ORIGINAL ARTICLE

Body mass index, physical activity and dietary habits between young Greek athletes and non-athletes

Avgerinos G. Andreas[1], Tsoulphas Chris, Douda Helen
Democritus University of Thrace

Abstract

The purpose of this study was to evaluate the body mass index (BMI), physical activity (PA) and dietary habits of students living in a province of North Greece, who exercised or not exercised regularly and compare the findings to the international guidelines for health. A total of 575 male and female students participated in the study and were divided into sub-groups according to their age (9-13 yrs, n=240 & 14-17 yrs, n=335) and their athletic experience (athletes, n=243 & non-athletes, n=332). The data were collected by the *Physical Activity & Lifestyle Questionnaire* (PALQ) and the *24 hour Dietary Recall Questionnaire* (24hDRQ). Data analysis showed that 85% of male and female athletes met international guidelines of PA for health, accumulating >60′ minutes/day of moderate-vigorous PA (MVPA), as compared to 37% of non-athletes. Moreover, the athletes accumulated significantly more MVPA as compared to their peers who did not participate in organized sports. Eating habits did not differ between athletes and non-athletes, and a percentage of 83% did not meet the international recommendations for a healthy diet. However, no statistically significant differences were found in BMI between athletes and non-athletes. These finding revealed that a significant proportion of the participants did not meet the recommended dietary and PA guidelines of international health organizations, and it seems that regular exercise did not protect young people from the problem of overweight. Thus, it is necessary to implement prevention programs that aim to improve food choices and increase PA.

Keywords: Obesity, primary, secondary education, exercise, nutrition

Introduction

Modern lifestyle has a direct relationship with increasing body weight which, nowadays, is a global health problem (Janssen, et al., 2005; Sameera & Amar, 2012). In the last years, Greece has been the negative lead among European countries since 29.5% of young people are classified as overweight and 11.7% as obese (Avgerinos, 2008). Researchers agree that changes in lifestyle and eating habits, combined with the decrease in PA are the main causes (Farajian, et al., 2011; Hill, Wyatt, Reed &, Peters 2003). Thus, international health organizations recommend specific guidelines for the prevention and treatment of the phenomenon (Khan, et al, 2009).

International guidelines encourage young people to participate in PA of moderate or higher intensity for at least an hour on a daily basis, while at least three times a week they should be involved in PA for about 20′ minutes and with such intensity that maintains and promotes fitness (Cavil, Biddle & Sallis, 2001). In addition, nutrition guidelines recommend that young people should

[1] Correspondence: Avgerinos G. Andreas, PhD, Dept of Physical Education & Sports Science, Democritus University of Thrace, University Campus, GR - 69100 Komotini , E-mail: aavgerin@phyed.duth.gr

consume 5-7 portions of grain per day, 3-4 portions of fruit, 4-6 portions of vegetables, 3 portions of milk and up to 2 portions of protein products to have a good health (USDHHS & USDA, 2005; ACSM, 2009).

However, as they grow up, males and especially females become progressively less active (Nader, Bradley, Houts, McRichie, & O'Brien, 2008; Avgerinos, Stathi, Almond & Kioumourtzoglou, 2002), risking their future health significantly (Anderson & Butcher, 2006). The risk becomes greater because the young adopt dietary habits characterized by overeating food with low nutritional value (Vlachou Kanioura, Klontza, Zachariadi, & Matsaniotis, 2004; Dowdell & Santucci, 2004; Hasspidou & Fotiadou, 2001). Research has shown that as children are getting older, they reduce fruit, vegetable, dairy product and breakfast consumption (Lytle, Seifert, Greenstein, & McGovern, 2000; Lien, Lytle & Klepp, 2001). This is more typical for boys, since girls seem to follow a more balanced diet in all ages (Warwick, McIlveen & Strugnell, 1999). In the study of Royo-Bordonada, et al. (2003), a sample of 1.112 children aged 6-7 years were evaluated for they dietary habits and diet quality through the *Healthy Eating Index* (HEI). The results showed that 3.7% of students had a *deficient diet*, 94.7% a diet *needing improvement* and only 1.6% had a *good diet* according to the ranking score of HEI. The results of studies on nutritional behavior are alarming for the Greek youth. The assessment of dietary habits of 1.122 young people aged 3-18 years showed that 30% had a *deficient diet*, 64% a diet *needing improvement*, and only 6% had a *good diet*, according to the score of HEI (Linardakis, 2005).

Promoting an active and healthy lifestyle should be a priority for the Greek youth. The regular involvement with sports is one of the basic guidelines recommended by various health organizations. One could assume that young people, who deal with sports consistently, will be considerably more active than their counterparts of the same age and gender who are not engaged in sports, and they will also have more favorable eating habits. This hypothesis is based on findings which support that young people who participate in organized sports accumulate 4.2 hours more PA per week, compared to non-athletes (12 versus 7.8 hours/week) (Croll et al., 2006) and they consume more dairy products, fruit, vegetables, vitamins and minerals compared to peers who do not engage in sports (Cavadini, Decarli, Grin, Narring, & Michaud, 2000; Cupisti, D'Alessandro & Castrogiovanni, 2002). This difference in lifestyle would also be expected to positively affect body weight of young people who are more active, as well.

The purpose of this study was to evaluate the body mass index, physical activity and dietary habits among young athletes and non-athletes and compare the findings to the international guidelines for health. The research hypotheses were that young people who exercised regularly as athletes: (1) would have a more favorable BMI, (2) would be more active and would meet a higher degree of the PA guidelines for health, and (3) would have healthier eating habits, compared to their peers of the same age and gender who are non-athletes.

Method

Participants

The participants were 575 clinically healthy students 9-17 years old, of primary and secondary education, living in one suburban area of northern Greece, who participated voluntary. The participants were: (a) Students who were not involved in any organized form of exercise/sport. They were randomly selected from the local public schools, and (b) Students who were involved systematically in sports (such as basketball, soccer, martial arts, skiing, track and field, tennis, climbing and weightlifting), they were enrolled in local sport clubs and they were involved in the sport, for at least three years. All participants were divided into sub-groups as following:

1. 75 male and 48 female athletes aged 9-13 years.
2. 98 male and 22 female athletes aged 14-17 years.
3. 44 male and 73 female non-athletes aged 9-13 years.
4. 63 male and 152 female non-athletes aged 14-17 years.

Measurements

Anthropometric measurements

Body height was measured using a Seca 208 to the nearest 1 cm. Weight was measured to the nearest 0.1 Kg with a calibrated mechanical scale (Seca 761). Body mass index (BMI) was calculated as body mass in kilograms divided by height in meters squared (Kg/m^2). Participants were classified as overweight if their BMI was equal to or higher than the sex-and age-specific 85^{th} percentile from the *Centers for Disease Control and Prevention*'s Growth Charts.

Physical Activity Assessment

Physical activity was assessed by the *Physical Activity and Lifestyle Questionnaire* (PALQ) (Avgerinos, 2002). The PALQ evaluates: a) the average daily energy expenditure (expressed in kcals • kg-1 • day-1), and b) the average time (in minutes) the participant spent on *light*, *moderate* and *vigorous* intensity PA. On this basis, the participants were classified: (i) for values <33 (kcals • kg^{-1} • day^{-1}) as *sedentary*, (ii) for values 33-36.99 as *inactive*, (iii) for values 37-39.99 as *moderate active*, and (iv) for values ≥40 as *active*. The subjects classified in the first two categories, accumulated <60 minutes of *moderate* intensity PA and did not meet the guidelines of PA for health (Cavill, Biddle & Sallis, 2001). The calculation of energy expenditure was based on the answers of the subject concerning his/her PA: a) at school (physical education, school breaks, participation in school sports) and b) outside the school (transportation, participation in sports clubs, free play). The validity and reliability of PALQ has already been measured in Greek population (Argiropoulou, Michalopoulou, Aggeloussis, & Avgerinos, 2004; Avgerinos, Argiropoulou, Almond & Michalopoulou, 2000).

Assessment of dietary behavior

The dietary behavior of the participants was assessed by the *24-hour Dietary Recall Questionnaire* (24hDRQ). The 24hDRQ has been used by other researchers in Greece (Kartsonas, 2009), and its validity and reliability had been proved (McPherson, Hoelscher, Alexander, Scanlon & Serdula, 2000). Moreover, the *Healthy Eating Index* (HEI) was used, which is a reliable method for assessing the type and quality of food for youth older than two years (USDHHS & USDA, 2005).

The *Healthy Eating Index* examines the eating behavior in relation to the portions of the five major groups of the food pyramid. The HEI consists of ten (10) components that each represents different aspects of a healthy diet. Specifically, the components 1-5 assess the extent to which a person's diet is consistent with the proposed dietary recommendations for each of the five major food groups shown in the food pyramid. The components 6-9 assess nutrient intake and finally the 10th component evaluates the variety of food consumption (Basiotis, Carlson, Gerrior, Juan, & Lino, 2002) (see Table 1). All components of HEI have a minimum score of zero (0) and a maximum score of ten (10), while the intermediate score was calculated proportionally. The total sum of the scores of all components is rated on a scale graduation with minimum value 0 and maximum 100, where values <51 evaluate nutrition as *inadequate*, 51 to 80 as in *need of improvement* and 80 to 100 as *good*.

Table 1. Ten components of Healthy Eating Index (HEI).

Components	Score[1]	Minimum scoring criterion	Maximum scoring criterion
1. Group of grain (bread, cereal, rice and pasta)	0-10	0 portions	6-11 portions[2]
2. Group of vegetables	0-10	0 portions	3-5 portions[2]
3. Fruit group	0-10	0 portions	2-4 portions[2]
4. Group of dairy (milk, yogurt and cheese)	0-10	0 portions	2-3 portions[2]
5. Group of meat (meat, poultry, fish, dry beans, eggs and nuts)	0-10	0 μερίδες	2-3 μερίδες[2]
6. Total fat intake	0-10	≥ 45% of energy	≤ 30% of energy
7. Intake of saturated fat	0-10	≥ 15% of energy	< 10% of energy
8. Cholesterol intake	0-10	≥ 450mg	≤ 300mg
9. Sodium intake	0-10	≥ 4800mg	≤ 2400mg
10. Variety of food	0-10	≤ 3 different types of food	≥ 8 different types of food

[1] The score between the minimum and maximum values (0 to 10) was calculated proportionately.
[2] The recommended number of portions depends on age, sex, the daily recommended energy and the level of PA of the individual (sedentary, moderately active and active enough).

Procedure

All measurements were completed within the schools' environment. The collection of data was performed in spring during March, April and May 2010. The two questionnaires were completed voluntarily and anonymously in class under the guidance and supervision of the research team. The researchers then evaluated the weight and height of participants. The subjects were dressed in light clothing and were barefoot. Height and weight assessments were conducted in a private setting.

Statistical analysis

The data were analysed using descriptive statistics, analysis of variance with three factors (three way ANOVA, 2x2x2) and the multiple comparison test of LSD. The homogeneity of variance was controlled by the Levene's test. Independent variables were sex (male, female), age (9-13 yrs & 14-17 yrs) and athletic experience (athletes, non-athletes). Dependent variables were BMI, PA, and HEI. The original data from the two questionnaires were transformed appropriately according to the manufacturers' instructions. Statistical significance was set at an *alpha* level of .05. For the statistical analysis the SPSS program v.15 was used.

Results

The anthropometric characteristics of the participants according to age, gender and athletic involvement are presented in Table 2.

Table 2. Anthropometric characteristics of the participants.

Sport		Participants (n)	Height (cm)	Weight (kg)	BMI	Variance of BMI
Males 9-13 yrs-old	Weightlifting	3	156±0.49	56.66±13.01	23.17±5.60	
	Basket Ball	22	159±0.11	55.59±11.78	21.81±3.67	
	Swimming	2	145±0.00	46.50±7.77	22.11±3.69	
	Football	32	155±0.84	47.61±7.94	19.63±2.50	
	Martial Arts	5	156±0.10	53±11.55	21.58±3.42	
	Skiing	2	158±0.02	53±4.24	21.12±2.25	
	Track & Field	8	158±0.09	41.25±5.70	16.50±1.79	
	Tennis	1	154	52	21.92	
	TOTAL	75	156±0.09	50.17±10.08	20.34±3.28	12.5-29.2
	NON-ATHLETES	44	155±0.10	48.02±11.55	19.55±3.50	13.8-29.5

Table 2. Anthropometric characteristics of the participants.

	Sport	Participants (n)	Height (cm)	Weight (kg)	BMI	Variance of BMI
Females 9-13 yrs-old	Basket Ball	18	159±0.08	52.77±8.80	20.76±2.54	
	Swimming	1	152	40	17.31	
	Martial Arts	3	150±0.14	45±5.65	19.97±2.13	
	Track & Field	17	161±0.05	49.11±7.85	18.80±2.50	
	Tennis	9	156±0.06	56±9.77	22.79±3.57	
	TOTAL	48	159±0.07	51.93±9.33	20.42±3.11	14.4-28.1
	NON-ATHLETES	73	156±0.08	50.08±11.93	20.09±3.76	13.8-30
Males 14-17 yrs-old	Basket Ball	22	178±0.08	71.31±11.20	22.22±2.33	
	Swimming	3	172±0.13	65.66±16.19	21.79±2.42	
	Football	62	175±0.07	68.78±9.35	22.33±2.54	
	Martial Arts	2	186±0.02	83±11.31	24.04±4	
	Track & Field	7	177±0.06	67.25±10.85	21.27±2.90	
	Tennis	2	158±0.11	48±2.24	19.25±1.05	
	TOTAL	98	176±0.08	68.90±10.32	22.18±2.43	17.7-27.4
	NON-ATHLETES	63	173±0.06	68.40±12.23	22.56±3.75	16.4-35.5
Females 14-17 yrs-old	Clibing	3	162±0.02	56±8.66	21.10±2.72	
	Weightlifting	2	165±0.04	63±2.82	23.13±0.15	
	Basket Ball	6	169±0.03	61.16±7.80	21.38±2.75	
	Martial Arts	1	176	57	18.40	
	Track & Field	10	164±0.03	53.55±6.71	19.88±2.34	
	TOTAL	22	166±0.05	57.62±6.87	20.76±2.32	17.7-25
	NON-ATHLETES	152	165±0.05	57.65±8.77	20.91±2.94	12.1-31.2

Table 3 presents the classification of the participants based on their BMI, in normal weight, overweight and obese, according to the Centers for Disease Control and Prevention's growth charts.

Table 3. Classification (%) of the participants based on their BMI.

9-13 yrs-old	Athletes (Males)	Non-Athletes (Males)	Athletes (Females)	Non-Athletes (Females)
Normal weight	64.3%	73.9%	70.8%	67.9%
Overweight	30%	21.7%	18.8%	21.8%
Obese	5.7%	4.3%	10.4%	9%
14-17 yrs-old				
Normal weight	71.9%	66.7%	92%	84.8%
Overweight	25.8%	25.8%	8%	14%
Obese	-	6.1%	-	0.6%

The three-way ANOVA showed that there were not statistically significant differences in BMI between athletes and non-athletes for both gender and age groups (9-13 years $F_{1,591}$=1.391, p>.05, and 14 - 17 years

$F_{1,591}$=1.949, p>.05). These findings reject the first research hypothesis, that young people dealing with sports consistently would have a more favorable BMI compared to their peers who were not athletes.

Table 4 presents descriptive data on the PA level of the participants (in kcals • kg^{-1} • day^{-1}), and Table 5 shows the ranking of participants in activity categories, according to their responses to the PALQ, by age and gender.

Table 4. Mean (M) and standard deviation (SD) of PA based on the PALQ (in kcals • kg-1 • day-1).

	Athletes (Males) M±SD	Non-Athletes (Males) M±SD	Non-Athletes (Females) M±SD	Non-Athletes (Females) M±SD
9-13 yrs-old	44±5	39±4	42±5	37±3
14-17 yrs-old	40±4	36±3	40±4	35±2

(i) <33 (kcals•kg^{-1}•day^{-1}) = sedentary, (ii) 33-36.99 = inactive, (iii) 37-39.99 = moderately active, (iv) ≥40 = active.

Table 5. Classification of participants (%) according to their score in PALQ.

9-13 yrs-old	Athletes (Males)	Non-Athletes (Males)	Athletes (Females)	Non-Athletes (Females)
Classification	(n=75)	(n=44)	(n=48)	(n=73)
i) Sedentary	-	-	-	1
ii) Inactive	7.1	45.7	8.3	56.4
iii) Moderately active	17.1	23.9	20.8	30.8
iv) Active	75.7	30.4	70.8	12.8
14-17 yrs-old	Athletes (Males)	Non-Athletes (Males)	Athletes (Females)	Non-Athletes (Females)
Classification	(n=98)	(n=22)	(n=63)	(n=152)
i) Sedentary	-	3	-	3.9
ii) Inactive	31.5	62.1	12	78.7
iii) Moderately active	22.5	24.2	36	13.5
iv) Active	46.1	10.6	52	3.9

The three-way ANOVA and the LSD multiple comparison test showed that the athletes were significantly more active than the non-athletes of the same age, in both age groups (age 9-13 $F_{1,595}$=131.803, p<.05, and at age 14-17 years, $F_{1,595}$=120.373, p<.05). Table 5 shows that both genders participating in organized sports regularly fulfil to a larger extent the PA guidelines for health, with boys being significantly more active than girls of the same age. These findings confirm the second research hypothesis which stated that young people dealing with sports consistently would be more active compared to their peers who were not athletes and they would fulfil the PA guidelines for health to a larger extent (Cavil, Biddle & Sallis, 2001).

Table 6 presents descriptive data on the performance of the participants in the healthy eating index (HEI), and Table 7 presents the daily intake of the five food groups, based on their responses to the 24hDRQ.

Table 6. Mean (M) and standard deviation of the participants on HEI.

	Athletes (Males) M±SD	Non-Athletes (Males) M±SD	Athletes (Females) M±SD	Non-Athletes (Females) M±SD
9-13 ετών	73±6	72±8	72±7	71±7
14-17 ετών	73±8	71±7	72±9	70±8

<51=*Inadequate nutrition*, 51-80=*need improvement*, and 80-100=*good nutrition*.

Table 7. Daily intake of the five food groups (expressed in portions).

		Food Groups				
	AGE	CEREAL	VEGETABLES	FRUITS	MILK / DAIRY	Lean MEAT / BEANS
(M) Athletes	9-13	6≥portions 34.3%	5≥portions 12.9%	3≥portions 7.1%	3≥portions 17.1%	5 portions 4.3%
Non-Athletes		30.4%	8.7%	10.9%	8.7%	4.3%
(F) Athletes		5≥portions 29.2%	4≥portions 16.7%	3≥portions 8.3%	3≥portions 14.6%	5 portions 10.4%
Non-Athletes		33.3%	11.5%	10.3%	6.4%	3.8%
(M) Athletes	14-17	7≥ portions 24.7%	6≥portions 3.4%	4≥portions 2.2%	3≥portions 15.7%	6 portions 11.2%
Non-Athletes		34.8%	3%	1.5%	12.1%	4.5%
(F) Athletes		6≥portions 20%	5≥portions 4%	3≥ μερίδες 12%	3≥portions 8%	5 portions 8%
Non-Athletes		20.8%	9%	5.1%	7.3%	6.7%
TOTAL of Athletes (M+F)	9-17	5-7 portions 27%	4-6 portions 10%	3-4 portions 7%	3 portions 14%	5-6 portions 8%
TOTAL of Non-Athletes (M+F)		30%	8%	7%	9%	5%

M=males, F=females

The three-way ANOVA revealed no statistically significant differences in energy intake expressed in portions, from the five food groups between athletes and non-athletes, for both gender and age groups. Table 8 shows the classification of the participants (%) according to their score on HEI.

Table 8. Classification of the participants (%) according to their score on HEI.

9-13 yrs-old	(M) Athletes	(M) Non-Athletes	(F) Athletes	(F) Non-Athletes
Inadequate	-	-	-	-
Need improvement	81.4%	80.4%	83.3%	85.9%
Good nutrition	17.1%	19.6%	16.7%	14.1%
14-17 ετών	(M) Athletes	(M) Non-Athletes	(F) Athletes	(F) Non-Athletes
Inadequate	-	1.5%	-	2.8%
Need improvement	80.9%	84.8%	88%	89.3%
Good nutrition	16.9%	10.6%	12%	7.3%

Where: M=males, F=females

Of the total number of the participants, the nutrition of 86% of the non-athletes and 83% of the athletes *needed improvement*, considering their ranking in HEI. The three-way ANOVA revealed no statistically significant differences in eating behaviour between male athletes and non-athletes ($F_{1,586}$=.996, p>.05) and between female athletes and non-athletes (F(1,586) =.662, p>.05) aged 9-13 years old. Also, there were no statistically significant differences between male athletes and non-athletes ($F_{1,586}$=1.263, p>.05) and between female athletes and non-athletes ($F_{1,586}$=1.465, p>.05) aged 14-17 years old. These findings reject the third research hypothesis that young people dealing consistently with sports would have healthier eating habits, compared to their peers who were not athletes.

Discussion

The purpose of this study was to evaluate the body mass index, physical activity and dietary habits of young students, who exercised or not exercised regularly and compare the findings to the international guidelines for health. The results showed that there were no statistical differences in BMI among young people who deal with sports consistently and their peers who are non athletes. These findings are in agreement with the findings of Hassapidou and Mastrantoni (2001) and disagree with other studies which support that athletes have either lower (Croll, et al., 2006) or higher BMI (Boisseau, et al., 2002) than non-athletes. This conflict may be due to the fact that the researchers did not take into account the individual characteristics of the athletes or the nature of the sport involved (aerobic, anaerobic, strength, etc), in opposition to the study of Croll et al. (2006). This perhaps led to raise BMI of all athletes artificially and may also explain partly why the athletes had BMI similar to their peer non-athletes. Also, the lack of difference is likely due to the fact that the researchers used the BMI as an indicator of obesity, which is not always suitable for athletes (Anderson & Butcher, 2006).

Analysis of the data confirmed the hypothesis that young people dealing with sports consistently would be more active than their peers of the

same sex and would satisfy the international PA guidelines for health in a greater proportion. However, the finding that children who did not engage in sports are to a large extent sedentary or inactive is alarming and increases with age especially for girls. The findings were similar to those of the study of Croll et al. (2006), where athletes accumulated about 12 hours of moderate/vigorous PA per week, while non-athletes accumulated 7.8 hours (respectively 10 hours for the female athletes, compared to 6.1 hours for the non-athletes of the same age), and other researchers (Walters, Barr-Anderson, Wall & Neumark-Sztainer, 2009).

The assessment of dietary habits showed that the largest percentage of the participants, regardless their consistent engagement with sports (86%) or not (83%), needed to improve their diet. This finding was unorthodox for children dealing systematically with sports, since nutrition should be considered crucial for improving performance and also because coaches are expected to have a positive influence on their athletes' eating behavior. This finding is in contrast to the findings of other researchers which showed that athletes have a better nutritional profile than their peers who do not participate in organized sports. Specifically, Cavadini et al. (2000) found that young athletes consume more cereals, dairy products, fruit, vegetables, larger quantities of carbohydrates, fiber, minerals and vitamins, and smaller amounts of fat (Cupisti et al., 2002) compared to non-athletes.

The findings of the present study on the eating behavior of the participants are remarkable, because they show that young people, especially those who do not meet the PA guidelines for health, are in danger of further weight gain, but also of confronting cardiovascular diseases, various types cancer, diabetes and others diseases associated with sedentary lifestyle and overeating, as they grow older (Khan et al, 2009). The discouraging results concerning the poor diet of the participants are in accordance with recent findings of other researchers in Greece. Specifically, the study of Tsamita, Kontogiannis and Kartelioti (2007) found that only 4% of the students consumed the recommended grain, 0.93% vegetables, fruit 38%, 58.5% milk and 15 % protein.

The findings suggest that a significant proportion of the participants do not meet the recommended dietary and PA guidelines, and it seems that regular exercise does not protect young people from the problem of weight gain. The findings of this study underline the implementation of intervention programs that aim to promote a healthy lifestyle. Particular emphasis should be given to improving dietary behaviour and increasing physical activity, especially for children who do not engage in organized forms of exercise, such as girls. Also, the findings indicate that it would be useful to implement programs aiming at informing the coaches and parents of young athletes about issues relating to the principles of balanced nutrition and the relationship between diet and performance.

References

American Dietetic Association, Dietitians of Canada & American College of Sports Medicine (2009). Nutrition and Athletic Performance. *Medicine in Science in Sports and Exercise*, 41(3), 709-731.

Anderson, P.M. & Butcher, K.F. (2006). Childhood Obesity: Trends and Potential Causes. *The Future of Children*, *16*(1), 19-45.

Argiropoulou, C.E., Michalopoulou, M., Aggelousis, N., & Avgerinos, A. (2004). Validity and reliability of physical activity measures in Greek high school age children. *Journal of Sports Science and Medicine*, *3*, 147-159.

Avgerinos, A. (2002). *Lifestyle and physical activity patterns of Greek children: The applicability of a school based intervention programme*. Unpiblished doctoral dissertation. Loughborough University, U.K.

Avgerinos, A. (2008). Lifestyle and physical activity of young people in Greece: The role of the school and the community in the promotion of active living. *European Psychomotricity Journal*, *1*, 73-77.

Avgerinos, A., Argiropoulou, E. Almond, L., & Mihalopoulou, M. (2000). A new instrument assessing energy expenditure: Reliability and convergent validity of the Physical Activity Questionnaire and Lifestyle. *Sport Performance and Health, 2*(4), 281-300.

Avgerinos, A., Stathi, A., Almond, L., & Kioumourtzoglou, E. (2002). Lifestyle and physical activity patterns of Greek students. *Physical Activity and Quality of Life, 3*, 18-30.

Basiotis, P.P., Carlson, A., Gerrior, S.A., Juan, W.Y., & Lino, M. (2002). The Healthy Eating Index: 1999-2000. U.S. Department of Agriculture, Center for Nutrition Policy and Promotion.

Boisseau, N., Le Creeff, C., Loyens, M., & Poortmans, J. (2002). Protein intake and nitrogen balance in male non-active adolescents and soccer players. *European Journal of Applied Physiology*, *88*(3), 288-293.

Cavadini, C., Decarli, B., Grin, J., Narring, F., & Michaud, P-A. (2000). Food habits and sport activity during adolescence: differences between athletic and non-athletic teenagers in Switzerland. *European Journal of Clinical Nutrition*, *54*(1), 16-20.

Cavill, N., Biddle, S., & Sallis, J.F. (2001). Health enhancing physical activity for young people: statement of the United Kingdom expert consensus conference. *Pediatric Exercise Science*, *13*, 12-25.

Khan, L.K., Sobush, K., Keener, D., Goodman, K., Lowry, A., Kakietek, J., & Zaro, S. (2009). Recommended Community Strategies and Measurements to Prevent Obesity in the United States. Centers for Disease Control and Prevention: *Morbidity and Mortality Weekly Report*, *58*, RR-7, 1-26.

Croll, J.K., Neumark-Sztainer, D., Story, M., Wall, M., Perry, C., & Harnack, L. (2006). Adolescents involved in weight-related and power team sports have better eating patterns and nutrient intakes than non sport-involved adolescents. *Journal of the American Dietetic Association*, *106*, 709-717.

Cupisti, A., D'Alessandro, C., & Castrogiovanni, S. (2002). Nutrition knowledge and dietary composition in Italian adolescent female athletes and non-athletes. *International Journal of Sports Nutrition and Exercise Metabolism*, *12*(2), 207-219.

Dowdell, E.B. & Santucci, M.E. (2004). Health risk behaviour assessment: Nutrition, weight, and tobacco use in one urban seventh-grade class. *Public Health Nursing*, *21*(2), 128-136.

Farajian, P., Risvas, G., Karasouli, K., Pounis, G.D., Kastorini, C.M., Panagiotakos, D.B., & Zampelas, A. (2011). Very high childhood obesity prevalence and low adherence rates to the Mediterranean diet inGreek children: the GRECO study. *Epub*, *217*(2), 525-30.

Hassapidou, M.N. & Manstrantoni, A. (2001). Dietary intakes of elite female athletes in Greece. *Journal of Human Nutrition and Dietetics*, *14*, 391-396.

Hill, J.O., Wyatt, H.R., Reed, G.W, & Peters J.C. (2003). Obesity and the environment: where do we go from here? *Science*, *299* (5608), 853-855.

Janssen, I., Katzmarzyk, P.T., Boyce, W.F., Vereecken, C., Mulvihill, C., Roberts, C., Currie, C., & Pickett, W. (2005). Comparison of overweight and obesity prevalence in school-aged youth from 34 countries and their relationships with physical activity and dietary patterns. *Obesity Reviews*, *6*, 123-132.

Kartsonas, Th. (2009). *Dietary habits and body composition of adolescent football players of A.E.K.* F.C. Thesis, Department of Nutrition and Dietetics, University of Crete .

Khan, L.K., Sobush, K., Keener, D., Goodman, K., Lowry, A., Kakietek, J., & Zaro, S. (2009). Recommended Community Strategies and Measurements to Prevent Obesity in the United States. Centers for Disease Control and Prevention: *Morbidity and Mortality Weekly Report*, *58*, RR-7, 1-26.

Lien, N., Lytle, L.A., & Klepp, K.I. (2001). Stability in consumption of fruit, vegetables, and sugary foods in a cohort from age 14 to age 21. *Preventive Medicine*, *33*(3), 217-226.

Linardakis, M. (2005). Incidence of metabolic syndrome in children, adolescents and adult population in Crete in relation to their diet. Thesis, Department of Medicine, Faculty of Health Sciences, Universitiy of Crete.

Lytle, L.A., Seifert, S., Greenstein, J., & McGovern, P. (2000). How do children's eating patterns and food choices change over time? Results from a cohort. *American Journal of Health Promotion*, *4*(4), 222-248.

McPherson, R.S., Hoelscher, D, M., Alexander, M., Scanlon, K.S., & Serdula, M.K. (2000). Dietary Assessment Methods among School-Aged Children: Validity and Reliability. *Preventive Medicine*, *31*(2), 11-33.

Nader, P.R., Bradley, R.H., Houts, R.M., McRichie, S.L., & O'Brien, M. (2008). Moderate-to-vigorous physical activity from ages 9 to 15 years. *Journal of the American Medical Association, 300*(3), 295-305.

Royo-Bordonada, M.A., Gorgojo, L., Martín-Moreno, J.M., Garcés, C., Rodríguez-Artalejo, F., Benavente, M., Mangas, A., & de Oya, M. (2003). Spanish children's diet: compliance with nutrient and food intake guidelines. *European Journal of Clinical Nutrition*, *57*(8), 930-939.

Sameera, K., & Amar, K. (2012). Childhood obesity: A global public health crisis. *International Journal of Preventive Medicine*, *1*, 1–7.

Tsamita, I., Kontogianni, P., & Karteliotis, K. (2007). Assessing dietary habits in a city of Greek province. *Inquiries in Physical Education & Sport*, *51*(1), 105-115.

U.S. Department of Health and Human Services and U.S. Department of Agriculture (2005). *Dietary Guidelines for Americans*, 6th Edition, Washington, DC: U.S. (www.usda.com).

Vlachou, K.A., Kanioura, H.F., Klontza, D.P., Zachariadi, A.X., & Matsaniotis, N., (2004). The effects of television viewing in Greece, and the role of the paediatrician: a familiar triangle revisited. *European Journal of Pediatrics*, *155*(12), 1432-1476.

Walters, S., Barr-Anderson, D.J., Wall, M., & Neumark-Sztainer, D. (2009). Does participation in organized sports predict future physical activity for

adolescents from diverse economic backgrounds? *Journal of Adolescent Health*, *44*, 268-274.

Warwick, J., McIlveen, H., & Strugnell, C. (1999). Food choices of 9-17-year olds in Northern Ireland, influences and challenges. *Nutrition and Food Science*, *99*, 229-238.

World Health Organization (2011). *Global Strategy on Diet, Physical Activity and Health*. Retrieved 17-11-2012 from http://www.who.int/dietphysicalactivity/publications/en/