RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND NUTRITIONAL STATUS OF PRE-SCHOOL CHILDREN

by

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LIST OF ABBREVIATIONS

PA	: Physical activity
KCAL	: Kilocalories
BMI	: Body Mass Index
IJT	: Indeks Jisim Tubuh
SD	:Standard Deviation

TERMINOLOGY

PHYSICAL ACTIVITY:

Physical activity is defined as any bodily movement produced by skeletal muscles that result in energy expenditure (Caspersen *et al.*, 1985)

NUTRITIONAL STATUS:

Intake of a diet sufficient to meet or exceed the needs of the individual will keep the composition and function of the otherwise healthy individuals within the normal range (Gandy, 2014).

OVERWEIGHT AND OBESITY:

Excessive fat accumulation that presents a risk to health (WHO, 2010)

SEDENTARY ACTIVITY:

A little physical movement in activity (CSEP, 2014).

LIGHT ACTIVITY:

Physical activities that involve large muscle groups. While engaging in light activities, people begin to notice their breathing, but they can still talk fairly easily (CSEP, 2014).

MODERATE ACTIVITY:

Physical activities that cause breathing and heart rate to increase. People engaging in moderate activities can hear themselves breathe, but they can still talk (CSEP, 2014).

VIGOROUS AND VERY VIGOROUS ACTIVITY:

Physical activities that cause breathing and heart rate to increase to a higher level, making it difficult to talk (CSEP, 2014)

ABSTRAK

Penyelidikan adalah terhad dijalankan untuk menentukan tahap aktiviti dan pemakanan fizikal peringkat kanak-kanak prasekolah. Walau bagaimanapun, kajian ini adalah yang pertama dijalankan untuk menentukan tahap aktiviti dan pemakanan fizikal di kalangan kanak-kanak prasekolah di Malaysia yang berumur di antara 4 hingga 6 tahun. Ini adalah penting untuk menentukan faktor-faktor yang menentukan status kesihatan dan kadar obesiti dalam kalangan kanak-kanak pada masa depan dan juga memastikan generasi yang akan datang akan menjadi lebih produktif bagi negara kita, Malaysia. Tujuan kajian ini dijalankan ialah untuk mengkaji penentuan hubungan antara tahap aktiviti fizikal dan status pemakanan dalam kalangan kanak-kanak prasekolah antara umur 4 hingga 6 tahun di Malaysia. Subjek kajian meliputi seramai 33 orang kanak-kanak dari usia 4 hingga 6 tahun termasuk kanak-kanak lelaki dan perempuan di Pusat Penyelidikan Perkembangan Kanak-kanak Negara (NCDRC), Universiti Pendidikan Sultan Idris (UPSI) di Perak. Pengukuran antropometri iaitu tinggi dan berat badan, soal selidik aktiviti fizikal, alat pengukuran tahap aktiviti fizikal dengan Accelerometer, 24 jam panggilan semula tentang pemakanan dan rekod makanan diperolehi semasa sesi lawatan kajian dijalankan. Indeks Jisim Tubuh kanak-kanak kemudiannya dihitung melalui tinggi dan berat badan yang diperoleh. Keputusan menunjukkan bahawa tahap aktiviti fizikal yang terlibat paling kerap adalah aktiviti yang tidak aktif dan aktiviti yang sangat aktif adalah yang paling kurang. Ia juga menunjukkan bahawa adanya perbezaan antara lelaki dan perempuan dalam keaktifan, kanak-kanak lelaki adalah lebih aktif daripada kanak-kanak perempuan. Di samping itu, keputusan juga menunjukkan bahawa kanak-kanak pada usia 4 tahun adalah lebih aktif daripada kanak-kanak 5 hingga 6 tahun. Hasil kajian menunjukkan bahawa jumlah langkah kanak-kanak tidak mempunyai korelasi dengan

jumlah pengambilan kalori (r = 0.19, p = <0.29). Dari keputusan yang diperolehi, adalah disimpulkan bahawa kurangnya aktiviti fizikal boleh menyebabkan berat badan yang berlebihan dan jika berterusan boleh membawa kepada obesiti dalam kalangan kanak-kanak prasekolah. Ia juga boleh memberi kesan yang tidak baik kepada kesihatan di kalangan kanak-kanak prasekolah, terutama yang berumur antara 4 hingga 6 tahun. Walau bagaimanapun, kajian selanjutnya adalah diperlukan untuk mendapatkan angka jelas tentang tahap aktiviti fizikal dan status pemakanan dalam kalangan kanak-kanak prasekolah yang berumur antara 4 hingga 6 tahun. Kanak-kanak juga perlu diberi peluang untuk pendedahan mengenai aktiviti-aktiviti fizikal untuk lebih mudah produktif, cekap dan selamat.

ABSTRACT

Limited research has been conducted to determine the level of physical activity and nutrition levels of pre-school children. However, this study is the first to be carried out in order to determine the level of physical activity and nutrition levels among Malaysian pre-school children between the age of 4 to 6 years old. It is important to determine the factors which can determine the health status and the obesity rate among children in future and also make sure the next generation to be more productive in our country Malaysia. The aim of this study was to investigate the relationship between levels of physical activity and nutrition status among pre-school children from aged between 4 to 6 years old in Malaysia. The subjects recruited were 33 children from age 4 to 6 years, including boys and girls in the National Child Development Research Center (NCDRC), Universiti Pendidikan Sultan Idris (UPSI) in Perak, Anthropometric measurements of height and weight, measurement of physical activity level by Accelerometer, 24-hours recall and food records was obtained during the visit . Their subjects BMI were then calculated from their height and weight. Results indicated that the level of physical activity involved most was of sedentary activity and very vigorous activity was the least. It was also show that was differences between the boys and girls, the boys were more active than the girls. In addition, the results also showed that children at age 4 years old were more than children active between 5 to 6 years old. Results showed that the total steps of children have no correlation with total Calories intake ($r = 0.19$, $p = < 0.29$). From the result obtained, it can be concluded that deceased levels of physical activity lead to excess weight and if it sustained can lead to be obesity among pre-school children. It could also affect negatively health among pre-school children, especially those in aged between 4 to 6 years old.

However, further investigation needs to be carried out to obtain clear figure of physical activity level and the nutritional status among pre-school children aged between 4 to 6 years old. Children should also be given the opportunity to expose to physical activities of more convenient, productive, efficient and safe.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Physical activity (PA) is health protective and essential for the physical growth and development of children; however, because of increasingly "toxic" and obesogenic environments (Swinburn & Egger, 2004), many young people are not sufficiently active. Physical activity is defined as bodily movement that enhances health and increases energy expenditure above basal levels (Westerterp & Klaas, 2013). Physical activity is also associated with improved physical and mental health among children (Janssen & Leblanc, 2010).

According to international recommendations children and adolescents (aged 5–17 years) should accumulate an average of at least 60 minutes of moderate to vigorous physical activity (MVPA) per day (WHO, 2010; Janssen & Leblanc, 2010). However, the majority of children do not meet the recommended 60 min of daily moderate to vigorous physical activity (Colley *et al.,* 2011; Hallal *et al.,* 2012). For many children, sedentary behaviours including television and screen-based games have replaced more active PA behaviours. The decreased level of habitual PA, in combination with poor eating behaviours, has a major impact on positive energy balance and undesirable weight gain in children and adolescents.

The first years of life represent an intense period of motor learning that provides the foundation for later, more complex and skilled performance. In a later age (5–8 years of age), an active lifestyle is associated with improved motor skills and development (Graf *et al.,* 2004). The development of the fundamental movement patterns of crawling, standing, walking, running and jumping in younger children is fostered by the opportunity to play. Young children need to explore their environment through movement and experiment with the movement capabilities of their bodies. At the start of the second year of life, children become involved in 'exercise play', defined as gross motor movements in the context of a play. The characteristic feature of this play is physical vigor. This type of play may or may not occur in a social context and increases from toddler age onwards and peaks during the pre-school period (4–5 years of age) and then declines during the primary school years. At ≈4 years of age, 20% of children's activity is characterized as physically vigorous.

Play and creativity contribute to health and well-being:

All children and young people need the chance to play if they are to develop to their full potential – this includes their physical competence and their emotional, social, moral and intellectual growth. (National Playing Fields Association, 2000).

Physical activity may be assessed using various methods, including indirect calorimetry, behavioural observation, physiological markers, motion sensors, and the self-report technique (Plasqui & Westerterp, 2007). Accelerometers, often used to measure physical activity, are instruments that quantify the acceleration of the body and have been used in several studies to validate self-report instruments that measure physical activity (Craig *et al.,* 2003; Cust *et al.,* 2008). Accelerometers can provide objective estimates of the amount of time children usually spend sedentary and in light PA (LPA) and moderate-to-vigorous PA (MVPA) (Hills *et al.,* 2014).

Nutritional status is an intake of a diet sufficient to meet or exceed the needs of the individual will keep the composition and function of the otherwise healthy individuals within the normal range (Gandy, 2014). Appropriate nutrition in early childhood is important for normal growth and may influence long-term health and chronic disease status (Field, 2009). There is concern that while the energy intakes of young children are increasing, this may not be matched by the nutrient density of their diets (Picciano *et al.,* 2000). This has been interpreted by some to indicate a modern phenomenon of malnutrition in the developed world -an increasing prevalence of childhood obesity co-existing with key micronutrient deficiencies (Zhou *et al.,* 2012).

Child malnutrition may be defined as a pathological state resulting from inadequate nutrition, including undernutrition (protein-energy malnutrition) due to insufficient intake of energy and other nutrients (WHO, 2010). Overnutrition such as overweight and obesity due to excessive consumption of energy and other nutrients. Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. Overweight and obesity are major risk factors for a number of chronic diseases, including diabetes, cardiovascular diseases, and cancer. Once considered a problem only in high-income countries, overweight and obesity are now dramatically on the rise in low and middle-income countries, particularly in urban settings (WHO, 2010). Previous study stated that rural children had higher prevalent of undernutrition compared to the urban children but the prevalent of obesity were same in both area (Aziz *et al.,* 2012).

The assessment of food intake is conducted with methods that enable the calculation of the nutritional composition of the diet by means of interviews. Among such methods, the 24-hour recall stands out for being fast, bringing about a recent memory related to consumption, besides being the method that is less prone to change eating behaviour. When employed as a series, it efficiently estimates usual intake. However, the method has disadvantages such as the dependence on memory and the cooperation of the participant, besides the fact that one 24 hour recall test does not show the usual intake of the individual due to the varied daily food intake. The reliability and validity of the 24-

hour dietary recall method were tested statistically by comparing observed with recalled intakes of kilocalories and protein (Carter *et al.*, 1981).

1.2 Objective of the study

General objective

I. To determine the relationship between physical activity level and nutritional status among pre-school children.

Specific objectives

I. To determine physical activity level of pre-school children
II. To determine the nutritional status among pre-school children.

1.3 Importance of the study

The importance of the study was to provide the evidence of physical activity and nutritional status among 4 to 6 years old among pre-school children from nursery PERMATA UPSI, Tanjung Malim, Perak, and thus to provide data of physical activity profile. We hope that this study can help parents, teachers, and society to develop a healthier future generation.

CHAPTER 2

LITERATURE REVIEW

2.1 The Importance of Physical Activity Among children

Physical activity is a behavior involving the movement of the body through space. It has several dimensions. Physical activity was viewed most often in terms of energy expenditure and the stresses and strains associated with weight-bearing and ground-reaction forces. It also has a major performance component viewed primarily in specific movement skills and measures of physical fitness (Malina & Katzmarzyk, 2006).

Physical activity is important especially for children because it is a special time set to do something with interesting and enjoyable will be emphasizing the positive feedback to the children. According to international recommendations children and adolescents (aged 5–17 years) should accumulate an average of at least 60 minutes of moderate to vigorous physical activity (MVPA) per day (WHO, 2010; Janssen & Leblanc, 2010). Studies were only included in the review when they explicitly reported the proportion of children who met the PA guidelines. In other words, the main outcome of the included studies was the proportion of children who engaged in MVPA for at least 60 min/day (Guinhouya *et al.,* 2013).

The importance of physical activity (PA) for children's development and as a long-term health resource, early promoting an active lifestyle is of primary concern in the global health policy (WHO, 2010). Regular exercise and a sufficient dose of daily PA were associated with several health benefits and help to prevent lifestyle-related risk factors such as obesity and cardiovascular disease (Janssen & Leblanc, 2010; WHO, 2010).

Physical activity is vital for a child's development and lays the foundation for a healthy and active life. Physical activity is important for child health and development of motor skill aspects (Nixon *et al.,* 1996: Tomassoni *et al.,* 1996: Andersen *et al.,* 1996). The health benefits of physical activity extend well beyond physical health, having a positive impact on the domains of motor skills, psychological well-being, cognitive development, social competence and emotional maturity (Cardon *et al.,* 2011: Cliff *et al.,*2011: Jones *et al.,*2011: Hinkley *et al.,* 2011 :Okely *et al.,* 2011: Reilly *et al.,* 2011: Trost *et al.,* 2011). A development of motor skill acquisition pre-school-age children general movement activities develop specific movement patterns and skills; these, in turn, provide the basis for the acquisition of future complex skills where greater emphasis can be placed on the health, fitness, and behavioral components of physical activities. Special attention will be directed to the nature of the physical activity that promotes healthy weight gain during childhood.

2.2 Play is The Nature of Children

Different people have different definitions of play. From an early age, play is important to a child's development and learning. It can involve cognitive, imaginative, creative, emotional and social aspects. It is the main way most children express their impulse to explore experiment and understand. Children of all ages play. Some may need support to get the best out of play (National Children's Bureau, 2005).

In Laws, Plato were discussed the physical nature of young children and stated

"The young of all creatures cannot keep their bodies still or their tongues quiet: they are always wanting to move and cry out; some are leaping and skipping and overflowing with playfulness and pleasure, and others uttering all sorts of cries" (Plato, 360 BC).

"Play is what I do when everyone else has stopped telling me what to do"

(Cole-Hamilton *et al.*, 2002)

The child's right to play is recognized in Article 31 of the United Nations Convention on the Rights of the Child, which was ratified by the UK Government in 1991:

> *"States recognise the right of the child to rest and leisure, to engage in play and recreational activities appropriate to the age of the child and to participate freely in cultural life and the arts"* (OUNHCHR, 1990).

Another important definition is that of free play. Free play is defined by Play England as:

> *"...children choosing what they want to do, how they want to do it and when to stop and try something else. Free play has no external goals set by adults and has no adult imposed a curriculum. Although adults usually provide the space and resources for free play and might be involved, the child takes the lead and the adults respond to cues from the child"* (Santer *et al.*, 2007).

Free play is relevant to the early years; with most literature on this topic applying to children aged 3-5 years old. Little was found on free play for children aged 5-7 years. This review focuses on active play. For the purpose of this review, this is any play that includes some element of physically active movement. This is a deliberately broad definition with no threshold for energy expenditure, meaning that active play might range from games with small, infrequent movements (such as playing marbles or clapping games) through to activities expending large amounts of energy such as running games or climbing trees. In using such a broad definition in this report we have however tried to focus on the type of active play that might be at a level thought likely to confer health benefits (Cavill *et al.*, 2001).

In addition, active play is physical activity. Engaging in active play with children is a good role-modelling, and a great way to relieve stress. Children learn behaviors from adults. Encouraging children to be physically active each day can help them develop a positive attitude toward movement, dance, sports, and other physical activity. Playing actively with children in your care could help them to develop healthy habits. It is important to encourage active play by moving more and sitting less, children learn to live in a healthful way. When children participate in active play, they develop their large muscles (U.S. Department of Agriculture, 2013). Large muscle development is important for movements such as walking, balancing, sitting up straight, kicking, jumping, lifting, reaching, and throwing a ball. Large muscle development also supports the development of small muscles, which helps with skills such as holding small objects and turning pages in a book (U.S. Department of Agriculture, 2013).

2.3 The Activity Pattern of Pre-school Children

The recommendation for physical activity in the Malaysian Dietary Guidelines suggests that per day pre-schoolers should achieve at least 2 hours of physical activity (60 minutes of structured and 60 minutes of unstructured physical activity) and should have less than 2 hours of screen time. (National Coordinating Committee on Food and Nutrition (NCCFN), 2010 & National Coordinating Committee on Food and Nutrition (NCCFN), 2013). Lee *et al.*, (2016) reported that time spent on active play, quiet play, and screen time was reported by parents. Boys spent significantly more time on active play and screen time than girls. Time spent on the quiet play was highest in East Coast Peninsular Malaysia and lowest in Sarawak. Some 40% of children achieved active play recommendation while 27% exceeded daily screen time recommendation. Most parents reported that their child played actively in the house area; and that the main barrier and motivator to active play were safety and child's enjoyment, respectively. The activity pattern of children has participated are active play (such as running, jumping, or climbing), quiet play (such as playing video games, or playing with toys, dolls, or puzzles) and in front of screens (such as watching television or video, or playing with computer, smartphones, or other electronic gadgets). Places at which children usually play actively (for example, playgrounds or parks) and the barriers and motivators that might influence physical activity were examined (Lee *et al.*,2016) .

Previous studies have reported that the physical activity of pre-schoolers differed by sex (Yamamoto *et al.*, 2011). The time spent on the active play was higher for boys than for girls, a result that is consistent with the findings of other studies (Hinkley *et al.*, 2008: Tucker, 2008). It has been suggested that boys tended to be more active due to biological, psychological, and social influences (Golombok *et al.*, 2008). A study among Australian pre-schoolers by Hinkley *et al.*, (2012) reported that girls were more interested in quiet play activities, such as drawing and crafts, which were associated with the lower overall physical activity. Interestingly, the previous study also found that boys spent a similar amount of time on the quiet play as girls. Although boys spent more time on active play, it is possible that they are discouraged from playing actively or vigorously and encouraged to participate in quiet play activities while indoors, as reported by Puglisi et al (Karnik *et al.*, 2012).

The availability and accessibility of playgrounds, recreational parks, and environment settings were suggested as possible correlates of the physical activity of pre-schoolers (Roemmich *et al.*, 2006). Sallis *et al.*, (1995) were reported stability of physical activity undertaken both at home and during breaks in kindergartens and elementary schools in children aged 3–6 years, but upon entering elementary school children's physical activity decreased almost in half during breaks. Another study has reported a positive association between higher levels of PA in pre-school children and lower weight gain and lower body fat later in the period of early adolescence (Moore *et al.*, 2003) indicating the importance of PA promotion in early childhood.

2.4 Feasibility and Validity of Accelerometer Measurements to Assess Physical Activity in Toddlers

Accelerometers are activity monitors that measure motion in multiple dimensions and provide valid objective estimates of intensity, duration, and frequency of physical activity (PA) (Hnatiuk *et al.*, 2012; Oliver *et al.*, 2007). Accelerometers can provide objective estimates of the amount of time children usually spend sedentary and in light PA (LPA) and moderate-to-vigorous PA (MVPA) (Hills *et al.*, 2014).

Accelerometer or accelerometry or motion sensor or activity monitor or ActiGraph or Actual or Actiwatch or RT3 or Tritac or R3D or Mini-matter) and (validity or validities or validity of results or validity and reliability or validation or valid or calibration or cut-points or cut-off or threshold) and (physical activity or physical activities or locomotor activity or motor activities or sedentary or moderate or vigorous or energy expenditure or free-living activities) and (adolescent or teen or teenager or youth or adolescence or child or children or early childhood or young child or students or young or pre-school (Romanzini *et al.*, 2011).

Accelerometers ActiGraph (wGT3X-BT) monitor used for the assessment of physical activity are typically light, small and robust making them particularly suitable for use in pre-school children. Furthermore, this model is Activity, lux, programmable sample rate, water resistant housing, high speed USB, heart rate, wireless interface (ANT+™). ActiGraph are used for measuring children's moderate-to-vigorous activity

(MVPA) (Sirard *et al.*, 2005) and allow measuring movement on three different axis with digital filtering technology and includes both an acceleration sensor and an ambient light sensor.

The majority of the accelerometer-based on PA studies in young children have focused on pre-school children (Hnatiuk *et al.*, 2014). These previous studies have reported considerable variability in total time spent in PA at all intensities and the proportion of children meeting PA guidelines (ranging from 5% to 99.5%) (Beets *et al.*, 2011; Colley *et al.*, 2013; Hinkley et al 2012; Hnatiuk *et al.*, 2014). Accelerometer measurements are valid, reliable, and feasible for quantifying PA at all intensities in pre-school-aged children (i.e., ages 36–59 months) (Adolph *et al.*, 2012; Cliff *et al.*, 2009; Pate *et al.*, 2006; Pfeiffer *et al.*, 2006).

These large discrepancies, partially explained by differences in devices used to measure PA, cut-points assigned to LPA and MVPA, and guidelines employed, make it difficult to accurately describe PA levels of pre-school children (Hnatiuk *et al.*, 2014). Previous study stated about prediction of energy estimate (EE) and physical activity intensity. After reintegration to 60- or 30-s epochs (depending on the equation), mean ActiGraph counts were converted into units of EE using the Freedson/ Trost (FT), Puyau (PU), Treuth (TR), and Mattocks (MT) prediction equations. There was no prediction equation associated with the Evenson (EV) cut points. Because the equations were developed to identify cut points for MVPA and had y-intercepts significantly higher than typical REE values, all predictions were made using a count ''flex point'' of 100 counts per minute—a widely adopted count threshold for sedentary activity (Matthews *et al.*, 2008). Thus, for these calculations, predicted EE values were constrained to resting levels (i.e., 1 MET or AEE = 0) when count values for a given activity trial were <100 counts per minute. In prediction of physical activity intensity, activity trials were classified as sedentary, light, moderate, or vigorous-intensity physical activity using the count cut points derived from each prediction equation. To evaluate the classification accuracy of these cut points, activity trials were also classified as sedentary, light, moderate, or vigorous-intensity physical activity on the basis of measured EE. For METs, the following classification scheme was adopted. Sedentary activity (SED) was defined as < 1.5 METs. Light activity (LPA) was defined as ≥1.5 and < 4 METs. Moderate activity (MPA) was defined as ≥4 and <6 METs. Vigorous activity (VPA) was defined as ≥ 6 METs. There has been debate within the field regarding the selection of MET intensity thresholds for children and adolescents (Harrell *et al.*, 2005 :Ridley & Olds., 2008). The MET thresholds used in the previous study were selected because they closely approximated the intensity thresholds used in most of the original calibration studies (Evenson *et al.*, 2008: Mattocks *et al.*, 2007:Treuth et al., 2004). Although some calibration in previous studies (Puyau *et al.*, 2002: Freedson *et al.*,2005) used the adult value of 3 METs or its equivalent to define MPA, there is consistent evidence that brisk walking, a key behavioural indicator of moderate-intensity physical activity, is associated with an energy cost of approximately 4 METs in children and adolescents (Mattocks *et al.*, 2007 : Pate *et al.*, 2006 : Ridley *et al.*, 2008 :Troiano *et al.*, 2008).

Previous studies assessed the validity of accelerometers in children less than 36 months of age, 2 demonstrated that accelerometers can accurately distinguish sedentary time from LPA in this age group (Costa *et al.*, 2015; Van Cauwenberghe *et al.*, 2011), and another demonstrated valid estimates of MVPA when compared with direct observation of PA (Trost *et al.*, 2012).

The previous study by Johansson *et al.*, (2015) stated that two-year-old children have an intermittent activity pattern and almost similar on weekdays and they spend about half of the daytime active. In addition, based on Costa *et al.*, (2015) were reported the feasibility valuable information for planning future studies and enhance recruitment and compliance with accelerometer protocols in toddlers.

2.5 Nutritional Status in Pre-School Children

Nutritional Status is an intake of a diet sufficient to meet or exceed the needs of the individual will keep the composition and function of the otherwise healthy individuals within the normal range (Gandy, 2014).

Nutrition is an important influencing factor with regard to the continuous growth and development that occur throughout the childhood period. Although anthropometry is widely accepted as the most useful tool for assessing the nutritional status of children, dietary assessment is also commonly used in epidemiological studies to monitor the nutritional status of children.

Nutritional status in pre-school children is commonly in malnutrition and over nutrition deficiencies intakes. Childhood malnutrition is influenced by multidimensional factors. These factors vary from biological, behavioral and environmental (Engle et., 1999). A number of studies demonstrated that childhood malnutrition is strongly rooted in poverty (Pongou *et al.*, 2006). Malaysia is an upper middle-income country with good improvement in economy and reduction of poverty. However, problems of childhood malnutrition still persist especially in the rural communities (Chee *et al.*, 2002: Norhayati *et al.*, 1997). Previous study was stated that lower socio-economic status, household food insecurity and poor child caring practices were associated with childhood malnutrition (Wong *et al.*, 2014). South African study children also demonstrated unhealthy eating habits with school tuck-shop choices favoring cool drinks, chips, cheese curls and fried cakes (70%), and urban primary school learners report eating fruit or vegetables less than 3 times per week (Temple *et al.*, 2006).

Nutritional deficiencies were slowly being reduced or eradicated in many of these countries but nowadays a disease like coronary heart disease, cancer, and diabetes has now become major health problems, particularly in urban areas. As countries, in the region, continue to develop rapidly the nutritional situations are expected to change rapidly as well (Tee *et al.*, 2002).

Besides that, the obesity epidemic is a global trend and is of particular concern in children. Obesity is the condition of excess body fat (Krebs *et al.*, 2007). Recent reports have highlighted the severity of obesity in children by suggesting: "today's generation of children will be the first for over a century for whom life expectancy falls (Hills *et al.*, 2007). Decreased physical activity and increased consumption of snacks, such as sweets, sugar-sweetened drinks, and fast foods, may have contributed to this trend and physical activity also influence on the nutritional status of pre-school children (Hills *et al.*, 2007). The rising prevalence of obesity among children and adolescents is of particular concern to many health authorities. However, there was currently a lack of adequate baseline data on the extent of the problem in the region. There has been limited data about national nutrition survey in Malaysia. Nutritional studies of communities have thus far been conducted on specific population groups, most often in rural areas (Tee *et al.*, 2002).

Next, the causes of obesity are complex and multifactorial, involving an interaction of our modern, obesogenic environment and individual lifestyle choices. Because excess weight gain occurs in a state of positive energy balance, increases in the amount of calorie-dense foods eaten, and increases in screen time (television, computer and video games) with a simultaneous decrease in the amount of physical activity undertaken by children have been cited as reasons for the current epidemic (Mulvihill & Quigley, 2003: Prentice & Jebb, 1995). Overweight is defined as having excess body weight for a particular height from fat, muscle, bone, water, or a combination of these factors. As this imbalance continues over time, the risk of overweight and obesity increases (Institute of Medicine, 2004).

The aim of the previous study was to examine the state of the level of nourishment of pre-school children in relation to their level of physical activity. There is evidence that physically inactive children were statistically significantly more often overweight and obese compared to malnourished and normally nourished children (Jovanovi *et al.,* 2004). The third National Health and Morbidity Survey (NHMS III) in 2006, there was one study that involved a nationally representative sample namely, the national survey of the Ministry of Health Malaysia and UNICEF in 1999-2000. This national survey on a total of 5,383 children below 5 reported an underweight prevalence of 19.8% among the boys and 18.5% in girls while the respective values for stunting were 17.5% and 15.5% (MOH, 2000). The prevalence of overweight in these children was 3.3% similar for both boys and girls (Khor *et al.,* 2009)

The previous study showed the used of body mass index (BMI) levels can strongly predictive of adult obesity these risk behaviors track from childhood (Naidoo *et al.,* 2009). Body mass index (BMI) is a ratio of weight and height (kilograms/meters^2) and is the most widely used and recommended measure to estimate weight status Children, who experience early adipose tissue rebound or the second rise in body mass index (BMI) are at high risk for later obesity (Monteiro and Victora, 2005). Because current BMI status is strongly predictive of future obesity (Dietz, 1998) intervening at a young age is important in curbing the epidemic. The previous study stated that the results indicated that data obtained by the dietary recall correlate highly with the children's weighed food intake if a parent or the primary caretaker providing the child's food responds to the interview (Klesges *et al.,* 1987). It is encouraging to note that parents can be a reliable reporter of their children's food intake at home environment. When errors did occur, they were errors in portion size, as 96% of foods eaten by the children were correctly identified by the parents. This slight tendency of under-report was consistent with other reports of the validity of the 24-hour dietary recall. In younger children, parents appear to be reliable reporters of their children's in-home dietary intake.

As children become older, they appear to be able to recall their own intake both within and outside the home (Klesges *et al.,* 1987). There are several possible explanations for these findings. First, several factors could have influenced the accuracy of parental reports of the child's intake during the day that we weighed foods. Because food was weighed in the homes, the parents undoubtedly attended more closely to their child's diet. Additionally, the dietary recalls were collected at the end of the day of observation. This was closer in time than most 24-hour recalls and may have reflected less memory decay than usual.

Also, since our sample was primarily middle-class families who were well educated, the correspondence between actual vs. reported dietary intake may have been artificially enhancing (Klesges *et al.,* 1987). The mother, who most often is responsible for serving the food to all household members, usually volunteered to answer for the entire household, but a few times other adults or older children responded in the place of the mother. Maternal 24-hour recalls of child diets have been validated in other settings (Dop *et al.,* 1994: Klesges *et al.,* 1987).The standard 24-hour recall method was adapted for the situation common in the rural Andes, where most meals are served from a common pot of homogenous ingredients (Berti & Leonard, 1998).

CHAPTER 3

METHODOLOGY

3.1 Research Design

Each accelerometer was identified with a label which allowed participants to clearly identify each member's unique accelerometer, thus reducing the possibility of unintentional switches between other children. During the first visit, parents were given the opportunity to ask questions and requested to sign informed consent forms for their children. They were briefed regarding the important of the study. Parents were given with written informed consent and the entire subject had been provided written assent that has to be signed as the agreement of the participating in this study before the research run. During the second day of the visit, subject's body height and body weight were been measured and their BMI then calculated from their height and weight. Parents and caregivers also interview about food consumption in their children by using Food Intake measurements (24-hour dietary recall method and food record method).

3.2 Participants

In total 33 participants involved were boys and girls between ages 4 to 6 years from nursery PERMATA UPSI, Tanjung Malim, Perak .

3.3 Instruments

Data collection was conducted using physical activity measurement (accelerometer), anthropometric measurement (body height and weight measurement) and food intake measurements using 24-hour dietary recall method and food record method.

3.3.1 Physical activity measurement

Accelerometers ActiGraph wGT3X+BT monitor used for the assessment of physical activity are typically light, small and robust making them particularly suitable for use in pre-school children. Furthermore, this model is Activity, lux, programmable sample rate, water resistant housing, high speed USB, heart rate, wireless interface (ANT+™). ActiGraph are used for measuring children's moderate-to-vigorous activity (MVPA) (Sirard *et al.,* 2005) and allow measuring movement on three different axis with digital filtering technology and includes both an acceleration sensor and an ambient light sensor. The acceleration sensor yields the following product specifications:

Table 3.1 – Accelerometer Key Specifications

Parameter	Value Units	Value Units
Axis	3	
Sensitivity	3	mg/LSB
Dynamic Range	+/- 6	G

The 3-axis accelerometer is following product specifications:

- Vertical Axis Activity Acceleration Data (Axis 1)
- Horizontal Axis Activity Acceleration Data (Axis 2)
- Perpendicular Axis Activity Acceleration Data (Axis 3)

Accelerometers measure movement in the Vertical Axis (up and down movement), the Horizontal Axis (forwards and backwards movement) and also the Perpendicular Axis (side to side movement).

Children's PA was measured with the ActiGraph wGT3X during school hours in 3 consecutive days. The ActiGraph wGT3X+ was set to record data at 60Hz, which was the maximum frequency possible for 3 consecutive days of data collection. Each device was programmed to start recording at 8:00 am on the first day (school hours), and stop recording at 12:00 pm on the same day (after school hours).

The device was place at the level of the anterior superior iliac spine, underneath or on top of clothes, and to place it consistently on the same side of the body (see Fig. 1 depicting the accelerometer on a 4- 6 year old child). The device has to place at underneath children's clothes, to avoid any issues resulting from children's curiosity (e.g. removal of the device, or erroneous acceleration data resulting from the child playing with the device).

After collecting the monitors at the second home visit, the raw accelerometry data (*.gt3x file) was downloaded and analysed in the proprietary software ActiLife (version 6.8.1). The raw accelerometry files were then transformed into an *.AGD file, displaying the acceleration counts by 10-s epoch using the low frequency extension filter. Due to the scarce research defining the correct criteria specifically for toddlers (Cliff *et al.*, 2009) wear-time validation and day inclusion criteria was undertaken in agreement with procedures used previously in pre-schoolers (Hinkley *et al.*, 2012) and toddlers (Cauwenberghe *et al.*, 2011). Following wear time validation, children's *.AGD files were scanned to assess what time the accelerometer was placed on and taken off, thus defining the start and end of each day. The start of a day was set at the first consecutive minute of acceleration data higher than zero, and the end of a day was defined as the last epoch with counts higher than zero before a consecutive ≥7600 min of zero counts.

Outcome variables were average PA expressed as counts per minute (CPM) for the vertical axis and Cut points with "VM" or "Vector Magnitude". Accelerometer steps have been validated in pre-school children using valid Cut points with "VM" or "Vector Magnitude by Freedson Children (2005).

Table 3.2 – Freedson for Children cut- off points

Sedentary	0 - 149 CPM
Light	150 - 499 CPM
Moderate	500 - 3999 CPM
Vigorous	4000 - 7599 CPM
Very Vigorous	7600 - ∞ CPM

Freedson Children (2005).

* Special Notes: Studies include walking, running and free-living activities in the testing protocol.

These cut points are based off of the MET formula METs = 2.757 + (0.0015*CPM) - (0.08957*age) - (0.000038*CPM*age) with assumed MET thresholds of 3, 6, and 9 METs (which produce cut point boundaries of 500, 4000, and 7600 CPM respectively). Trost, in Comparison of Accelerometer Cut Points for Predicting Activity Intensity in Youth (Trost et. al, 2011) assumed the following MET cut points: Sedentary: 0 - 1.78 METs; Light - 1.79 METs - 3.99 METs; Moderate: 4.00 METs - 5.99 METs; Vigorous: >= 6.00 METs. These thresholds resulted in the following cut points: Sedentary: 0-99 CPM; Light: 100 - 2219 CPM; Moderate: 2220 - 4135 CPM; Vigorous: 4136 - ∞ CPM.

Minutes per day spent in in low and high-intensity PA was calculated based on intensity thresholds developed by this group. Accelerometer counts ≤149 and ≥7600 per ten seconds for the axis were used for sedentary and high-intensity PA, respectively.

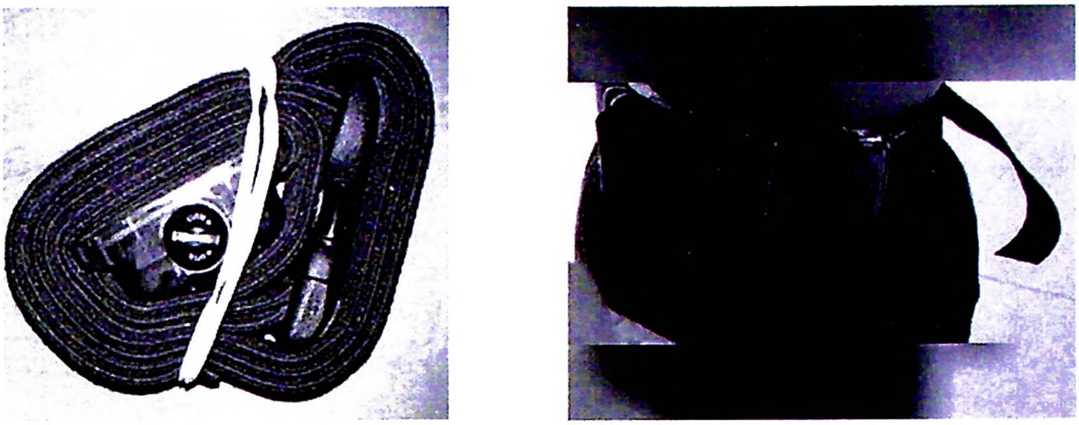

Figure 1: Accelerometer placement on a 4-6 years old child.

3.3.2 Antropometry measurement

The subject's body weight was measured using a digital weighing scale (Karada Scan). The body weight of the subjects was measured to the nearest 0.1 kilograms respectively. During the body weight measurement, subjects were asked to remove the shoes before they stepped onto the scale. Subject's head was up and the eyes looked directly ahead with the weight distributed evenly on both feet (see Fig. 2 depicting the body weight measurement) (ISAK, 2006).

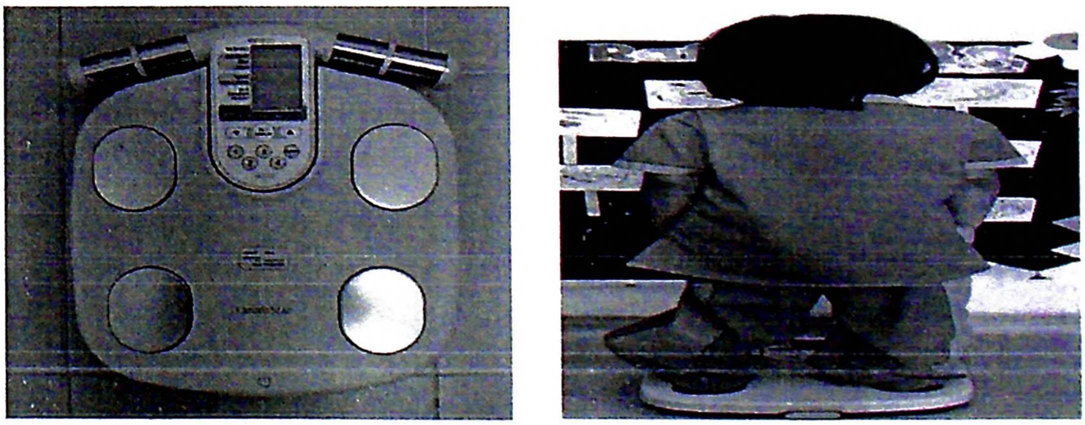

Figure 2: Body weight measurement

The body height was measured using a stadiometer (SECA,Germany).The body heights of the subjects were measured to the nearest 0.1 centimeters respectively. The measures were taken after the subject were instructed to inhale deeply, face forward and tilt up the face, as the vertex is the highest point on the skull. The subject was also required to standing with the feet together and the heel, buttocks and upper part of the back were touching the scale. The measurement was taken at the end of a deep inward breath (see Fig. 3 depicting the body height measurement) (ISAK, 2006).

Figure 3: Body height measurement

Their body mass index (BMI) was calculated by using the formula of:

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m}^2\text{)}}$$

3.3.3 Food Intake measurement

This method involves a structured interview. Food intake was measured using 24-hour dietary recall method and food record for seven consecutive days through interview parents and caregivers. An interviewer asks parent or caregiver to recall all food and drink during previous 24 hours about their child food consumption .A 24-hour recall can be administered via paper records. The 24 hours recall was develop based on time of dishes, type of food, sizing of dishes on Food Intake. The questionnaires were developed in Bahasa Melayu (appendix A). A 24HR usually requires 20 to 30 minutes to complete.The household measures were used to help their parent recall the quantity of foods from child had eaten. The amounts of foods from the 24-hour dietary recall were converted to grams and the nutrient values computed using DIET 4, a computerized version of the Nutrient Composition of Malaysian Foods (Tee *et al.*, 1988). Calories were measured of energy food or drink are contains. The term calorie is a commonly used as "kcal".

3.4 Data analysis

Data was analysis and interpreted by using the Statistical Package for Social Science (SPSS) version 22.0 for Windows. The significance level correlation, mean and standard deviation (SD) were derived from the program for numerical and categorical variables respectively.

CHAPTER 4

RESULTS

Table 4.1: Anthropometrical measurement for both boys and girls

Variables	Boys	Girls
n=33	15	18
Age (years old)	5.1 ± 0 .6	5.3 ± 0.9
Height (cm)	105.28 ± 5.11	105.40 ± 7.81
Weight (kg)	17.60 ± 3.85	17.25 ± 5.51
BMI (kg/m^2)	15.83 ± 2.00	15.47 ± 2.88

Values are mean ± SD

Table 4.1 shows the number of participants from each gender for age, body height, body weight and BMI. At these ages, the height, weight and BMI were about similar for both boys and girls.