COGNITIVE, PSYCHO-PHYSIOLOGICAL AND PHYSICAL BENEFITS OF AEROBIC EXERCISE AND MILK CONSUMPTION AMONG FEMALE SECONDARY SCHOOL STUDENTS

by

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ABBREVIATIONS

CVD	**Cardiovascular Disease**
VO_{2max}	**Maximal Oxygen Consumption**
CFA	**Confirmatory Factor Analysis**
BMI	**Body Mass Index**
CNS	**Central Nerves System**
WHO	**World Health Organization**
LDL-C	**Low Density Lipoprotein Cholesterol**
HDL-C	**High Density Lipoprotein Cholesterol**
WC	**Waist circumference**
PA	**Physical Activity**
PE	**Physical Education**
DVT	**Digit Vigilance Test**
DST	**Digit Span Test**
HR_{max}	**Maximum Heart Rate**
TC	**Total Cholesterol**
TG	**Triglyceride**
PAQ-A	**Physical Activity Questionnaire for Adolescents**
PAR-Q	**Physical Activity Readiness Questionnaire**
FFQ	**Food Frequency Questionnaire**
FBS	**Fasting Blood Glucose**
BP	**Blood Pressure**
CMJ	**Counter Movement Jump**
SJ	**Squat Jump**
WMS	**Wechsler Memory Scale**
ANOVA	**Analysis of Variance**
SPSS	**Statistical Package for Social Science**

KESAN KOGNITIF, PSIKO-FISIOLOGIKAL DAN FIZIKAL LATIHAN SENAMAN AEROBIK DAN PENGAMBILAN SUSU DALAM KALANGAN MURID PEREMPUAN SEKOLAH MENENGAH

ABSTRAK

Kajian ini bertujuan untuk mengenalpasti kelebihan/kebaikan dari segi kognitif, psiko-fisiologikal dan fizikal terhadap latihan senaman aerobik dan pengambilan susu dalam kalangan murid perempuan sekolah menengah. Kajian ini melibatkan dua fasa. Fasa awal melibatkan 93 murid perempuan berumur 16 tahun yang telah dipilih secara rawak dan dikategorikan kepada empat kumpulan eksperimen iaitu; kumpulan susu, kumpulan latihan senaman, kumpulan gabungan susu dan latihan senaman dan kumpulan kawalan. Pelajar yang terlibat sebagai peserta kajian kumpulan susu mengambil 250ml susu rendah lemak sehari selama lima hari persekolahan pada masa yang ditetapkan. Manakala pelajar yang terlibat menyertai kumpulan latihan senaman menghadiri aktiviti latihan senaman tarian aerobik selama dua kali seminggu. Kumpulan gabungan pula mengambil susu rendah lemak sebanyak 250ml sehari dan menghadiri latihan senaman tarian aerobik. Di dalam fasa utama pula, kajian yang dilakukan hampir sama tetapi berbeza prosedur eksperimen dimana murid yang terlibat sebagai peserta kumpulan gabungan dan kumpulan latihan senaman perlu menghadiri latihan senaman tarian aerobik selama tiga kali seminggu, manakala kumpulan gabungan dan kumpulan susu mengambil sebanyak 500ml susu rendah lemak setiap hari selama 5 hari dalam seminggu (dihidangkan sebanyak dua kali; satu kali disebelah pagi dan satu kali disebelah petang). Ujian dilakukan pada sesi minggu keenam dan minggu kedua belas intervensi. Hasil analisis menggunakan pengukuran berulang ANOVA mendapati keputusan fasa pertama kumpulan gabungan (latihan senaman tarian aerobik dan susu

250ml sehari) menunjukkan pengurangan signifikan ukuran lilitan pinggang, peratus lemak dan kolesterol HDL ($p < 0.05$) berbanding kumpulan kawalan. Selain itu, kumpulan gabungan juga menunjukkan pengaruh signifikan kesan latihan senaman tarian aerobik dan pengambilan susu terhadap peningkatan memori jangka pendek dan kawalan fokus/pemerhatian mampan ($p < 0.001$, $p < 0.05$) berbanding peserta kumpulan kawalan dan kumpulan susu. Hasil analisis selepas tiga bulan intervensi menunjukkan kesan signifikan kumpulan gabungan, kumpulan latihan senaman dan kumpulan susu terhadap pengurangan ukuran lilitan pinggang dan peratus lemak berbanding kumpulan kawalan dengan nilai beza purata yang lebih tinggi bagi kumpulan gabungan. Selain itu, peserta kumpulan gabungan menunjukkan kesan signifikan terhadap perubahan positif lipid darah berbanding kumpulan kawalan. Berdasarkan daripada keputusan di fasa utama, jumlah skor tekanan emosi dalam kalangan peserta intervensi menunjukkan penurunan signifikan berbanding sebelum intervensi selepas tiga bulan dengan perubahan nilai beza purata (beza min = 5.21, $p < 0.01$). Selain itu, kajian ini juga menunjukkan kelebihan kesan latihan senaman dan pengambilan susu terhadap kekuatan otot di bahagian bawah badan. Walaubagaimanapun, fasa utamamenunjukkan kesan signifikan perubahan penambahbaikan bagi kumpulan gabungan berbanding kumpulan kawalan dan kumpulan susu. Sebagai kesimpulan, jumlah ulangan serta tempoh masa latihan senaman dan jumlah pengambilan susu merupakan kombinasi terbaik meningkatkan keberkesanan bagi pembolehubah yang dipilih dan ini terbukti apabila kumpulan gabungan intervensi merupakan kumpulan yang menunjukkan kesan terbaik dalam pengukuran yang telah dijalankan.

COGNITIVE, PSYCHO-PHYSIOLOGICAL AND PHYSICAL BENEFITS OF AEROBIC EXERCISE AND MILK CONSUMPTION AMONG FEMALE SECONDARY SCHOOL STUDENTS

ABSTRACT

The objectives of the present study were to identify the cognitive, psycho-physiological and physical benefits of aerobic exercise and milk consumption among female secondary school students. The intervention was conducted in two preliminary and main studies, separately. In the preliminary phase, ninety three female students aged 16 years old were randomly assigned in the four study groups: milk, exercise, combined and control groups. The participants in the milk group consumed 250ml/day low fat milk for five days of school days at specific time and the participants in the exercise group attended an aerobic dance exercise twice a week and the participants in the combined group consumed 250ml/day low fat milk consumption and attended aerobic exercise. The main phase of the present study was conducted with same participants of the preliminary phase, however, it followed different intervention procedures. Participants in the combined and exercise groups were required to attend aerobic exercise class three times/week, whereas participants in the milk and combined groups were taking 500ml/day low fat milk (first serving in the morning and second serving in the evening). Selected parameters were assessed after the 6^{th} and 12^{th} weeks of the intervention. The results of the two-way repeated measure ANOVA from the preliminary phase revealed that the participants of the combined intervention group (two times/week aerobic exercise plus 250ml/day milk consumption) had significantly lower waist circumference, fat percentage and HDL Cholesterol ($p < 0.05$) compared to their counterparts in the control group. Furthermore, combination of aerobic exercise plus intake of milk

consumption significantly influenced higher improvement of short term memory and sustained attention ($p < 0.001$, $p < 0.05$) compared to those in the control and milk groups. Outcomes of the main phase over three months intervention however revealed that the participants in the combined, exercise and milk groups exhibited significantly lower fat% and waist circumference compared with the participants in the control group with higher mean difference for combined group ($p < 0.01$). Moreover, the participants of the combined group had significantly positive change in blood lipids compared to the control group. According to the results of main phase, scores of emotional distress of the all participant in the intervention groups decreased significantly more from baseline to post intervention with greater mean differences in the combined group (mean differences = 5.21, $p < 0.01$). Furthermore, additional benefits of aerobic exercise and milk intake for muscular power surfaced just in the main phase with significant improvement in the combined and exercise groups compared to the control and milk groups. In conclusion, the frequency and duration of aerobic exercise and amount of milk consumption as well as combination of aerobic exercise plus intake of low fat milk improved selected parameters. Although, combining aerobic exercise and milk consumption was observed to be more effective to produce sizable changes on the mentioned parameters.

CHAPTER 1

INTRODUCTION

1.1 Background and Scope of the Study

Physical exercise and nutrition have been regarded as essential factors in prevention and treatment of many diseases. Physical exercise and nutrition have their own individual effects, but it has been recognized that when these two are combined, it will produce even more favorable effects (Kauko, 2010).

Evidence is accumulating that the onset of many chronic diseases of adulthood lies in childhood (Zieske *et al*., 2002). Moreover, epidemiological data has shown an increase in the prevalence of obesity and hyperlipidemia among youth that coincide with a quick decrement in activity during childhood and adolescence (Ogden *et al*., 2003). As a consequence, physical inactivity increasingly becoming a topic of interest for researchers and practitioners (Jamner *et al*., 2004).

Sedentary lifestyles increase all cause of body and mental problems. Increasing sedentary behaviour of adolescents and its association with cardiovascular risk factors and mental disorders is alarming (Tremblay *et al.,* 2002). This trend has long-term health consequences including several CVD risk factors and mental disorders including obesity (Freedman *et al.*, 2001; Reilly *et al*., 2003), hyperlipidemia (Nicklas *et al*., 2002) stress, anxiety and depression (Aşçı *et al*., 2003; Bicer *et al.,* 2012).

Being physically active throughout life has numerous health benefits, from preventing chronic diseases, obesity as well as improving mental health. The American

College of Sports Medicine recommends an exercise regime of three times a week at an intensity of 55% to 85% of the maximal heart rate in order to obtain health related benefits (Rahl, 2010). It has also been suggested that continuous training with duration of 20 to 60 minutes of rhythmic and aerobic activity could activate groups of large muscle in the human body thus provide physiological benefits from the activity (Fletcher *et al*., 1996; Wenger and Bell, 1986; Gossard *et al*., 1986).

Despite the known benefits of exercise on body and mental health, many of adolescent's physical activity is not intense enough to achieve health benefits and many of them are not meeting the recommended guidelines (Tremblay *et al*., 2002). Further, these already insufficient amounts of physical activity are in declining pattern in physical education class time and organized sport (Dollman *et al.,* 2005). Therefore, it would be ideal for adolescents to participate in physical activity from within the school setting such as physical education and extra-curricular physical activity program which in many instances, the participation is compulsory (Trost, 2007).

The development of exercise habit during childhood and adolescence could encourage the habit of exercise later in life (Marsh & Peart, 1988). However, sustaining exercise habits for long duration is very hard to accomplish and many people often quit it easily (Nigg *et al*., 2008). In this regards, types of physical activities that provide enjoyment, such as aerobic dance, may be beneficial for long term benefirs (Deci & Ryan, 2011; Piipari *et al*., 2012). Besides, this type of activity, which involves complex whole body coordination has been found to provide positive cognitive benefits (Best, 2010).

Past research has indicated that adding music during exercise has a positive outcome on psychological aspects among participants (Fearon *et al*., 2011). Aerobic dance is one of the enjoyable exercise that is performed with music and rhythmic steps of aerobics with graceful dance movements (Williford *et al.,* 1989). As with other forms of aerobic exercise, aerobic dance performed within a target heart rate of between 60% and 85% of the maximal heart rate (MHR) that used to improve cardiovascular fitness as well as mental health (Myrna-Bekas *et al*., 2012).

Besides physical activity, the diet plays an important role in one's overall body and mental health (Huey, 2005). It has been suggested that percentage of obesity and hyperlipidemia are outcomes of consuming foods rich in fat and sugar that influence human's health (Shepherd, 2009). The quality of food intake influences the quality of life and health. Furthermore, dietary intake has important influences on the physiological and mental function as well as the learning ability of students. It was approved that unhealthy diets could be one of the risks for cardiovascular disease (CVD) and mental disorders that together with absence of physical activity are the central lifestyle risk factors and would be reasons of several human diseases (Mozaffarian *et al*., 2008).

Dairy foods are a naturally nutrient-rich way to promote wellness that contribute only small amount of calories in the food supply, but more of the other essential component such as micronutrients and macronutrients. Milk one type of dairy products, is one of the high quality foods which has good potential in increasing serum levels and decreasing deficiencies of micronutrients, known to impair growth, cognition as well as disease prevention and health promotion (Neumann *et al*., 2002; Miller, 2001).

Understanding the effects of milk and exercise may give insight on the benefits of regular milk consumption and exercise on adolescent's body and mental performance. Since schools have been identified as important institutions for the delivery of physical activity and dietary interventions, therefore, in an environment of academic like school, establishing the evidences may encourage students to exercise and consuming healthy diet.

This research attempts to look at research that addresses the effect of nutrition and physical activity on cognitive and psychophysiological parameters among female secondary school students. The findings may help to develop awareness of students and parents regarding benefits of regular physical activity and healthy diet.

Despite evidence suggesting the benefits of aerobic exercise and milk consumption, contradictory findings could also be observed. These contradictions may be attributed to frequency, intensity, duration and type of aerobic exercise as well as type of dairy food with different component and various amount of milk consumed. Therefore, there is a need to identify the effects of combining aerobic exercise and milk consumption in a different frequency and volume to determine its associated benefits.

Thus the present study was proposed to investigate the effects of combination of aerobic exercise and milk consumption on cognitive, physical and psycho physiological parameters of 24 sessions of aerobic exercise with 250ml daily low fat milk in the preliminary phase and 36 sessions of aerobic exercise with 500ml daily low fat milk in the main phase of the study among female secondary school students.

1.2 Conceptual Framework

Distress and wellness framework

A growing number of studies have shown evidence that physical activity and exercise can be also used in the treatment of mental disorders (Zschucke *et al.*, 2013). The mechanism of how exercise impacting mental disorders is less clear, however, it has been proposed that it results from the behavioral, physical and emotional adaptive response (Charlesworth & Nathan, 1982; Ströhle, 2009).

Indeed, in a framework of stress and wellness, Charlesworth and Nathan (1982) postulated the interrelated process of stressors, stress response (i.e., the methods to handle the stressors) and the outcomes associated with the methods. Charlesworth and Nathan (1982) further speculate that the interaction between three domains of response namely behavioral such as being assertive, physical such as optimal diets and exercise and psychological such as thinking positively will result in favorable physical and psychological outcome, which in turn will lead to general health and wellbeing.

Stress is a common occurrence in every individual daily living that can come from people and event around them as well as from their inner thoughts and struggles. When these demands increase people often feel that they are under excessive stress. For school aged adolescents, the stressors may come from a variety of sources including academic related stressors such as the pressure to perform well in examination as well social stressors such as family and peers. These stressors if they are left unregulated will consequently affect not only their academic domain, but are also likely to affect their general well being.

A useful framework in understanding the relationship between stressors is the Wellness Cycle Model proposed by Charlesworth and Nathan (1982). This model is conceptualized as a cyclic process of stressors, the methods to regulate the stressful experience, and the potential outcomes of the applied methods.

The first stage in the cycle focuses on the sources of stressors. These sources can come from the environment in which an individual lives. Life changes, social relationship, work or academic demand are some of the stressors in which in not properly regulated may affect individual physical, psychological and emotional health. Thinking of stressors in different categories will help people become more aware of the varieties of stress in their life.

Emotional stressors include the fears and anxieties with which people struggle that may lead to poor performance. Interaction with family members or other people could be another source of stress that calls family and social stressors. Social stressors involve our interactions with other people. Many people have exaggerated fears of situations which they know pose no immediate danger. These intense fears are called phobias such as school phobia and social phobias that can be specific fears of activities such as speaking in front of large groups or meeting new people.

Working a lot hours each week without getting adequate rest can be physical stressor. Physical stressors are demands that change the state of our bodies. Physical stressors can be the strain we feel when we physically overextend ourselves, fail to get enough sleep, lack an adequately nutritious diet, or suffer an injury. Menstrual discomforts are examples of physical stressors that are specific to women.

Condition of some chronic or acute disease may or may not be caused by stress that calls disease stressors. Besides, they can be aggravated by stress and may last longer that cause pain over a long period of time. Pains then would be part of stress over a long period of time that may result in a decrease of both physical and social activities. Thus the stress of chronic pain may lead to still more stress through isolation and inactivity.

Charlesworth and Nathan (1982) further propose the demand of these stressors on the three domains of life (behavioral, physical, and emotional/psychological) should be managed using domain specific techniques and skills. Specifically, for behavioral domain, adaptive techniques and skills to manage behavioral related stress response such as time management and being assertive demands may provide beneficial outcomes to areas such as increased self-esteem, self-respect and self-confidence.

The second domain, the physical domain demand adaptive physical response such as exercises and proper diet may provide physical related health benefits. Indeed there is evidence to suggest that exercise and nutrition bring out physical benefits such as achieve and maintain a healthy weight, reduce the risk factors associated with metabolic syndrome, improve energy level in the body, strengthen muscles, bones, and joints. Chief benefits of a healthful diet and physical activity is a reduction in the risk of obesity that is a major risk factor for several of today's most serious health conditions and chronic diseases.

Related to both behavioral and physical adaptive response is the psychological and cognitive response such adaptive cognitive and emotional responses (stress inoculation, cognitive restructuring). These responses are proposed to benefits individuals in terms of improved mental health and resistance to future stressors.

It should be noted that the three domains are interrelated and are not exclusive. In facts evidence exist that behavioral response such as being assertive lead to enhance self esteem, which is manifested in the general physical health. On the other hand, lack of self confidence, poor self esteem is related to decreased physical health via mental-physical related pathway. The aggregated benefits of these three domain to stressors, in turn, will lead to overall wellness.

DISTRESS AND WELLNESS

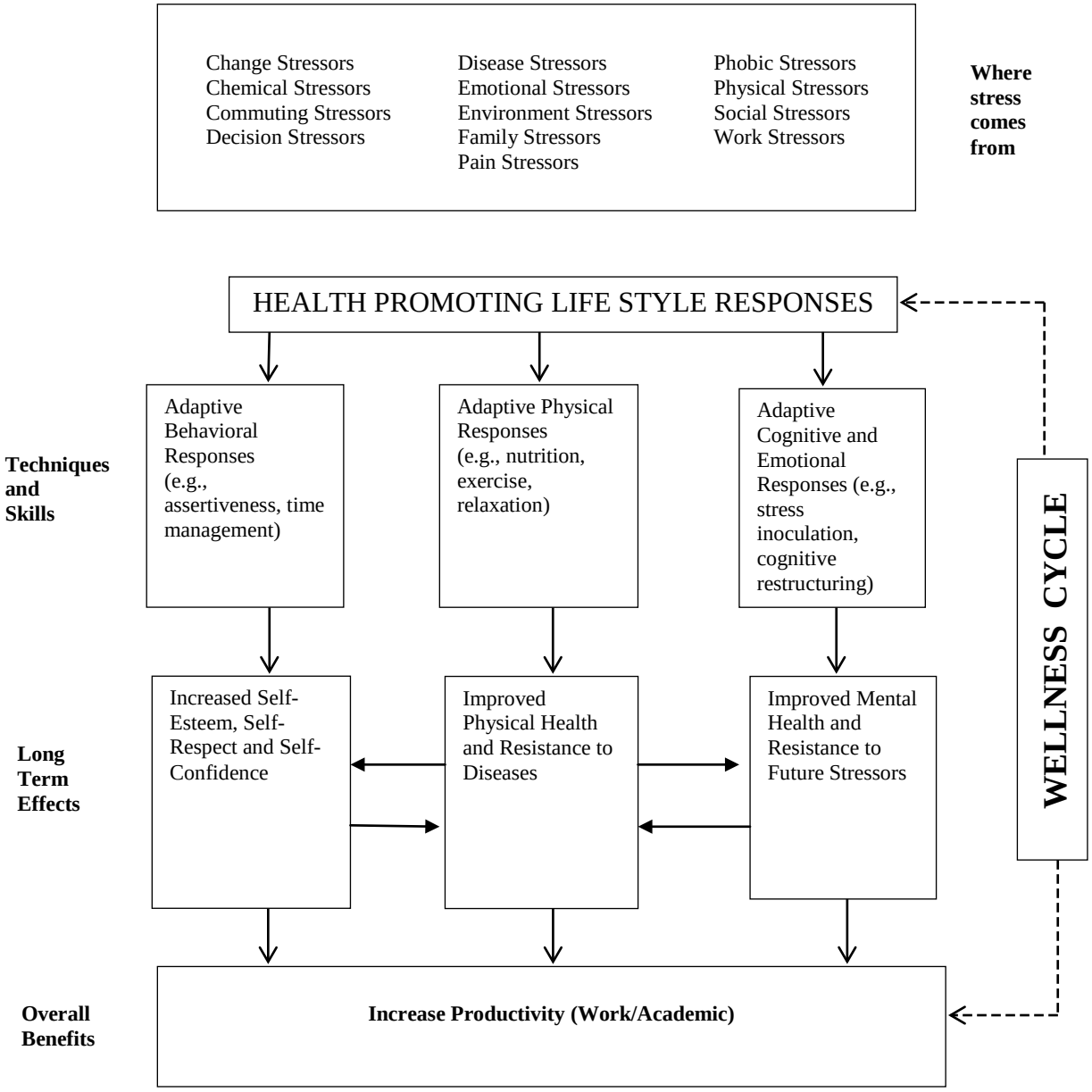

Figure 1.1. *Framework of distress and wellness by Charlesworth and Nathan (1982)*

1.3 Definition of Terms

(a) Physical activity:

Physical activity is bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure.

(b) Aerobic exercise

Aerobic exercise is one type of exercise that has been designed to increase oxygen consumption and improve functioning of the cardiovascular and respiratory systems.

(c) Step Aerobics

Step aerobics is distinguished from other forms of aerobic exercise by its use of an elevated platform (step), which enables a more vigorous workout than can be achieved with regular aerobics.

(d) Dairy Products

Dairy products are food produces from milk. All fluid milk products and many foods made from milk are considered part of this food group.

(e) Macronutrient

Macronutrients are nutrients that provide calories or energy. There are three broad classes of macro-nutrients: proteins, carbohydrates, and fats.

(f) Micronutrient

A substance, such as a vitamin or mineral, that is essential in minute amounts for the proper growth and metabolism of a living organism.

(g) Maximal Oxygen Consumption (VO_{2max})

$VO_{2\ max}$ refers to the maximum amount of oxygen that an individual can utilize during intense or maximal exercise. It is measured as "millilitres of oxygen used in one minute per kilogram of body weight."

(h) Body Mass Index (BMI)

BMI is a number calculated from a person's height and weight. It provides a reliable indicator of body fatness for most people and is used to screen for weight categories that may lead to health problems.

(i) Adolescence

Adolescence is the period in human growth and development that occurs after childhood and before adulthood, from ages 10 to19. It represents one of the critical transitions in the life span and is characterized by a great speed in growth and change.

(j) Anthropometry

Anthropometry is relating to the measurement of human individuals to examine physical characteristics and variation. It is the study of the size, shape and strength of the human body.

(k) Short Term Memory

Short term memory is a system for temporarily storing and managing information required to accomplish complex cognitive tasks such as learning, reasoning, and comprehension. Short-term memory is involved in the selection, initiation, and termination of information-processing functions such as encoding, storing, and retrieving data.

(L) Attention

Attention is the behavioral and cognitive process of selectively concentrating on one aspect of the environment while ignoring other things. Attention plays a very important role in students' success in the classroom. By doing this, students are able to concentrate and focus on the important information being given by teachers

`1.4 Objective of the study

1.4.1 General objective

The general objective of this study is to evaluate the cognitive, psycho-physiological and physical benefits of aerobic exercise and milk consumption among female secondary school students.

1.4.2 Specific Objective

The specific objectives of this study are:

1. To investigate the effects of 24 sessions aerobic dance exercise (2times/week) on selected cognitive performance, psycho-physiological and physical parameters among 16 years old sedentary females of boarding school students in Kota Bharu.

2. To investigate the effects of daily consumption of 250ml low fat milk (1serving/day) for 3 months on selected cognitive performance, psycho-physiological and physical parameters among 16 years old sedentary females of boarding school students in Kota Bharu.

3. To determine the effects of combined “24 sessions aerobic dance exercise ” and daily consumption of 250ml low fat milk for 3 months on selected cognitive performance, psycho-physiological and physical parameters among 16 years old sedentary females of boarding school students in Kota Bharu.

4. To investigate the effects of 36 sessions aerobic dance exercise (3times/week) on selected cognitive performance, psycho-physiological and physical parameters among 17 years old sedentary females of boarding school students in Kota Bharu.

5. To investigate the effects of daily consumption of 500ml low fat milk (2serving/day) for 3 months on selected cognitive performance, psycho-physiological and physical parameters among 17 years old sedentary females of boarding school students in Kota Bharu.

6. To determine the effects of combined 36 sessions aerobic dance exercise and daily consumption of 500ml low fat milk for 3 months on selected cognitive performance, psycho-physiological and physical parameters among 17 years old sedentary females of boarding school students in Kota Bharu.

1.5 Research Hypothesis

To achieve the study objectives the following hypotheses are formulated:

Null Hypothesis (H0):

1. No differences are expected in the cognitive, psychophysiological and physical parameters as a result of combined 24 session's aerobic exercise and consuming 1serving/day low fat milk.
2. No differences are expected in the cognitive, psychophysiological and physical parameters as a result of combined 36 session's aerobic exercise and consuming 2serving/day low fat milk.

Alternative Hypothesis (HA):

1. Significant changes are expected in the cognitive, psychophysiological and physical parameters as a result of combined 24 session's aerobic exercise and consuming 1serving/day low fat milk.
2. Significant changes are expected in the cognitive, psychophysiological and physical parameters as a result of combined 36 session's aerobic exercise, and consuming 2serving/day low fat milk.

1.6 Problem Statement

Brain development and bodily fitness are important for school students which may help them in school and improve their academic performance. Although there were sufficient studies conducted by researches to discover the effect of exercise and nutrition towards student's health, but the results were not always consistent.

The combination of nutrition and exercise focus on the body and mental health, is an interesting study in order to discover the inter-relationship between aerobic exercise, milk consumption and students well-being. To date, there is no study conducted in Malaysia investigating the effects of both the nutrition and exercise in cognitive, psychophysiological and physical parameters among school students.

CHAPTER 2

LITERATURE REVIEW

2.1 Physical Activity and Exercise

Physical activity is any movement of the body that creates contraction of skeletal muscle and raises energy expenditure considerably (American College of Sports Medicine, ACSM, 2008). On the other hand, exercise is considered as a subset of physical activity, conducted in a planned and structured fashion with a goal of maintaining or improving physical fitness. The major components of exercise programmes are aerobic, muscle-strengthening and flexibility, balance exercise, and neuromuscular training (Rahl, 2010).

Physical activity and exercise play a crucial role in achieving and maintaining good health. (Spirduso *et al*. 2008). Regular physical activity and exercise have been documented to improve and/or to maintain different aspects of overall health and wellness such as physical wellness, psychological wellness, physiological wellness and social wellness (Bouchard *et al.,* 2007). It has been widely accepted that exercise contributed to physical health benefits such as reduction in the rate of early mortality in adults from cardiovascular and coronary heart disease and other sicknesses, facilitating weight loss, strengthening muscles and improving overall physical health (Asci *et al.*, 2002). Moreover, physical activity with the aim to improve endurance and strength will allow people to perform activities more effectively for longer periods (Corbin et al., 2007)

Likewise, physical activity is one of the ways to help lessen emotional distress. . Moreover, exercise is also known to improve social health through increased ability to interact well with people and the environment, thus creating satisfying interpersonal relationships (Greenberg, 2004). Furthermore, physical activity affects the brain cognitive functions such as attention and working memory, through the increase of neurotic activity in the brain. Hence, it could be a healthy and possible natural alternative for students learning improvement (Tomporowski *et al.*, 2008).

2.1.1 Prevalence of Physical Activity among Adolescents

Despite these acknowledged benefits, the trend in physical activity is declining in all age groups. This decline is found steeper in the transition age from children to adolescents (Craggs *et al.*, 2011). U.S. Department of Health and Human Services (1996) reported that half of the American adolescents aged 12 to 21 years are not physically active on a regular basis. In addition, the U.S. National Youth Risk Behavior Study reported a dramatic decline in the percentage of attendance of youths in daily physical activity classes from 42% to 27% between 1991 and 1997 (CDC, 1997). Furthermore, in a study done by Wang *et al.*, (1994) among Singaporean Chinese and American Chinese youths, they found that Singaporean Chinese youths have more sedentary life style compared with Chinese living in America.

Studies have also shown that Malaysian children and adolescents have between low to moderate levels of physical activity. For instance, in a study by Dan et al. (2007) reported that majority of adolescents have moderate physical activity levels. In another study among adolescents, Aniza *et al*. (2009) reported that the prevalence of physical

inactivity is low among adolescents. Furthermore, the findings by Hashim *et al.* (2011) indicated that majority of adolescents have only low to moderate level of physical activity and only smaller group of adolescents have high level of physical activity. Lim (2005) found that majority of adolescents are in the sedentary category, whereas, smaller group of them are in very active or moderate classifications.

In other adolescents population, Lasheras *et al.* (2001) reported that among Spanish youths, only 30% of them are in active category and between boys and girls, boys are about 2.6 time more physically active than girls. The findings by Aarnio *et al*. (2002) indicated that the proportion of 16 years old Finns boys who are engaged in physical activity with a frequency of four times per week or more is only 33.5% and only 25% among girls.

Indeed, it has been consistently shown that the level of physical activity is only low to moderate among adolescents and girls have much lower level of physical activity compared to boys. This exposes them to increasing threat of diseases due to their lesser participation in physical activity compared with the boys. Moreover, several studies have found evidence that the rate of drop out in physical activity among girls is higher compared with the boys (Vescio *et al*., 2005; Wang & Liu, 2007).

2.1.2 Aerobic Exercise

Aerobic exercises such as aerobic dance is one of exercise regime performed with music and rhythm. It has been recognized as common types of exercise for people worldwide (Williford *et al*., 1989). In Malaysia, aerobic dance training is one of the

most popular workout training that is performed by people of all age groups. However, it is more popular among women compared to men (Mastura *et al*., 2012).

Aerobic dance exercise or any other types of aerobic training, carried out within 60% and 85% of the maximal heart rate can have beneficial effects on cardiovascular and metabolic health. It can improve aerobic endurance capacity, increase maximal oxygen consumption and energy expenditure (Mastura *et al*., 2012), improve the strength of lower limb and blood lipids (Shigematsu *et al*., 2002), and enhance emotional development (Van de Winckel *et al*., 2004).

Aerobic dance is a workout that demands the organization of a group exercise, accompanied by music and rhythmic movement. It plays an important role in enhancing motor memory if properly executed (Myrna-Bekas, 2012). The intensity of aerobic dance is based on music tempo and movement of upper and lower limbs that can develop cardiovascular fitness. Aerobic dance exercise consists of rhythmic steps such as skips, jumps, turns and movements in all directions. These movements are performed in rhythmic styles and choreography carried out according to the readiness and the ability of the person who are exercising. The intensity of the aerobic exercise allows activation of different body parts such as upper and lower limbs, depending on the experience of the coach. If several body parts are activated at the same time, the intensity of aerobic exercise will be greater (Kostić *et al.*, 2006). Furthermore, the average beat per minute during aerobic dance is about 130 to 140 bpm, depending on the type of music used (Myrna-Bekas, 2012).

There are many variations and levels of aerobic dance. The steps of the dance, the form, and the level which it is performed depend on the readiness of the group. The use of additional equipment or weights during workout, tempo of music, step level and the type of rhythmic movements are essential determinants of the training intensity. In addition, in step dance aerobics, lower limbs and lower back muscles are exercised more than other parts of the body (Myrna-Bekas, 2012).

Combination of aerobic dance exercise and step aerobics exercise are appropriate for all beginners to advanced exercisers and even it has been recommended for top level athletes in order to achieve maximum aerobic effects. The choreography designs prepared by coach repeat for several times with various tempo of music and use different movements in an appropriate arrangement (American College of Sport Medicine, ACSM).

2.1.3 Importance of Physical Activity among School-Aged Adolescents

People achieve about 50% of their adult weight, more than 20% of adult height, and 50% of their adult skeletal mass during adolescence (WHO, 2000). However, the rate of growth and maturation during adolescence are different in males and females. Females start their puberty and increase fat mass earlier. On the other hand, males experience acceleration of peak height, increase of fat-free mass and increase in shoulder width earlier (Vizmanos & Marti-Henneberg, 2000). This affects body shape and further changes in the self-concept especially among females (Rathus, 2013).

Physical activity is an essential activity during the stage of adolescence. It contributes to the development of a normal skeletal growth and weight bearing

necessary for adolescents to attain and maintain their suitable bone mass (Lasheras *et al*., 2001), and body weight by increasing energy expenditure (Woods *et al.,* 2010). Likewise Tomporowski *et al*. (2008) and U.S Department of Health and Human Services, (2008), indicated that children and adolescents who have regular physical activity, experience greater improvement in their body and mental health. In addition, they have reduced probability of diseases in the future compared with inactive individuals.

For example, participation in regular physical activity has also been found to decrease the rule-breaking behaviours and improving behaviour in the classroom. Furthermore, engagement in regular physical activity and various sports can play an essential role in improving the social life and social skills among students (Hallal *et al*., 2006; Woods *et al*., 2010).

Studies have also indicated that starting of physical activity earlier and having fitness during adolescence are important determinants of adult fitness at the population level. Furthermore, children and adolescents with low fitness are more likely to have unfavourable obesity. Therefore, physical activity programmes can help them to improve and maintain their fitness (Dwyer *et al.,* 2009).

Moreover, regular physical activity in adolescence may increase cardiovascular health further during adulthood in three ways. First, there is a direct relationship between adolescent physical activity and adult cardiovascular health. Second, the effect of early physical activity on adult cardiovascular health may be simplified by following of physical activity from adolescents to adulthood. Third, early physical activity increase

adolescence cardiovascular health that may improve adult cardiovascular health (Twisk *et al*. 2002).

2.1.4 Promotion of Exercise from Within School Setting

There are so many aspects in the environment that influence physical activity in adolescence. These include environments such as home, school, neighbourhood, city, and also country (Ferreira *et al*., 2007). Among these environments, school is the only place where the adolescents spend at least one third of their day (Hylok, 2011; Taylor *et al*., 2000; Fox *et al*., 2004). Therefore, it can be an important environment for the delivery of physical activity (Kim, 2007). Indeed, it has been consistently suggested that health promoting "active" school models can address childhood health concerns (Naylor *et al*., 2006; Verstraete *et al*., 2007).

Indeed, evidence shows that school-based exercise programmes may be effective for increasing self-reported physical activity behaviours (Stone *et al.,* 1998). Physical activity among high school students has also been shown to bring about significant health improvement in adolescents, especially females (Fardy *et al*., 1996). Furthermore, students who are engaged in extracurricular sports generally interact more with their peers. They have greater educational motivation, and have greater level of satisfaction with their educational experience (Eccles & Barber, 1999). Therefore, schools should encourage students to do exercise training and should provide opportunities to learn and perform physical activity skills, especially those that can create feeling of enjoyment in students. Moreover, schools should educate and demonstrate to them the benefits of physical activity towards the improvement and preservation of life span through exercise

(Fletcher, 1996). In this way, physical activity can be improved in the schools through school based programmes, during recess, physical education lessons, classroom-based physical activity, physical activity clubs, and interscholastic sports (Koplan *et al.,* 2005).

It is believed that by increasing the allocated time for physical education class and by adding related skills to enhance the quality of physical education classes would provide the benefits of student participating in physical education classes. In addition, by enhancing physical education sessions in schools or increasing the duration, and by recruiting physical education specialist in the school-based programmes the quality of physical education in schools can be improved. More importantly, to encourage school students to exercise and participate in physical activities within the school time, it would be more desirable for the schools to provide structured or unstructured exercise for their students (U.S. Department of Health and Human Services, 2010).

2.2 Metabolic Health Indicators

The increase of inactive behaviour among adolescents and its relationship with being overweight and obese is alarming (Tremblay, 2002). This behaviour has several risk factors for coronary heart disease such as obesity (Reilly *et al*., 2003), dyslipidaemia (Nicklas *et al*., 2002), and blood pressure (Lane, 2004).

The common indicator of obesity is body mass index (BMI). This is associated with an unfavourable lipid profile, namely high amount of total cholesterol, LDL cholesterol and triglycerides, and lower amount of high density lipoprotein (HDL) cholesterol in young men and women (Brenner *et al*., 2010). These are often assessed in

clinical situations when assessing body fat and weight (WHO, 2000). BMI classification for children and adolescents is presented in table 2.1.

Table 2.1
The CDC Classification of Children and Adolescents for BMI

Body Mass Index (kg/m^2)	Classification
< 18.5	Underweight
18.5-24.9	Healthy weight
25.0-29.9	Over weight
>30	Obese

Note. Adapted from McGuire, M., and K. A. Beerman. 2009. Back inside Cover in Nutritional Science, 2nd ed. Belmont. CA: Brooks/Cloe-Cengage Learning

Waist circumference (WC), a simple measure of abdominal fat, has been observed to be a stronger predictor of obesity-related risk factors compared with the BMI (Brenner *et al*., 2010). Studies have shown the relative strengths of WC and BMI as predictors of cardio-metabolic risk in young adults from different ethno-cultural backgrounds. Waist circumference (WC) is an indication of central body fat reserve that has been attributed to an increased risk of metabolic complications (Wang *et al*., 2005). Researchers have suggested that waist circumference of more than 102 cm for males and 88 cm for females is an independent risk factor for disease. However, this measurement would not be suitable for those with height less than 150 cm or with a BMI of 35 or more (Centers for Disease Control and Prevention, 2002).

Combined information of waist circumference and BMI provide a stronger indicator to estimate metabolic risk factors, rather than using the BMI alone (Ardern *et al*., 2003; Janssen *et al*., 2002). Indeed, it has been recommended that BMI, adjusted for age and gender, is a practical estimation for overweight in adolescence and children, and if it is used together with waist circumference, provide additional evidence to identify