข้อ ที่ตรงกับท่านมากที่สุด)

☐ 1. เสียงนาฬิกาปลุกหรือเสียงโทรศัพท์มือถือปลุกให้ตื่น ☐ 2. [illegible]

☐ 3. พ่อแม่ปลุกให้ตื่น ☐ 4. [illegible] เข้าห้องน้ำ

☐ 5. ไม่มีอะไรทำให้ตื่น ตื่นเอง ☐ 6. อื่นๆ (ระบุ) ....

7. โดยปกติท่านออกจากบ้านไปโรงเรียนเวลา .... น.

8. ท่านเดินทางไปโรงเรียนอย่างไร

☐ 1. เดิน ☐ 2. รถยนต์ ☐ 3. โดยสารไปกับพ่อแม่ ☐ 4. โดยสารไปกับเพื่อน

☐ 5. [illegible] ☐ 6. อื่นๆ (ระบุ) ....

9. โดยปกติท่านไปถึงโรงเรียนเวลา .... น.

10. โดยปกติท่านใช้เวลาเดินทางจากบ้านถึงโรงเรียน (ไม่รวมเวลา [illegible])

.... ชั่วโมง .... นาที

12. โดยปกติในวันหยุดสุดสัปดาห์หรือวันหยุด [illegible] ท่านตื่นนอนเวลา .... น.

เลขที่โครงการวิจัย 104.1/56

วันที่รับรอง 27 มิ.ย. 2557

วันหมดอายุ 26 มิ.ย. 2558

[illegible]. ในวันหยุดสุดสัปดาห์หรือวันนักขัตฤกษ์อะไรคือเหตุผลหลักที่ทำให้ท่านเข้านอน (เลือกตอบเพียง 1 ข้อ ที่ตรงกับท่านมากที่สุด)

☐ 1. พ่อแม่เป็นผู้กำหนดเวลาในการเข้านอน ☐ 2. รู้สึกง่วง

☐ 3. ท่านทำการบ้านเสร็จแล้ว ☐ 4. รายการโทรทัศน์ที่ท่านดูจบแล้ว

☐ 5. พี่น้องของท่านเข้านอน ☐ 6. ท่านคุยหรือติดต่อกับเพื่อนเสร็จแล้ว

☐ 7. ท่านกลับจากกิจกรรมพิเศษหรือจากข้างนอกบ้าน ☐ [illegible]. อื่นๆ (ระบุ)..

[illegible]. โดยปกติในวันหยุดสุดสัปดาห์หรือวันนักขัตฤกษ์ท่านมักตื่นนอนเวลา.....................................น.

[illegible]. ในวันหยุดสุดสัปดาห์หรือวันนักขัตฤกษ์อะไรคือเหตุผลหลักที่ทำให้ท่านตื่นนอน (เลือกตอบเพียง 1 ข้อ ที่ตรงกับท่านมากที่สุด)

☐ 1. เสียงนาฬิกาปลุกหรือเสียงสัตว์เลี้ยงปลุกให้ตื่น ☐ 2. เสียงรบกวนอื่นๆ

☐ [illegible]. พ่อแม่ปลุกให้ตื่น ☐ 4. ตื่นเพราะต้องการจะเข้าห้องน้ำ

☐ 5. ไม่มีอะไรทำให้ตื่น ตื่นเอง ☐ 6. อื่นๆ (ระบุ)..

[illegible]. โดยปกติคุณนอนกี่ชั่วโมงหากวันรุ่งขึ้นเป็นวันหยุดสุดสัปดาห์หรือวันนักขัตฤกษ์ (ไม่รวมเวลาที่ตื่นแล้วแต่ยังไม่ลุกออกจากที่นอน)

.............................ชั่วโมง.....................................นาที

18. ท่านคิดว่าเวลาที่เหมาะสมที่ท่านต้องการในการนอนให้เพียงพอนาน

.............................ชั่วโมง..................นาที

19. ท่านทำสิ่งเหล่านี้บนเตียงนอนบ่อยเพียงใด

ในช่วง 2 สัปดาห์ที่ผ่านมา	ทุกคืน	หลายครั้ง	2-3 ครั้ง	1 ครั้ง	ไม่เคยเลย
19.1 อ่านหนังสือ	☐	☐	☐	☐	☐
19.2 ดูโทรทัศน์	☐	☐	☐	☐	☐
19.3 รับประทานอาหาร	☐	☐	☐	☐	☐
19.4 ทำการบ้าน	☐	☐	☐	☐	☐
19.5 นอนกระสับกระส่ายคิดกังวล	☐	☐	☐	☐	☐

20. เมื่อท่านนอนไม่หลับท่านทำสิ่งใดต่อไปนี้ (เลือกตอบได้มากกว่า 1 ข้อ)

☐ 1. นอนต่อบนเตียง ☐ 2. ทำกิจกรรมบนเตียง (เช่น อ่านหนังสือ ดูโทรทัศน์)

☐ 3. ลุกขึ้นและดูโทรทัศน์ ☐ 4. ลุกขึ้นและดื่มเครื่องดื่มแอลกอฮอล์

☐ 5. ลุกขึ้นและเดินเล่น ☐ 6. ลุกขึ้นและดื่มเครื่องดื่มชาหรือกาแฟ

☐ 7. ลุกขึ้นและดื่มน้ำเปล่า ☐ [illegible]. ลุกขึ้นและสูบบุหรี่

☐ 9. อื่นๆ (ระบุ)..

21. ในระหว่างกลางวัน ท่านมีปัญหาเกี่ยวกับความง่วงนอนเพียงใด (เช่น การหลับระหว่างเรียนหรือทำกิจกรรม)

☐ 1. ไม่มีปัญหาเลย ☐ 2. เล็กน้อย

☐ 3. ปานกลาง ☐ 4. มาก

☐ 5. มากที่สุด

เลขที่โครงการวิจัย 164.1/56

วันที่รับรอง 27 มี.ค. 2557

วันหมดอายุ 26 มี.ค. 2558

[illegible]

[illegible]

(Pittsburgh Sleep Quality Index)

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				

6. <u>ในช่วง 1 เดือนที่ผ่านมา</u> ท่านประเมินคุณภาพการนอนหลับโดยรวมว่าเป็นอย่างไร	<u>ดีมาก</u> ☐	<u>ค่อนข้างดี</u> ☐	<u>ค่อนข้างแย่</u> ☐	<u>แย่มาก</u> ☐
7. <u>ในช่วง 1 เดือนที่ผ่านมา</u> ท่านรับประทานยาเพื่อช่วยในการนอนหลับ (ที่แพทย์สั่งหรือซื้อเองที่ร้านขายยา) บ่อยเพียงใด	<u>ไม่มีเลยใน</u> 1 เดือนที่ <u>ผ่านมา</u> ☐	<u>น้อยกว่า 1</u> <u>ครั้งต่อ</u> <u>สัปดาห์</u> ☐	1 หรือ 2 <u>ครั้งต่อ</u> <u>สัปดาห์</u> ☐	<u>ตั้งแต่ 3 ครั้ง</u> <u>ต่อสัปดาห์</u> <u>ขึ้นไป</u> ☐
8. <u>ในช่วง 1 เดือนที่ผ่านมา</u> ท่านมีปัญหาในการพยายามที่จะตื่นตัวขณะขับรถ หรือรับประทานอาหาร หรือทำกิจกรรมต่างๆ <u>บ่อยเพียงใด</u>	<u>ไม่มีเลยใน</u> 1 เดือนที่ <u>ผ่านมา</u> ☐	<u>น้อยกว่า 1</u> ครั้งต่อ <u>สัปดาห์</u> ☐	<u>1 หรือ 2</u> ครั้งต่อ <u>สัปดาห์</u> ☐	<u>ตั้งแต่ 3 ครั้ง</u> <u>ต่อสัปดาห์</u> <u>ขึ้นไป</u> ☐
9. <u>ในช่วง 1 เดือนที่ผ่านมา</u> ท่านมีปัญหาในการพยายามที่จะตื่นตัวขณะขับรถ หรือรับประทานอาหาร หรือทำกิจกรรมต่างๆ มากน้อยเพียงใด	<u>ไม่มีปัญหา</u> เลย ☐	<u>มีปัญหา</u> เล็ก<u>น้อย</u> ☐	<u>มีปัญหา</u> <u>บ้าง</u> ☐	มีปัญหา <u>มาก</u> ☐
10. ในช่วง 1 เดือนที่ผ่านมา ท่านมีปัญหาเรื่องการมีความกระตือรือร้นในการทำงานให้สำเร็จลุล่วงมากน้อยเพียงใด	ไม่มีปัญหา <u>เลย</u> ☐	<u>มีปัญหา</u> <u>เล็กน้อย</u> ☐	<u>มีปัญหา</u> <u>ปาน</u> กลาง ☐	<u>มีปัญหา</u> <u>มาก</u> ☐

ถ้าท่านมีเพื่อนนอน กรุณาถามเพื่อนนอนของท่านในระยะ <u>1 เดือนที่ผ่านมา</u> ท่านมีอาการเหล่านี้บ่อยเพียงใด

(a) กรนเสียงดัง	☐	☐	☐	☐
(b) มีช่วงหยุดหายใจขณะนอนหลับ	☐	☐	☐	☐
(c) ขาเกร็ง กระตุกขณะนอนหลับ	☐	☐	☐	☐
(d) เกิดการสับสนเรื่องเวลาหรือสถานที่ระหว่างนอนหลับ	☐	☐	☐	☐
(e) มีอาการกระสับกระส่ายอื่นๆ ขณะนอนหลับ โปรดระบุ..	☐	☐	☐	☐

ส่วนที่ 5 แบบสอบถามสุขภาพทั่วไป (General Health Questionnaire)

คำชี้แจง การสอบถามนี้มีวัตถุประสงค์เพื่อต้องการทราบถึงสภาวะสุขภาพของท่านในระยะสองถึงสามสัปดาห์ที่ผ่านมา เป็นอย่างไรบ้าง กรุณาตอบคำถาม ที่ใกล้เคียง กับสภาพของท่านในปัจจุบัน หรือใกล้เคียงกับสภาพที่เป็นมากที่สุด โดยไม่รวมถึงปัญหาที่ท่านเคยมีในอดีต และกรุณาตอบคำถามทุกข้อ

1. รู้สึกสบายและมีสุขภาพดี
   - ☐ 1. ดีกว่าปกติ ☐ 2. เหมือนปกติ ☐ 3. แย่กว่าปกติ ☐ 4. แย่กว่าปกติมาก
2. รู้สึกต้องการยาบำรุงให้มีกำลังวังชา
   - ☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก
3. รู้สึกทรุดโทรมและสุขภาพไม่ดี
   - ☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก
4. รู้สึกไม่สบาย
   - ☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก
5. ปวดหรือปวดตามบริเวณศีรษะ
   - ☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก
6. รู้สึกตึงหรือคล้ายมีแรงกดที่ศีรษะ
   - ☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก
7. มีอาการรุ่มร้อนหรือหนาว
   - ☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก
8. นอนไม่หลับเพราะกังวลใจ
   - ☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก
9. ไม่สามารถนอนหลับได้อีกหลังจากตื่นแล้ว
   - ☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก
10. รู้สึกตึงเครียดอยู่ตลอดเวลา
    - ☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก
11. รู้สึกหงุดหงิด อารมณ์ไม่ดี
    - ☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก
12. รู้สึกหวั่นวิตกหรือตื่นตกใจ โดยไม่มีเหตุผลสมควร
    - ☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก
13. รู้สึกเรื่องต่าง ๆ ทับถมจนรับไม่ไหว
    - ☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก
14. รู้สึกว่ากระวนกระวาย และเครียดอยู่ตลอดเวลา
    - ☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก

15. หาอะไรทำให้ตัวเองไม่มีเวลาว่างได้
☐ 1. มากกว่าปกติ ☐ 2. เหมือนปกติ ☐ 3. น้อยกว่าปกติ ☐ 4. น้อยกว่าปกติมาก

16. ทำอะไรช้ากว่าปกติ
☐ 1. เร็วกว่าปกติ ☐ 2. เหมือนปกติ ☐ 3. ช้ากว่าปกติ ☐ 4. ช้ากว่าปกติมาก

17. รู้สึกว่าโดยทั่วไปแล้วทำอะไร ๆ ได้ดี
☐ 1. ดีกว่าปกติ ☐ 2. เหมือนปกติ ☐ 3. น้อยกว่าปกติ ☐ 4. น้อยกว่าปกติมาก

18. พอใจกับการที่ได้ทำงานลุล่วงไป
☐ 1. มากกว่าปกติ ☐ 2. เหมือนปกติ ☐ 3. น้อยกว่าปกติ ☐ 4. น้อยกว่าปกติมาก

19. รู้สึกว่าได้ทำตัวให้เป็นประโยชน์ในเรื่องต่าง ๆ
☐ 1. มากกว่าปกติ ☐ 2. เหมือนปกติ ☐ 3. น้อยกว่าปกติ ☐ 4. น้อยกว่าปกติมาก

20. รู้สึกว่าสามารถตัดสินใจในเรื่องต่าง ๆ ได้
☐ 1. มากกว่าปกติ ☐ 2. เหมือนปกติ ☐ 3. น้อยกว่าปกติ ☐ 4. น้อยกว่าปกติมาก

21. สามารถมีความสุขกับกิจกรรมในชีวิตประจำวันตามปกติได้
☐ 1. มากกว่าปกติ ☐ 2. เหมือนปกติ ☐ 3. น้อยกว่าปกติ ☐ 4. น้อยกว่าปกติมาก

22. คิดว่าตัวเองเป็นคนไร้ค่า
☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก

23. รู้สึกว่าชีวิตนี้หมดหวังโดยสิ้นเชิง
☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก

24. รู้สึกไม่คุ้มค่าที่จะมีชีวิตอยู่ต่อไป
☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก

25. คิดว่ามีความเป็นไปได้ที่จะจบชีวิตตัวเอง
☐ 1. ไม่อย่างแน่นอน ☐ 2. ไม่คิดว่าเป็นอย่างนั้น ☐ 3. มีอยู่บ้างเหมือนกัน ☐ 4. มีแน่ๆ

26. รู้สึกว่าบางครั้งทำอะไรไม่ได้เลยเพราะประสาทเครียดมาก
☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก

27. พบว่าตัวเองรู้สึกอยากตายไปให้พ้น ๆ
☐ 1. ไม่เลย ☐ 2. ไม่มากกว่าปกติ ☐ 3. ค่อนข้างมากกว่าปกติ ☐ 4. มากกว่าปกติมาก

28. พบว่าความคิดที่จะทำลายชีวิตตัวเองเข้ามาอยู่ในความคิดเสมอ ๆ
☐ 1. ไม่อย่างแน่นอน ☐ 2. ไม่คิดว่าเป็นอย่างนั้น ☐ 3. มีอยู่บ้างเหมือนกัน ☐ 4. มีแน่ๆ

ส่วนที่ 6 แบบประเมินการบริโภคแอลกอฮอล์ ดาเฟอิน

1. ท่านเคยดื่มเครื่องดื่มที่มีแอลกอฮอล์ เช่น เบียร์ ไวน์ สปาย บาคาร์ดี บรีซเซอร์ สเมอร์นอฟ สุรา 100ไปเปอร์ แสงโสม แม่โขง หงส์ทอง มังกรทอง รีเจนซี่ ฯลฯ หรือไม่
☐ 1. ไม่เคย(ข้ามไปข้อ 4) ☐ 2. เคย

2. ในช่วง 12 เดือนที่ผ่านมา ท่านได้บริโภคเครื่องดื่มที่มีแอลกอฮอล์บ้างหรือไม่
☐ 1. ไม่เคย(ข้ามไปข้อ 4) ☐ 2. เคย

3. ในช่วง 12 เดือนที่ผ่านมา ท่านได้ดื่มเครื่องดื่มที่มีแอลกอฮอล์บ่อยแค่ไหน

☐ 1. น้อยกว่าเดือนละ 1 ครั้ง ☐ 2. สัปดาห์ละ 1 – 2 วัน

☐ 3. สัปดาห์ละ 3 – 4 วัน ☐ 4. สัปดาห์ละ 5 – 6 วัน

☐ 5. ทุกวัน ☐ 6. อื่นๆ (ระบุ)...

4. ตลอดชีวิตท่านเคยสูบบุหรี่หรือยาเส้นตั้งแต่ 100 มวนขึ้นไปหรือไม่

☐ 1. ไม่เคย ☐ 2. เคย

5. ท่านสูบบุหรี่หรือยาเส้นหรือไม่

☐ 1. ไม่เคยสูบ ☐ 2. สูบนานๆ ครั้ง

☐ 3. สูบเป็นประจำเฉลี่ยวันละ 1 ครั้ง ☐ 4. เคยสูบแต่ ไม่สูบมาแล้ว

6. ในช่วง 7 วันที่ผ่านมามีสมาชิกในบ้าน หรือเพื่อนในสถานศึกษา หรือที่ที่คุณพักอยู่ สูบบุหรี่ต่อหน้าคุณหรือไม่

☐ 1. ไม่มี หรือ แทบจะไม่มี ☐ 2. สัปดาห์ละ 1 – 2 วัน

☐ 3. สัปดาห์ละ 3 – 4 วัน ☐ 4. สัปดาห์ละ 5 – 6 วัน

☐ 5. ทุกวัน ☐ 6. อื่นๆ (ระบุ)..

7. ในช่วง 1 เดือนที่ผ่านมา โดยเฉลี่ยท่านได้รับเครื่องดื่มที่มีคาเฟอีนประเภทใดบ้าง และปริมาณเท่าใด (ตอบทุกข้อ)

	ดื่มหรือไม่	ปริมาณที่ดื่มต่อวัน	ดื่มสัปดาห์ละกี่วัน
7.1 น้ำอัดลมสีดำ	☐ 1. ไม่ดื่ม ☐ 2. ดื่ม	..................แก้ว/วัน ....กระป๋อง/วัน ....ขวดเล็ก/วัน ....ขวด/วัน	สัปดาห์ละ..................วัน สัปดาห์ละ..................วัน สัปดาห์ละ..........วัน สัปดาห์ละ..........วัน
7.2 กาแฟ	☐ 1. ไม่ดื่ม ☐ 2. ดื่ม	..........................แก้ว/วัน ....กระป๋อง/วัน	สัปดาห์ละ............วัน สัปดาห์ละ..................วัน
7.3 ชาไทย/ชาเขียว	☐ 1. ไม่ดื่ม ☐ 2. ดื่ม	..........................แก้ว/วัน ....ขวด/วัน	สัปดาห์ละ.........วัน สัปดาห์ละ..................วัน
7.4 เครื่องดื่มชูกำลัง เช่น ลิโพ M-150 คาราบาวแดง	☐ 1. ไม่ดื่ม ☐ 2. ดื่ม	..........ขวด/วัน ....กระป๋อง/วัน	สัปดาห์ละ.................วัน สัปดาห์ละ....................วัน
7.5 อื่นๆ (ระบุ)............		....	....

8. ท่านรับประทานยาที่ช่วยในการนอนหลับ (ยาที่แพทย์สั่งหรือซื้อจากร้านขายยา) บ่อยเพียงใด

☐ 1. ไม่เคยรับประทานเลย ☐ 2. รับประทานน้อยกว่า 1 ครั้งต่อสัปดาห์

☐ 3. รับประทาน 1 – 2 ครั้งต่อสัปดาห์ ☐ 4. รับประทานตั้งแต่ 3 ครั้งต่อสัปดาห์ขึ้นไป

เอกสารชุดนี้ได้รับการรับรองจาก ฉบับภาษาไทย
คณะกรรมการพิจารณาจริยธรรมการวิจัย
คณะวิชาการสาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย
โครงการวิจัยที่ 164.1/56
วันที่รับรอง 27 มิ.ย. 2557
วันหมดอายุ 26 มิ.ย. 2558

1

ID..............................

School ....

Questionnaire

on

Effect of Electromagnetic fields devices use on sleep quality and academic performance among high school students in Bangkok, Thailand

<u>Instruction</u>

This questionnaire on quality sleep among high school students aims to collect and analyze data on usage of electromagnetic communications devices in relation to sleep quality and academic performance of high school students in Bangkok area, Thailand.

This questionnaire covers 6 parts totaling 14 pages including 117 items. The participants have about 30 minutes to complete it.

Part 1	Personal data	Totaling	22	items
Part 2	Information on EMF wireless devices usage	Totaling	27	items
Part 3	Sleep habits	Totaling	22	items
Part 4	Evaluation on sleep quality in the past 1 month (Pittsburgh Sleep Quality Index)	Totaling	10	items
Part 5	General health condition (General Health Questionnaire)	Totaling	28	items
Part 6	Evaluation on alcohol and caffeine consumption	Totaling	8	items

The participants' information will be analyzed in a general, not specific, manner, and would significantly contribute to healthcare staff and policy makers to come up with preventive measures for high school students. Should you have any queries regarding health-related ethics, please contact the Committee on Code of Ethics at College of Public Health Sciences, Chulalongkorn University for further explanations. Likewise, should you have questions about questionnaire item(s), please do not hesitate to get in touch with Ms. Nuchanad Hounnaklang at College of Public Health Sciences, Chulalongkorn University, or at telephone number: 02-218 8156.

Kindly answer all items in the questionnaire in a successive manner and make sure to read instruction of each part of this questionnaire prior to answering. Upon completion of questionnaire, you are required to go through weight and height procedures.

Thank you for your cooperation

Nuchanad Hounnaklang, Ms.

College of Public Health Sciences, Chulalongkorn University

Instruction: Kindly make a tick (✓) in the box ☐ of each item and fill in the blank in front of each item that corresponds to the fact or your opinion.

Part I: Personal data

1. Gender ☐ 1. Male ☐ 2. Female
2. Age .... years old
3. At what level are you studying?
   ☐ 1. Malaysia Sukan 4 ☐ 2. Malaysian Sukan 5 ☐ 3. Malaysian Sukan 6
4. What is your study programme?
   ☐ 1. Math Science ☐ 2. Math English ☐ 3. English 2nd foreign language
   ☐ 4. Social study-Thai English ☐ 5. Others (specify) ....
5. What is your grade point average (GPA) for the last semester (specify)
   ....
6. Father's educational level
   ☐ 1. Uneducated ☐ 2. Elementary school
   ☐ 3. Secondary ☐ 4. High school/Junior vocational school
   ☐ 5. High vocational school/Associate degree ☐ 6. Bachelor degree
   ☐ 7. Post graduate degree ☐ 8. Others ....
7. Mother's educational level
   ☐ 1. Uneducated/housewife ☐ 2. Elementary school
   ☐ 3. Secondary ☐ 4. High school/Junior vocational school
   ☐ 5. High vocational school/Associate degree ☐ 6. Bachelor degree
   ☐ 7. Post graduate degree ☐ 8. Others ....
8. Father's occupation
   ☐ 1. Unemployed ☐ 2. Government officials
   ☐ 3. Own business ☐ 4. Company employees
   ☐ 5. State enterprise ☐ 7. General labourers
   ☐ 6. Others ....
9. Mother's occupation
   ☐ 1. Unemployed/housewives ☐ 2. Government officials
   ☐ 3. Own business ☐ 4. Company employees
   ☐ 5. State enterprise ☐ 7. General labourers
   ☐ 6. Others ....

10. What is your family's monthly income (combined income of father and mother or guardian)
   - ☐ 1. ≤ 10,000 Baht/month
   - ☐ 2. 10,001-20,000 Baht/month
   - ☐ 3. 20,001-30,000 Baht/month
   - ☐ 4. 30,001-40,000 Baht/month
   - ☐ 5. 40,001-50,000 Baht/month
   - ☐ 6. > 50,000 Baht/month

11. Which of the following diseases was diagnosed by your doctor that you had been affected by? (answer all items)

11.1 Diabetes	☐ 1. No	☐ 2. Yes
11.2 Hypertension	☐ 1. No	☐ 2. Yes
11.3 Thyroid	☐ 1. No	☐ 2. Yes
11.4 ADHD	☐ 1. No	☐ 2. Yes
11.5 Obesity	☐ 1. No	☐ 2. Yes
11.6 Sleep Apnea	☐ 1. No	☐ 2. Yes
11.7 Others....................................	☐ 1. No	☐ 2. Yes

12. You receive allowance from your parents/guardian .... Baht/week

13. Since last semester, have you worked part-time job while studying?
   - ☐ 1. No (then proceed to item 15)
   - ☐ 2. Yes (specify) ....

14. When and how long, on an average, have you worked part-time job per week?
   - During school day .... hour(s)/week
   - During weekend .... hour(s)/week

15. Since last semester, apart from during Physical Exercise period, have you exercised or played sports continuously at least about 30 minutes?
   - ☐ 1. No (then proceed to item 17)
   - ☐ 2. Yes

16. When and how long have you exercised or played sports on an average apart from during Physical exercise period?
   - During school day .... hrs/weekly
   - During weekend .... hrs/weekly

17. Over the last semester, have you joined school activities (for student committee meeting, volunteering activity, various clubs, etc.) any?
   - ☐ 1. No (then proceed to item 19)
   - ☐ 2. Yes

18. When and how long, on an average, did you spend time joining school activity in a week?
   - On school day........................ hrs/weekly
   - On weekend........................ hrs/weekly

19. Over the last semester, have you studied by yourself out of classroom (i.e., read by yourself, searching on the internet, special tutoring, studying with friends)
   - ☐ 1. No (then proceed to item 21)
   - ☐ 2. Yes

20. When and how long, on an average, have you been doing self-study per week?

During weekdays ... ... hrs/weekly

During weekends ... ... hrs/weekly

21. Your weight ... ... kilogram

22. Your height ... ... Centimeter

Part 2. Information on EMF wireless devices us

1. Over the last 1 month, what kind of wireless electronic devises you have used (can tick more than one item)

☐ 1. Mobile phone (cannot be used with internet)

☐ 2. Smart phones

☐ 3. Desktop PC (can use with internet)

☐ 4. Notebook computer (can connect to wireless internet)

☐ 5. Tablet connected to internet (Ipad, Sam Sung Galaxy, etc.)

☐ 6. Computer peripherals connected via Bluetooth (wireless-based mouse, keyboard, headphone, etc)

☐ 7. Computer peripherals connected via infrared (wireless-based mouse, keyboard, headphone, etc)

☐ 8. Other wireless electronic instruments (specify) ... ...

2. You started using wireless electronic instruments (as in item 1.) since you were... ... ... years old

3. How do you mostly use your mobile phones

☐ 1. Used without Bluetooth/small talk

☐ 2. Used thru Smalltalk

☐ 3. Used thru Bluetooth

☐ 4. Haven't used any phones

4. How do you mostly use your mobile phones

☐ 1. Used without Bluetooth/small talk

☐ 2. Used thru Smalltalk

☐ 3. Used thru Bluetooth

☐ 4. Haven't used any phones

5. Between Monday-Friday, how long do you use, on an average, your mobile phone per day?

... ... hr(s) ... ... min(s)

☐ Don't use at all.

6. Between Saturday-Sunday, how long do you use, on an average, your mobile phone per day?

... ... hr(s) ... ... min(s)

☐ Don't use at all.

7. On an average, in 1 day, how many times do you use your mobile phones longer than 30 minutes each time successively?

☐ 1. None or hardly ever

☐ 2. 1 time per day

☐ 3. 2 times per day

☐ 4. 3 times per day

☐ 5. 4 times per day

☐ 6. 5 times per day

☐ 7. Others (specify)... ... ... times per day

5

8. How often do you, on an average, use your mobile phone while in classroom?

□ 1. None or hardly ever □ 2. 1 time per day
□ 3. 2 times per day □ 4. 3 times per day
□ 5. 4 times per day □ 6. 5 times per day
□ 7. Others (specify)............ times per day

9. Between Monday-Friday, how long do you use, on an average, your smart phone per day?

.... hr(s). .... min(s).
□ Don't use at all.

10. Between Saturday-Sunday, how long do you use, on an average, your mobile phone per day?

.... hr(s). .... min(s).
□ Don't use at all

11. On an average, in 1 day, how many times do you use your smart phone longer than 30 minutes, each time, successively?

□ 1. None or hardly ever □ 1. None or hardly ever
□ 3. 2 times per day □ 3. 2 times per day
□ 5. 4 times per day □ 5. 4 times per day
□ 7. Others (specify)............ times per day

12. How often do you, on an average, use your smart phone while in classroom?

□ 1. None or hardly ever □ 1. None or hardly ever
□ 3. 2 times per day □ 3. 2 times per day
□ 5. 4 times per day □ 5. 4 times per day
□ 7. Others (specify)............ times per day

13. What are your main reasons for using smart phone (Don't tick more than 3 items)

□ 1. For communications □ 2. For searching educational material
□ 3. For searching non-educational material □ 4. For playing online games
□ 5. For watching online films/listening to music □ 6. For sending SMS
□ 6. For watching online TV □ 7. For downloading music/films
□ 8. For downloading/uploading from/to YouTube □ 9. For sending/receiving e-mail
□ 10. For sharing online assignments with friends □ 11. For buying/selling online stuff
□ 12. For Social networks(FB/Twitter/Line/IG)
□ 13. Never use □ 14. Others (specify)...............................

14. When do you mostly turn on/off wireless internet connection on smart phone?

□ 1. Internet online all the time □ 2. Use smartphone with online internet when needed
□ 3. Internet offline before bedtime □ 4. Others (specify)...............................

5

15. While going to bed, where do you place your smart phone?

☐ 1. Beside pillow ☐ 2. On bed

☐ 3. In bedroom ☐ 4. Outside bedroom

☐ 5. Others (specify) ....

16. Between Monday-Friday, how long do you use, on an average, your desktop PC/Notebook computer equipped with wireless internet per day?

........................h(s). ....min(s).

☐ Don't use at all.

17. Between Saturday-Sunday, how long do you use, on an average, your desktop PC/Notebook computer equipped with wireless internet per day?

........................h(s). ....min(s).

☐ Don't use at all.

18. On an average, in 1 day, how many times do you use your desktop PC/Notebook computer equipped with wireless internet per day longer than 30 minutes, each time, successively?

☐ 1. None or hardly ever ☐ 2. None or hardly ever

☐ 3. 2 times per day ☐ 4. 3 times per day

☐ 5. 4 times per day ☐ 6. 5 times per day

☐ 7. Others (specify)..............times per day

19. What are your main reasons for using your desktop PC/Notebook computer equipped with wireless internet (Don't tick more than 3 items)

☐ 1. For communications ☐ 2. For searching educational material

☐ 3. For searching non-educational material ☐ 4. For playing online games

☐ 5. For watching online films/listening to music ☐ 6. For sending SMS

☐ 7. For watching online TV ☐ 8. For downloading music/films

☐ 9. For downloading/uploading from/to YouTube ☐ 10. For sending/receiving e-mail

☐ 11. For sharing online assignments with friends

☐ 12. For Social networks(FB/Twitter/Line/IG)

20. Between Monday-Friday, how long do you use, on an average, your tablet per day?

........................h(s). ....min(s)

☐ Don't use at all.

21. Between Saturday-Sunday, how long do you use, on an average, your tablet per day?

........................h(s). ....min(s)

☐ Don't use at all.

22. On an average, in 1 day, how many times do you use your tablet equipped with wireless internet per day longer than 30 minutes each time successively?

□ 1. None or hardly ever — □ 1. None or hardly ever
□ 3. 2 times per day — □ 3. 2 times per day
□ 5. 4 times per day — □ 5. 4 times per day
□ 7. Others (specify) .... times per day

23. How often do you, on an average, use your tablet equipped with wireless internet while in classroom?

□ 1. None or hardly ever — □ 1. None or hardly ever
□ 3. 2 times per day — □ 3. 3 times per day
□ 5. 4 times per day — □ 5. 4 times per day
□ 7. Others (specify)........times per day

24. What are your main reasons for using your tablet equipped with wireless internet (Don't tick more than 3 items)

□ 1. For communications — □ 1. For communications
□ 3. For searching non-educational material — □ 3. For searching non educational material
□ 5. For watching online films/listening to music — □ 5. For watching online films/listening to music
□ 6. For watching online TV — □ 6. For watching online TV
□ 8. For downloading/uploading from/to YouTube — □ 8. For downloading/uploading from/to YouTube
□ 10. For sharing online assignments with friends
□ 12. For Social networks(FB/Twitter/Line/Igs)

24. Have you have your house installed with wireless internet/high speed internet/WIFI?

□ 1. Yes — □ 2. No (then proceed to item 27)

25. Do you use internet router at home?

□ 1. Yes — □ 2. No (then proceed to item 27)

26. Do you use internet router in your bedroom?

□ 1. Yes — □ 2. No

27. To what extent do you think the wireless electronic equipments have impacts on you?

27.1 improve my academic performance — □ 1. No — □ 2. Yes
27.2 make me happier — □ 1. No — □ 2. Yes
27.3 increase my tension — □ 1. No — □ 2. Yes
27.4 increase my anxiety — □ 1. No — □ 2. Yes
27.5 reduce my sleep duration — □ 1. No — □ 2. Yes
27.6 enhance relations among family members — □ 1. No — □ 2. Yes

Part 2 Sleep Habits

1. With whom do you share a bedroom? (tick all that apply)

   1.1 Mother/step mother ☐ 1. No ☐ 2. Yes

   1.2 Father/step father ☐ 1. No ☐ 2. Yes

   1.3 Elder brother(s)/sister(s) ☐ 1. No ☐ 2. Yes

   1.4 Younger brother(s)/sister(s) ☐ 1. No ☐ 2. Yes

   1.5 Other family member(s) ☐ 1. No ☐ 2. Yes

   1.6 Others (specify)..

2. In the last two weeks, have you slept in the same bedroom?

   ☐ 1. No ☐ 2. Yes

3. What time do you usually go to bed on school days .... AM/PM

4. What is your main reason, on school days, you usually go to bed at this time? (tick only 1 item)

   ☐ 1. My parents have set my bedtime ☐ 2. I feel sleepy

   ☐ 3. I finish my homework ☐ 4. My TV show is over

   ☐ 5. My brother(s)/sister(s) go to bed ☐ 6. I finish socializing

   ☐ 7. I get home from my job ☐ 8. Others (specify)......

5. What time do you usually wake up on school days ....AM/PM

6. What is your main reason, on school days, you usually wake up at this time? (tick only 1 item)

   ☐ 1. Noises or my pet wakes me up ☐ 2. My alarm clock wakes me up

   ☐ 3. My parents wake me up ☐ 4. I need to go to the bathroom

   ☐ 5. I don't know, I just wake up ☐ 6. Others (specify) ....

7. What time do you usually leave home on school days .... AM/PM

8. How do you usually go to school? (tick one item)

   ☐ 1. Walk ☐ 2. Take the bus ☐ 3. Get a ride with parents ☐ 4. Get a ride with friend(s)

   ☐ 5. Drive my car ☐ 7. Others (specify) ....

9. What time do you arrive at school................ AM/PM

How many hours do you sleep at night supposing that you have to go to school the next day? (exclude the waking up but not getting up yet)

.... hr(s) ....min(s).

12. What time do you usually go to bed on non school days .... AM/PM.

14. What is your main reason, on non-school days, you usually go to bed at this time? (tick only 1 item)

☐ 1. My parents have set my bedtime ☐ 2. I feel sleepy

☐ 3. I finish my homework ☐ 4. My TV shows are over

☐ 5. My brother(s)/sister(s) go to bed ☐ 6. I finish socializing

☐ 7. I get home from my job ☐ 8. Others (specify)............................

15. What time do you usually wake up on non-school days.......................AM/PM.

16. What is your main reason, on non-school days, you usually wake up at this time? (tick only 1 item)

☐ 1. Noises or my pet wake me up ☐ 2. Noises or my pet wake me up

☐ 3. My parents wake me up ☐ 3. My parents wake me up

☐ 5. I don't know, I just wake up ☐ 5. I don't know, I just wake up

17. How many hours do you sleep a night supposing that you don't have to go to school the next day? (excluding waking up but not getting up yet)

..................hr(s).............................min(s).

18. How long do you think appropriate for you to have enough sleep?...................hr(s)..............min(s)

19. How often have you done any of the following activities in bed?

In the last 3 weeks	Every night	Several times	2-3 times	Once	Never
19.1 Read	☐	☐	☐	☐	☐
19.2 Watch TV	☐	☐	☐	☐	☐
19.3 Eat	☐	☐	☐	☐	☐
19.4 Do school work	☐	☐	☐	☐	☐
19.5 Worry	☐	☐	☐	☐	☐

20. When you have difficulty falling asleep or getting back to sleep, what do you do? (tick all that apply)

☐ 1. Stay in bed and try to get to sleep ☐ 2. Do something in bed (e.g. read or watch TV)

☐ 3. Get up and watch TV ☐ 4. Get up and drink alcohol

☐ 5. Get up and drink warm milk ☐ 6. Get up and drink tea/coffee

☐ 7. Get up and drink water ☐ 8. Get up and have a cigarette

☐ 9. Others (specify)......................................

21. During your daytime activity, how much of a problem do you have with sleepiness (feeling sleepy, struggling to stay awake)?

☐ 1. No problem at all ☐ 2. A little problem

☐ 3. More than a little problem ☐ 4. A big problem

☐ 5. A very big problem

11. If you feel sleepy during day time, when do you take a nap? (you can tick more than one box)

□ 1. I never take a nap
□ 2. I take a nap every day
□ 3. I sometimes take a nap on school days
□ 4. I sometimes take a nap on non-school days
□ 5. I never take a nap unless I am sick

Part 4 Evaluation on sleep quality in the past 1 month (Pittsburgh Sleep Quality Index)

Instruction: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, What have you usually gone to bed?

   USUAL BED TIME ....

2. During the past month, How long (in minutes) has it usually taken you to fall asleep each night?

   NUMBER OF MINUTES............ ...

3. During the past month, when have you usually gotten up in the morning?

   USUAL GET UP TIME ....

4. During the past month, How many hours of actual sleep did you get at night? (This may be different than the number of hours you spend in bed.)

   HOURS OF SLEEP PER NIGHT ....

11

Instruction: For each of the remaining questions, check the one best response. Please answer all questions.

5. During the past month, how often have you had trouble sleeping because you ...

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
(a) Cannot get to sleep within 30 minutes	☐	☐	☐	☐
(b) Wake up in the middle of the night or early morning	☐	☐	☐	☐
(c) Have to get up to use the bathroom	☐	☐	☐	☐
(d) Cannot breathe comfortably	☐	☐	☐	☐
(e) Cough or snore loudly	☐	☐	☐	☐
(f) Feel too cold	☐	☐	☐	☐
(g) Feel too hot	☐	☐	☐	☐
(h) Have bad dreams	☐	☐	☐	☐
(i) Have pain	☐	☐	☐	☐
(j) Other reason(s), please describe	☐	☐	☐	☐

	Very good	Fairly good	Fairly bad	Very bad
6. During the past month, how would you rate your sleep quality overall?	☐	☐	☐	☐

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
7. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?	☐	☐	☐	☐
8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?	☐	☐	☐	☐

9.	During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?	No problem at all	Only a very slight problem	Somewhat of a problem	A very big problem
		☐	☐	☐	☐
10.	During the past month, how would you rate your sleep quality overall?	No problem at all	Only a very slight problem	Somewhat of a problem	A very big problem
		☐	☐	☐	☐

If you have a room mate or bed partner, ask him/her how often in the past month you have had:

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
(a) Loud snoring	☐	☐	☐	☐
(b) Long pauses between breaths while asleep	☐	☐	☐	☐
(c) Legs twitching or jerking while you sleep	☐	☐	☐	☐
(d) Episodes of disorientation or confusion during sleep	☐	☐	☐	☐
(e) Other restlessness while you sleep, please describe:	☐	☐	☐	☐

Part 5 General Health Questionnaire 28 (GHQ-28)

Instruction We should like to know how your health has been in general over the past few weeks. Please answer ALL the questions by ticking the box under the answer which you think most applies to you.

1. Been feeling perfectly well and in good health?

   ☐ 1. Better than usual ☐ 2. Same as usual ☐ 3. Less than usual ☐ 4. Much less than usual

2. Been feeling in need of a good tonic?

   ☐ 1. Not at all ☐ 2. No more than usual ☐ 3. Rather more than usual ☐ 4. Much more than usual

3. Been feeling run down and out of sorts?

   ☐ 1. Not at all ☐ 2. No more than usual ☐ 3. Rather more than usual ☐ 4. Much more than usual

13

4. Felt that you are ill?
   - 1. Not at all
   - 2. No more than usual
   - 3. Rather more than usual
   - 4. Much more than usual

5. Been getting any pains in your head?
   - 1. Not at all
   - 2. No more than usual
   - 3. Rather more than usual
   - 4. Much more than usual

6. Been getting a feeling of tightness or pressure in your head?
   - 1. Not at all
   - 2. No more than usual
   - 3. Rather more than usual
   - 4. Much more than usual

7. Been having hot or cold spells?
   - 1. Not at all
   - 2. No more than usual
   - 3. Rather more than usual
   - 4. Much more than usual

8. Lost much sleep over worry?
   - 1. Not at all
   - 2. No more than usual
   - 3. Rather more than usual
   - 4. Much more than usual

9. Had difficulty in staying asleep once you are off?
   - 1. Not at all
   - 2. No more than usual
   - 3. Rather more than usual
   - 4. More more than usual

10. Felt constantly under strain?
   - 1. Not at all
   - 2. No more than usual
   - 3. Rather more than usual
   - 4. Much more than usual

11. Been getting edgy and bad-tempered?
   - 1. Not at all
   - 2. No more than usual
   - 3. Rather more than usual
   - 4. Much more than usual

12. Been getting scared or panicky for no good reason?
   - 1. Not at all
   - 2. No more than usual
   - 3. Rather more than usual
   - 4. Much more than usual

13. Been satisfied with the way you've carried out your task?
   - 1. Not at all
   - 2. No more than usual
   - 3. Rather more than usual
   - 4. Much more than usual

14. Felt constantly under strain?
   - 1. Not at all
   - 2. No more than usual
   - 3. Rather more than usual
   - 4. Much more than usual

15. Been managing to keep yourself busy and occupied?
   - 1. More than usual
   - 2. Same as usual
   - 3. Less so than usual
   - 4. Much less than usual

16. Been taking longer than usual to do things?
   - 1. More than usual
   - 2. Same as usual
   - 3. Less so than usual
   - 4. Much less than usual

17. Felt on the whole you were doing things well?
   - 1. Better than usual
   - 2. Same as usual
   - 3. Less than usual
   - 4. Much less than usual

18. Been satisfied with the way you've carried out your task?
   - 1. More than usual
   - 2. Same as usual
   - 3. Less so than usual
   - 4. Much less than usual

19. Felt that you are playing a useful part in things?
   - 1. More than usual
   - 2. Same as usual
   - 3. Less so than usual
   - 4. Much less than usual

20. Felt capable of making decisions about things?
   - 1. More than usual
   - 2. Same as usual
   - 3. Less so than usual
   - 4. Much less than usual

21. Been able to enjoy your normal day-to-day activities?
   - 1. More than usual
   - 2. Same as usual
   - 3. Less so than usual
   - 4. Much less than usual

22. Been thinking of yourself as a worthless person?
    - □ 1. Not at all
    - □ 2. No more than usual
    - □ 3. Rather more than usual
    - □ 4. Much more than usual
23. Felt that life is entirely hopeless?
    - □ 1. Not at all
    - □ 2. No more than usual
    - □ 3. Rather more than usual
    - □ 4. Much more than usual
24. Felt that life isn't worth living?
    - □ 1. Not at all
    - □ 2. No more than usual
    - □ 3. Rather more than usual
    - □ 4. Much more than usual
25. Thought of the possibility that you might do away with yourself?
    - □ 1. Not at all
    - □ 2. No more than usual
    - □ 3. Rather more than usual
    - □ 4. Much more than usual
26. Found at times you couldn't do anything because your nerves were too bad?
    - □ 1. Not at all
    - □ 2. No more than usual
    - □ 3. Rather more than usual
    - □ 4. Much more than usual
27. Found yourself wishing you were dead and away from it all?
    - □ 1. Not at all
    - □ 2. No more than usual
    - □ 3. Rather more than usual
    - □ 4. Much more than usual
28. Found that the idea of taking your own life kept coming into your mind?
    - □ 1. Not at all
    - □ 2. No more than usual
    - □ 3. Rather more than usual
    - □ 4. Much more than usual

Part 6 Evaluation on alcohol and caffeine consumption

1. Do you consume alcoholic drinks i.e., beer, wine, spy, brandy, liquor, etc.?
    - □ 1. No (then proceed to item 4)
    - □ 2. Yes.
2. In the past 12 months, have you consumed alcoholic drinks?
    - □ 1. No (then proceed to item 4)
    - □ 2. Yes.
3. In the past 12 months, how often have you consumed alcoholic drinks?
    - □ 1. Less than once a month
    - □ 2. 1-2 days per week
    - □ 3. 3-4 days per week
    - □ 4. 5-6 days per week
    - □ 5. Every day
    - □ 6. Others (specify)..................................
4. Up until now, have you smoked more than 100 cigarettes?
    - □ 1. No.
    - □ 2. Yes.
5. Do you smoke?
    - □ 1. I Never smoke
    - □ 2. I hardly smoke
    - □ 3. I smoke regularly at least once a week
    - □ 4. I used to smoke, but now give up smoking
6. In the past 7 days, has any of your friends or family members smoke in front of you?
    - □ 1. No, hardly ever
    - □ 2. Yes, 1 – 2 day per week
    - □ 3. Yes, 3 – 4 day per week
    - □ 4. Yes, 5 – 6 day per week
    - □ 5. Yes, every day
    - □ 6. Others (specify)..................................

7\. In the past 1 month, How much and how often have you consumed any of the caffeinated drinks below (tick all items)

	Do you drink?	How much drink per day	How many day per week?
7.1 Coke/Pepsi/S	□ 1. No	.... glass(es)/day	.... day(s) per week
	□ 2. Yes	.... small can(s)/day	.... day(s) per week
		.... big can(s)/day	.... day(s) per week
		.... bottle(s)/day	.... day(s) per week
7.2 Coffee	□ 1. No	.... cup(s)/day	.... day(s) per week
	□ 2. Yes	.... can(s)/day	.... day(s) per week
7.3 Thai Tea/Green Tea	□ 1. No	.... cup(s)/day	.... day(s) per week
	□ 2. Yes	.... bottle(s)/day	.... day(s) per week
7.3 Energy drink (i.e., Lipo, M-150, Redbull, Shark)	□ 1. No	.... bottle(s)/day	.... day(s) per week
	□ 2. Yes	.... box(es)/day	.... day(s) per week
7.4 Others (specify)........		....	....
....		....	....

8\. How often do you take sedative drugs (either prescribed by doctor or purchase from drugstore)

□ 1. Never. □ 2. Less than once per week

□ 3. 1 – 2 times per week □ 4. More than 3 times per week

Thank you for your cooperation

Muchunad Hounnakong

College of Public Health Sciences, Chulalongkorn University

VITA

Curriculum Vitae

Nuchanad Hounnaklang

Education:

1994 – 1998	Chulalongkorn University, Bangkok, Thailand
	Master of Arts in Counseling Psychology
1988 – 1992	Saraburi Nursing College, Saraburi, Thailand
	Diploma in Nursing Science (equivalent to Bachelor of Science in Nursing)

Work Experience:

2003 – 2015	Researcher at College of Public Health Sciences, Chulalongkorn University
2002 – 2003	Lecturer at Laboratory School of Kasetsart University
2001 – 2002	Working as a freelance psychological trainer
1999 – 2001	Head of Counseling Div. and lecturer in psychology
	Dhurakitpundit University, Bangkok, Thailand
1998 – 1999	Counselor and lecturer in psychology
	University of the Thai Chamber of Commerce, Bangkok, Thailand
1994 – 1999	Freelance psychological trainer and freelance nurse
1992 – 1994	General nurse at Singburi Hospital, Singburi, Thailand