THE EFFECT OF BRAIN-BREAKS ON PHYSICAL ACTIVITY LEVEL, PHYSICAL ACTIVITY MOTIVATION AND COGNITIVE FUNCTIONS AMONG THE MEDICAL STUDENTS AT UNIVERSITI SAINS MALAYSIA

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by

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LIST OF ABBREVIATIONS

ADHD- Attention Deficit-Hyperactivity Disorder

BMI- Body Mass Index

CAS- Cognitive Assessment System

CHD- Coronary Heart Disease

DST- Digit Span Test

DVT- Digit Vigilance Test

EF- Executive Functions

GCH- Global Community Health

IQ- Intelligence Quotients

LSTM- Long Short-Term Memory

LTEQ- Leisure-Time Exercise Questionnaire

NHS- National Health Services

PALMS- Physical Activity and Leisure Motivation Scale

PALMS-Y- Physical Activity and Leisure Motivation Scale (youth version)

REMM- Recreational Exercise Motivation Measure

SPSS- Statistical Package for Social Science

WHO- World Health Organisation

KESAN VIDEO 'REHAT MINDA' KEAATAS TAHAP AKTIVITI FIZIKAL, MOTIVASI DALAM BERAKTIVITI FIZIKAL, DAN FUNGSI KOGNITIF DALAM KALANGAN PELAJAR PERUBATAN UNIVERSITI SAINS MALAYSIA

ABSTRAK

Kajian ini bertujuan untuk mengkaji kesan intervensi rehat otak pada tahap aktiviti fizikal, keseimbangan keputusan, keberkesanan diri, dan fungsi kognitif di kalangan pelajar perubatan Universiti Sains Malaysia. Dalam kajian ini, dua puluh peserta (Umur: 22.47 ± 1.22 tahun) direkrut di mana mereka menjalankan dua ujian kognitif dan tiga soal selidik pada pra dan pasca intervensi. ujian kognitif termasuk Uji Masa Reaksi dan Ujian Stroop untuk mengukur masa tindak balas dan daya tarikan dan fleksibiliti mental. Soal selidik yang digunakan meliputi Decisional Balance, Self-Efficacy dan juga Leisure Time Exercise (LTEQ). Peserta dibahagikan kepada dua kumpulan kawalan dan intervensi secara rawak. Tempoh intervensi adalah tiga minggu dengan dua belas video rehat otak. Setelah menyelesaikan fasa intervensi, hasilnya menunjukkan bahawa kumpulan intervensi mempunyai hasil yang signifikan pada masa tindak balas (p = 0.002) dan daya tarikan mental dan fleksibiliti perhatian (p = 0.011). Tahap aktiviti fizikal peserta dari kedua-dua kumpulan juga menunjukkan kenaikan di mana jumlah peserta kumpulan tidak aktif berkurang dan jumlah kumpulan tahap aktif meningkat. Kesimpulannya, intervensi rehat otak mempunyai kesan yang signifikan terhadap fungsi kognitif, motivasi aktiviti fizikal dan juga tahap aktiviti fizikal di kalangan pelajar perubatan Universiti Sains Malaysia.

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ABSTRACT

This study aimed to examine the effect of brain-breaks intervention on physical activity level, decisional balance, self-efficacy and cognitive functions among the medical students of Universiti Sains Malaysia. In the present study, twenty participants (age: 22.47 ± 1.22 years old) were recruited for this study, and they completed two cognitive tests and three questionnaires at pre- and post- intervention. The cognitive test includes the Reaction Time Test and Stroop Test, which are used to measure the response time, mental attentional vitality and flexibility. The questionnaires used include Decisional Balance, Self-Efficacy and also Leisure Time Exercise questionnaire (LTEQ). The participants were randomly assigned to two groups: 1) control, and 2) Intervention. The intervention period was three weeks of brain breaks videos. After completing the intervention phase, the result show that the intervention group have significant result on response time (p = 0.002) and attentional mental vitality and flexibility (p = 0.011). Also, significant increase in decisional (p = 0.0018). The physical activity level of the participants in both groups also shows increment, where the number of sedentary participants decreasing and the number of active participants increasing. In conclusion, the brain-breaks intervention has a positive effect on cognitive functions, physical activity motivation and physical activity level among the medical students at Universiti Sains Malaysia.

CHAPTER 1

1. INTRODUCTION

1.1 Problem statement

Previous studies have shown that physical inactivity has a detrimental effect on health. It implies that the National Health Service (NHS) from the United Kingdom, should set an example for other employers, since they are the first line when it comes to the public health field (Doh 2009; 2010). Action should be taken to increase the motivation for nurses and medicine students since they are the next generation of NHS employees (Doh 2010). But there are certain factors that been affecting their likelihood to adopt and engage in physical activity. One of them is lack of motivation. Brain-breaks intervention boost stimulate student's health and learning, and it also can motivate students to enhance cognition and provide the opportunity not only physical health but also for mental health (Chin et al., 2013). To date, direct relationships between brain-breaks and physical activity level, health-related fitness and cognitive functions have not been widely explored, especially among medical or nursing students. Thus, limited evidence was found examining the effectiveness of brain-breaks for those effects. This study aimed to examine the effect of brain-breaks intervention on physical activity level, decisional balance, self-efficacy and cognitive functions among the medical students of Universiti Sains Malaysia.

1.2 Objectives

The aim of this study is to investigate the effectiveness of Brain Breaks online programme among medical students at Universiti Sains Malaysia (USM).

The specific objectives are:

1. To examine the effect of Brain Breaks activity interventions on cognitive functions between experimental and control groups after three-weeks of implementation.
2. To examine the mean difference on physical activity level (LTEQ) between experimental and control groups after three-weeks of brain breaks intervention.
3. To examine the mean difference on decisional balance and self-efficacy between experimental and control groups after three-weeks of brain break intervention.

1.3 Hypotheses

HO_1: There is no significant effect of Brain Breaks activity interventions on cognitive functions between experimental and control groups after three-weeks of implementation.

HA_1: There is a significant effect of Brain Breaks activity interventions on cognitive functions between experimental and control groups after three-weeks of implementation.

HO_2: There is no mean difference of Brain Breaks on physical activity level (LTEQ) between experimental and control groups after three-weeks of brain breaks intervention.

HA_2: There is a mean difference of Brain Breaks on physical activity level (LTEQ) between experimental and control groups after three-weeks of brain breaks intervention

HO_3: There is no mean difference of Brain Breaks on decisional balance and self-efficacy between experimental and control groups after three-weeks of brain break intervention.

HA_3: There is a mean difference of Brain Breaks on decisional balance and self-efficacy between experimental and control groups after three-weeks of brain break intervention.

1.4 Significance of study

Brain-breaks is a school-based, video-exercise intervention that enhance students' health and learning. The United Nations endorsed the foundation for Global Community Health (GCH Foundation), is the organisation that initiated the brain-breaks intervention movement (Uzunoz et al., 2017). Present research on school-based physical activity interventions have shown an affirmative improvement in the cognitive functions and attitudes, academic performance and behaviour (Mura et al., 2015). The relationship between physical activity and cognitive functions have become a rising interest in the school system, as most of the schooling hours is spent working in the cognitive domain (Sibley & Etnier,

2003). However, similar situation was also observed in the Malaysian health care settings. The proportion of physically inactive among healthcare professionals continues to rise (Kumbrija et al. 2007). Thus, higher education institutions such as Universiti Sains Malaysia should also emphasise on the importance of physical activity among students, in particularly to the medical students.

However, we found limited literature available for university policies, which had successfully implemented brain-breaks activity among the students for enhancing their physical activity level. In this regard, more research is needed on the implementation of brain-breaks activity to support the initiatives of policy-makers. It also helps to implement more physical activity programs for inactive medical students to motivate them into a healthy lifestyle and reduce the prevalence of physical inactivity among the future health care professionals.

By stimulating the cognition ability or functioning through brain-breaks intervention, it can enhance their intrinsic and extrinsic motivation. Cognitive functioning reflects a number of underlying mental processes such as perception, attention, executive functioning, intelligence, academic achievement, memory and concentration (Niet, 2015). The focus is on emphasising a new approach to promote physical activity and encourage behaviour change to perpetuate physical activity participation by making it interactive, fun, as well as engaging.

CHAPTER 2

2. LITERATURE REVIEW

2.1 Brain-Breaks and Physical activity

Regular physical activity helps in the development of the skills of movement and helps prevent and control the feelings of anxiety and depression (U.S. Department of Health and Human Services, 1996). It has been found that children and adolescents who are more physically active showed higher academic performance compared to inactive individual (Grierson, 2005; Sigman, 2007). Therefore, physical education in school should not only provide physical activity programs but should also prepare students for a lifetime of habitual physical activity (Kee et al., 2010).

The school environment is ideal for implementing physical activity interventions due to the possibility to reach a wide number of children who are spending most of their time in schools (Hills et al., 2015). Presently, research on implementation of school-based physical activity programs indicates a positive improvement of cognitive skills and attitudes, academic performance and academic behaviour with only a few studies indicating negative relationship (Mura et al., 2015). In this regard, more research is required to investigate the effect of school-based physical activity to support the effort of initiating policies to promote changes at decision- making levels aimed at providing children with more regular access to physical activity in school settings (Uzunoz et al., 2017). In addition, emphasis must be placed on finding new ways to promote physical activity and

encourage behaviour change to perpetuate physical activity participation among children by making it interactive, fun, as well as engaging.

In review paper by Esteban et al. (2015) two of them analysed both cognitive and academic performance in relation to physical activity. Four articles (18%) found no association between physical activity and academic performance, 11 (50%) found positive association and one showed negative association (5%). Five articles (23%) found positive association between physical activity and cognitive performance and one showed negative association (5%). The findings of these studies show that cognitive performance is associated with vigorous physical activity and that academic performance is related to general physical activity, but mainly in girls. Results of the review also indicate that type of activity and some psychological factors (i.e., self-esteem, depression) could mediate the association between physical activity and academic performance.

One promising intervention brought forward by HopSports (2014), is a school-based, video-exercise known as the Brain Breaks® Physical Activity Solutions or brain-breaks for short. It is a web-based structured physical activity breaks that stimulate student's health and learning as well as being specifically designed for the classroom setting to motivate students to enhance their theoretical lessons and provide opportunity not only to be physically active during breaks, but also learn new motor skills, language, art, music and different cultures (Chin et al., 2013). In the GCH foundation website, educators from all across the world contribute by uploading exercise videos which suit their respective customs and cultures. These videos are then shared online and are accessible to anyone that would like to implement these short exercises during class. Of particular note,

Malaysian educators have even uploaded their own exercise video, using ‘silat’ as a medium for exercise. By contributing these videos, educators from all over the world with access to an internet connection can implement physical activity and simple exercises to promote cognitive development and health. This movement is also endorsed by the United Nations as a means of health promotion. Other implementations of brain breaks are simple transitional physical and mental exercises designed to equip the teacher with tools to manage the physiology and attention of the class as well as to keep children in the most receptive state for learning (Weslake & Christian, 2015).

Physical education is often misinterpreted as a way of only improving physical fitness such as cardiovascular fitness, flexibility and muscular strength. However, it should be noted that physical education advocates a holistic approach to human development which emphasises the mind and body as one entity, and that anything that happens to one will affect the other (Sibley & Etnier, 2003). In other words, physical educators believe that a child comes to school to be educated, both mentally and physically. Additionally, there are many educators that believe physical activity and physical education may have a positive effect on concentration, learning and academic success. These traits are often traced back to the general term coined as cognitive ability or functioning. Cognitive functioning reflects a number of underlying mental processes such as perception, attention, executive functioning, intelligence, academic achievement, memory and concentration (Niet, 2015).

One of the most pronounced factors that stimulate and maintain individual’s participation in physical activity is motivation (Kueh et al., 2017). Researchers

have used motivational theories such as self-determination theory (Deci & Ryan, 2000) and achievement goal theory (Nicholls, 1989) to act as guidelines in studying human motivation in physical activity. Each of these theories consists of two main components, namely intrinsic and extrinsic motivation as well as task and ego orientations respectively. Many questionnaires have been developed to measure participation motivation in exercise and physical activity. Recently, a measure of participation motivation was developed by Rogers and Morris (2003) known as the Recreational Exercise Motivation Measure (REMM) and was later revised to the Physical Activity and Leisure Motivation Scale (PALMS) in 2004. The use of PALMS was advantageous in the sense that it can incorporate both the self-determination and achievement goal theoretical frameworks as well as be suited to both recreational and to a certain extent, sporting context (Zach, Bar-Eli, Morris, & Moore, 2012).

2.2 Physical activity and cognitive function

The present systematic review found positive evidence suggesting that there are associations between physical activity and fitness, cognition, and academic achievement. However, the findings are inconsistent and the effects of numerous elements of physical activity on cognition remain to be further explored, such as type, amount, frequency, and timing. Many questions remain unanswered regarding how to best incorporate physical activity within schools, such as activity breaks versus active lessons in relation to improved academic achievement. Regardless, the literature suggesting that increased in physical activity showed positive relationship on cognition or academic achievement. physical activity is important

for growth and development and general health. Based on the evidence available, the authors concluded that physical activity has a positive influence on cognition as well as brain structure and function; however, more research is needed to determine the mechanisms and long-term impact, as well as strategies to translate laboratory findings in the school environment.

Research supports the view that single bouts of physical activity, and physical activity interventions demonstrated beneficial effect on children's cognitive functioning. However, limited evidence was available concerning the effects of physical activity on learning, with only one cross-sectional study meeting the inclusion criteria. Evidence indicates that physical activity has a positive relationship on areas of the brain that support complex cognitive processes, such as during laboratory tasks. While favorable results have been obtained from cross-sectional and longitudinal studies related to academic achievement, the results obtained from controlled experiments evaluating the benefits of physical activity on academic performance are mixed and additional, well-designed studies are needed.

The relationship between physical activity and cognitive vitality was likely first established in children (Clarke, 1954). However, the evidence for the benefits of exercise on human cognition has been focusing towards older adults. Several of these experiments clearly demonstrated that routine exercise alters specific brain structures and functions and the changes were associated with older adults' cognitive performance (Colcombe et al., 2006; Kramer et al., 1999). In particularly, tests requiring greater amounts of Excutive Functions (EF), which describes a subset of goal-directed cognitive operations underlying perception, memory, and

action, are organised along with three interrelated component processes: working memory, response inhibition, and mental flexibility (Diamond, 2013; Miyake et al., 2000).

The benefits of physical activity on cognitive performance, learning, brain structure, and brain function for children are also important and is gaining a lot of interest. It is due to these effects may be the foundation upon which more global improvements in academic achievement are attained. Although the extant literature in this area is relatively modest, the early work was meta-analytically reviewed on two occasions. In 1997, Etnier et al. reported that in studies testing the effects of acute physical activity on cognitive performance with children (6-13 years), a small positive effect was observed (Hedge's g = 0.36). Next, in a meta-analysis focused exclusively on children ages 6-13 years, Sibley and Etnier (2003) reported a similar overall effect size (Hedge's g = 0.32) for 44 studies using a variety of designs (including both chronic and acute physical activity paradigms).

There are many mechanisms that have been considered to interpret the relationship between physical activity and cognition. These mechanisms can be categorised into physiological and learning/developmental mechanisms (Sibley & Etnier, 2003). The physiological mechanism consists of increased blood flow, alterations in brain neurotransmitters, and structural changes in the central nervous system as well as modified arousal levels due to physical activity. On the other hand, learning or developmental mechanism suggest that physical activity is required in order for proper cognitive development to occur. However, there are still conflicting results, with some studies showing a facilitative effect on physical activity, some reporting cognitive impairment, and others reporting no difference

(Tomporowski & Ellis, 1986). Despite these research findings, a strong relationship between physical activity and cognitive performance has yet to be established (Sibley & Etnier, 2003). In recent years, the overall quality of the studies pertaining to the relationship between academic achievement and physical activities especially in the western countries has increased, but the results continue to be inconsistent (Howie & Pate, 2012).

In a much later meta-analysis study, limited evidence has pointed towards a positive effect of physical activity on cognitive functioning in young to middle-aged adults (Peng et al., 2016). Furthermore, studies that examine the effects of exercise on children's intelligence, cognition, or academic achievement were reviewed and results were discussed in light of (a) contemporary cognitive theory development directed toward exercise, (b) recent research demonstrating the salutary effects of exercise on adults' cognitive functioning, and (c) studies conducted with animals that have linked physical activity to changes in neurological development and behaviour (Tomporowski, Phillip, Davis, Miller, & Naglieri, 2008). Cognitive functioning which is defined as a process of selecting, organising and initiating actions that are goal-oriented, is facilitated by exercise. Exercise may prove to be a simple, yet important, method of enhancing those aspects of children's mental functioning central to cognitive development (Tomporowski et al., 2008).

Based on a meta-analytic review of physical activity and cognition, researchers have found an overall effect size of 0.25, based on 1260 effect sizes from 134 studies (Etnier et al., 1997). However, limitations have been found in the form of low-quality studies that obtained the largest effect sizes in the meta-

analysis, in which many of them were correlational in nature. As noted by Etnier et al., these two problems tend to limit the interpretation of the positive findings from the analysis. Furthermore, age group was a moderator variable in which the results suggested that the effect sizes were larger for children than for the population as a whole. This was specifically true for primary school children that had an effect size of 0.36 for chronic activity as compared to 0.77 effect size among high school students. In short, additional research is warranted in order to determine in more depth the relationship between these variables in this particular age category. As a conclusion, however, studies have still proven that children and adolescents who are more physically active showed higher academic performance (Grierson, 2005; Sigman, 2007).

Most of the s1qatudies in the physical activity present their findings after consideration of potential confounding variables that may have offered competing explanations for the results because of their relationship to fitness and cognitive performance. In studies testing fitness as a continuous variable, potential confounders were consistently considered and statistically controlled, and positive relationships were observed between fitness and cognitive performance in seven of the eight studies. Specific findings were as follows: Buck et al. (2008) statistically controlled for age, BMI, and IQ and reported that fitness was predictive of cognitive performance as assessed with the stroop color, word, and color-word tasks. Besides, Jacob et al. (2011) controlled for sex and BMI and found that fitness was predictive of comprehension and block design performance, Then, Davis and Cooper (2011) controlled for race, gender, and education level of the primary caregiver and reported that fitness was predictive of planning scores on the

Cognitive Assessment System (CAS). Next, Scudder and colleagues (2014) reported that fitness predicted reaction time on the flanker task and performance on the spatial n-back (a measure of working memory) after controlling for grade, sex, household income, and BMI. Drollette et al. (2015) consistently found that girls preformed poorer on measures of working memory as compared to boys when controlling for SES and fitness in three distinct data sets. Lastly, Syväoja and colleagues (2014) controlled for gender, parental education, and remedial education and demonstrated that moderate-to-vigorous physical activity has a positive association with attention. These studies suggested that fitness and physical activity are correlated with cognitive outcomes independent of most confounders.

Relative to brain function, future research should provide proper control groups, as several studies included no-contact controls (e.g., Davis et al., 2011, Hilman et al., 2014) or failed to include a proper control group (e.g., Chang et al., 2013). In addition, properly powered sample sizes are needed to move many of the findings from randomised pilot studies to fully powered randomised controlled trials. These strategies are necessary for the field to advance in a manner that can inform public health. Future research should continue to aid our understanding of physical activity and aerobic fitness effects on brain structure and function using the most recent innovations in neuroimaging to gain a more complete understanding of the effects of physical activity on the entire brain rather than on isolated brain regions. Early attempts on this front have been made (Krafft et al., 2014) and future research will need to follow up on these interesting findings. Although brain structure and function data are intriguing, our understanding of the