ORIGINAL ARTICLE

WEIGHT STATUS AND ITS DETERMINANTS AMONG MOROCCAN ADOLESCENTS IN THE PROVINCE OF EL JADIDA

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ABSTRACT

Background. Despite the efforts of health systems, the prevalence of malnutrition reflected by weight status still poses challenges for many countries around the world. In fact, with the decrease in undernutrition, excess weight and obesity are gradually increasing in parallel with that of chronic diseases. Among school-going adolescents, however, weight status is less studied, particularly in developing countries.

Objective. The objective of this research is to examine the situation and the determinants of the weight status of adolescents in the province of El Jadida in Morocco.

Material and methods. The study was carried out on a sample of 463 students from the province of El Jadida of which 58.1% are boys and 41.9% girls, ages 9 and 17. Nutritional status was assessed by anthropometric measurements including height, weight and waist and hip circumference. Body mass index (BMI) was calculated to determine underweight, overweight and general obesity and waist circumference and the waist circumference to hip circumference ratio were used to determine abdominal obesity.

Results. The results indicate that only 59.6% of students had normal weight status, 40.4% had abnormal BMI values corresponding to thinness in 18.8% and overweight (overweight and obesity) in 21.6%. A significant difference in the prevalence of abnormal weight status by sex and level of physical activity was found. The results of the present study reveal an abnormal weight status in a large proportion of adolescents linked in addition to the peculiarities of the puberty phase to the sedentary lifestyle in the study population.

Conclusions. The results obtained revealed the coexistence of over-nutrition and undernutrition which require a prevention policy based on regular monitoring of weight status as well as on nutritional education and the promotion of physical activity for children and parents.

Key words: *underweight, overweight, obesity, weight status, socioeconomic status, adolescents, Morocco*

INTRODUCTION

Malnutrition is a global problem that affects both developed and developing countries, despite the efforts of health systems. It is manifested as undernutrition, a problem of poor countries, which includes among other problems, underweight, micronutrient deficiency or stunted growth in children. On the other hand, over-nutrition, which is a characteristic of rich countries, includes overweight, obesity and associated non-communicable diseases [35]. Like other emerging countries, Morocco is undergoing in parallel with economic, demographic and epidemiological transitions, a nutritional transition associated with changes in eating habits and changes in lifestyles [3, 30] leading to an increase in obesity and its comorbidities [30].

In children and young people obesity has become a major public health problem in the world and is on the rise in Mediterranean countries. In the countries of the southern Mediterranean, including Morocco, the problems of overweight and obesity are more present in the adult population. In these countries, few studies exist on the extent of this problem and its various factors among young people. Adolescence is considered as the period of transition between childhood and adulthood [36]. Numerous studies in countries in the northern rim of the Mediterranean

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report a gradual and steady decrease of the quality of diet of adolescents over time [16, 23], with unhealthy eating practices and behaviors harmful for current and future Public Health. This age category that coincides also with the period of life when young people make their own food choices without the direct control of their families is also associated with a decrease in the level of physical activity or a sedentary lifestyle leading to a rapid rise in childhood obesity that become increasingly worrisome in adolescents [15]. Indeed, the WHO estimated 42 million overweight children in 2010, of which almost 35 million (83%) are in developing countries [33]. In Tunisia, the prevalence of overweight and childhood obesity has been estimated at 8.7% [26] and 23.1% in Algeria [5, 35] . In Morocco, the WHO reports that a child and an adolescent Moroccans in ten are affected by the scourge of obesity, corresponding to 10.3% of boys and 9.9% of girls aged 5 to 19 [35]. The adolescents and the very young adults age category (15 to 20 years old) constituting future adults, represent 20% of the Mediterranean population [34]. In Morocco, it was estimated in 2017 at 6,035 million constituting 17.3% of the total population [36]. This figure reflects the magnitude of the problems associated with overweight and obesity among young people and which persist into adulthood. The prevention and management of this problem involves regular monitoring of weight status and the evaluation of overweight and malnutrition in general, in children and adolescents, with a preventive and curative goal [7, 32].

The problems of overweight and obesity in the countries of the southern shore compared to those of the northern rim of the Mediterranean's, are more present in adults. Few studies exist on the extent of these problems and on the weight status of adolescents, particularly in developing countries including Morocco.

Given the evolution of lifestyles and that the young population of today is the adult population of tomorrow, the objective of this research was to determine the prevalence and the determining factors of the weight status and the nutritional status of schoolchildren in the Moroccan province of El Jadida.

MATERIAL AND METHODS

Survey

This cross-sectional study involved a sample of 463 children and adolescents schoolers recruited from three schools, one primary and two secondary, in the urban area of the province of El Jadida (Casa-Settat region). The survey was carried out during the 2016/2017 and 2017/2018 school years, over a period from September 2016 to the end of June 2018. A structured questionnaire was used to collect information on demographic and

socioeconomic characteristics of the participants and their parents, and anthropometric parameters were measured. The participants are of both sexes (58.1% girls and 41.9%% boys) aged 9 to 17 years old.

The information collected on demographic and socioeconomic characteristics are age, sex, the schoolers educational level with 3 level categories : Ppimary, middle and high school, parental education level determined by the highest level of one of the schoolers parents divided in 3 categories according to the number of years of education attained: Low (<7years), Medium (7 to <11years), High (>11years), household size, the housing type categorized in owner or renters status and the socio-economic status (SES) determined by the type of the parents professional situation in addition to the monthly household income. The SES level was classified into four categories: 1 - very low (<2500DH), 2 - low (2500 -7000DH), 3 - Medium (> 7000DH- 15000DH) and 4 - High (>15000DH).

Anthropometric measurements

The anthropometric parameters measured on the children studied were weight, height, circumference of the abdomen and circumference of the hips. These measurements were recorded by the protocol and standard instruments of the World Health Organization (WHO, 1995). The students' weight to the nearest 0.1 kg was measured using a standard mechanical beam scale, with light clothing. Standing height was measured without shoes, nearest 0.1cm, using a measuring rod, with the legs straight, heels together, arms dangling and shoulders relaxed. Body mass index (BMI) is calculated by dividing weight (in kg) by height in meters squared (kg/m^2). The distribution of BMI values is used to determine BMI Z-scores to obtain a numerical indication of the standard deviation (SD) from the median for sex and age. Depending on the value of the Z-score obtained, the adolescent's weight status is considered in the category indicating un<+ 1DS", overweight if "Z Score $\geq$ + 1DS" and obesity if "Z Score $\geq$ + 2DS" [35].

The waist circumference (or the circumference the weight if "Z Score $\leq$-2DS", normal weight if "-2DS <Z Score of the abdomen) is measured in the children/ adolescents participating in this study using a tape measure halfway between the costal edge (bottom of the lower ribs and the antero-superior iliac spine/crest on the mid-axillary line, at the narrowest level of the torso at the end of a normal exhalation and without exerting pressure on the skin. Waist circumference (WC) is linked to the risk of cardiovascular and other chronic diseases [2, 21] . Waist circumference (WC) to height ratio (H) WHTR) is also calculated and the cutoff of 0.5 is used to define presence or absence of abdominal obesity in boys and girls [19]. A WHTR $\geq$

0.5 means the presence of abdominal fat and a WHTR <0.5 means no abdominal fat [19].

Statistical analysis

Data analysis was performed using Statistical Package for the Social Sciences (SPSS) software for Windows version 23.0. Quantitative variables are expressed as means +/- standard deviations, and qualitative variables as frequencies and percentages. The children were classified into 4 categories based on the reference standards established by WHO for sex and age and using the WHO Anthro software for SPSS.

Analysis of variance (ANOVA) was used for the comparison of several means. Student's test was used for independent samples and the chi-square test to compare categorical variables.

Univariate and multivariate binary regression analyzes were performed. P values less than 0.05 are used to consider the differences statistically significant.

Ethical considerations

The study is carried out after obtaining authorization from the Regional Academy of Education, officials of the selected schools and after obtaining the oral consent of the schoolers and their parents. All the participants were informed of the objectives, the progress of the investigation as well as on their willingness to withdraw from the study at any time, if they so wish.

RESULTS

Demographic, socioeconomic and anthropometric characteristics

Table 1 presents the anthropometric parameters of the school-going adolescents studied. The mean age of the sample was 14.16 ± 1.93 years, mean weight was 50.35 ± 13.43 kg and the mean height was 1.57 ± 0.12 m. The mean BMI was 20.03 ± 3.83. The comparison of the means of these biodemographic parameters by sex

using *Student's* t test, shows that weight, height, waist circumference and ratio WHTR were significantly higher (p≤0.05) in boys compared to girls while the mean BMI were comparable in both sexes.

The socio-demographic characteristics of the study population are shown in the Table 2. The overall sample (n=463) is composed of 58.1% of girls and 41.9% of boys. The majority of the youngsters participants were of 15 to 17 years old (58.74%), followed by the 12-14 years age group (29.8%) and that of 9 to 11 years old (11.44%). According to their school levels, 21.59% of participants were at primary level, 26.99% at intermediate level while 51.4% were at the high school level.

Concerning the children' parents education levels, the results show that about 33% have a low while 43.6% have high education level with about 43% of the pupils' fathers and 19.9% of their mothers of university level. Concerning the professional occupation of the parents, (results not shown), 72.4% of the students mothers were housewives without any remunerated employment, 14.5% were public employees, 8.9% were craftsmenand4.3%were workers. For the pupils' fathers, the majority (44.5%) were craftsmen, 28.5% public employees, 21. 8% were workers and 3.7% were businessmen. The Table 2 shows also that for the housing status, the parents of the majority of students (74.7%) were owners and only 25.3% were rent of their house.

THE NUTRITIONAL STATUS OF THE STUDIED CHILDREN

Weight status classes and the demographic and socioeconomic characteristics in the studied children

Table 3 shows the prevalence of the different BMI categories according to different demographic and socioeconomic characteristics of the study objects. The results show that overweight (including obesity) was more prevalent in girls (67%) than boys (33%) and in the 15 to 17 years age category (61%). The prevalence

Table 1. Biodemographic characteristics of all schoolchildren of both sexes

	Total Mean ± SD	Girls (n=269) Mean ± SD	Boys (n=194) Mean ± SD	P-value
Age (years)	14.16±1.93	14±1.93	14.37±1.92	0.039*
Height (m)	1.57±0.12	1.55±0.1	1.60±0.14	<0.001***
Weight (Kg)	50.35±13.43	49.28±12.07	51.84±15.02	0.043*
BMI (kg/m²)	20.03±3.83	20.25±3.88	19.71±3.76	NS
Waist circumference (cm)	48.51±23.43	45.18±22.97	53.11±23.34	<0.001***
WHTR	0.31±0.15	0.29±0.15	0.33±0.14	0.007**

BMI: Body Mass Index; WHTR: waist-to-height ratio; values are Mean ± Standard deviation; *: Significant; NS: Not significant; test performed is t-test.

Table 2. Socio-demographic and economic characteristics of the schoolers by sex

	Total 463	Females 269(58.1)	Males 194 (41.90)
	N (%)	N (%)	N (%)
Age (years)			
9-11	53(11.44)	32(11.9)	21(10.82)
12-14	138(29.80)	94(34.94)	44(22.68)
15-17	272(58.74)	143(53.16)	129(66.49)
Education level			
Primary	100(21.6)	53(19.70)	47(24.22)
Middle school	125(27)	95(35.31)	30(15.46)
High school	238(51.4)	121(44.98)	117(60.30)
Housing type			
Owners	346(74.7)	160(59.47)	112(57.73)
renters	117(25.3)	109(40.52)	82(42.26)
Socioeconomic status (SES)			
SES 1	163(35.2)	93(34.2)	70(35.6)
SES 2	85(18.4)	50(18.6)	35(18)
SES 3	112(24.2)	66(24.5)	46(23.7)
SES 4	103(22.2)	60(22.3)	43(22.2)
Education levels of the parents			
Low	155(33.47)	49(18.2)	35(18)
Medium	105(22.67)	98(36.4)	57(29.4)
High	202(43.62)	122(45.4)	102(52.6)
Household size			
3-4	203(43.8)	115(42.8)	88(45.4)
5-6	212(45.8)	121(45)	91(46.9)
7-8	48(10.4)	33(12.3)	15(7.7)

N (%): number (percentage); SES 1-4: Socioeconomic status categories (Very low, Low, Medium, High)

of overweight/obesity was also more marked (90%) in households with a size between 3 to 6 people and in the schoolers with parents of high education level (52%) while it was present at comparable percentages whatever the socioeconomic status.

Table 3 shows also that underweight was more present in boys (56.3%) and in adolescents of 12to 17years old (79.3%). These malnourished youngsters were more present in households of a size between 3 to 6 people (87.3%), in poor socio economic status (39.1%) and with parents with medium (32.2%) or high (37.9%) education level.

Nutritional status of children according to age and socioeconomic characteristics

Table 4 shows that in the overall sample the prevalence of underweight was higher in boys (25.25%) compared to girls (14.13%) and increases with age in both sexes affecting more than half (51.0%) of boys and (31.6%) of girls aged between 15 and 17 years.

On the other hand, overweight including obesity was prevalent in about a quarter (24.90%) of girls and

17.01% of boys and more markedly for students in the 15 to 17 age group of both sexes, where this prevalence was 69.7% in boys and 56.7% in girls.

Abdominal fat evaluated by the waist to height ration (WHTR) was prevalent in around 11% of the schoolers sample comparable in girls and boys with a high prevalence in the 15-17years age group in both sexes.

Table 5 shows that overweight including obesity was more prevalent among boys of high socioeconomic level (30.3%), whose parents are with high education level (54.5%) and of households' size of 3 to 6 people (96.9%). On the contrary, being underweight was more present in boys of poor economic status (42.9%). In girls, overweight (including obesity) was more prevalent among those of poor economic status (32.8%) and those whose parents had a high education level (50.7%).

Table 6 shows that in general, more than 56% of girls practiced sport for at least one hour per day with 10% of them exerted it for more than 3 hours/day; 22%

Table 3. Weight status of the study adolescents according to demographic and socioeconomic characteristics

		BMI categories			
		Normal weight	Overweight & obesity	Underweight	P-value
		N (%)	N (%)	N (%)	
Sex	Males	112 (40.6)	33(33)	49(56.3)	0.04*
	Females	164(59.4)	67(67)	38(43.7)	
Age categories	9-11	27(9.8)	8(8)	18(20.7)	0.004**
	12-14	75(27.2)	31(31)	32(36.8)	
	15-17	174(63)	61(61)	37(42.5)	
School level	Primary School	55(19.9)	16(16)	29(33.3)	0.003**
	Middle School	67(24.3)	29(29)	29(33.3)	
	High School	154(55.8)	55(55)	29(33.3)	
Housing type	Owners	152(55.1)	68(68)	52(59.8)	NS
	Renters	124(44.9)	32(32)	35(40.2)	
Househol size	3-4	123(44.6)	43(43)	37(42.5)	NS
	5-6	126(45.7)	47(47)	39(44.8)	
	7-8	27(9.8)	10(10)	11(12.6)	
Parents education level	Low	48(17.4)	10(10)	26(29.9)	0.009**
	Medium	89(32.2)	38(38)	28(32.2)	
	High	139(50.4)	52(52)	33(37.9)	
Socioeconomic status (SES)	SES 1	98(35.5)	31(31)	34(39.1)	NS
	SES 2	51(18.5)	17(17)	17(19.5)	
	SES 3	72(26.1)	24(24)	16(18.4)	
	SES 4	55(19.9)	28(28)	20(23)	

BMI : body mass Index ; N (%): number(percentage); SES 1-4: Socioeconomic status categories (Very low, Low, Medium, High).; *: Significant; NS: Not significant; test performed is Chi^2.

Table 4. Nutritional status of girls and boys by age groups

	Boys N= 194					Girls N= 269				
	Total N (%)	[9-11] N (%)	[12-14] N (%)	[15-17] N (%)	p-value	Total N (%)	[9-11] N (%)	[12-14] N (%)	[15-17] N (%)	p-value
Normal weight	112 (57.73)	9 (8.0)	22 (19.60)	81 (72.30)	NS	164 (60.96)	18 (11)	53 (32.3)	93 (56.7)	0.02*
Overweight & obesity	33 (17.01)	3 (9.1)	7 (21.20)	23 (69.70)		67 (24.90)	5 (7.5)	24 (35.8)	38 (56.7)	
Underweight	49 (25.25)	9 (18.4)	15 (30.60)	25 (51.00)		38 (14.12)	9 (23.7)	17 (44.7)	12 (31.6)	
WHTR≥0.5	22 (11.34)	31 (3.6)	5 (22.70)	14 (63.60)	NS	28 (10.40)	8 (28.6)	4 (14.3)	16 (57.1)	0.004**
WHTR <0.5	172 (88.65)	18 (10.5)	39 (22.70)	115 (66.90)		241 (89.59)	24 (10)	90 (37.3)	127 (52.7)	

N (%): number (percentage); WHTR: waist-to-height ratio; *significant, NS: Not significant; test performed is Chi^2.

used to take a siesta, 27% occasionally consume fast food snacks and 63% use food delivery from outside.

Among overweight girls, 82.1% do not take a siesta and 55.2% exert sport activity for less than an hour per day. In addition, 67.2% of these girls never take fast food snacks while 64.2% occasionally have home food deliveries.

Table 5. Nutritional status of boys and girls according to socioeconomic status

			Normal weight	Overweight & obesity	Underweight	p-value	WHTR≥0.5	p-value
			N (%)	N (%)	N (%)		N (%)	
Boys	Socioeconomic status (SES)	SES 1	39 (35.7)	9 (27.3)	21(42.9)	0.48 NS	8(36.4)	0.55NS
		SES 2	19 (17.0)	6 (18.2)	10(20.4)		4(18.2)	
		SES 3	31 (27.7)	8 (24.2)	7(14.3)		3(13.6)	
		SES 4	22 (19.6)	10 (30.3)	11(22.4)		7(31.8)	
	Household size	3-4	54 (48.2)	14 (42.4)	20(40.8)	0.62 NS	9(40.9)	0.24NS
		5-6	48 (42.9)	18 (54.5)	25(51.0)		13(59.1)	
		7-8	10 (8.9)	1 (3.0)	4(8.2)		0(0.0)	
	Parents education level	Low	16 (14.3)	3 (9.1)	16(32.7)	0.02*	3(13.6)	0.77NS
		Medium	31 (27.7)	12 (36.4)	14(28.6)		6(27.3)	
		High	65 (58.0)	18 (54.5)	19(38.8)		13(59.1)	
Girls	Socioeconomic status (SES)	SES 1	57 (34.8)	22 (32.8)	13(34.2)	0.96 NS	12(42.9)	0.55NS
		SES 2	32 (19.5)	11 (16.4)	7(18.4)		6(21.4)	
		SES 3	41 (25.0)	16 (23.9)	9(23.7)		4(14.3)	
		SES 4	33 (20.1)	18 (26.9)	9(23.7)		6(21.4)	
	Household size	3-4	69 (42.1)	29 (43.3)	17(44.7)	0.62 NS	15(53.6)	0.41NS
		5-6	78 (47.6)	29 (43.3)	14(36.8)		11(39.3)	
		7-8	17 (10.4)	9 (13.4)	7(18.4)		2(7.1)	
	Parents education level	Low	32 (19.5)	7 (10.4)	10(26.3)	0.94 NS	4(14.3)	0.81NS
		Medium	58 (35.4)	26 (38.8)	14(36.8)		10(35.7)	
		High	74 (45.1)	34 (50.7)	14(36.8)		14(50.0)	

N (%): number (percentage); WHTR: waist-to-height ratio; SES 1-4: Socioeconomic status categories (Very low, Low, Medium, High); * significant, NS: Not significant; test performed is *Chi²*.

Generally, in boys a quarter have siesta every day or sometimes, and about 73% practice a sport at least 1 hour/day with 11% that exercise that more than 3 hours/day, around 41% take fast snacks and 70% use food delivered from outside. Among the overweight boys, the results show that 75.8% do not take a siesta and that 57.6% have a sporting activity for 1 to 3 hours per day. In addition, 39.4% of these boys occasionally have fast food snacks and 72.7% occasionally use home food deliveries. Likewise, among boys with abdominal obesity, 59.1% participate in an average sport activity of 1 to 3 hours/day and 36.4% less than an hour per day.

Relationship between BMI classes (overweight including obesity and underweight), lifestyle and socio-demographic of school children

The results of the univariate and multivariate analyses performed to assess the interrelation among the variables and abnormal weight status (underweight and overweight including obesity), using logistic regression model are presented in Table 7. The table indicates that except for WHTR and fast food all variables were not significantly associated to overweight (including obesity). The

results of the univariate logistic regression analysis showed that underweight is associated with gender, age, school level, parents education level, fast food and food delivery uses. After adjusting for sex and age, multiple regression analysis showed that sex ([ORa]: 2.22, 95% CI: 1.33-3.70), age ([ORa]: 3.53, 95% CI: 1.73-7.21), Food delivery ([ORa]: 0.44, 95% CI: 0.26-0.75) significantly influence the prevalence of underweight, whereas the school level of the pupils, the parents education level and the fast food were no longer significant after the adjustment for sex and age.

On the other hand, the WHTR and fast foods remain associated to overweight (including obesity) after adjusting for sex and age ([ORa]: 12.31, 95% CI: 5.92-25.59 and ORa: 0.10, 95% CI: 0.01-0.90, respectively). As shown in the Table 7, elementary school students were more likely to be underweight than high school students ([OR]: 2.80, 95% CI: 1.54 - 5.10, and OR: 2.30, 95% CI: 1.28 - 4.14, respectively).

Children of 9 to 11 age group were approximately 3.14 times (95% CI: 1.57–6.28) more likely to be underweight than those aged 12 to 14yrs. This finding suggests that high school students are more likely to be overweight (including obesity) than middle and elementary school students. Thus, age can be a critical

Table 6. Nutritional status according to boys and girls lifestyles

Girls (N=269)								
		Total	Normal weight	Overweight & obesity	Underweight	p-value	WHTR≥0.5	p-value
		N(%)	N (%)	N (%)	N (%)		N (%)	
Siesta	Yes	55 (18.58)	40 (24.4)	8 (11.9)	7 (18.4)	0.21NS	3(10.7)	0.35NS
	Sometimes	13(4.83)	6 (3.7)	4 (6.0)	3 (7.9)		1(3.6)	
	No	201(74.72)	118 (72.0)	55 (82.1)	28 (73.7)		24(85.7)	
Sport activity	<1 hour/d	117(43.49)	66 (40.2)	37 (55.2)	14 (36.8)	0.22NS	12(42.9)	0.14NS
	1- 3 hours /d	125(46.46)	79(48.2)	26 (38.8)	20 (52.6)		16(57.1)	
	> 3 hours/d	27(10.04)	19 (11.6)	4 (6.0)	4 (10.5)		0(0.0)	
Fastfood snacks	Never	196(72.86)	124 (75.6)	45 (67.2)	27 (71.1)	0.04*	16(57.1)	0.002**
	Occasionally	70(26.02)	40 (24.4)	19 (28.4)	11 (28.9)		10(35.7)	
	Everyday	3(1.12)	0 (0.00)	3 (4.5)	0 (0.0)		2(7.10)	
Food delivery	Never	96(35.69)	55 (33.5)	22 (32.8)	19 (50.0)	0.15NS	5(17.9)	0.05NS
	Occasionally	170(63.2)	108 (65.9)	43 (64.2)	19 (50.0)		22(78.6)	
	Everyday	3(1.12)	1 (0.6)	2 (3.00)	0 (0.0)		1(3.60)	
Boys (N=194)								
		Total	Normal weight	Overweight & obesity	Underweight	p-value	WHTR≥0.5	p-value
		N(%)	N (%)	N (%)	N (%)		N (%)	
Siesta	Yes	38 (19.59)	23 (20.5)	4 (12.1)	11 (22.4)	0.25NS	1 (4.5)	0.13NS
	No	146 (75.26)	84 (75.0)	25 (75.8)	37 (75.5)		19 (86.4)	
	Sometimes	10 (5.15)	5 (4.5)	4 (12.1)	1 (2.0)		2 (9.1)	
Sport activity	<1hour/d	52 (26.80)	27 (24.1)	11 (33.3)	14 (28.6)	0.29NS	8 (36.4)	0.38NS
	1- 3hours /d	120 (61.86)	75 (67.0)	19 (57.6)	26 (53.1)		13 (59.1)	
	> 3hours/d	22 (11.34)	10 (8.9)	3 (9.1)	9 (18.4)		1 (4.5)	
Fastfood snacks	Never	112 (57.73)	69 (61.6)	19 (57.6)	24 (49.0)	0.57NS	10 (45.5)	0.27NS
	Occasionally	79 (40.72)	42 (37.5)	13 (39.4)	24 (49.0)		11 (50.0)	
	Every day	3 (1.54)	1 (0.9)	1 (3.0)	1 (2.0)		1 (4.5)	
Food delivery	Never	59 (30.41)	29 (25.9)	8 (24.2)	22 (44.9)	0.10NS	5 (22.7)	0.61NS
	Occasionally	130 (67.0)	79 (70.5)	24 (72.7)	27 (55.1)		16 (72.7)	
	Everyday	5 (2.58)	4 (3.60)	1 (3.0)	0 (0.0)		1 (4.5)	

N (%): number (percentage); WHTR: waist-to-height ratio; * significant, NS: Not significant; test performed is *Chi²*.

factor in predicting overweight (including obesity) and underweight in children and adolescents.

Table 7 also that the OR for sex with overweight (including obesity) was 1.39 (95% CI: 0.86-2.24) with girls more likely to be overweight than boys and the OR for sex and underweight was (OR = 0.53, 95% CI: 0.33 -0.86) with girls less likely to be underweight than boys. In addition, children whose parents had low education level were about 2.28 times (95% CI 1.24 -4.20) more likely to be underweight. This result suggests that children whose parents have a high level of education are more likely to be overweight (including obesity).

DISCUSSION

The present study revealed a coexistence of overweight and underweight problems in the Moroccan adolescent studied, testifying the existence of the double burden of malnutrition in this young population. Indeed, data from this study reports that about fifth of children were underweight, one fifth were overweight and 1.1% were obese. The reported prevalence of overweight in this work is higher than that found in children of other Moroccan cities such as Marrakech city (8%) [18], Rabat city (8.7%) [6] and than that obtained in a study carried out in a primary school of Marrakech which reported a prevalence of overweight of 12.9% in girls and 9.1% in boys [6].

Table 7. Association of weight status with lifestyle, demographic and socioeconomic characteristics of the study school children

		Overweight & obesity				Underweight			
		Univariable analysis		Multivariable analysis		Univariable analysis		Multivariable analysis	
		OR (IC 95%)	p-value	OR_a (IC 95%)	p-value	OR (IC 95%)	p-value	OR_a (IC 95%)	p-value
Sex	Females	1.39 (0.86-2.24)	0.183	0.73 (0.45-1.19)	0.20	0.53 (0.33-0.86)	**0.01***	2.22 (1.33-3.70)	0.001**
Age categories	9-11	0.85 (0.36-1.96)	0.695	0.82 (0.35-1.90)	0.64	3.14 (1.57-6.28)	**0.001***	3.53 (1.73-7.21)	**0.001***
	12-14	1.18 (0.71-1.96)	0.527	1.12 (0.67-1.88)	0.67	2.01 (1.16-3.46)	**0.01***	2.33 (1.33-4.09)	**0.001***
	15-17	reference				reference		reference	
WHTR	WHTR≥0.5	9.64 (4.89-19.00)	0.001**	12.31 (5.92-25.59)	0.001**	0.44 (0.10-1.98)	0.28	0.35 (0.08-1.65)	0.19
School level	Primary School	0.81 (0.43-1.54)	0.527	0.52 (0.13-1.98)	0.33	2.80 (1.54-5.10)	0.001	1.61 (0.44-5.80)	0.47
	Middle School	1.21 (0.71-2.07)	0.48	0.80 (0.31-2.12)	0.66	2.30 (1.28-4.14)	**0.01***	2.55 (1.00-6.51)	0.05
	High School	reference				reference		reference	
Household size	5-6	reference				reference			
	7-8	0.94 (0.42-2.11)	0.888	0.98 (0.43-2.24)	0.97	0.74 (0.33-1.63)	0.45	0.92 (0.54-1.58)	0.77
	3-4	1.01 (0.45-2.24)	0.986	1.03 (0.46-2.31)	0.95	0.76 (0.35-1.67)	0.49	1.15 (0.50-2.64)	0.75
Parents education level	Low	0.56 (0.26-1.18)	0.127	0.49 (0.21-1.12)	0.09	2.28 (1.24-4.20)	**0.01***	1.32 (0.63-2.79)	0.46
	Medium	1.14 (0.70-1.87)	0.601	1.03 (0.60-1.78)	0.91	1.33 (0.75-2.34)	0.33	0.98 (0.51-1.87)	0.94
	High	reference				reference		reference	
Socio-economic status (SES)	SES 1	reference				reference			
	SES 2	0.62 (0.34-1.14)	0.125	0.61 (0.32-1.13)	0.12	0.96 (0.49-1.88)	0.91	1.03 (0.51-2.07)	0.94
	SES 3	0.65 (0.32-1.34)	0.244	0.62 (0.30-1.28)	0.19	0.64 (0.33-1.25)	0.19	0.76 (0.38-1.52)	0.43
	SES 4	0.65 (0.34-1.25)	0.201	0.64 (0.33-1.22)	0.18	1.05 (0.55-1.99)	0.89	1.38 (0.70-2.74)	0.35
Sport activity	1- 3 hours /d	reference				reference			
	> 3 hours/d	2.14 (0.87-5.24)	0.096	2.09 (0.85-5.13)	0.11	0.99 (0.58-1.70)	0.98	0.82 (0.46-1.45)	0.50
	<1 hour/d	1.21 (0.50-2.95)	0.674	1.26 (0.51-3.07)	0.62	1.49 (0.68-3.24)	0.32	1.22 (0.54-2.75)	0.63
Fastfood snacks	Never	reference				reference		reference	
	Everyday	1.18 (0.72-1.93)	0.521	0.07 (0.01-0.68)	0.02*	1.62 (0.98-2.67)	**0.06***	0.20 (0.01-3.29)	0.26
	Occasionally	12.0 (61.32-109.90)	0.027*	0.10 (0.01-0.90)	0.04*	3.78 (0.23-61.55)	0.35	0.41 (0.02-6.87)	0.54
Food delivery	Never	reference				reference		reference	
	Everyday	1.00 (0.61-1.66)	0.99	0.51 (0.11-2.32)	0.38	0.50 (0.31-0.83)	**0.01***	0.44 (0.26-0.75)	**0.001***
	Occasionally	1.68 (0.38-7.46)	0.495	0.55 (0.12-2.39)	0.42	0.04 (0.02-0.01)	0.999	0.03 (0.02-0.01)	0.999

OR: l'odds ratio ORa; l'odds ratio after adjusting for sex and age; WHTR: waist-to-height ratio ;* significant

The prevalence of overweight including obesity observed in the survey sample is somewhat comparable or lower than that reported in some Mediterranean countries. Indeed, this prevalence was estimated as 36.3% in Algeria in 2014 [8], 31.1% in Lebanon [37], 37.9% in Syria and 32.4% in Greece [4]. In Tunisia, the prevalence of overweight including obesity was found to be 13.2% in 2011 [26]. Overweight and obesity are highly prevalent among adolescents in the European countries of the northern shore of the Mediterranean basin. It is the case of Italy where a study has reported that 50.2% of adolescents aged 15 are overweight [20], in France where 28% of adolescents aged 10 to 18 are overweight with 12.8 % were girls and 15.2% boys [13] and in Spain where a study also revealed a prevalence of 42.8% of overweight or obesity in young people with a higher prevalence among boys (25.3%) than girls (17.5%) [10] .

While the difference in excess weight between the sexes of adolescents is variable in industrialized countries [14], in the present work girls are more affected by the scourge of overweight than boys. It is known that the prevalence of overweight is greater in the puberty phase, and that the difference between boys and girls can be explained by the specificities of growth linked to gender and the different evolution of the distribution of fat mass according to sex [25]. However, this may be associated with the societal constraints encountered by girls, unlike boys, in the population studied as they have less freedom to exercise physical activities outside the home.

Childhood obesity is reported to be 16.9% in the United States [24] and around already 15% in 2002 in France [24]. In Africa, although low prevalence is recorded for some countries such as Togo, where a percentage of 2.86% for obesity and 1.72% for overweight is reported [11], a prevalence of 8.5 % was recorded in 2010 among African children and, this percentage was expected to reach 12.7% by 2020. The same is true in other parts of the world such as Asia where a relatively low prevalence of overweight and obesity estimated at 4.9% in 2010 is reported in Indian children [9]. In these developing and underdeveloped countries, where undernutrition was the rule reflected by underweight which is decreasing thanks to the efforts of governments, the problem of overweight and obesity is emerging and on continuous rise. This observation is linked to several factors including dietary changes and lifestyle characterized by a growing sedentary lifestyle linked to urbanization and globalization [1, 27].

In this study, the data confirms the nutritional transition in place in Morocco, as in other countries of the Mediterranean region and elsewhere in the world. Indeed, although in Morocco where the diet is of Mediterranean-type known as healthy, a gradual decrease in adherence to this diet especially among young people has already been reported in Greece, Spain, Italy and Cyprus with unhealthy eating practices and behaviors more marked in the 12-17 year age group likely to pose health problems in the future in this population once in adulthood [23]. Hence the need to promote a healthy diet among young people to avoid the development of weight excess and its consequences on health.

The present data also reports the presence of underweight among the participants in this study indicating the existence of the double burden of malnutrition, expressed by the coexistence of both over-nutrition and undernutrition characterized by being overweight and underweight respectively. Indeed, in many emerging countries the increase in obesity often coexists in the same population with chronic undernutrition [17].

Despite that the difficulty to compare prevalence of overweight, obesity and underweight are difficult to compare with those mentioned in the literature, sociodemographic and socioeconomic characteristics have been reported as determinant factors of weight status [12, 28, 29]. Accordingly age, sex, parents education level, the SES examined in the current study adolescents appeared to be associated with both under and overweight. In addition to these factors, a lifestyle characterized by a low level of physical activity or a sedentary lifestyle also contributes to childhood obesity [22, 31]. Among the life-style factors examined in this study fast food consumption and physical activity level are found as characteristics of the both underweight and overweight in the present young study population. Indeed, the fact that girls this study practiced less physical activities than boys (52.3% and 37.1% respectively) could explain the higher percentage of girls with the overweight (66.6%) compared to boys (33.7%).

The present results confirm the complex association of changes in diet and in eating behavior, industrialization, urbanization and increasingly sedentary lifestyles with overweight and obesity. The data reported here also bear witness to the unsustainability of diet and the need for policies to combat malnutrition by promoting adequate food in quantity and quality in addition to physical activity targeting school-aged children.

CONCLUSIONS

The results from this survey identified a number of the risk factors for malnutrition (overweight, obesity and underweight) that would provide information for the implementation of a prevention policy based on regular monitoring of body weight status as well

as nutrition education as well as the promotion of physical activity for children and parents.

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