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Editorial

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New Insight on Adipose Tissue Function in Advanced Renal Failure

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Adipose tissue has been considered simply as an exclusive fat storage organ for a long period. Later in the mid-1990s and after identification of leptin, a revolution occurred in understanding of white adipose tissue function. In fact, adipose tissue has been recognized as a dynamic endocrine organ, which could affect whole body homeostasis.[1] Thereafter, more than 50 secretory peptides, which are called "adipokines" or "adipocytokines", with diverse metabolic functions have been identified[2] and the biological role of adipose tissue became more sophisticated and interesting.

The adipokines may act through an autocrine, paracrine and endocrine manner. They are supposed to be involved in a wide range of physiologic to pathologic processes including dietary intake and appetite regulation, energy expenditure, insulin resistance, lipid metabolism, immunity, inflammation and acute-phase responses, vascular homeostasis, endothelial function, angiogenesis and so on.[2,3] Leptin, adiponectin, ghrelin, resistin, visfatin, vaspin, omentin, TNF-α, and IL-6 are among the most studied adipokines in health and disease. However, studies regarding the extensive biological and metabolic functions of adipokines are still ongoing.

Along with the recent advances in the field of obesity, adipose tissue and adipokines, a great interest has been emerged regarding their relationship with different pathophysiological conditions and their probable mechanism in metabolic disorders. Diabetes, metabolic syndrome, non-alcoholic fatty liver and cardiovascular diseases are among the common diseases, which have been studied. Moreover, pharmacological, nutritional and medical interventions have been done increasingly with the aim of altering the function of adipose tissue, and consequently the gene expression and circulating levels of adipokines in order to decline metabolic dysfunctions and improve the patients' outcomes. Investigating the role of adipose tissue and adipokines in renal insufficiencies especially in End Stage Renal Disease (ESRD) and patients under dialysis has been taken into consideration in recent years.

Adipokines could be destructive for kidney tissue due to the impairment of endothelial function, inducing oxidative stress and inflammation, and stimulating the sympathetic nervous system of kidneys.[4] It has been proposed that most adipokines act as proinflammatory factors. In contrast, few adipokines act as anti-inflammatory agents and could be protective against the metabolic complications.[5] Obesity could induce kidney disease through disrupting the balance between protective such as adiponectin and pathologic such as TNF-α adipokines.[4] The changes of the adipokines' levels such as leptin, adiponectin, visfatin, resistin, IL-6 and TNF-α could result in the reduction of Glomerular Filtration Rate (GFR) and increasing albuminuria, which are among the major pathophysiological mechanisms in CKD. Although the exact mechanism of adipokines' action is still unclear, they may play their role by affecting various types of cells in kidney nephrons.[6] Previous studies have shown that increased levels of leptin could lead to hypertrophy in glomerular mesangial cells that could activate fibrotic and inflammatory pathways, and also thickening of the basement membrane and consequently glomerulosclerosis.[6] Moreover, it has been demonstrated that hyperleptinemia could alter the metabolic function of proximal tubular cells and lead to tubular apoptosis.[7] These structural changes in the nephrons

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could result in increased proteinuria, albuminuria and fibrotic pathways in tubular cells through altering the permeability of the cells.[6] Adiponectin, another major adipokine, is recognized essentially as a protective peptide.[6] It has been shown that in obesity, hypoadiponectinemia increases Reactive Oxygen Species (ROS) generation and thereby oxidative stress in podocytes, which could probably change the GFR.[6]

Regardless of the roles of adipocytokine in the pathophysiology of renal diseases, the gene expression and circulating levels of these peptides change significantly along with disease progression, particularly in ESRD and dialysis therapy.[6,8,9] Considering the multiple effects of adipocytokines, their alterations may have considerable biologic, metabolic, and clinical outcomes, which are not well studied in uremic conditions so far.[9,10] For example, the circulating levels of adiponectin increase in diabetic nephropathy and ESRD, which unexpectedly have been observed to be correlated with higher mortality[11-12] and complicate the role of adiponectin in kidney failure.

Moreover, with the identification of new adipokines including Zinc alpha-2 glycoprotein (ZAG), apelin, lipocalin, adiploin, etc. investigating their probable roles in different metabolic aspects of advanced kidney insufficiencies are of major importance. For instance, ZAG is an adipokine that has been proposed to play a role in various metabolic disorders including lipid metabolism,[13] insulin resistance,[14-15] energy hemostasis,[13,16-17] inflammation,[18,19] and determining body composition.[20,21] In addition, recent studies indicated that the circulating levels of ZAG are increased in hemodialysis.[22-23] However, there are not enough data regarding the effect of ZAG elevation on mentioned disorders in ESRD or patients under regular hemodialysis and the probable effects on patients' prognosis.

In summary, it seems that adipose tissue and its products could be considered as a novel field of study, which may play a major role in the metabolic alteration of advanced renal failure. The limited and mainly descriptive data indicate that further studies are required, more specifically with the aim of identifying the precise roles and mechanisms of adipose tissue and its products in uremic patients, and their probable impact on patients' outcome.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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Research

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Behavioural and Psychological Variables Associated with Overweight and Obesity in Gran Canaria, Spain

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ABSTRACT

Objective: To obtain data of the prevalence of overweight and obesity of adolescents from educational centers in Gran Canaria (Spain) and to analyze behavioural and psychological factors associated with weight status.
Method: 1336 participants aged 12-20 years, were randomly selected. The studied variables related to weight status were: adherence to the Mediterranean diet, physical activity, nutritional knowledge and meal frequency. All of these were assessed by validated questionnaires.
Results: The prevalence of obesity was 10.4% (8.6% girls, 12.6% boys) and overweight 22.3% (24% girls, 20.4% boys). There are no significant differences between weight status and adherence to the Mediterranean diet but we observed that participants with normal weight obtained the highest mean score in the KIDMED test and the highest frequency in the "high" group of adhesion. Adolescents with normal weight spent fewer hours in sedentary activities ($p \leq 0.05$) and more hours on physical activity ($p \leq 0.05$) than those with underweight, overweight or obesity. There were no significant differences between nutritional knowledge and weight status. Participants who never or almost never had breakfast, morning break, afternoon break and dinner had a higher prevalence of obesity and overweight (respectively, $p \leq 0.001$; $p \leq 0.001$; $p \leq 0.001$; $p \leq 0.05$) than those who had these meals every day.
Conclusion: The prevalence of obesity and overweight in the adolescent population is still very high in the Canary Islands. The consideration of factors related to obesity in adolescence and learning more about the variables that predispose or prevent these problems can significantly contribute to the development of treatments and prevention programs specifically for this context or other similar contexts.

KEYWORDS: Obesity; Prevalence; Mediterranean diet; Behavioural variables.

ABBREVIATIONS: ESO: Educación Secundaria Obligatoria; WHO: World Health Organisation; HELENA: Healthy Lifestyle in Europe by Nutrition in Adolescence.

INTRODUCTION

Obesity remains a major public health problem. The potential and serious consequences that can derive from it, as well as its high prevalence in the world, justify the need to find accurate and periodic information about obesity.[1]

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The increase in obesity and overweight in children and adolescents in the past two decades is particularly alarming.[2] According to WHO, in 2013 more than 42 million children under five years old were already overweight.[3]

In Spain, and especially in the Canary Islands, the prevalence of obesity among children and adolescents is very high, particularly among Canarian adolescent girls.[4] The enKid studies have shown the prevalence of obesity in Spain to be 13.9% and of overweight 12.4% (of overweight and obesity 26.3%).[5] Geographically, the Canary Islands and Andalusia had the highest prevalence of obesity, and La Rioja, Asturias, the Basque Country, Galicia and Madrid had the lowest prevalence of obesity.[5,6]

Regarding the etiology of obesity, it includes genetic and lifestyle factors. In relation to lifestyle, analyzing eating habits and physical activity in the population is basic. Therefore, in this work we have studied the adherence of the participants to the Mediterranean diet. This concept was proposed and developed by Keys and Grande[7] and was defined as a dietary pattern followed in regions around the Mediterranean (mainly Crete, Greece and the south of Italy). The principal aspects of this dietary pattern include high consumption of fruit and vegetables, olive oil as a source of fat, low consumption of meat and dairy products and moderate consumption of wine.[8]

Its health benefits have been amply demonstrated by numerous epidemiological studies[9] and are related to a lower total mortality and a lower incidence of cardiovascular disease, obesity, type 2 diabetes, metabolic syndrome and hypertension.[10]

In relation to eating habits we also studied the frequency of meals. Breakfast is the meal most related to obesity, and skipping it has been identified as a factor associated with excess weight.[1,11] We have also related the morning break, lunch, afternoon break and dinner to the weight status of the participants.

Regarding physical activity, scientific studies have evidenced its association with obesity in adolescents, as well as with metabolic and cardiovascular diseases. Therefore, it is important to pay attention to the amount of physical activity performed by adolescents in order to consider the development of effective obesity prevention and treatment programs.[12]

Other sociodemographic variables such as educational level of parents have been related to weight status, so we have included them in this study. We also found interesting the assessment of adolescents nutritional knowledge level and its association with their weight status. Children are conditioned by their family dietary practices, while adolescents are cognitively more able to choose what they eat and to think about the dietary habits that they follow.[13] There are many studies that have shown the association between variables like eating habits and obesity in childhood and adolescence. However, there is a lack of investigations focused on Spanish adolescents.[11,14-16] Therefore, the aim of this research was to find overall data of prevalence of overweight and obesity in the Canarian adolescents and associate them with different behavioural variables.

MATERIAL AND METHODS

Participants and Procedure

This study was reviewed and approved by the Ethics Committee of the University of Las Palmas de Gran Canaria. All participants or (in the case of minors) their legal representatives signed an informed consent agreeing to participate in this research.

The sample of this cross-sectional study was representative and consisted of 1336 participants with a mean age of 15.0 (SD = 2.1 years). All adolescents who participated were from compulsory secondary education (aged 12 to 16; known in Spain as Educación Secundaria Obligatoria - ESO) to post-compulsory education at high school (aged 16 to 18; known in Spain as Bachillerato) or vocational training enrolled in various schools on the island of Gran Canaria.

The different educational centers and classrooms (one per level) were randomly selected. We contacted the centers and met with heads or school counselors to explain what the work was to consist of, to distribute the informed consent and to coordinate the activity. Once the date was specified, the team moved to the participating centers for the implementation of the different tests. The time required for conducting these tests was approximately 40 minutes, and they were at all times supervised by a team member. Later, the students were weighed and measured without shoes, jackets or heavy coats. The anthropometric study was conducted by experienced professionals.

Instruments

An ad hoc sociodemographic questionnaire was used, which collected information such as gender, age, educational level of parents, family illnesses reported by participants, being on diets, meal frequency and so on.

The Mediterranean Diet Quality Index (KIDMED) questionnaire[17] was used to determine the level of adherence to the Mediterranean diet. It consists of 16 items that are related to Mediterranean dietary patterns. Each of the 12 items that denoted positive connotation with respect to the Mediterranean diet were scored as a +1, while questions that had a negative connotation to the Mediterranean diet (there are four) were scored as a -1. Then, all the items were summed to produce a total score. Based on this score, participants' adherence was classified as high (score ≥ 8), medium (4–7) or low (score ≤ 3).

To assess physical activity habits of adolescents the

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Krece Plus questionnaire was used.[18] This test consisted of two questions that assessed the number of hours per day dedicated to sedentary activities like watching TV or playing video games and the number of hours per week dedicated to physical activity. So, it allowed us to obtain an easy index for screening the level of activity or inactivity of the adolescents.

Each question offered six possible answers and scored ranges from 0 to 5. The maximum total value of the test was 10 and the minimum 0. According to this overall score individuals were classified into three categories corresponding to their level of physical activity:

- Good: score ≥ 9 for boys; ≥ 8 for girls
- Regular: 6–8 points in boys; 5–7 in girls
- Bad: score ≤ 5 in boys; ≤ 4 in girls

The NKT questionnaire was used to study the nutritional knowledge of participants in a formal way. This test was previously validated in children and adolescents.[19,20] The NKT questionnaire was designed for students who had not received any special education on "nutrition".[19] The questionnaire included a total of 23 multiple choice questions categorized in specific scales: knowledge of concepts (e.g. subscales "energy intake and energy metabolism" or "physical activity"), instrumental knowledge (e.g. subscale "nutrient contents") and knowledge of causal relationships (e.g. subscales "sweeteners" or "oral health"). Each multiple-choice question offered three possible answers and the "don't know" category, and only one was correct. To calculate the total score, correct answers scored 1 and the rest 0. Finally, all correct answers were summed up and calculated as a percentage of the total.

To weigh students we used a scale ranging from 0 to 150 kg with a precision of 200 g. For the measurement of body height a Holtain stadiometer (Holtain Ltd., Dyfed, UK) with an accuracy of 1 mm was used. Waist circumference was measured with a metal, flexible but inextensible tape (Holtain Ltd., Dyfed, UK) on a 0.1 cm scale.

Growth references from the WHO[21,22] were used to establish the weight status of the adolescents, following this criteria:

Weight state	Criteria
Overweight	IMC > +2 SD
Obesity	IMC > +1 SD
Thinness	IMC < -2 SD
Severe thinness	IMC < -3 SD

Data Analysis

The SPSS statistical package (version 19.0. for Windows) was used throughout for the analysis. Descriptive analyses of the variables used the test of proportions for qualitative variables, measurements of central tendency (mean or median) and measures of dispersion (Standard Deviation - SD) for quantitative variables. Bivariate analyses of the proportionality of distribution of categorical variables were estimated using the $\chi 2$ test.

For continuous variables, we used the Kolmogorov-Smirnov test to check that the variables were normally distributed. Normality was accepted as $p > 0.05$. For comparisons of continuous variables in which the distributions were normal, the comparisons of absolute means between groups were assessed with Student's t-test. For comparisons of variables in which the distributions were non-normal, the comparisons of absolute means between groups were made with the nonparametric Wilcoxon test of the sum of the ranges.

RESULTS

Obesity Prevalence

The overall prevalence of obesity was 10.4% (n=139), of overweight 22.3% (n=299), of normal weight 65.1% (n=873) and of underweight 1.9% (n=25). Six participants of the total initial sample (N=1342) would not be weighed (because they would not let us to do it), representing a 0.4% of missing subjects. So the final sample was of 1336 adolescents.

Table 1 shows prevalence data of weight status in relation to sociodemographic characteristics. By sex, the prevalence of obesity in boys was of 12.6% (n=76) and in girls it was of 8.6% (n=63). Regarding age groups, we found a higher prevalence among participants of 13 years old or less (16.3%) and of 18 years old or more (11.6%) than in the other groups. Moreover, the prevalence of obesity was higher among adolescents with a father and/or mother with a medium-low level of education, family history of obesity (self-referential) and among those participants who had been on diets in the last year. We did not find significant differences in weight status among participants of public and private schools or among those who reported having relatives with anorexia or bulimia.

Adherence to the Mediterranean diet

In relation to the questionnaire of adherence to the Mediterranean diet (KIDMED), the mean score of the population was 5.83±2.52. A total of 19.2% of the population belonged to the group of "low adherence", 53.7% to the group "medium adherence" and the 26.9% belonged to the "high adherence" group. Table 2 shows lower scores in girls (5.56±2.47) than in boys (6.15±2.54) ($p < 0.001$).

There were no significant differences between weight status and adherence to the Mediterranean diet between the participants (Table 3). However, we observed that participants with normal weight obtained the highest mean score in the KIDMED

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	Underweight n (%)	Normal weight n (%)	Overweight n (%)	Obesity n (%)	Total n (%)	p
Gender						0.063
Boys	10 (1.7%)	393 (65.3%)	123 (20.4%)	76 (12.6%)	602 (100%)	
Girls	15 (2%)	480 (65.4%)	176 (24%)	63 (8.6%)	734 (100%)	
Age (years)						<0.001
≤13	7 (2.3%)	161 (52.4%)	89 (29%)	50 (16.3%)	307 (100%)	
14-15	7 (1.5%)	319 (67.7%)	102 (21.7%)	43 (9.1%)	471 (100%)	
16-17	7 (1.7%)	295 (73.2%)	73 (18.1%)	28 (6.9%)	403 (100%)	
≥18	4 (2.6%)	98 (63.2%)	35 (22.6%)	18 (11.6%)	155 (100%)	
Center type						NS
Public	19 (1.9%)	642 (64.1%)	228 (22.8%)	113 (11.3%)	1002 (100%)	
Private	6 (1.8%)	231 (69.2%)	71 (21.3%)	26 (7.8%)	334 (100%)	
Father's educational level						0.027
High	4 (1.5%)	198 (73.1%)	52 (19.2%)	17 (6.3%)	271 (100%)	
Medium-Low	17 (2.4%)	448 (63.6%)	162 (23%)	77 (10.9%)	704 (100%)	
Mather's educational level						0.016
High	5 (1.7%)	217 (72.8%)	59 (19.8%)	17 (5.7%)	298 (100%)	
Medium-Low	17 (2.2%)	480 (63.4%)	179 (23.6%)	81 (10.7%)	757 (100%)	
Family diseases						
Alcoholism						NS
YES	1 (1.8%)	36 (65.5%)	13 (23.6%)	5 (9.1%)	55 (100%)	
NO	24 (1.9%)	835 (65.3%)	286 (22.4%)	134 (10.5%)	1279 (100%)	
Family obesity						
YES	0 (0%)	65 (51.2%)	28 (22%)	34 (26.8%)	127 (100%)	
NO	25 (2.1%)	806 (66.8%)	271 (22.5%)	105 (8.7%)	1207 (100%)	
Family anorexia						NS
YES	0 (0%)	9 (52.9%)	5 (29.4%)	3 (17.6%)	17 (100%)	
NO	25 (1.9%)	862 (65.5%)	294 (22.3%)	136 (10.3%)	1317 (100%)	
Family bulimia						NS
YES	0 (0%)	7 (50%)	4 (28.6%)	3 (21.4%)	14 (100%)	
NO	25 (1.9%)	864 (65.5%)	295 (22.3%)	136 (10.3%)	1320 (100%)	
Dieted in past year						<0.001
YES	1 (0.3%)	131 (41.3%)	115 (36.3%)	70 (22.1%)	317 (100%)	
NO	24 (2.4%)	740 (72.8%)	184 (18.1%)	68 (6.7%)	1016 (100%)	

Table 1: Weight status (WHO) and socio demographic characteristics.

	BOYS Media (DT)	GIRLS Media (DT)	TOTAL Media (DT)	p
KIDMED	6.15 (2.54)	5.56 (2.47)	5.83 (2.52)	<0.001
Krece Plus	6.05 (2.17)	5.06 (2.31)	5.51 (2.30)	<0.001
Hours TV, etc.	2.33 (1.27)	2.21 (1.26)	2.26 (1.26)	NS
Hours physical activity	3.37 (1.72)	2.28 (1.77)	2.77 (1.84)	<0.001

Table 2: KIDMED and Krece Plus distributed by gender.

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test and the highest frequency in the "high" group of adhesion.

	Normal weight	Overweight	Obesity	p
Mediterranean diet adherence				NS
Total M (DT)	5.89 (2.55)	5.76 (2.50)	5.64 (2.31)	
Groups n(%)				NS
Low	166 (19%)	56 (18.7%)	8 (32%)	
Intermediate	463 (53%)	166 (55.5%)	11 (44%)	
High	244(27.9%)	77 (25.8%)	6 (24%)	

Table 3: Mediterranean diet adherence (KIDMED) and weight status

Physical Activity

A total of 55.1% of the adolescents belonged to the group of "bad physical activity", 29.8% to the "regular physical activity" group and 14.8% of the population belonged to the "good physical activity" group. The overall mean of hours of sedentary activities of the population was 2.26±1.26. The mean of hours that the adolescents practice physical activity was 2.77±1.84.

Table 2 shows a higher score in boys (6.05±2.17) than in girls (5.06±2.31) (p< 0 .001) in the Krece Plus (physical activity). Participants with normal weight spent fewer hours in sedentary activities such as watching television or playing video games (p< 0 .05) and more hours of physical activity (p< 0.05) than those with underweight, overweight or obesity (Table 4).

	Normal weight	Overweight	Obesity	p
Physical activity				
Total hours sedentary activities M (DT)	2.20 (1.24)	2.33 (1.34)	2.45 (1.18)	0.007
Total hours physical activity M (DT)	2.86 (1.84)	2.64 (1.82)	2.68 (1.81)	0.034
Groups n (%)				0.008
Poor	457 (52.4)	175 (58.5)	84 (60.4)	
Regular	266 (30.5)	87 (29.1)	46 (33.1)	
Good	149 (17.1)	37 (12.4)	9 (6.5)	
TOTAL n (%)	873 (100%)	299 (100%)	139 (100%)	

Table 4: Physical activity (Krece Plus) and weight status.

Nutritional Knowledge

Ten out of twenty-three questions were answered correctly by more than 50% of respondents. The overall percentage of correct answers in the population was 47.2. In the total sample girls had similar scores as boys (respectively, 46.9% and 47.5%). By sex, there were significant differences only in subscale C (sweeteners and oral health; p< 0.000) and subscale E (special terms and definitions; p= 0.01). In both subscales, boys had higher scores. There were no significant differences between nutritional knowledge and weight status.

Meal Frequency

A total of 18.6% of the adolescent population never or almost never had breakfast (11.9% boys, 24.1% girls). There were significant differences between girls and boys in breakfast (p<0.001), afternoon break (p= 0.007), dinner (p<0.001) and snacking between meals (p= 0.005). In all of them, girls never or almost never ate.

Table 5 shows that participants who never or almost never had breakfast, morning break, afternoon break and dinner had a higher prevalence of obesity and overweight (respectively, p= 0.001; p= 0.001; p= 0.001; p= 0.028) than those who had these meals every day or almost every day. The only meal in which there were no significant differences was lunch.

DISCUSSION

The objective of this study was to calculate the prevalence of obesity and overweight in adolescents in Gran Canaria (Canary Islands, Spain) and to analyze the relation between excess weight and different variables. Results showed a prevalence of obesity of 10.4% (12.6% of boys and 8.6% of girls) and of overweight of 22.3% (boys 20.4%, girls 24%). We observed a relation between obesity and the educational level of the parents, having a relative with obesity, hours of sedentary activities and frequency of meals.

The serious physical and psychological consequences resulting from overweight and obesity highlight the importance of addressing these issues from an early age.[23] Epidemiological studies have shown that the prevalence of overweight has surpassed the prevalence of malnutrition in all ages and social and demographic strata. This represents a short and long term risk factor for the increase of Non-communicable chronic diseases (NCCD).[24-26]

The prevalence rates of overweight and obesity vary depending on the geographical area where the studies were conducted, as well as age groups, tables or classification systems used, etc. However, there is a consensus that marks a worldwide increase of child and adolescent obesity, which constitutes an important public health problem.[1]

The enKid study 5, conducted in Spain with children and youths, found a prevalence of obesity (13.9%) higher than in our work (10.4%). However, in our study, the data of the prevalence of overweight were much higher (22.3%) than in the en-

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	Normal weight	Overweight	Obesity	Total
Breakfast**				
Never/almost never	137 (15.7%)	71 (23.7%)	39 (28.1%)	247 (18.8%)
Always/almost always	736 (84.3%)	228 (76.3%)	100 (71.9%)	1064 (81.2%)
Morning break**				
Never/almost never	192 (22%)	93 (31.1%)	48 (34.5%)	333 (25.4%)
Always/almost always	681 (78%)	206 (68.9%)	91 (65.5%)	978 (74.6%)
Lunch				
Never/almost never	11 (1.3%)	4 (1.3%)	1 (0.7%)	16 (1.2%)
Always/almost always	862 (98.7%)	295 (98.7%)	138 (99.3%)	1295 (98.8%)
**Afternoon break ** **				
Never/almost never	244 (27.9%)	134 (44.8%)	72 (51.8%)	450 (34.3%)
Always/almost always	629 (72.1%)	165 (55.2%)	67 (48.2%)	861 (65.7%)
Dinner*				
Never/almost never	58 (6.6%)	34 (11.4%)	13 (9.4%)	105 (8%)
Always/almost always	815 (93.4%)	265 (88.6%)	126 (90.6%)	1206 (92%)
Snacking between meals**				
Never/almost never	543 (62.2%)	235 (78.6%)	111 (79.9%)	889 (67.8%)
Always/almost always	330 (37.8%)	64 (21.4%)	28 (20.1%)	422 (32.2%)

**p< 0.001
*p< 0.05
Table 5: Frequency of meals and weight status.

Kid study (12.4%). The National Health Survey 2006-2007 6 obtained a prevalence of obesity in Spanish children of 10.3% and of overweight of 18.8%. Another work in Castilla y León (Spain) showed a prevalence of obesity of 5.8% and of 16.7% of overweight.[27] These data are much lower than ours.

We observed similar results in other studies such as the one of Garcia-Continente et al.[11] In this work they found a lower prevalence than in our study. However, they also found more obese boys (6.2%) than obese girls (3.7%) and more overweight boys (19.9%) than overweight girls (17%). The prevalence of overweight boys was similar to ours. The AVENA study[28] obtained similar data of prevalence to the study of Garcia-Continente.[11] In boys they found 5.7% obese and 20% overweight. In girls obesity and overweight prevalence were lower than ours: 3.8% and 16%, respectively. These works found higher rates of obesity prevalence among boys than among girls. However, Henríquez et al.[2] found higher obesity prevalence among girls than boys in Gran Canaria. They obtained a prevalence of 14.8%: 17.6% of girls and 12% of boys. In a more recent study, Sánchez-Cruz[29] found a prevalence of obesity of 12.9% among boys and of 12.3% among girls, and a prevalence of overweight of 28.6% and 23.5% among boys and girls, respectively. Obesity prevalence of boys and overweight prevalence of girls were similar to ours. Comparing age groups, as in the enKid study 5, we found the highest prevalence of obesity in participant's ≤ 13 years old.

There is some controversy among studies that examine the relationship between weight and the Mediterranean diet. Numerous prospective studies that investigate the relationship between diet quality and the risk of obesity found that the Mediterranean diet was inversely associated with the risk of obesity or weight gain.[30] However, other studies such as the SUN cohort study, found no such relationship, observing that participants increased their average weight during the follow-up period.[31] In our study, the highest average KIDMED score was observed in adolescents with normal weight. Nevertheless, there were no significant differences in the level of adherence to the Mediterranean diet and the weight status.

According to the scientific literature, breakfast represents a clear protector factor of obesity.[32] Other specific eating habits have also been related to the increase of weight such as the frequency of meals or the intake of snacks. However, the results of the studies in relation to eating habits are inconsistent.[33] In our research we found significant differences in meal frequency and weight status. We observed that skipping meals (breakfast, morning break, afternoon break and dinner) was associated to obesity.

However, most interventions focused on obesity prevention consider not only a dietary change component but also a physical activity component or a combination of both. A number of interventions are focused on increasing frequency and duration of physical exercise, while others on decreasing time devoted to sedentary activity.[34] In our research, we observed that participants with normal weight had the lowest number of hours

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of sedentary activities and the most hours of physical activity.

Another variable studied in this research was the nutritional knowledge level, using the validated test NKT. As in the HELENA study (Healthy Lifestyle in Europe by Nutrition in Adolescence), in our study there was no correlation between BMI values and total NKT score. However, they found gender differences that we did not find. Their results showed a higher knowledge level among girls than among boys. Obesity and overweight have also been linked with lower educational levels.[1,35] This paper also found a higher prevalence in adolescents whose fathers and/or mothers had low-medium educational level *versus* those with a higher educational level.

Overall prevalence of overweight and obesity continue to be very high, especially in the Canary Islands. Therefore it is necessary to search for more effective prevention programs and treatments specifically for adolescents, which might consider the variables analyzed in this research.

CONFLICTS OF INTEREST: None.

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Research

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Cardiovascular Diseases in Relation to Anthropometric, Biochemical and Dietary Intake in Women: A Case Control Study

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ABSTRACT

Background: Cardiovascular diseases in women are increasing at an alarming rate but very little attention has been given due to economic and socio-cultural reasons. A study was undertaken to examine the relationship between cardiovascular diseases and nutritional status in Pakistani women.

Methods: A case-control study was carried out in the Outpatients department (OPD) of the Cardiology Unit, Rehman Medical Institute (RMI), Peshawar, Khyber Pakhtunkhwa, Pakistan. The inclusion criteria for selection of cases were females having complaints of myocardial infarction and free from all other infectious and chronic diseases. Forty three cases and 43 controls were selected for the study. Subjects were interviewed for their medical history, dietary intake demographic and socio-economic characteristics. Weight, height measurements and blood samples from both the cases and controls were taken for assessing their nutritional status. Data were analyzed using Student's t-test, Chi-square test, univariate and multivariate unconditional logistic regression to study the relationship between different variables.

Results: The results revealed that the cases had a significantly ($p<0.05$) higher median age than the controls but there were no significant ($p>0.05$) differences in the mean weight, height, BMI, serum ferritin and haemoglobin concentrations between the cases and controls. High prevalence of overweight and obesity was found in both cases (67.4%) and controls (81.4%). Cases had a significantly lower mean dietary energy, protein, carbohydrates, and fat intake than the controls but there was no significant difference ($p>0.05$) in the mean iron intake between the cases and controls. Results of logistic regression showed no significant association between the dependent (CVD) and independent variables (age, diastolic blood pressure, BMI, exercise, family history, family type, family size, haemoglobin, ferritin, carbohydrates and protein).

Conclusions: The study does not reveal significant relationship between the CVDs and nutritional status. The prevalence of overweight and obesity in women was found to be alarmingly high and needs to be addressed by appropriate interventions to prevent the incidence of metabolic syndromes and chronic diseases in population.

KEYWORDS: Cardiovascular diseases; Nutritional status; Overweight and obesity; Pakistani women.

ABBREVIATIONS: CVD: Cardiovascular disease; DALY: Disability Adjusted Life Year; OPD: Outpatients department; OR: Odds Ratio; CAD: Coronary Artery Disease; MI: Myocardial Infarction; CI: Confidence Interval; RMI: Rehman Medical Institute; IQR: Inter-quartile range; IDA: Iron Deficiency Anaemia.

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INTRODUCTION

Cardiovascular diseases (CVDs) are one of the leading causes of disability and premature deaths in adults worldwide, low income to middle income countries bear the brunt by accounting for over 80% of the global disease burden and overwhelming health expenditures amounting to billions of dollars annually.[1,2] The prevalence of CVDs increases with advancing age and varies among racial, ethnic, geographic, and socio-demographic groups. It has been estimated that by the year 2020, the prevalence of CVDs will increase by 75% with predominance in developing counties. CVDs account for 17.3 million deaths per year that are likely to reach 23.6 million deaths per year by 2030.[3] The social and economic implications of CVDs in terms of increased burden on the healthcare system, family sufferings, Disability Adjusted Life Years (DALYs) lost, reduced productivity and economic outputs are enormous and well documented.[4,5,6]

Pakistan has been confronted with an increasing risk of cardiovascular diseases due to non-implementation of food safety laws, unhealthy dietary practices, poor sanitation and hygiene practices, population explosion, rapid urbanization, limited resources, lack of physical activity and unhealthy lifestyles.[7,8] Women share a greater burden of CVDs than men due to sedentary lifestyles, reproductive stress and poor dietary intake.[9] CVDs shorten the life expectancy of women by about 5 years as compared to non-CVDs women.[10] In Pakistan, CVDs account for 19% of all the deaths occurring among adults aged 30-70 years.[11]

Since very limited work has been done on the risk factors associated with cardiovascular diseases in women in this part of the world, a case-control study was undertaken to assess the relationship between CVDs in women and their nutritional status by taking their anthropometric, biochemical, dietary and demographic and socio-economic characteristics.

MATERIALS AND METHODS

A case-control study was carried out in the Outpatients department (OPD) of the Cardiology Unit, Rehman Medical Institute (RMI), Peshawar, Pakistan. Permission to undertake the study was taken from ethical committee of the hospital. The inclusion criteria used for selection of cases were female adults having complaints of myocardial infarction confirmed by clinical and laboratory tests including ECG, ETT, ECHO and blood pressure by a Cardiologist. The controls were women accompanying patients without having any disease. The cases and controls were representing a sample from different geographical areas as RMI is a reputable health care centre with a specified cardiac unit which attracts patients from all over the province. Both cases and controls were exposed to similar risk factors and the latter resembled with the cases in all respects except for the presence of disease. Informed consent was obtained from the 43 cases and 43 controls enrolled in the study.

Medical history, general characteristics and weight-height measurements of women were taken by following the recommended procedures.[12] Body mass index of the subjects was computed and prevalence of overweight and obesity was assessed by following the WHO cut-offs.[13] Haemoglobin and serum ferritin concentration of women were determined by digital portable Hemocue and ELISA, respectively.[14,15] A 24-hr dietary recall was used to assess dietary energy, carbohydrate, protein, fat and iron intakes of women.[16]

STATISTICAL ANALYSIS

Anthropometric, biochemical, dietary, demographic and socio-economic data were analysed by using STATA software version 12.0.[17] Descriptive statistics were expressed as mean and standard deviation for discrete and continuous measures, whereas percentages were reported for categorical variables. Median and Inter-quartile range (IQR) was reported for skewed data. An independent sample t test was used to compare the mean differences between the cases and controls in anthropometric measurements (weight, height and body mass index), biochemical indicators (haemoglobin and ferritin concentrations) dietary intake (energy, carbohydrate, protein, fat and iron) and demographic-socioeconomic characteristics (age, family size, number of children) at 5% level of significance. A Chi-square test of independence was performed to measure the extent of association between two categorical variables with continuity correction where appropriate and a Mann-Whitney U test was used to compare the differences in medians.

A multivariate analysis was undertaken using unconditional logistic regression *logit* procedure in STATA Version 12[17] for unmatched case-control design. Univariate logistic regression was first performed variable by variable, without any adjustment. This was done to explore the association between each variable and the risk of myocardial infarction. Multivariate modelling approach was undertaken by putting all variables considered clinically important. This was done to adjust for each variable with all of the other variables listed in the model. The estimates were expressed as unadjusted Odds Ratio (OR) from univariate model and adjusted OR from multivariate model. The ORs were considered statistically significant if their 95% Confidence Interval (CI) did not include unity. The more the OR deviated from 1, the stronger was the association between the exposure variable.

RESULTS AND DISCUSSION

General characteristics of cases and controls presented in Table 1 indicate that cases had significantly ($p<0.05$) higher median age and mean systolic blood pressure than the controls, but no significant differences were observed in the mean weight, height, body mass index and diastolic blood pressure between

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the cases and controls. Lack of a significant difference in the mean BMI between the cases and controls is somewhat contrary to the general perception that obesity is one of the risk factors for cardiovascular diseases. The categorization of women on the basis of BMI revealed that only about 5% of women in CVDs group were under weight, while 35% and 33% were overweight and obese, respectively. In other words 68% of women in CVDs group were overweight and obese in comparison to about 81% overweight and obese women in non CVDs group (control group) indicating a higher prevalence of overweight and obesity in the non CVDs group (Table 1). Similarly, no significant (p>0.05) association between health status (MI yes-no) and body mass index (high and low) negates the established association between the BMI and CVDs.[18-21] No significant association between BMI and CVDs also identifies BMI as a poor predictor of health status and its cut-off values for categorization of individuals into underweight, normal, overweight and obesity and applicability among different races and ethnic groups has been questioned seriously.[22] However, the difference in mean anthropometric results and association between different categorical variables across different countries could be attributed to differences in genetic and environmental factors that influence the relationships between different variables.

Table 2 shows the mean Heaemoglobin (Hb) and Serum Ferritin (SF) concentrations of CVD cases and controls as well as the prevalence of Anaemia (An), Iron Deficiency (ID) and Iron Deficiency Anaemia (IDA) between the cases and controls. As evident from Table 2, there were no significant (p<0.05) differences in the mean Hb and SF levels between the cases and controls. However, mean SF concentration of cases as well as non-iron deficient group tended to show an increase of 30% and 63%, respectively, over the corresponding iron status groups of controls reflecting a trend of weak relationship due to non-significant results between SF and CVDs (Table 2). Similarly, there was no significant association between the iron status groups (anemic and non-anaemic; iron deficient and non-iron deficient; iron deficient anaemic and iron deficient non-anaemic) and CVDs status (Table 2).

The results related to non-significant association between the CVDs, SF and other iron status indicators are in fair agreement with findings of the earlier researchers[23] who also reported no significant association between the increasing risk of CVD and SF. Similarly, no significant association was found between the mortality of CVDs' patients and SF.[24] Conversely, a U-shaped relationship was found between CVD, IHD and SF levels in women and no significant association between CVD and SF in men.[25] Another study[26] revealed that SF ≥200 ng/ml was associated with four fold higher risk of coronary heart disease in Iranian men. Likewise, other researchers[27-30] also reported a significant association between CVDs and SF. The conflicting results in establishing an association between CVDs and SF may be attributed to differences in ethnicity, ages, gender, socioeconomic characteristics, study designs and type and severity of CVDs. No significant association (p>0.05) between the health status (MI yes-no) and iron status indicators also suggests that Hb and SF do not share any relationship with CVDs.

Dietary energy, carbohydrates, protein, fat and iron intakes of the cases and controls shown in Table 3 revealed that the cases had significantly lower mean dietary energy, carbohydrates, protein and fat intakes than the controls but there was no significant difference in the mean dietary iron intake between the cases and controls. The lower nutrients intake of cases may have been partly attributed to patients' stress and illness and partly to confounding variables such as BMI. The lower energy and carbohydrates intake have been reported[31] to have protective affects against cardiovascular diseases but in our study the lower nutrients intake by cases could not prevent the occurrence of MI. The differences in results amongst the various studies could be attributed to the differences in intensity of CVDs, study designs, dietary and environmental variations. The present results suggest that hospitalized CVD patients are at a greater risk of malnutrition. The nutrients intake of controls also appeared to be lower when compared with the mean nutrients intake of corresponding age non-hospitalized adult normal women as well with those of recommended dietary allowances.[32-34] Thus, one day 24-hr dietary recall of hospitalized patients (cases) and non-patients

Variable	Total (n=86)	Cases(n=43)	Control (n=43)	p-value
Age (yrs), Median (IQR)	46.5 (40.0-50.0)	50.0 (45.0-56.0)	42.0 (40.0-50.0)	<0.01
Weight (kg), Mean ± SD	66.9±13.4	65.8±16.0	68.1±10.8	0.43
Height (kg), Mean ± SD	152.5±4.3	153.30±4.30	152.44±4.4	0.37
Body mass index, Mean ± SD	28.3±5.5	27.3± 6.0	29.3± 4.7	0.10
Systolic, mm/Hg, Mean ± SD	128.0±17.13	132.47±20.94	123.02±11.45	0.01
Diastolic, mm/Hg, Mean ± SD	84.98±12.75	86.16±14.68	83.79±10.51	0.39
Under weight (BMI <18.5) n (%)	2 (2.3)	2 (4.7)	-	-
Normal weight (18.5 ≤ BMI <25) n (%)	20 (23.3)	12 (27.9)	8 (18.6)	0.44
Overweight (25 ≤ BMI <30) n (%)	31 (36.0)	15 (34.8)	16 (37.2)	0.99
Obese ≥30 n (%)	33 (38.4)	14 (32.6)	19 (44.2)	0.38

SD=Standard deviation; IQR=Inter quartile range (25th-75th Percentile); p values are based on Mann Whitney U test for age (skewed distribution); Independent sample t-test for systolic, diastolic and BMI variables (symmetric distribution) and Chi-square test for a categorical variable body mass index

Table 1: General characteristics of subjects.

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Variable	Cases (n=43)	Controls (n=43)	p-value
Hemoglobin (Hb), Mean ± SD	13.52±2.18 (n=43)	13.14±1.18 (n=43)	0.3828
Anaemic (Hb< 12 g/dl), Mean ± SD	10.20±1.66 (n=8)	10.62±0.65 (n=9)	0.5166
Non-anaemic (Hb≥ 12 g/dl), Mean ± SD	14.28±1.45 (n= 35)	13.81±1.37 (n=34)	0.1699
Serum Ferritin (SF), Mean ± SD	53.75±76.93 (n=43)	41.39 ± 69.79 (n=43)	0.4374
Iron deficient (SF<12 ng/ml), Mean ± SD	2.39±3.41 (n=18)	4.55±3.49 (n=12)	0.1062
Non-iron deficient (SF ≥ 12 ng/ml) Mean ± SD	90.74±83.34 (n=25)	55.65±77.86 (n=31)	0.1132
Anaemic (Hb<12 g/dl) n (%)	8 (18.60)	9 (20.93)	0.787
Non-anaemic (Hb≥ 12 g/dl) n (%)	35 (81.40)	34 (79.07)	
Iron deficient (SF<12 ng/ml) n (%)	18 (41.86)	12 (27.91)	0.175
Non-iron deficient (SF ≥ 12 ng/ml)n (%)	25(58.14)	31 (72.09)	
Iron deficient anaemic (SF<12 ng/ml and Hb<12 g/dl) n (%)	5 (11.63)	2 (4.65)	0.339
Non-iron deficient anaemic (SF ≥12 ng/ml (Hb<12 g/dl) n (%)	13 (30.23)	10 (23.26)	
Iron deficient non-anaemic (SF<12 ng/ml) (Hb ≥ 12 g/dl) n (%)	3 (6.98)	7 (16.28)	
Non-iron deficient non-anaemic (SF ≥12 ng/ml) (Hb ≥12 g/dl) n (%)	22 (51.16)	24 (55.18)	

Table 2: Biochemical status of cases and controls (n=86).

Variable	Cases (n=43)	Control (n=43)	p-value
Energy (kcal), Mean± SD	699.09±269.77	949.23±275.86	0.0001
CHO (g), Mean± SD	107.17±51.72	141.77±50.51	0.0023
Protein (g), Mean± SD	31.86±10.86	41.76±17.34	0.0022
Fat (g), Mean± SD	23.84±21.18	33.35±12.00	0.0127
Iron (mg), Mean± SD	8.63±5.44	10.11±4.44	0.4374

Table 3: Dietary nutrients intake per day of cases and control.

(controls) selected from attendants and accompanied persons of cases may not be suitable to capture their usual dietary intake and therefore, dietary results may be used with caution.

The demographic and socio-economic characteristics of cases and controls presented in Table 4 show that 95% of the women from cases and 86% of the women from the controls had education up to secondary school level and there was no significant association between education and health status groups. Similarly, 93% of cases were housewives in comparison to 84% of women in the control group and no significant association was found between the subjects' profession and health status groups (Table 4). Likewise, no significant association was found between the economic and health status categorical variables (Table 4). These findings differ from the generally established perception that individuals with lower socio-economic status have increased morbidity and shorter life expectancy than those of higher socio-economic status. Lack of association between the socio-demographic and health status variables suggests that causes of CVDs in women are beyond the socio-demographic domain. The results are in line with those of others[35] who studied an association between the socio-demographic characteristics and cardiovascular risk factors in patients with severe mental disorders and reported that increased cardiovascular profile in young adults could not be explained by socio-demographic variables alone. Conversely, there was a compelling body of evidence that populations from lower socio-economic status had higher incidence CVDs and premature deaths as compared to those of the higher socio-economic status.[36]

Results of logistic regression presented in Table 5 showed no significant association between the dependent (CVD) and independent variables (age, diastolic blood pressure, BMI, exercise, family history, family type, family size, haemoglobin, ferritin, carbohydrates and protein). Non-significant association between CVDs and independent variables suggest the complex nature of the disease that may result from a variety of factors not included in this study, in other words, to establish an association between CVDs and risk factors, a more thorough and comprehensive investigation is required by taking into consideration genetic, environmental (anthropometric, dietary, biochemical, clinical), lifestyle factors, socio-economic characteristics, a larger sample size and robust study design. These arguments are substantiated by other researchers[37] who reported a significant association between Coronary Artery Disease (CAD) and smoking (OR=1.89; 95% CI=1.74-2.05); CAD and hypertension (OR=1.56; 95%

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CI=1.48-1.65); CAD and alcohol (OR=1.37; 95% CI=1.30-1.46); CAD and diabetes (OR=1.37; 95% CI=1.25-1.50); CAD and high fat diet (OR=1.35; 95% CI=1.28-1.43); CAD and BMI>24 kg/m^2 (OR=1.09; 95% CI=1.03-1.17). Similarly, others investigators[2] have also reported a significant association between Myocardial Infarction (MI) and smoking (OR=2.87, CI=2.58-3.19); MI and diabetes (OR=2.37, CI=2·07-2·7); MI and hypertension (OR=1.91, CI=1.74-2·1); MI and abdominal obesity (OR=1.62,CI=1.45-1.80); MI and psychosocial factors (OR=2.67; CI=2.21-3.22); MI and Apoβ/ApoA1 ratio (3 *vs.* 1) (OR=1.84; CI=1.58-2.13).

LIMITATIONS OF THE STUDY

The sample size of the study was relatively small which may limit its scope and applications to be generalized. Ideally, controls should have been selected from the general population but controls were selected from accompanying patients who may not necessarily be relatives of the patients. It is customary in this part of the world that friends and relatives from distant places visit hospitals for inquiring about patients' health but still the selection of controls from the attendants could have introduced a selection bias and distorted some results. Due to funding con-

Health and socio-demographic characteristics	Total (n=86)	Cases (n=43)	Controls (n=43)	p-value
Education				
Lower secondary	78 (90.7)	41 (95.4)	37 (86.1)	0.14
Higher secondary	8 (9.3)	2 (4.6)	6 (13.9)	
Profession				
Unemployed (Housewife)	76 (88.4)	40 (93.0)	36 (83.7)	0.18
Employed	10 (11.6)	3 (7.0)	7 (16.3)	
Family Type				
Nuclear	49 (57.0)	26 (60.5)	23 (53.5)	0.51
Joint	37 (43.0)	17 (39.5)	20 (46.5)	
Family History				
No	59 (68.6)	33 (76.7)	26 (60.5)	0.10
Yes	27 (31.4)	10 (23.3)	17 (39.5)	
Socio-economic Status				
Moderate rich	58 (67.4)	31 (72.1)	27 (62.8)	0.36
Rich	28 (32.6)	12 (27.9)	16 (37.2)	
Exercise				
No	50 (58.1)	28 (65.1)	22 (51.2)	0.19
Yes	36 (41.9)	15 (34.9)	21 (48.8)	

Percentages are in parentheses. p values are based on Chi-square test

Table 4: Health and demographic-socioeconomic characteristics of cases and controls.

Variable (Categorical)	Unadjusted		Adjusted[a]	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Age, y (≤ 40 *vs.* > 40)	2.59 (0.97-6.95)	0.06	3.08 (0.87-10.86)	0.08
SBP, mmHg (≤ 140 *vs.* > 140)	9.60 (1.14-80.52)	0.04	24.00 (2.00-288.52)	0.01
DBP, mmHg (≤ 90 *vs.* > 90)	2.30 (0.71-7.42)	0.16	1.36 (0.25-7.41)	0.72
BMI (≤ 30 *vs.* > 30)	0.55 (0.23-1.33)	0.18	0.33 (0.10-1.06)	0.06
Exercise (No *vs.* Yes)	0.56 (0.24-1.33)	0.19	0.41 (0.13-1.26)	0.12
Family History (No *vs.* Yes)	0.46 (0.18-1.18)	0.11	0.41 (0.12-1.38)	0.15
Family Type (Nuclear *vs.* joint)	0.75 (0.32-1.77)	0.51	0.95 (0.31-2.93)	0.94
Family Size (≤ 5 *vs.* > 5)	0.71 (0.22-2.25)	0.56	1.41 (0.28-7.12)	0.68
Haemoglobin (≤ 10 *vs.* > 10)	1.00 (0.19-5.26)	0.99	0.88 (0.11-7.16)	0.91
Ferritin (≤100 *vs.* > 100)	3.53 (0.88-14.09)	0.07	2.42 (0.41-14.32)	0.33
Carbohydrates (≤ 100 *vs.* > 100)	0.32 (0.12-0.84)	0.02	0.35 (0.10-1.23)	0.10
Protein (≤ 50 *vs.* > 50)	0.21 (0.04-1.07)	0.06	0.40 (0.06-40.53)	0.76

SBP=Systolic blood pressure; DBP=diastolic blood pressure; BMI=Body mass index; OR=Odds ratio; CI=Confidence interval
A= Each risk variable was adjusted for with all of the other risk variable listed in the table.

Table 5: Unconditional logistic regression model of socio-demographic and nutritional factors associated with CVD cases over control.

straints, the control sample size (n=43) was kept equal to cases (n=43) that could have limited the statistical power of the study. In addition, all variables of interest could not be included in the study and that could be one of the reasons for not establishing any association between the dependent and independent variables. Keeping in view the above stated limitations, the results may be used with caution further studies are needed in the area to augment the study findings.

CONFLICTS OF INTEREST

This is to declare that none of the authors have any conflict of interests.

INDIVIDUAL CONTRIBUTION

PIP conceptualized, designed and supervised the study; HW conducted field and laboratory work; SIP assisted PIP in manuscript drafting and critically reviewing the paper; SU did the statistical analysis of the data; SSB facilitated HW during data collection and management.

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Letter to the Editor

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Can Hormones Regulating Appetite be a Major Factor Contributing to Obesity?

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Obesity is a growing problem throughout the whole world; it is a complex condition that causes much suffering. There are many factors associated with obesity. Those factors include; individual genetics, increased food intake, and/or a lack of physical exercise. In addition hormonal balance plays a very critical role in weight control. There are a number of established hormonal disorders that is associated with obesity. The most common syndromes include Cushing's syndrome and Hypothyroidism.[1,2]

Other hormones play an important role in the pathology of obesity includes:

GUT HORMONES

The Gastrointestinal – pancreatic complex is a source of important regulatory peptides. Most of Gastrointestinal tract hormones; increase satiety and decrease food intake, with exception of ghrelin that has the opposite effects.[3,4]

Ghrelin

It is 28-amino acid peptide produced from the fundus of the stomach and upper intestines; is involved in both the long-term regulation of body weight and the short-term regulation of postprandial satiety. Ghrelin is best described as an appetite-stimulatory signal that acts on the brain. Also ghrelin regulates the release of growth hormone from the pituitary gland. It affects appetite is by binding to Growth Hormone Secretagogue Receptors (GHS-R), which are present in the hypothalamus and pituitary. This increases the intracellular Ca^{2+} concentration through inositol 1, 4, 5-trisphosphate signal transduction, resulting in release of Growth Hormone (GH). Since GH is involved in many metabolic processes.

Fasting ghrelin level increases prior to food intake and is rapidly suppressed after eating. The secretion of ghrelin in stomach is stimulated by the combination of several factors; neural (vagus), mechanical (distension), and hormonal (insulin) secretion. Moreover, obese people have lower fasting ghrelin levels and reduced post-prandial suppression when compared to non-obese people. They also have low levels of GH, which could have significant effects on how the body process food and store nutrients. Moreover, Hyerinsulinemia and insulin resistance in obese people are associated with ghrelin suppression.

Cholecystokinin (CCK)

It is a secreted by the mucosal cells in the duodenum, as well as by neurons in the brain, following consumption of a meal especially fat. The mechanism of action of CCK includes stimulation of gastric acid, gallbladder and pancreatic secretion, modulation of gastrointestinal motility and suppression of energy intake. It plays a role in the regulation of appetite and energy intake, It induces post-prandial satiety.

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Glucagon Like Peptide (GLP)-1

It is a product of proglucagon cleavage; it is released from the L-cells of the gastrointestinal tract post-prandially in proportion to amount of the calories ingested. (GLP)-1 enhances the insulin response to ingested food, slows gastric emptying and inhibits glucagon response in a glucose dependent manner. In addition, it promotes satiety.

Peptide YY or Peptide Tyrosine Tyrosine

It is a 36-amino acid peptide; It is released from the L-cells of the gastrointestinal tract together with (GLP)-1 post-prandially in proportion to amount of the calories ingested. It induces satiety and reduces the amount of food intake; it also inhibits gastrointestinal motility and reduces gastric and intestinal secretions. Depressed production is associated with obesity.

Oxyntomodulin

It is co-secreted with GLP-1 and Peptide YY from the intestinal L-cells in response to food ingestion. It induces post-prandial satiety.

Gastric Inhibitory Polypeptide (GIP)

A 42-amino acid polypeptide secreted by enteroendocrine K cells, from the duodenum and jejunum after the ingestion of a meal containing glucose or fat. It potentiates glucose induced insulin secretion; Moreover, GIP stimulates islet growth, proliferation of β-cells and reduces β-cell apoptosis. GIP increases the adipose tissue volume indirectly by potentiating fatty acid synthesis, and adipocyte fat deposition.GIP operates as an anabolic hormone in the bone.

Insulin

It is a peptide hormone that is secreted from the beta cells of the pancreas. Insulin concentration in plasma increases rapidly after eating and decreases with starvation.

Plasma insulin levels are most sensitive to changes in blood glucose concentrations. Insulin binds to its receptor to initiate GLUT-4 in order to allow glucose to enter the cell either for energy production or storage. In addition, Plasma insulin concentrations depend on peripheral insulin sensitivity, which is related to both total body fat stores and fat distribution, with visceral fat being a key determinant.

PERIPHERAL REGULATORS OF APPETITE- ADIPOSE TISSUE HORMONES

Adiponectin

It is a 244-amino acid protein secreted exclusively from adipose tissue. Its circulating levels are up to 1,000-fold higher than other circulating hormones such as leptin and insulin. It activates AMP-activated protein kinase (AMPK) in peripheral tissues, mediating increased insulin sensitivity.[5] The central effects of adiponectin, through 2 major adiponectin receptors, AdipoR1 and AdipoR2, both are abundantly expressed in the Arcuate hypothalamus (ARH). They act by controlling AMPK activity and food intake. Adiponectin is considered a starvation hormone: during starvation, high adiponectin levels stimulate central and peripheral AMPK leading to increased food intake and decreased energy expenditure.

After a meal, adiponectin level decreases with a concomitant decrease in AMPK activity leading to satiety and an increase in energy expenditure.

Leptin

It is a peptide hormone with numerous actions, including influences on energy homeostasis and neuroendocrine and immune function. It is released predominantly from adipocytes but also at lower levels from gastric epithelial cells and the placenta. In the hypothalamus, leptin has an opposite effect: it decreases AMPK activity, thus reducing the appetite centrally and increasing the peripheral energy expenditure.

Circulating leptin concentration is positively correlated with adipose tissue mass, but food restriction results in decreased plasma leptin, which is associated with increased hunger, this condition can be reversed by refeeding or insulin. Also absence of leptin, due to a mutation in the *Ob* gene has profound effects on body weight. It leads to hyperphagia and obesity.

CONCLUSION

The etiology of obesity is complex and multifactorial, one of the important factors is the regulation of food intake; there are a number of gastrointestinal hormones, which act additively in inducing satiety and achieving efficient nutrient absorption.

This coupled with incomplete understanding of all factors responsible of appetite regulation and prevention of obesity. GIT hormones act through a short term effect; peptides as GLP-1 decrease hypothalamic AMPK activity leading to reduction in food intake, while ghrelin leads to AMPK activation and increased food intake. On the other hand, long term effect produced through peripheral adipose tissue hormones as leptin and adiponectin.

This means that single treatment approach, may be inefficient to control weight loss and may explain the failure of some morbidly obese patients to achieve a successful weight loss.

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Review

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Physical Education Teacher Education: The Key to Eliminating Childhood Obesity

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ABSTRACT

Physical Education Teacher Education (PETE) will be the key to eliminating childhood obesity for the future by preparing physical education teacher candidates in the knowledge and skills they need to teach P-12 students, as well as to prepare them for the sensitivity and caring needed to teach overweight and obese students. The purpose of this article is to advocate for more time in physical education at all levels of schooling to increase P-12 students' motivation to participate, to increase their academic achievement, and to increase their skills to enable them to participate in sport and physical activities for many years. Childhood obesity has become an epidemic in the last 30 years, and school physical education is the best venue for educating children about the proper nutrition and exercise needed to control weight. Children spend most of their time in the day in schools. Budget cuts to physical education are unwise in our current history, and school "physical activity" programs cannot take the place of educating children on how best to use their physical skills in the future to participate for a lifetime in physical activities. Quality school physical education delivered by quality physical educators may be the answer to the childhood obesity epidemic.

KEYWORDS: Obesity; Teacher education; School physical education.

INTRODUCTION

The rise in childhood obesity rates in the United States has created the need to address the activity patterns and nutritional habits of school-aged children. There has been a drastic rise in obesity rates among adults, but childhood obesity rates have reached epidemic proportions.[1] Diets of fast food and sugary drinks, along with declining amounts of physical activity, have contributed to a tripling of childhood obesity rates in last 30 years.[2] Obese children and adolescents are more likely to be overweight or obese as adults.[3] Obesity is related to an increased risk of asthma, type 2 diabetes, hypertension, orthopedic complications, and sleep apnea.[4] These risk factors also lead to approximately $14 billion in national health care costs each year.[5] In contrast to these physical risk factors, obesity also exerts a social and psychological burden on adolescents in the form of depression and low self-esteem – the likelihood of a low quality of life for obese adolescents is 5.5 times greater than for their healthy weight counterparts.[6] In addition, the sedentary lifestyles of children are exacerbated due to and increased use of television, video games, computers and the internet. Children in America spend 75% of their waking hours being inactive, compared to very little time in physical activity – estimates at 12 minutes per day.[7]

Today's youth are considered the most inactive generation in history.[8] Physical education teachers can help overweight children build healthy bodies and establish healthy lifestyles by teaching their students ways to include physical activity in their daily lives. Physical educators can play an important role in the treatment and prevention of overweight in children by giving them the skills and confidence they need to participate in physical activity for a lifetime and educating children about the importance of health-related fitness concepts. Children and

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adolescents who regularly run, play, and sweat also demonstrate fewer behavioral problems, greater concentration, and improved performance on standardized tests.[9]

PHYSICAL EDUCATION TEACHER EDUCATION

Physical education teacher education (PETE) programs prepare teachers to teach physical education in P-12 schools. As in other content areas, PETE is constantly looking to improve the delivery of content to increase the accountability of physical education programs. There are diverging points of view as to what the content of physical education is, and how that content relates to preparing future physical education teachers. Prior to Franklin Henry's[10] call for reinventing physical education as an academic discipline, the philosophy was that a physical education teacher needed to have knowledge and skill to be a quality physical educator. Since 1964, PETE programs have emphasized a more "academic" curriculum, with content knowledge defined as the information found in exercise physiology, anatomy, biomechanics, and motor learning.[11] Teacher candidates in physical education spend far too much time studying about the science of movement and for too little time studying about the games and sports content they are likely to teach. The professionals who emphasize health-related fitness as the content for physical education often show little regard for the overt messages they send to school-aged children about bodies, weight and normality.[12] Currently, there is research[13] to show that future teachers with greater knowledge and skills tend to give more specific and richer feedback when they teach activity. In addition, Lund[11] stated that good physical education involves more than just measuring fitness or keeping kids active. When P-12 students engage in sports, games, or activities, they tend to participate for longer periods of time and get the same or better fitness benefits than participating in fitness activities.[14]

The school physical education curriculum is the primary source of physical activity instruction for adolescents.[15] It has been suggested that the quantity, and in particular, the quality of school physical education has a significant positive effect on the health-related fitness of adolescents by increasing their participation in moderate to vigorous physical activities.[16] High quality physical education gives adolescents the opportunity to learn the fundamental movement skills needed to establish and maintain physically active lifestyles throughout their lives. States and local school districts determine the amount of required physical education children and adolescents receive on a daily basis. In 2006, few schools provided daily physical education or its equivalent for the entire school year to all students.[17] Across the nation in 2007, only 30% of high school students attended physical education classes for five days in an average school week, compared with 42% in 1991.[18] To promote physical activity and its resulting benefits, school systems should require at least 225 minutes per week of required daily physical education in all secondary schools. Sedentary behavior in adolescents may be influenced by insufficient motor or physical fitness, because competence in movement is crucial to activity participation.[19]

A recent revolutionary study by Cawley, Frisvold, and Meyerhoefer[20] presented some of the first evidence showing that physical education at the elementary school level helps to reduce obesity. In doing so, this study provides support for the recommendations by the United States Surgeon General[4] that time in school physical education should be increased in order to reduce the risk of childhood obesity. Although there is a large amount of research on the correlation between time in physical education and childhood obesity, few studies estimate the causal impact of physical education on weight. In the Cawley, et al. study,[20] results indicated that additional time in physical education lowers a child's BMI z-score and the probability of becoming obese. Increasing the amount of time in physical education up to the recommended amount of 150 minutes per week would lower BMI z-scores by 8% of a standard deviation, which is 12% of the mean, and would reduce the probability of obesity by four percentage points. The results of this study represent some of the first evidence that physical education for elementary school children has a causal impact on obesity. Thus, it confirms the critical policy assumptions that physical education time should be increased in order to reduce the risk of childhood obesity.

OBESITY/OVERWEIGHT DISCRIMINATION

Students who are overweight or obese are often discriminated against or stereotyped as being lazy, and some physical educators may fail to provide the safety, encouragement, and instruction these students need.[21] Much attention has been given lately to the effects of bullying and teasing in schools. Teasing often targets another student's weight or appearance, and this bullying has been shown to contribute to social isolation, depression, low self-esteem, and even suicide.[22] The childhood obesity epidemic requires the development of appropriate attitudes toward overweight and obese individuals who may feel especially ostracized in physical activity settings. Research has shown that individuals who are overweight and obese are often victims of prejudice, marginalization, oppression, and stereotyping. The social consequences of obesity are equally, if not more, detrimental to their well-being than the physical consequences. Being the victim of harassment and weight bias and feeling dissatisfied with their bodies further contributes to childhood obesity.[23]

Physical educators may also inadvertently demonstrate these negative biases.[22] Research on the attitudes of physical education majors found that they held strong, negative stereotypes and prejudices against obese people.[23] In fact, a study comparing the attitudes of physical education majors and psychology majors found that the physical education majors possessed higher levels of anti-fat biases than their psychology counterparts.[24] Preparing future physical education teachers to be aware of their biases and to become more sensitive to the diverse body types of their students will help alleviate the anti-fat biases. Although our

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field is committed to helping people acquire healthy lifestyles, we also need to understand the causes and ways to prevent obesity and develop programs that make a positive contribution to the well-being of obese and overweight students. Physical education teachers and teacher candidates should be trained about the impact of weight stigmatization on their P-12 students, and they should receive professional development about strategies to reduce teasing at school.[25] Physical education teachers can develop organizational and dispositional strategies that can help children feel comfortable in an educational setting and also experience a sense of accomplishment as they become physically skilled.[26]

CONCLUSION

One of the best ways that physical education teachers can be successful in teaching overweight or obese students is to meet their needs and interests. Over the past 20 years, an increasingly diverse assortment of physical activities has developed in the popular culture. New activities such as disc golf, corn hole, geocaching, yoga, adventure racing, skateboarding, Pilates, cross fit, and home exercise systems like Wii Fit or Xbox Kinect, make this an exciting time to be looking for ways that physical education can contribute to educating children to become more physically active. Most adults and children are looking for a sense of novelty and engagement in their play and physical activities that are different from what is commonly provided in physical activity settings and in physical education curriculums.[27]

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