LUCY ANTHONY

STUDENT NUMBER: ST05002246

SCHOOL OF SPORT, PE AND RECREATION

UNIVERSITY OF WALES INSITUTE, CARDIFF

THE RELATIONSHIP BETWEEN BODY MASS INDEX, DIET AND PHYSICAL ACTIVITY IN ADOLESCENTS

Table of Contents

Acknowledgements i

Abstract ii

CHAPTER ONE

Introduction 1

1.1. Hypothesis 3

CHAPTER TWO

Review of Literature ..... **Error! Bookmark not defined.**

2.1. Childhood Obesity ..... **Error! Bookmark not defined.**

2.2. Childhood Obesity and Physical Activity ... **Error! Bookmark not defined.**

2.3. Physical Activity and Health ..... **Error! Bookmark not defined.**

2.4. Children's Attitudes Towards Physical Activity ..... **Error! Bookmark not defined.**

2.5. Depression, Self-esteem and Obesity ..... **Error! Bookmark not defined.**

2.6. Benefits of Physical Activity and Exercise . **Error! Bookmark not defined.**

CHAPTER THREE

Methodology 19

3.1. Sample 19

3.2. Questionnaires 20

3.3. Conducting the research 21

3.4. Data Analysis 22

CHAPTER FOUR

Results 25

4.1. Descriptive Analysis 25

4.2. Evaluating Weight Status 26

4.3. Relationship between Diet and BMI 27

4.4. Relationship between Physical Activity and BMI 29

4.5. Relationship between $\dot{V}O_2$ max and BMI 30

4.6. Relationship between Physical activity and $\dot{V}O_2$ max 31

4.7. Independent Samples T-Test 32

CHAPTER FIVE

Discussion ..... **Error! Bookmark not defined.**

5.1. Limitations ..... **Error! Bookmark not defined.**

5.2. Further Research ..... **Error! Bookmark not defined.**

CHAPTER SIX

Conclusion.....44

References.....45

Appendices

Appendix A - Participant information and Informed Consent Form

Appendix B - Physical Activity Questionnaire

Appendix C - Dietary Intake Questionnaire

Appendix D - Physical Activity Readiness Questionnaire (PAR-Q)

Appendix E - Head Teacher letter

Appendix F - Predicted $\dot{V}O_2$ max for the multistage fitness test

List of Tables

Table		Page
1	Descriptive analysis for participants within the study	25
2	The number and percentage of participants according to classified weight status	26
3	The mean and standard deviation of diet scores	27
4	The mean and standard deviation of BMI values	28
5	Pearson Product Moment Correlation Coefficient of the sample between weight status and diet scores	28
6	The mean and standard deviation of physical activity scores	29
7	Pearson Product Moment Correlation Coefficient of the sample between weight status and physical activity scores	30
8	The mean and standard deviation of $\dot{V}O_2$ max values	30
9	Pearson Product Moment Correlation Coefficient between $\dot{V}O_2$ max and BMI.	31
10	Pearson Product Moment Correlation Coefficient between physical activity and $\dot{V}O_2$ max.	31
11	The results of the independent samples T-test between gender scores	32

List of Figures

Figure		Page
1	Theory of Planned Behaviour (Ajzen, I. 1991)	9
2	Health Belief Model (http://ohprs.ca, undated)	10

Acknowledgements

I would like to express my appreciation to Deborah Welford for all her time and effort in guiding me through this dissertation.

Thanks to my mum and dad for their constant support, advice and guidance throughout my university years.

I also would like to thanks the pupils at Amman Valley School for their participation in the study, and a special thanks to the physical education staff for their assistance and support.

Abstract

It has been claimed that a lack of physical activity in young people increases the risk of obesity in the younger population. The current environment in which we live is changing gradually to one that promotes a sedentary lifestyle, in turn reducing physical activity levels. The purpose of the study was to investigate whether adolescents' physical activity levels and dietary intake related to their Body Mass Index (BMI), while also relating to the maximal oxygen uptake ($\dot{V}O_2$ max). A school in South Wales was involved in the study, where 42 participants (males, n = 23; females, n = 19) aged 14years – 15 years (mean age: 14.6) were chosen at random. Two questionnaires identifying physical activity levels and dietary intake were designed by the author. Height and weight of the participants were also measured to calculate their BMI status. The evaluation of BMI values resulted in the following means, males BMI = 21.42 ± 2.67 kg/m², and females BMI = 22.36 ± 3.38 kg/m². All descriptive statistics were assessed for normality, resulting in the use of Pearson Product Moment Correlation Coefficient, to distinguish relationships between the variables in question. Following analysis of the results, there was no evidence found of a relationship between physical activity and BMI, or between BMI and $\dot{V}O_2$ max ($p > 0.05$). Nevertheless a significant positive relationship ($p < 0.05$) was identified between BMI and dietary intake and between physical activity and $\dot{V}O_2$ max, showing that a higher score of diet and physical activity relates to higher values of BMI and $\dot{V}O_2$ max. In contrast to the statistical findings, the study found that obese and overweight participants had a lower physical activity score when compared to average weight participants. Further research is required to generalise findings and identify barriers and factors that affect participation, in turn aiding the design of future interventions to promote a healthy lifestyle and physical activity.

CHAPTER I

INTRODUCTION

Introduction

There is a high level of debate concerning the physical activity levels of young people and whether the fact that they are not active enough increases their risk of becoming obese. (Martinez-Gonzalez *et al.*, 1999)

In previous years, the younger generation were considered to be fitter and more active compared to other age ranges (Bouchard, 2000), however evidence has shown that this is not the case now. Changes in technology have occurred in the past few decades that have affected physical activity levels of the population dramatically (Goran *et al.*, 1999). The current environment in which we live is changing gradually to one that promotes less physical activity resulting in sedentary lifestyles. Physical activity is an important aspect in maintaining a healthy status, as highlighted in the literature. The risk of developing heart disease, hypertension, osteoporosis, colon cancer and obesity has been found to decrease with regular physical activity and exercise (Bouchard, 2000).

Health enhancing effects can be promoted by physical activity and exercise with even the smallest change in energy expenditure improving an individual's health status. The relationship between obesity and low levels of physical activity was identified by several studies (Goran *et al.*, 1999; Trost *et al.*, 2001), suggesting that obese individuals often reported low levels of physical activity.

Obesity has been defined as a condition where there is excess body weight due to an abnormal accumulation of fat (Schemmel, 1980). Obesity has been identified as a

universal epidemic by the World Health Organisation (WHO: online 2008). There is a wide range of causes of obesity, though generally the cause develops from an imbalance of energy expenditure and intake (Goran *et al.*, 1999). Diseases that are related to obesity include cardiovascular disease and type 2 diabetes, which have been found to increase an adolescent's morbidity and mortality rates (Must, 1996).

Psychological and social hazards of obesity are serious factors contributing to the prevalence of obesity (Braet *et al.*, 1997), with aspects such as self-esteem, self-perception and body image having a negative effect on an individual (Strauss, 2000). Physical activity and exercise are found to have a reducing effect on anxiety and can improve physical self-perceptions and self-esteem (Fox 1999). These have been shown to improve quality of life (Ravens-Sieberer *et al.*, 2001) and strengthen attitudes in aid of behaviour change (Madden *et al.*, 1992).

The implementation of physical activity interventions in reducing the risk factors for obesity has been proven affective (Sahota *et al.*, 2001). The World Health Organisation (WHO: online 2008) states that 'schools present unique opportunities to provide time, facilities and guidance for young people', therefore enhancing a physically active lifestyle.

The purpose of this study was to examine the relationship between physical activity, dietary intake and the participants' Body Mass Index (BMI) while relating to maximal oxygen uptake ($\dot{V}O_2$ max), a measure of aerobic fitness. It is believed that this research will enable an understanding of current physical activity levels and

dietary intake among adolescents, in turn aiding the process of evaluating adolescent obesity and facilitating recommendations to alleviate the current epidemic.

1.1. Hypothesis

The hypotheses are that:

H01 – There is no significant relationship between BMI and dietary status.

Null H01 – There is a significant relationship between BMI and dietary status.

H02 – There is no significant relationship between BMI and physical activity

Null H02 – There is a significant relationship between BMI and physical activity.

H03 – There is no significant relationship between BMI and $\dot{V}O_2$ max.

Null H03 – There is a significant relationship between BMI and $\dot{V}O_2$ max.

H04 – There is no significant relationship between $\dot{V}O_2$ max and physical activity.

Null H04 – There is a significant relationship between $\dot{V}O_2$ max and physical activit

CHAPTER III

METHODOLOGY

Methodology

This study attempts to determine a relationship between physical activity levels, dietary intake and Body Mass Index (BMI) while also investigating $\dot{V}O_2$ max values. Two questionnaires were designed that identified a participant's physical activity level and dietary intake, being evaluated to determine whether the two variables are related to with the participant's BMI. This chapter defines the utilized methods and data analysis of the study.

3.1. Sample

The study was undertaken in a large comprehensive school in the Carmarthenshire area. Prior to the start of the investigation and before the collection of any data, ethical consent was obtained from the UWIC Research Ethics Committee (UREC).

The study focused on pupils in year 10, that is those young people aged 14years-15 years old. This group was selected as it is accepted that risk factors concerning obesity are more prevalent in adulthood if an individual is an overweight or obese adolescent (Guo *et al.,* 2002). Both sexes were evaluated to make the study relevant and valid. Participants were selected through a sample of convenience including mixed academic and physical ability; a group containing three form groups were chosen at random to participate in the present study.

There were 42 participants within the study, 23 males and 19 females. The mean and standard deviation measurements of the participants were 164.2 ± SD cm in height and 59.6± SD kg in weight. The mean age of the participants was 14.6 ± SD years as all participants were currently in year 10. Prior to the start of the study each participant was given a participant information sheet and consent form (See Appendix A), and each participant was required to provide written informed consent along with their parent's/guardian's consent prior to taking part in the study.

3.2. Questionnaires

A questionnaire measuring physical activity level was designed (Appendix B), and also a diet intake questionnaire (Appendix C). The physical activity questionnaire consisted of thirteen questions concerning a variety of aspects regarding day-to-day living. The questions were formulated from the identification of key issues found from the literature concerning physical activity levels and general lifestyle behaviour, while taking into consideration previous questionnaires such as the 'Global Physical Activity Questionnaire' (WHO, no date). The dietary intake questionnaire consisted of three questions concerning a recall of food consumed within the previous twenty four hours. As school pupils were used for research the questionnaires were anonymous.

The measurement of the participant's physical activity levels was determined via an evaluation of the responses to the seven questions portraying high or low physical activity levels. In relation to the dietary intake questionnaire, an evaluation was made

about the amount and type of food consumed over a time period of twenty four hours.

The questionnaire was presented to the participants explaining the purpose. The participants were asked to complete the questions as honestly as possible, with the researcher available to answer any queries. A chaperone was present at all times.

3.3. Conducting the research

The research was conducted in December 2007 and January 2008 over a period of two weeks. A letter was sent to the head teacher of the prospective school requesting permission to carry out the study using the schools pupils (Appendix E). Permission was given via a letter, and a meeting was arranged with a member of staff of the Physical Education department, discussing a suitable time to conduct the research. It was decided that the questionnaires were to be administered in a Physical Education lesson, along with measurements of height and weight being done in the same session.

The author measured the height and weight of all participants following the completion of the questionnaires. The height of the participants was measured in metres, determined by a stadiometer and a digital weighing scale (SECA model 770) supplied by the university and measured weight in kilograms.

It was necessary in gain informed consent from both parents/guardians and participants due to the age of the participants and nature of the study. Once the

consent forms had been returned, pupils completed the relevant procedures of the study. A total of 50 consent forms were given to pupils with a response rate of 84%.

Following the completion of relevant data, a multistage fitness test (bleep test) was undertaken in a separate session to evaluate the participant's $\dot{V}O_2$ max. The multistage fitness test is used as an estimate of individuals $\dot{V}O_2$ max, which involves running continuously between two points that are 20 metres apart which are synchronised with a pre-recorded CD. The bleep test CD was supplied by the participating school. Prior to the participant's participation in the test, they each completed a Physical Activity Readiness Questionnaire (PAR-Q) to determine their physical health (See Appendix D). The multistage fitness test was conducted in the school sports hall, the area being inspected for safety prior to the test. The primary researcher provided the participants with an explanation of the purpose and procedures of the test, following the explanation the participants were divided into four smaller groups to promote the safety of each participant. A chaperone was again present at all times.

3.4. Data Analysis

Once the questionnaires and multistage fitness test were completed, the participant's BMI was calculated to asses their weight status, using the height and weight values. The BMI is the mass (weight, kg) divided by the square height (m^2);

$$\text{BODY MASS INDEX} = \frac{\text{KG}}{\text{M}^2}$$

The participant's physical activity levels were calculated by the answers to seven questions. If a participant marked an answer relevant to a high physical activity level, this scored a three; similarly if a participant marked an answer relevant to an average physical activity level, this scored a two, the same applied with a low physical activity level answer, and this scored a one. The seven scores were then added together to give a total score for each participant. The possible scores of the evaluation range from 7 (7 x 1 = not physically active) and 21 (7 x 3 = physically active) with an average physical activity level scoring 14 (7 x 2 = moderately physically active).

To test for a relationship between adolescents' BMI status, physical activity levels, dietary status and maximal oxygen uptake ($\dot{V}O_2$ max) a Pearson's Product Moment Correlation Coefficient was used. The SPSS 12.0.1 programme was used to perform the statistical test, using the participants' BMI, physical activity, diet and $\dot{V}O_2$ max scores, to establish whether the data combined showed a positive or a negative relationship between the variables in question. An independent T-test was used to determine whether males and females differed in their BMI, physical activity levels, dietary status and $\dot{V}O_2$ max values.

The data obtained from the diet questionnaire concerning dietary intake was evaluated and participants were given a score relevant to their eating habits. If a participant reported a large quantity of food high in fat, these were considered unhealthy and given a score of three, similarly if the participant reported a medium

to low quantity of food which consisted of a variety of fat levels and included some vegetables; these were considered to be moderately healthy and given a score of two. The same applied to participants that reported a medium to low quantity of food which consisted of a number of fruit and vegetables and minimum levels of fat within their diet, these participants were considered to be healthy and given a score of one.

The scores obtained from the multistage fitness test were analysed and converted into a predicted maximum oxygen uptake value ($\dot{V}O_2$ max) for each participant. The table used for the conversion of the data (See Appendix F) was developed by the Department of Physical Education and Sports Science Loughborough University (1987)

CHAPTER IV

RESULTS

Results

Throughout this chapter all heights are given in meters (m) and all weights in kilograms (kg). To determine relationships between the different variables, Pearson Product Moment Correlation Coefficient was used. Preliminary analyses were performed to ensure no violation of the assumptions of normality. The results shown are predominantly of the whole sample, but in parts are separated to define differences between gender and different BMI status.

4.1. Descriptive Analysis

The statistics for diet, physical activity, height, weight and BMI are presented in table 1 for the whole sample. As there may be differences in gender within the results, males and females are also presented separately.

Table 1. Descriptive analysis for participants within the study.

	Whole Sample		Males		Females	
	Mean	± Sd	Mean	± Sd	Mean	± Sd
Height	1.64	± 7.83	1.67	± 8.07	1.59	± 5.14
Weight	59.57	± 9.86	60.14	± 8.16	58.88	± 11.79
BMI	21.91	± 3.01	21.42	± 2.67	22.36	± 3.38

4.2. Evaluating Weight Status

Weight status was determined by the researcher according to Cole *et al*. (2000) which provided average values of age and gender specific.

- Individuals with a BMI < 17 kg/m were said to be underweight
- Females with a BMI < 24.17 kg/m and males BMI <23.60 kg/m, but > than a BMI 17 kg/m were said to be average weight.
- Females with a BMI >24.17 kg/m, but BMI <29.29, and males with a BMI > 23.60 kg/m, but BMI <28.60 kg/m were classified as overweight.
- Females with a BMI >29.29 and males with a BMI > 28.60 kg/m were classified as being obese.

The following table illustrates the classified weight status of participants according to number and percentage.

Table 2. The number and percentage of participants according to classified weight status.

	Females		Males	
	n	%	n	%
Underweight	0	0	2	8.6
Average	15	78.9	16	69.5
Overweight	3	15.8	4	17.4
Obese	1	5.2	0	0

4.3. Relationship between Diet and BMI

One of the aims of the study was to determine subject's dietary habits and to test for a relationship between diet scores and weight status. Due to the low number of obese individuals, a combination of the two higher weight status groups was performed, providing a larger sample for testing. The following results have been obtained using the whole sample, males and females and the different weight status groups. The following table illustrates the statistics of the diet scores recorded by the different variable groups.

Table 3. The mean and standard deviation of diet scores

	Means ± Sd
Whole Sample	1.88 ± 0.63
Females	1.89 ± 0.65
Males	1.86 ± 0.62
Underweight	2.00 ± 0
Average weight	1.74 ± 0.51
Overweight/obese	2.33 ± 0.86

The following table displays the statistics of BMI values recorded by the different weight status groups.

Table 4. The mean and standard deviation of BMI values.

	Mean ± Sd
Underweight	16.55 ± 1.34
Average weight	20.98 ± 2.22
Obese/Overweight	24.60 ± 3.92
Females	22.36 ± 3.38
Males	21.42 ± 2.67

The correlation between weight status and diet of the sample identified a positive relationship ($r = 0.446$, $P < 0.05$). This result defines evidence of a significant positive relationship between weight status and diet scores. The summary of the results are displayed in table 5.

Table 5. Pearson Product Moment Correlation Coefficient of the sample between weight status and Diet scores.

	BMI/Diet
Whole Sample	0.446**
Males	0.349
Females	0.544*

** $P<0.01$, * $P<0.05$

4.4. Relationship between Physical Activity and BMI

The main aim of the study was to determine subject's physical activity levels and to test for a relationship between the physical activity scores, and weight status. The following results have been obtained using the whole sample, males and females and the different weight status groups. The following table illustrates the statistics of the physical activity scores recorded by the different variable groups.

Table 6. The mean and standard deviation of physical activity scores

	Means ± Sd.
Whole Sample	14.53 ± 2.71
Females	13.52 ± 2.50
Males	15.34 ± 2.72
Underweight	14.50 ± 6.36
Average weight	14.80 ± 2.46
Overweight/obese	13.55 ± 3.08

The correlation between weight status and physical activity of the sample identified no relationship ($r = -0.194$, $P > 0.05$). This result defines no evidence of significant relationship between weight status and physical activity scores. The summary of the results are displayed in table 7.

Table 7. Pearson Product Moment Correlation Coefficient of the sample between weight status and Physical Activity scores.

	BMI/Physical Activity
Whole Sample	-0.194
Males	-0.152
Females	-0.157

4.5. Relationship between $\dot{V}O_2$ max and BMI

The statistics for the $\dot{V}O_2$ max values are presented in table 8, including the means and standard deviation for the whole sample as well as each sub group.

Table 8. The mean and standard deviation of $\dot{V}O_2$ max values.

	Mean	Standard Deviation
Whole Sample	38.28	8.23
Males	42.92	7.32
Females	32.66	5.64
Underweight	35.00	7.35
Average weight	40.21	8.18
Obese/Overweight	32.34	6.41

The results of the correlation between $\dot{V}O_2$ max and BMI of the sample revealed no significant evidence of a relationship ($r = -0.285$, $P > 0.05$). The table below illustrates the results.

Table 9. Pearson Product Moment Correlation Coefficient between $\dot{V}O_2$ max and BMI.

	$\dot{V}O_2$ max /BMI
Whole Sample	-0.285
Males	-0.074
Females	-0.469*

* P <0.05

4.6. Relationship between Physical activity and $\dot{V}O_2$ max

The correlation results between physical activity and $\dot{V}O_2$ max of the sample indicated a significant positive relationship ($r = 0.551$, $p < 0.01$). The following table displays the results.

Table 10. Pearson Product Moment Correlation Coefficient between physical activity and $\dot{V}O_2$ max.

	Physical Activity/ $\dot{V}O_2$ max
Whole Sample	0.551**
Males	0.377
Females	0.623**

** P < 0.01

4.7. Independent Samples T-Test

To evaluate whether males and females showed a difference in the BMI, physical activity, diet and $\dot{V}O_2$ max, an independent sample T-test was performed, showing a variety of significance between the genders.

Table 11. The results of the independent samples T-test between gender scores.

	Males			Females			P
	n	m	Sd	n	m	Sd	
BMI	23	21.42	2.67	19	22.36	3.38	0.03
Physical Activity	23	15.34	2.72	19	13.52	2.50	0.90
Diet	23	1.86	0.62	19	1.89	0.65	0.00
$\dot{V}O_2$ max	23	42.92	7.32	19	32.66	5.64	0.32

CHAPTER VI

CONCLUSION

Conclusion

As indicated by the present study, the effect of physical activity and diet on BMI and physical fitness is controversial. Lower physical activity rates were confined to obese and overweight participants when compared to the average weight group. However, no significant relationship was found between the two variables in question. A variety of relationships were identified between BMI, diet and $\dot{V}O_2$ max, therefore we can anticipate the true effect of physical activity, diet and physical fitness on weight status and health.

Research recommends that physical activity and diet in relation to weight status is an important issue, particularly with evidence that increased weight gain can have an influence on physical and mental well-being (Fox, 1999; Maffeis *et al*., 1998; Trost *et al.,* 2001).

As discussed in the previous chapter many limitations are apparent in this area of research. A modification of these factors would be necessary to gain the greatest evaluation of physical activity rates in children and adolescents. To increase the reliability of future research, researchers should relate to the same methodological strategies to prevent controversial results.

In order to achieve increase participation in physical activity, it is clear that there is a need for further research to identify barriers and factors that affect participation. This will aid the design of future interventions involving overweight children and adolescents.

REFERENCES

References

Ajzen (1988). The Theory of Planned Behaviour, cited in Buckworth J., and Dishman R., (2002). Exercise Psychology. Human Kinetics

Ajzen, I (1991) Theory of Planned Behaviour, online: http://tcw.utwente.nl, acc. 12/11/07.

Armstrong, N., and Welsman, J. R. (1996) The Measurement and Interpretation of Aerobic Fitness in Children: Current Issues. *Journal of the Royal Society of Medicine*. Vol. 89, 281 – 285.

Armstrong, N., Balding, J., Gentle, P., and Kirby, B. (1990) Patterns of Physical Activity among 11 to 16 year old British Children. *British Medical Journal.* Vol. 30, 203 – 205.

Bouchard, C. (2000) *Physical activity and obesity*. Human Kinetics: Leeds.

Braet, C. and Mervielde, I. (1997) Psychological aspects of childhood obesity: A controlled study in a clinical and nonclinical sample. *Journal of Pediatric Psychology*. Vol. 22, No. 1, 59 – 71.

Brustad, R. J. (1993) Who will go out to Play? Parental and psychological influences on children's attraction to physical activity. *Pediatric Exercise Science.* Vol. 5, 210 – 223.

Buckworth, J. and Dishman R. (2002). Exercise Psychology. Human Kinetics: Leeds.

Cole, T. J., Bellizzi, M. C., Flegal, K. M., and Dietz, W. H. (2000) Establishing a Standard Definition for Child Overweight and Obesity Worldwide: International Survey. *British Medical Journal*. Vol. 320.

Deckelbaum, R. J., and Williams, C. L. (2001) Childhood obesity: The health issue. *Obesity Research.* Vol. 9, No. 4, 239 – 242.

Department of Physical Education and Sports Science Loughborough University (1987) 'Predicted $\dot{V}O_2$ max for the multistage fitness test' online: http://thebleeptest.com/calculator, acc 30/01/08

Durnin, J. V. G. A. (1992) Physical Activity levels past and present, cited in Biddle, S., Sallis, J., and Cavill, N. (1998) Young and Active?: Young people and Health-Enhancing Physical Activity – Evidence and Implications. Health Education Authority: London.

Fox, K. R. (1999) The influence of physical activity on mental well-being. *Public Health Nutrition.* Vol. 2, No. 3a, 411 – 418.

Franklin, J., Denyer, G., Steinbeck, K. S., Caterson, I. D. and Hill, A. J. (2006) Obesity and risk of low self-esteem: A statewide of Australian children. *Pediatrics.* Vol. 118, No. 6, 2481 – 2486

Goodman, E. and Whitaker, R. C. (2002) A Prospective study of the role of depression in the development and persistence of adolescent obesity. *Pediatrics*. Vol. 109, No. 3, 497 – 503.

Goran, M. I. (2001) Metabolic Precursors and effects of Obesity in Children: a Decade of Progress, 1990-1999. *American Journal of Clinical Nutrition.* Vol. 73, 158 – 171.

Goran, M. I., Ball, G. D. C., and Cruz, M. L. (2003) Obesity and Risk of Type 2 Diabetes and Cardiovascular Disease in Children and Adolescents. *The Journal of Clinical Endocrinology and Metabolism.* Vol. 88, No. 4, 1417 – 1427.

Goran, M. I., Reynolds, K. D. and Lindquist, C. H. (1999) Role of physical activity in the prevention of obesity in children. *International Journal of Obesity.* Vol. 23, No. 3, 18 – 33.

Goran, M., Fields, D. A., Hunter, G. R., and Weinsier, R. L. (2000) Total Body Fatness does not Influence Maximal Aerobic Capacity. *International Journal of Obesity*. Vol. 24, No. 7, 841 – 848.

Guo, S. S., Wu, W., Chumlea, W. C., and Roche, A. F. (2002) Predicting Overweight and Obesity in Adulthood from Body Mass Index Values in Childhood and Adolescence. *American Journal of Clinical Nutrition.* Vol. 76, 653 – 658.

Hardman, A. E., and Stensel, D. J. (2004) *Physical Activity and Health, The Evidence Explained.* Routledge: London.

Harris, J., and Cale, L. (2006) A Review of Children's Fitness Testing. *European Physical Education Review.* Vol. 12, No. 2, 201 – 225.

Health Education Authority (1997) *Young People and Physical Activity, Promoting Better Practice.* Health Education Authority: London.

Janz N., Becker M., (1984). The Health Belief Model: A decade later. Health Education Vol. 11, No.1, 11-47.

Madden T., Ellen P., Ajzen I., (1992). A comparison of theory of planned behaviour and the theory of reasoned action. Personality and social Psychology. Vol 18, No. 1, 3-9.

Maffeis, C. (2000) Aetiology of Overweight and Obesity in Children and Adolescence. *European Journal of Pediatrics.* Vol. 159, No. 13, 35 – 44.

Maffeis, C., Talamini, G. and Tato, L. (1998) Influence of diet, physical activity and parents obesity on chidlren's adiposity: a four-year longitudinal study. *International Journal of obesity.* Vol. 22, 758 – 764.

Martinez-Gonzalez, M. A., Martinez, J. A., Hu, F. B., Gibney, M. J., and Kearney, J. (1999) Physical Inactivity, Sedentary Lifestyle and Obesity in the European Union. *International Journal of Obesity*. Vol. 23, 1192 – 1201.

Must, A. (1996) Morbidity and Mortality Associated with Elevated Body Weight in Children and Adolescents. *American Society for Clinical Nutrition.* Vol. 63, 445 – 447.

Must, A., and Strauss, R. S. (1999) Risks and Consequences of Childhood and Adolescent Obesity. *International Journal of Obesity*. Vol. 23, No. 2, 2 – 11.

Ontario Health Promotion Resource System (undated) 'Health Belief Model' online: http://ohprs.ca, acc. 14/10/07

Ortega, F. B., Ruiz, J. R., Castillo, M. J. and Sjöström, M. (2008) Physical Fitness in Childhood and Adolescence: a Powerful Marker and Health. *International Journal of Obesity*. Vol. 32, 1 – 11.

Paffenbarger, R. S., Hyde, R. T., Wing, A. L., and Hsieh, C. (1986) Physical Activity, all-cause Mortality, and Longevity of College Alumni, cited in Biddle, S., Sallis, J., and Cavill, N. (1998) Young and Active?: Young people and Health-Enhancing Physical Activity – Evidence and Implications. Health Education Authority: London.

Ravens-Sieberer, U., Redegeld, M. and Bullinger. (2001) Quality of life after in-patient rehabilitation in children with obesity. *International Journal of Obesity*. Vol. 25, No.1, S63-S65

Sahota, P., Rudolf, M. C. J., Dixey, R., Hill, A. J., Barth, J. H. and Cade, J. (2001) Evaluation of implementation and effect of primary school based intervention to reduce risk factors for obesity. *British Medical Journal.* Vol. 323.

Schemmel, R. (1980) *Nutrition, Physiology and Obesity.* CRC Press: Florida

Starnes, J. W., and Bowles, D. K. (1995) Role of exercise in the cause and prevention of Cardiac Dysfunction, cited in Biddle, S., Sallis, J., and Cavill, N. (1998) Young and Active?: Young people and Health-Enhancing Physical Activity – Evidence and Implications. Health Education Authority: London.

Strauss, R. S. (2000) Childhood Obesity and Self-esteem. *Pediatrics.* Vol. 105, No. 1.

Trost, S. G., Kerr, L. M., and Pate, R. R. (2001) Physical activity and Determinants of Physical Activity in Obese and non-obese Children. *International Journal of Obesity*. Vol. 25, 822 – 829.

Tucker, L. A., Seljaas, G. T., and Hager, R. L. (1997) Body fat percentage of children varies according to their diet composition. *Journal of the American Dietetic Association.* Vol. 97, No. 9, 981 – 986.

Whitaker, R. C., Wright, J. A., Pepe, M., Seidel, K. D., and Dietz, W. H. (1997) Predicting Obesity in Young Adulthood from Childhood and Parental Obesity. *The New England Journal of Medicine.* Vol. 337, 869 – 873.

World Health Organisation (2004) 'Global Strategy on Diet, Physical Activity and Health' online: http://who.org/dietphysicalactivity/childhood, acc 15/02/08

World Health Organisation (2008) 'Recommended amount of Physical Activity' online: http://who.org/dietphysicalactivity/factsheet_recommendations, acc. 10/01/08

World Health Organisation (undated) 'Global Physical Activity Questionnaire' online: http://who.org/entity/chp/steps/resources, acc. 14/10/07

APPENDICES

APPENDIX

A

Participant Information

General Information about the Study

As the lack of physical activity is frequently in the media I am undertaking a study to evaluate whether physical activity and dietary intake relates to a Childs BMI. Knowing this information will increase your personal awareness of your status of health and also provide evidence to the media coverage which can then be applied to improve this current epidemic.

To take part in this study you will be required to have your height and weight measured, complete two questionnaires regarding your physical activity patterns and your dietary intake and also participate in a fitness test (multi stage fitness test) to determine your current fitness levels. Previous experience with this fitness test is required.
All measurements will be taken silently and in private and a chaperone will be present at all times.

Why have you been asked?

You are currently in year 10 you are in your final stages of compulsory education, which means that you have opted to do things that interest you. As the rate of drop out increases as children get older, it is beneficial to find out whether these rates are influencing children's health and therefore leading to an increased BMI.

What happens if you change your mind?

Participation is entirely voluntary and you can withdraw from this study at any time.

What are the risks?

There are no obvious risks in participating in this study, other than general health and safety issues regarding the fitness test.

What happens to the results?

All the information gathered will be kept on a computer where only I and my supervisor will be allowed access. Confidentiality will be upheld and your name will not be recorded.

Are there any benefits from taking part?

The only direct benefit of participating in this study is the knowledge of your health status at the end of the collection of data. Indirect benefits include improving research.

Contact details of my Supervisor

Deborah Welford
Email: DWelford@uwic.ac.uk Phone: 02920 41 7062

PARTICIPANT CONSENT FORM

UWIC Ethics Protocol Number: **12.12/07**

Participant name:

Title of Project: **How Physical activity and Diet relates to a Childs BMI**

Name of Researcher: **Lucy Anthony**

Participant to complete this section: Please initial each box.

1. I confirm that I have read and understand the information sheet dated ..... for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my relationship with UWIC, or my legal rights, being affected. ☐

3. I understand that relevant sections of any of research notes and data collected during the study may be looked at by responsible individuals from UWIC for monitoring purposes, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records. ☐

4 I agree to take part in the above study. ☐

Signature of Participant:……..Date:……

Signature of Parent/Guardian:……Date:…….

Name of person taking consent: **Lucy Anthony**

Signature of person taking consent:……..Date:……...

APPENDIX

B

Physical Activity Questionnaire

Please help me with my research by answering a few short questions

Please answer all the questions as honestly as you can

Q1 How many hours a week do you take part in moderate physical activity (such as light sports and physical exercise or long walks)?

- *0-2 hours* ☐
- *2-6 hours* ☐
- *6+ hours* ☐

Q2 How many hours a week do you take part in hard or very hard physical activity (such as jogging, running, swimming or strenuous sports)?

- *0-2 hours* ☐
- *2-6 hours* ☐
- *6+ hours* ☐

Q3 On average over the past year what time do you get up?

On a weekday..... ☐

On a weekend ..... ☐

Q4 On average over the past year what time do you go to bed?

On a weekday..... ☐

On a weekend ..... ☐

Q5 How do you get to and from school?

- *Bus* ☐
- *Car* ☐
- *Walk* ☐
- *Cycle* ☐

Q6 Which form of transport do you use MOST OFTEN apart from your journey to school?

	Car	*Walk*	*Bus*	*Cycle*
Less than 1 mile	☐	☐	☐	☐
1-5 miles	☐	☐	☐	☐
More than 5 miles	☐	☐	☐	☐

Q7 Do you enjoy taking part in physical activity?

- *I really enjoy it* ☐
- *I enjoy it sometimes* ☐
- *I dont enjoy it at all* ☐

Q8 How important do you think it is to exercise?

- *Very important* ☐
- *Quite important* ☐
- *Not very important* ☐

Q9 How many hours a week do you spend watching TV or playing on your computer?

- *None at all* ☐
- *1-10 hours* ☐
- *10-20 hours* ☐
- *20-30 hours* ☐
- *30+ hours* ☐

Q10 Are you a member of a sports team?

- *Yes* ☐
- *No* ☐

Q11 Apart from P.E lessons do you take part in any extra curricular activities involving exercise?

- *Yes* ☐
- *No* ☐

Q12 Do you take part in any extra curricular activities that dont involve exercise?

- *Yes* ☐
- *No* ☐

Q13 Do your parents take part in any form of physical activity?

- *Not at all* ☐
- *Sometimes* ☐
- *Often* ☐

Thank you for your time

APPENDIX

C

Dietary Intake Questionnaire

Please answer all the questions as honestly as you can

Q1. Please List any food you have consumed in the past 24 hours:

	Time	Place	What and how much?
Breakfast/1st Meal			
Snack			
Lunch/2nd meal			
Snack			
Evening/3rd meal			
Snack			

Q2. Please state any other food you consumed in the past 24 hours:

Other food	Time	How much?

Q3. Please list any beverages you consumed in the past 24 hours:

Beverages	Time	How much?

Thank you for your time

APPENDIX

D

Physical Activity Readiness Questionnaire (PAR-Q)

Please circle the answers to the following questions:

1. Will this be the first time you have participated in a Multi stage fitness test (Bleep test)? Yes / No
2. Do you suffer from a heart condition or have you ever had a problem with your heart? Yes / No
3. Do you feel pains in the chest when you do physical activity? Yes / No
4. Have you ever lost consciousness (Fainted)? Yes / No
5. Do you have any injuries that could be made worse by physical activity?

   Yes / No
6. Are you currently taking any medication? Yes / No
7. Do you know of any other reason why you should not do physical activity?

   Yes / No

If you have answered yes to any of these questions, please add details below. Similarly, if there are any situations which will prevent you from exercising write them here

Signed…….

Date…….

APPENDIX

E

3 Lon Llys Havard
Betws
Ammanford
Carmarthenshire
SA18 2HT
30TH November 2007

Amman Valley School
Margaret Street
Ammanford
Carmarthenshire
SA18 2NW

Dear Headmaster,

I am a final year student studying sport and physical education at University of Wales, Institute Cardiff. I am in the process of researching my dissertation project which is 'How diet and physical activity relates to children's Body Mass Index (BMI)'. My research looks at the amount of physical activity undertaken and the dietary habits in relation to a child's body mass index (BMI). I am also looking at the fitness levels of a child in relation to the results obtained.
I am looking at year 10 pupils in particular and would appreciate your schools participation in my study.

The study will include about 40 pupils from year 10, completing 2 short questionnaires on their physical activity patterns and dietary habits. Children will undergo a multi stage fitness test (Bleep test); also measurements of body height and weight will be recorded. Names will not be written on the questionnaires and all the information will be dealt with confidentiality. Copies of the questionnaires are enclosed.

Both the child and his/her parent or guardian will need to sign a consent form to confirm their participation in the research and also fill out a physical activity readiness questionnaire (par-q) to determine whether they are fit enough to participate.
If you give your consent, please contact me to arrange an appropriate time to come into the school to undertake my research at your convenience.

Thank you for your time

Yours Sincerely

Lucy Anthony

APPENDIX

F

Predicted $\dot{V}O_2$ max for the multistage fitness test, developed by the Department of Physical Education and Sports Science Loughborough University, 1987

Level	Shuttle	VO2 Max	Level	Shuttle	VO2 Max
4	2	26.8	5	2	30.2
4	4	27.6	5	4	31.0
4	6	28.3	5	6	31.8
4	9	29.5	5	9	32.9

Level	Shuttle	VO2 Max	Level	Shuttle	VO2 Max
6	2	33.6	7	2	37.1
6	4	34.3	7	4	37.8
6	6	35.0	7	6	38.5
6	8	35.7	7	8	39.2
6	10	36.4	7	10	39.9

Level	Shuttle	VO2 Max	Level	Shuttle	VO2 Max
8	2	40.5	9	2	43.9
8	4	41.1	9	4	44.5
8	6	41.8	9	6	45.2
8	8	42.4	9	8	45.8
8	11	43.3	9	11	46.8

Level	Shuttle	VO2 Max	Level	Shuttle	VO2 Max
10	2	47.4	11	2	50.8
10	4	48.0	11	4	51.4
10	6	48.7	11	6	51.9
10	8	49.3	11	8	52.5
10	11	50.2	11	10	53.1
			11	12	53.7

Level	Shuttle	VO2 Max	Level	Shuttle	VO2 Max
12	2	54.3	13	2	57.6
12	4	54.8	13	4	58.2
12	6	55.4	13	6	58.7
12	8	56.0	13	8	59.3
12	10	56.5	13	10	59.8
12	12	57.1	13	13	60.6