

The role of breakfast consumption and participation in extracurricular physical activity in the development of obesity in students from 10 to 12 years old.

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Abstract

The purpose of the present research was to study the role of breakfast consumption and participation in extracurricular physical activity in the development of obesity in Greek students from 10 to 12 years old. In the present study, took part 301 students aged 10-12 years old from elementary schools of various areas in Greece. Measurements were conducted concerning the height, body weight, waist circumference (WC) and hip circumference (HC) of the children. Body Mass Index (BMI) was used for the evaluation of the degree of the excess weight and obesity, while WC was used for the evaluation of the degree of central obesity, according to the rates for children and adolescents which are determined by the American Center for Disease Control (CDC). A questionnaire about dietary habits, adapted to the Greek reality (Papadopoulou, 2001) and based on Lapalainen et al. (1998) and Contento et al. (1995) questionnaires was used. The type, intensity, frequency and duration of physical activity were recorded by the Leisure-Time Exercise Questionnaire of Godin and Shephard (1985). For the statistical analysis, the statistical package SPSS ver. 18.0 for windows was used. The data analysis showed that about 1/3 of the students presented excess weight or/and obesity (32%), according to the categorization of the BMI, but they also did not participate in extracurricular physical activities (33%). T-test analysis for independent samples revealed that BMI was significantly higher in students who did not exercise, compared to students who participated in extracurricular physical activities ($t=-5.57$, $p<0.01$). The application of chi square test showed a significant effect of the participation in physical activities in students' rating according to BMI ($\chi^2=35.967$, $p<0.001$). In addition, the Pearson correlation analysis revealed that BMI had a significant negative correlation with physical activity ($r=-0.286$, $p<0.01$), showing that as physical activity is increasing so BMI is decreasing. As far as breakfast is concerned, about 1/3 of the students rarely consume breakfast (28%), while 15% of the students sometimes consume breakfast, but not on a daily basis. The one way Analysis of Variance showed that BMI is affected by breakfast consumption. Thus, from the post hoc analysis with the student-Newman-Keuls test was evident that students who rarely eat breakfast have a significantly higher BMI than students who sometimes or always eat breakfast ($F=5.678$, $p<0.01$). The Analysis of Variance revealed that children's physical activity is affected by breakfast consumption. Indeed, post hoc analysis with Scheffe test showed that children who rarely eat breakfast had significantly lower physical activity score ($F=8.372$, $p<0.001$) than children who always or sometimes eat breakfast. In conclusion, from the results of the present study arise high percentages of excess weight and obesity, high percentages of students who do not exercise and also high percentages of students who rarely or/and sometimes consume breakfast. The combination of the above factors, which interact with each other, consist a problem that requires prevention and is associated with increased occurrence of health disorders associated with obesity, both directly and in adulthood. For their prevention it is worth giving special emphasis and attention on increasing children's physical activity, on breakfast consumption, as well as on students' nutrition in general. The truth is that the combination of physical activity and diet may be more effective in combating obesity and its installation from childhood.

Key words: breakfast consumption, diet, inactivity, exercise, leisure time, obesity.

Introduction

Worldwide changes in people's lifestyle regarding eating behavior and exercise habits have resulted in the increase of the number of obese people. According to the World Health Organization (WHO, 2002) and the

International Obesity Task Force (IOTF, 2004) in recent years, more than 1 billion people in the world were overweight and at least 300 million were obese.

Today obesity constitutes one of the major problems as its percentage is increasing and even it has doubled in the last 20 years (Centers for Disease Control & Prevention, 2004) not only in adults, but also in adolescents and children, in whom it is increasing at a dangerous rate. The occurrence and prevalence of childhood obesity have highlighted obesity problems in many countries in the world as a very important and therefore national health problem (WHO, 2004; Lobstein, & Jackson-Leach, 2006; Ogden et al., 2010; Wang, & Lobstein, 2006).

Consequently, the prevalence of childhood obesity in the USA is more than 25% of the child population, while in countries in South America such as Peru and Mexico just 6% and 4.8% of the children are obese respectively (IOTF, 2004). Moreover, in a study of schoolchildren in 13 countries in Europe, Israel and USA, the biggest obesity percentage was found in USA and Greece, specifically 29.2% and 28% for boys and 28.9% and 27.9% for girls, respectively (Lissau et al., 2004). Especially in Greece, during 1982-2002, there was observed a vertical increase in excess weight from 16.5% to 26.9% and in prevalence of obesity from 4.2% to 12.7% in 12 years old boys (Manios et al., 2005), as well as an average increase of 6 Kg of body weight in children up to 18 years old (Roditis et al., 2009).

Nevertheless, obesity does not only concern a person's appearance and body image, but unfortunately has adverse health effects due to the associated morbidity risk. It is worth mentioning that overweight or obese children are more likely to have a predisposition to cardiovascular diseases, hypertension, dyslipidemia and diabetes type II (Freedman et al., 1999; Daniels, 2006). Furthermore, childhood obesity is an important risk factor for adult life, since a percentage of 25-50% of obese children and adolescents become obese adults (Fachantidou, & Hassapidou, 2002).

Obesity is a combination of many factors. These factors include heredity, lack of physical activity, excess food consumption low in nutritional value and lack of breakfast consumption (Fachantidou, & Hassapidou, 2002; Department of Health, Physical Activity, Health Improvement and Prevention, 2004). However, although a significant obesity incrimination factor is genetic, the prevailing scientific view today is that its flare-up is probably due to some environmental factors, the most important of which is considered the "modern" way of life (Centers for Disease Control & Prevention, 2009).

The modern man presents an increased daily calorie intake and in contrary a reduced energy consumption, both in simple everyday activities and in organized forms of physical activity (Hallal et al., 2006; Sugiura et al., 2007; Manios et al., 2010). Therefore, many children become obese as a consequence of few opportunities for physical activity in combination with the consumption of high-calorie food (Sothorn, 2004), as well as the general habits related to nutrition. Certainly, it is worth mentioning that childhood is the age during which people adopt behaviors related to healthy nutrition, such as breakfast consumption, and to physical activity, which can potentially affect children's health in the future (Beyers, 2001). However, these two factors have not been studied in combination adequately in a sample of Greek students. For this reason, the purpose of the present research was to study the role of breakfast consumption and participation in extracurricular physical activity in the development of obesity in Greek students from 10 to 12 years old.

Method

Sample

Three hundred and fifty students were selected randomly among the students of the last two grades from eight elementary schools of various areas in Greece and particularly from primary schools in Patra, Veria, Edessa, Skydra, Paros and Kefalonia. Students were selected by the method of random sampling from the nominal catalogue kept in Primary Schools according to the participation criteria of the research. The students who had significant health problems associated with exemption from the lesson of physical education and exclusion from physical activity programs, a special diet or/and medication that could affect results, were disqualified.

After the selection followed a communication with the parents of the chosen students regarding the research. The parents received a written consent form about their children's participation in the research, as well as a questionnaire about the personal medical history of their children, concerning any health problems. However, there were not any pupils with such health problems, while those students who reported unwillingness to participate in the research or/and did not submit their parents' written consent and the questionnaire about their personal medical history were excluded. Thus, the sample of the research consisted of 301 students, 149 girls and 152 boys, aged 10-12 years.

Data Collection Process

The approval for the research conduction was provided by the principals of the primary schools in consultation with the teachers of Physical Education, after a brief description of the purpose and plan of the research. Students participated in the research process voluntarily and with their parents' written consent. The research protocol was approved by the Laboratory of Hygiene and Sports Nutrition, and Laboratory of Sports Medicine of the School of Physical Education and Sport Sciences of Aristotle University in Thessaloniki. The data collection took place during the lesson of Physical Education concerning the anthropometries, as well as the completion of

the questionnaires by students and their parents regarding dietary habits and physical activity. The procedures were consistent with the ethical standards set by the World Medical Association (2000).

Anthropometry Measurements

Measurements were conducted concerning:

- a. body weight with the precision scale SECA beam balance 710 with approximation 0.1 kg and with light clothing without shoes.
- b. height with the special measuring heightmeter SECA 208, adjusted on the wall with approximation 0.5cm, barefoot.
- c. waist circumference in centimeters with a special plastic tape at the height of the navel and below the costal arch.
- d. hip circumference in centimeters with a special plastic tape at the height of the pubes.

The degree of obesity was assessed by determining the Body Mass Index (BMI), which is a reliable tool for assessing the degree of obesity in both adults and children. The degree of obesity was determined using the norms for the children of Centers for Disease Control and Prevention, which proposes the 85th percentile as overweight threshold and determines the obesity level above the 95th percentile (Dietz, & Robinson, 1998; Cole et al., 2000).

Moreover, the ratios waist-to-hip (WHR) and waist-to-height (WHtR) were calculated.

Questionnaires

Eating habits

A questionnaire about dietary habits adapted to the Greek reality (Papadopoulou, 2001) was used regarding the control of eating habits. It was based on Lapalainen et al. (1998) and Contento et al. (1995) questionnaires.

Physical Activity

The type, intensity (light, moderate, high), frequency and duration of physical activity were recorded by the Leisure-Time Exercise Questionnaire of Godin and Shephard (1985). The validity and reliability of the questionnaire were documented by relevant researches (Godin, & Shepard, 1985; Kriska, & Caspersen, 1997).

Statistical Analysis

The statistical package SPSS ver. 18.0 was used for the statistical analysis and data processing. Descriptive statistics was used for qualitative and quantitative variables with the presentation of frequency distributions and percentages. Regarding the differences between two groups, it was used t-test for independent samples, while for the differences between more groups it was used analysis of variance (one way ANOVA), as well as the non-parametric test Kruskal-Walis. Additionally, χ^2 test was executed to determine the differences between qualitative variables. A correlation analysis with Pearson or Spearman coefficient was applied in order to determine the existence of correlation between the studied variables, and crosstabulations in order to present the distributions of the variables' values. Finally, a linear regression analysis and a stepwise regression analysis were used to find the factor with the greatest contribution to the BMI. The level of significance was set to $p < 0.05$.

Results

Table 1 presents the averages and standard deviations of the students' anthropometric characteristics.

Table 1. Students' anthropometric characteristics

Variables	Mean	Std.Dev.
Age (years)	11.00	1.0
Height (m)	1.49	0.08
Weight (kg)	44.17	9.43
BMI (kg/m ²)	19.65	3.22

Figure 1 shows students' distribution according to BMI. As shown in Figure 1, the percentage of students who are overweight and obese reached cumulatively the 32%. That is, the 1/3 of the sample presented excess weight and/or obesity.

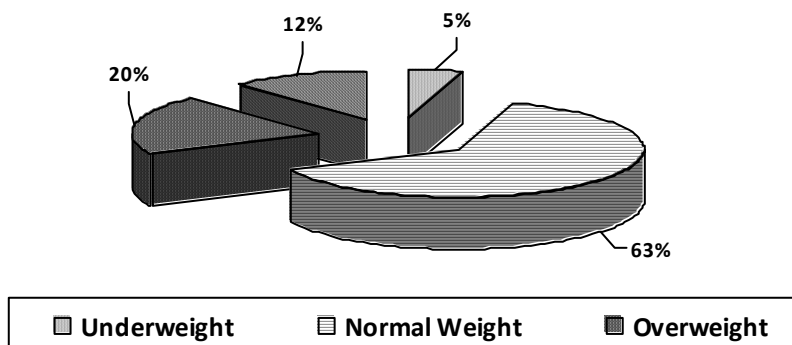


Figure 1. Students' distribution according to Body Mass Index

Figure 2 presents the percentage of students according to their participation in extracurricular sports activities.

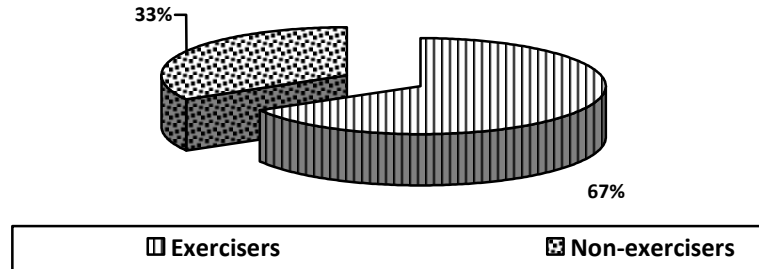


Figure 2. Students' participation in extracurricular sports activities

As shown in Figure 2, the majority of students participate in extracurricular sports activities. However, 1/3 of the total sample does not participate in extracurricular sports activities. The students who exercise participate in sports activities about 3.3 ± 1 times a week for about 1.62 ± 0.5 hours on average each time. Figure 3 shows the distribution of the students who exercise according to the energy expenditure of sports activities.

Sports Activities Intensity

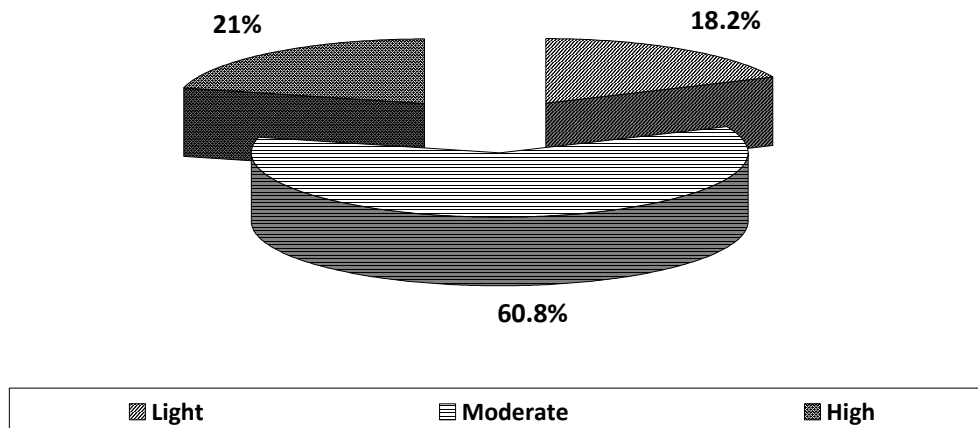


Figure 3. Distribution of the students who participate in extracurricular physical activity according to the energy expenditure of sports activities

As shown in Figure 3, from all the students who exercise, 18.2% participated in activities of light intensity with an energy expenditure <4 METS, 60.8% participated in moderate activities with an energy expenditure 4-7 METS and 21% participated in activities of high intensity with an energy expenditure >7 METS. Figure 4 shows the BMI for the students who participate in extracurricular physical activity (PA) and the students who do not participate in extracurricular physical activity (PA). As shown, the students who exercise have higher BMI compared to the students who do not exercise.

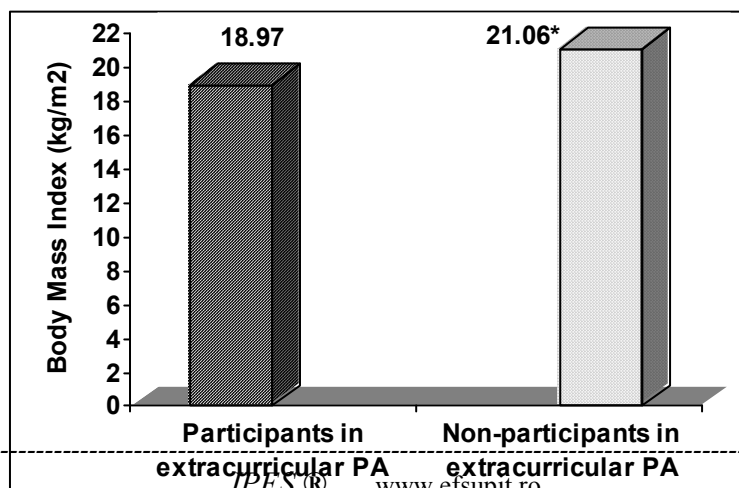


Figure 4. BMI of students who participate and do not participate in extracurricular PA (*: $p < 0.01$)

T-test analysis for independent samples showed that there is a significant difference between the students who participate in extracurricular PA and those who do not participate regarding their BMI ($t = -5.57$, $p < 0.01$). Figure 5 presents the distribution of the students who exercise and the students who do not exercise according to BMI. It is evident that the 2/3 of the students who exercise have a normal weight. Instead, the 1/2 of the students who do not exercise are overweight or/and obese.

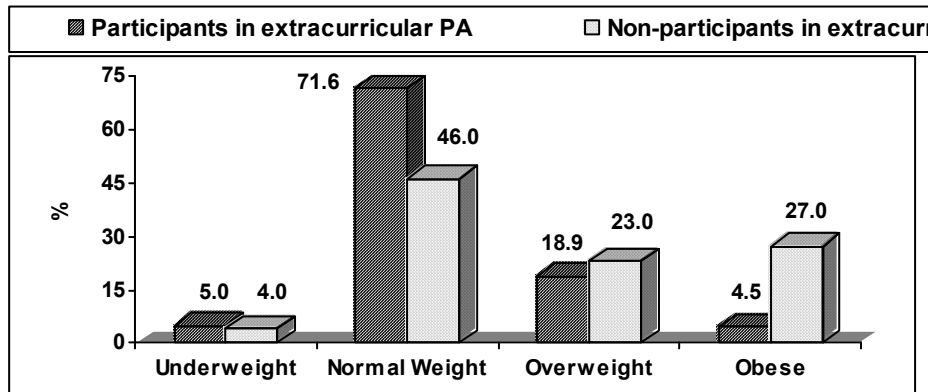


Figure 5. Distribution of students who participate and do not participate in extracurricular PA according to BMI

The application of the chi square test showed a significant effect of the participation in extracurricular PA in students' rating according to BMI ($\chi^2 = 35.967$, $p < 0.001$). In addition, the Pearson correlation analysis revealed that BMI had a significant negative correlation with PA ($r = -0.286$, $p < 0.01$), showing that as PA is increasing so BMI is decreasing. In Figure 6 is presented the percentage of the students with respect to breakfast consumption.

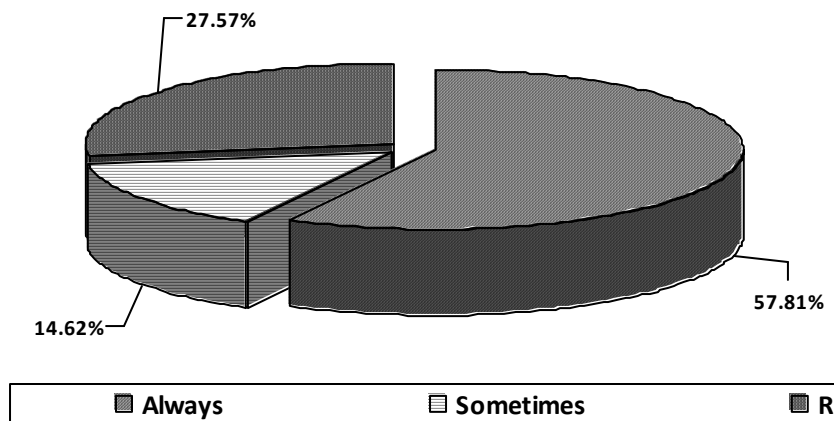


Figure 6. Breakfast consumption

As it is shown, a significant percentage of the students, 28% of them, rarely consume breakfast. On the other hand, a non-negligible percentage, 15% of the students sometimes consume breakfast, but not on a daily basis (Fig. 6). Figure 7 presents BMI regarding breakfast consumption. As it is shown, BMI increases as the frequency of breakfast consumption decreases.

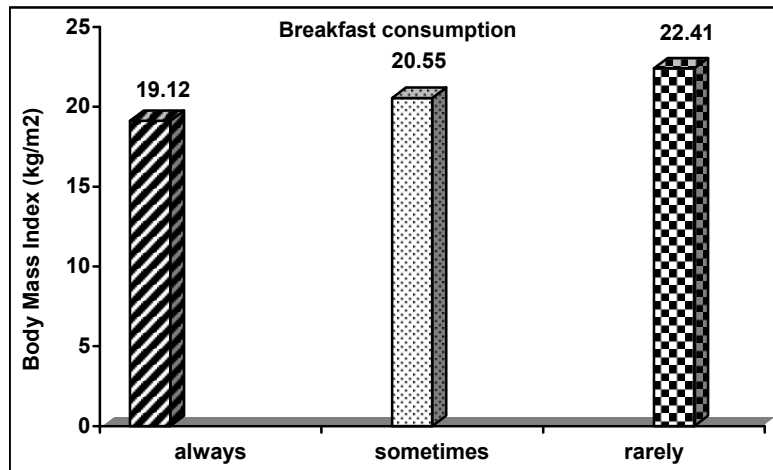


Figure 7. Breakfast consumption and BMI.

The one way ANOVA showed that BMI is affected by breakfast consumption. From the post hoc analysis with the student-Newman-Keuls test was evident that students who rarely eat breakfast have a significantly higher BMI than students who sometimes or always eat breakfast ($F=5.678$, $p<0.01$). In Figure 8 below is presented the score, in units, of extracurricular PA according to Godin and Shephard (1985). As it is shown, PA decreases as the consumption of breakfast is reduced (Fig. 8).

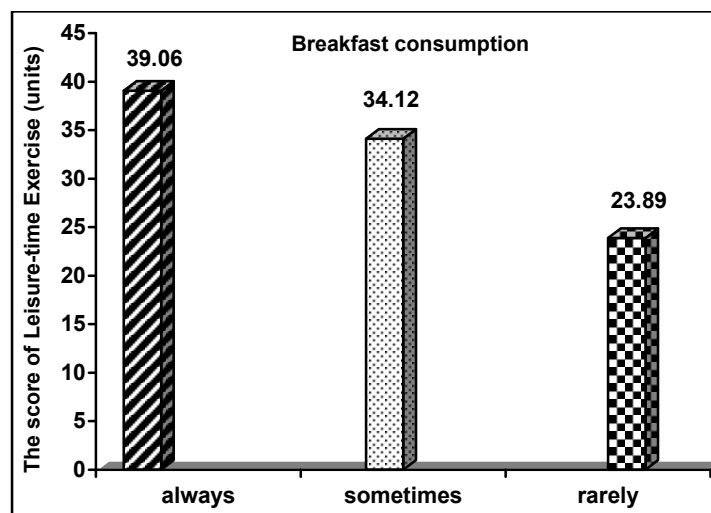


Figure 8. The score of extracurricular PA in relation to breakfast consumption.

The one way ANOVA revealed that children's physical activity is affected by breakfast consumption. Indeed, post hoc analysis with Scheffe test showed that children who rarely eat breakfast had significantly lower physical activity score ($F=8.372$, $p<0.001$) than children who always or sometimes eat breakfast (Fig. 8). Below, in Table 2 is presented the stepwise multiple linear regression which was conducted between students' breakfast consumption and physical activity in order to find the most important factor influencing BMI (Table 2).

Table 2. Stepwise multiple linear regression about the variation in students' BMI.

Prognostic factors	R ² change	β	T	P
Breakfast consumption	0.048	0.227	4.02	0.000
Physical activity	0.082	0.289	-5.55	0.000

The stepwise multiple linear regression showed that the variation concerning the BMI is explained at a rate of 8.2% by physical activity, and 4.8% from breakfast consumption (Table 2).

Discussion

It is a fact that in the last three decades lifestyle has changed dramatically, preventing the involvement of individuals in physical activities. This lifestyle has a direct impact on children as well, leading them to spend

less and less time on physical activity and free play (Pate et al., 2006). However, sedentary lifestyle is not just a bad habit, but unfortunately it is responsible for the death of two million people every year since it causes health problems such as heart disease, diabetes and obesity (WHO, 2005).

In the present study high percentages of excess weight or/and obesity were observed. More specifically, 20% of the students were overweight and 12% obese. That is, cumulatively, the 1/3 of the students were overweight or/and obese. The results of the present study are in agreement with other researchers' results concerning Greek children (Bouziotas et al., 2004; Koutsis et al., 2008; Lissau et al., 2004; Manios et al., 2005; Mavrovouniotis, & Argiriadou, 2005; Mavrovouniotis et al., 2008; Mavrovouniotis, 2012; Roditis et al., 2009; Tambalis et al., 2013).

Among the major causes of childhood obesity are the reduced physical activity and sedentary lifestyle, combined with many hours of television and with changes that have occurred from time to time in eating habits, such as increased calorie intake especially from food rich in fats and low in dietary fibers (Bouziotas et al., 2004; Koutsis et al., 2008; Mavrovouniotis, & Argiriadou, 2005; Mavrovouniotis al., 2008; Mavrovouniotis, 2012).

The reduction of physical activity and inactivity, which starts even from infancy and childhood, are the beginning of future health problems (Diggelidis et al., 2007; Koutsis et al., 2008; Mavrovouniotis et al., 2008; Mavrovouniotis, & Argiriadou, 2005). Unfortunately, most studies show a significant reduction of physical activity in children and especially in teenagers in recent years (Dehghan et al., 2005; Haslam, & James, 2005) while a research of Canadian Pediatric Society (2002) in children aged 9-12 years old showed that only 56% had the required levels of physical activity. Reduced physical activity was also observed in the students of our sample, since 33% of them, that is 1 in 3 does not participate in any organized extracurricular sports activity, and 67% participate in organized sports activities in their free time. However, the activities in which the students participate are in the largest percentage (79%) of low or/and moderate intensity. Similar results, regarding the type and intensity of exercise in which the students of the present study participated, were reported in the researches of Harrell et al. (2003) and Frömel et al. (2002), as well as in researches in Greece (Klonaridou et al., 2006; Koutsis et al., 2008; Papadopoulou, 2001).

Moreover, the present results revealed that students' BMI has a significant negative correlation with physical activity. Other studies which are consistent with the present results also demonstrate that more hours of physical activity reduce the chance for excess weight and obesity (Ha et al., 2005; Dietz, 1996; Durant et al., 1994; Nicklas et al., 2001). Therefore, the present results showed that the BMI of the students involved in sports is significantly lower compared to the BMI of the students who do not exercise. Physical activity, thus, contributes to the reduction of BMI (Obarzanek et al., 1994; Sallis, & McKenzie, 1991) and of body fat percentage in children as well (Moore et al., 2003). In addition, the present results showed that physical activity is the most important predictor in terms of BMI, a fact that highlights the value and importance of participation in physical activities.

Except for physical activity, eating habits are responsible for the increase in obesity. A research of Collison et al. (2010) showed that BMI has a positive correlation with bad nutrition. Therefore, children should follow and develop a healthy attitude towards food and they should adopt healthy eating habits and prudent diet even from preschool age (Mikkila et al., 2005), as these preferences will accompany them in adulthood as well (Guo et al., 2000).

Thus, Zerva et al. (2007) found that frequent and small in quantity meals associate with lower percentages of total and central obesity in children compared to those who ate less meals. On the contrary, an irregular eating schedule has a high association with obesity installation (Elgar et al., 2005; Salbe et al., 2002). It is worth mentioning that the frequency of meals, the adoption of Mediterranean diet and breakfast consumption help in treating excess weight and obesity (Kontogianni et al., 2010).

Breakfast is the most important meal of the day. However, it is the meal which is more often omitted. The results of the study of Rampersaud et al. (2005) in USA and Europe recorded a decrease in the frequency of breakfast consumption ranging from 10-30% in children and adolescents (Siega-Riz et al., 1998). In agreement with the results of the present study, it appears that 27.57% of the children rarely eat breakfast and 14.62% sometimes eat breakfast, while just more than half of the students (57.81%) always eat breakfast.

However, regular breakfast intake is very important because it has been associated with reduced weight and lower BMI compared to children who do not receive breakfast regularly (Affenito, 2007; Barton et al., 2005; Keski-Rahkonen et al., 2003; Rampersaud, 2005). In agreement, Kapantais et al. (2010), their research in Greece has also showed that skipping breakfast is associated with obesity and unhealthy habits. Moreover, in another large study conducted in Greece by the Foundation "Aristides Daskalopoulos" (2007) was revealed that breakfast consumption in children is directly related to BMI and their mothers' educational level. Similarly, in the present study the analysis of variance showed that BMI is affected by breakfast consumption. Thus, students who rarely eat breakfast have significantly higher BMI than those who sometimes or always eat breakfast. In addition, it was observed a significant negative correlation of BMI with breakfast consumption in children. It could be said that regular breakfast consumption prevents obesity and causes longer sense of repletion which depends on breakfast composition such as conciseness in fibers, and it also helps the appetite regulation and reduces the amount of lunch (Giovannini et al., 2008; Panagiotakos et al., 2008; Yang et al., 2006).

Moreover, breakfast consumption is associated in most studies with cognitive ability and school performance reinforcement, and generally with better mental health (Lien, 2008; Liu et al., 2013; Widenhorn-Müller et al., 2008). In the present study was found that breakfast consumption affects children's physical activity. Specifically, children who rarely consume breakfast had significantly lower physical activity scores than children who sometimes or always eat breakfast. It also showed that breakfast consumption is an important predictor and affects students' BMI. This is consistent with the findings of other researches which reveal that breakfast consumption and meals with the family have been associated with healthy eating and obesity prevention (Patrick, & Nicklas, 2005; Rodriguez, & Moreno, 2006).

In conclusion, from the results of the present study arise high percentages of excess weight and obesity, high percentages of students who do not exercise and also high percentages of students who rarely or/and sometimes consume breakfast. The combination of the above factors, which interact with each other, consist a problem that requires prevention and is associated with increased occurrence of health disorders associated with obesity, both directly and in adulthood. For their prevention it is worth giving special emphasis and attention on increasing children's physical activity, on breakfast consumption, as well as on students' nutrition in general. The truth is that the combination of physical activity and diet may be more effective in combating obesity and its installation from childhood.

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