OVERWEIGHT IN ADOLESCENTS: MODERATING ROLE OF GENDER AND MOTHER'S EDUCATION LEVEL

Excesso de peso em adolescentes: papel moderador do sexo e da escolaridade materna

Exceso de peso en adolescentes: papel moderador del sexo y de la escolaridad materna

Original Article

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ABSTRACT

Objective: To investigate the moderating effect of gender and mother's education level on the relation between overweight and associated factors in adolescents. **Methods**: This is a descriptive cross-sectional study, performed with 945 students, of both sexes, aged between 14 and 18 years, of Ponta Grossa, Paraná. Weight and height measurements were collected. The adolescents filled out a questionnaire addressing sociodemographic information (gender, age, occupation/work, adolescent's address and parents' level of education), sedentary behavior (time watching TV/at the computer), participation in Physical Education classes and practice of physical activities. For data analysis, Poisson regression was used in STATA 9.2 software, adopting a significance level of $p<0.05$. **Results**: The prevalence of overweight among the adolescents was 18.8%. There was association between overweight and the variables age and sedentary behavior. However, when the estimates were adjusted for all the other independent variables, only the ages of 15 and 16 remained associated with overweight. A moderating effect of gender was observed in the association between overweight and sedentary behavior, and a moderating effect of mother's education on the association between adolescents' age and prevalence of overweight. **Conclusion**: The prevalence of overweight in adolescents was lower in the age range of 14 to 16 years old. Nevertheless, the age increase and the presence of sedentary behaviors were associated to lower risk of being overweight among boys whose mothers had lower formal schooling. As for the girls, a lower risk of overweight was observed when mothers presented higher level of education.

Descriptors: Adolescent; Overweight; Obesity.

RESUMO

Objetivo: *Verificar o efeito moderador do sexo e da escolaridade materna na relação entre excesso de peso e fatores associados em adolescentes.* **Métodos:** *Estudo transversal descritivo, realizado com 945 escolares, de ambos os sexos, entre 14 e 18 anos, de Ponta Grossa, Paraná. Foram coletadas as medidas de peso e estatura. Os adolescentes preencheram um questionário sobre dados sociodemográficos (sexo, idade, ocupação/trabalho, moradia do adolescente e escolaridade do pai e da mãe), comportamento sedentário (tempo assistindo TV/computador), participação nas aulas de Educação Física e prática de atividade física. Para análise dos dados foi utilizada a regressão de Poisson no programa STATA 9.2, adotando-se um nível de significância de p<0,05.* **Resultados:** *A prevalência de excesso de peso foi de 18,8%. Houve associação entre excesso de peso e as variáveis idade e comportamento sedentário. Porém, quando as estimativas foram ajustadas para todas as outras variáveis independentes, apenas as idades de 15 e 16 anos mantiveram-se associadas ao excesso de peso. Foi observado um efeito moderador do sexo na associação entre excesso de peso e comportamento sedentário, e um efeito moderador da escolaridade materna na associação entre idade e prevalência de excesso de peso dos adolescentes.* **Conclusão:** *A prevalência de excesso de peso entre os adolescentes foi menor na faixa dos 14 aos 16 anos. No entanto, o aumento da idade e a presença de comportamentos sedentários foram associados ao menor risco de excesso de peso entre os meninos cujas mães possuem menor escolaridade. No caso das meninas, um menor risco de excesso de peso foi observado quando as mães apresentavam maior escolaridade.*

Descritores*: Adolescente; Sobrepeso; Obesidade.*

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RESUMEN

Objetivo: *Verificar el efecto moderador del sexo y de la escolaridad materna en la relación entre el exceso de peso y factores asociados en adolescentes.* **Métodos:** *Estudio transversal descriptivo realizado con 945 escolares de ambos los sexos entre los 14 y 18 años, de Ponta Grossa, Paraná. Fueron recogidas las medidas de peso y altura. Los adolescentes rellenaron a un cuestionario sobre sus datos sociodemográficos (sexo, edad, ocupación/trabajo, vivienda del adolescente y escolaridad del padre y de la madre), el comportamiento sedentario (tiempo mirando la TV/ordenador), la participación en las clases de Educación Física y la práctica de actividad física. Para el análisis de datos se utilizó la regresión de Poisson en el programa STATA 9.2, adoptándose un nivel de significación de p<0,05.* **Resultados:** *La prevalencia del exceso de peso fue del 18,8%. Hubo asociación entre el exceso de peso y las variables edad y conducta sedentaria. Sin embargo, cuando las estimativas fueron ajustadas para todas las otras variables independientes solamente las edades entre 15 y 16 años se mantuvieron asociadas con el exceso de peso. Se observó un efecto moderador del sexo para la asociación entre el exceso de peso y la conducta sedentaria y un efecto moderador de la escolaridad materna para la asociación entre la edad y la prevalencia de exceso de peso de los adolescentes.* **Conclusión:** *La prevalencia de exceso de peso entre los adolescentes fue menor en la franja de edad entre los 14 y 16 años. Sin embargo, el aumento de la edad y la presencia de conductas sedentarias estuvieron asociados al menor riesgo de exceso de peso entre los niños cuyas las madres tienen baja escolaridad. Para las niñas el menor riesgo de exceso de peso se observó cuando las madres presentaron mayor escolaridad.*

Descriptores*: Adolescente; Sobrepeso; Obesidad.*

INTRODUCTION

Excess weight (EW) in adolescence is associated with obesity in adult life and represents an important risk factor for chronic noncommunicable diseases[1-3]. In Brazil, the 2008-2009 Family Expenditure Survey (Pesquisa de Orçamentos Familiares - POF), conducted by IBGE, highlighted the EW prevalence of 20.5% in this age group, with 21.7% in boys and 19.4% in girls[4]. In 1989, this prevalence was 7.7% in boys and 13.9% in girls, showing a significant increase[4]. The literature indicates that genetic, sociodemographic, behavioral and environmental factors are associated with the prevalence of EW in adolescents[5,6].

The prevalence of EW is higher in boys[7,8], in individuals with a high socioeconomic status[8,9] and in schoolchildren of mothers with higher education level[9]. In this way, identifying the factors associated with EW is important in order to identify groups at higher risk and propose more specific interventions.

Although there is reasonable knowledge about the prevalence and some factors associated with EW in Brazil, the studies[10,11] have emphasized the statistical relationship in an independent way between the variables, that is, a factor is isolated and its relation to the EW is estimated. Therefore, the interaction between two or more variables is not investigated.

A study with adolescents in Germany identified that the association between parents' schooling and the prevalence of EW was moderated by sex. However, this effect was observed only in females, that is, the daughters of parents with lower education level had a higher prevalence of EW[12]. In another study, conducted with French adolescents[13], the researchers observed that age was negatively associated with EW in females. Among the boys, the association, although not significant, was in the opposite direction. The authors also identified that longer time watching television (TV) (> 2h/day) was associated with a higher prevalence of EW only among girls.

Thus, it is evident that only the analysis of the direct association between variables may not be sufficient for a complete understanding of the factors associated with EW. Therefore, the present study aims to verify the moderating effect of sex and maternal schooling on the relationship between excess weight and associated factors in adolescents.

METHODS

A cross-sectional and descriptive, school-based study (n=6,597 students) was carried out in the public school system in the city of Ponta Grossa, Paraná, Brazil. Individuals of both sexes, enrolled in the high school grades during the day, participated in the study in public schools of the urban area.

Sampling was proportionally stratified by conglomerates in two stages. Initially, all schools were listed and grouped according to their geographic location (north, south, east, west and center). Nine schools were sorted as primary sampling units, with adoption of stratification by geographic region, which ensured the representativeness of the regions of the city. The number of classes selected in each school was defined in order to reach the proportional representativeness of the geographic area in relation to the municipality as a whole, and the selection occurred randomly.

For the sample size calculation, the study considered the prevalence of excess weight of 20% in Brazilian adolescents[4], a 95% confidence interval, an error of 3.0 percentage points, and a design effect of 1.5. The minimum sample was estimated at 928 individuals, being considered eligible for the study the adolescents who were in the

classroom on the day of collection and whose responsible had authorized their participation. The exclusion criteria were age≥19 years and pregnant adolescents. In total, 945 adolescents participated in the study.

Data collection was carried out from March to December 2014 and occurred during Physical Education classes. Initially, the researchers delivered the Informed Consent Form (ICF) to the person responsible for providing authorization for the student's participation in the study. The following day, the adolescents who wished to participate in the study filled out the questionnaire guided by the researchers. Subsequently, the participants went to another room, where body weight and height were measured according to World Health Organization procedures[14]. A digital scale, brand Plenna®, with a 100-gram resolution and a maximum capacity of 150 kg, and a wall stadiometer, model Wiso®, with a maximum height of 210 cm and a resolution of 1 cm, were employed. The collection was conducted by two trained researchers to carry out the measurements, with a technical error of measurement <1%.

From the measures of weight and height, the body mass index (BMI) was calculated. For classification of the nutritional status, the normative table proposed for Brazilian adolescents was adopted, which considers sex and age[15]. For the analysis, the categories were grouped into no excess weight (underweight or normal weight) and excess weight (overweight or obese).

The questionnaire applied to the students contained the following independent variables: sex, age (14 to 18 years of age), occupation/job (yes versus no), adolescent's housing (lives with father or mother; lives with father and mother; and others) and education level of the father and the mother, obtained by self-report of adolescents. To that end, schoolchildren reported up to what year (grades) the father and mother studied. Subsequently, the study years were classified into a dichotomous variable: <8 years of schooling (up to incomplete elementary school) and ≥ 8 years of schooling (complete elementary education or more).

Still as an independent variable, the sedentary behavior was evaluated by means of the time spent in front of the computer/TV per day (from zero to eight hours or more), participation in Physical Education classes (yes versus no) and physical activity practice by Middle of the International Physical Activity Questionnaire (IPAQ) short version[16]. For classification of the level of physical activity, specific recommendations to adolescents were applied, considering inactive/insufficiently active those who performed 0 to 299 min/week, of moderate to vigorous activities, and active the ones who reached the recommendation of 300 min/week[17].

For data analysis, the study used descriptive statistics (absolute and relative frequency distribution), stratified by sex, for characterization of the sample. Subsequently, the crude Poisson regression analysis was performed, which was then adjusted for all variables with use of the STATA 9.2 software, adopting a significance level of $p<0.05$. In order to test the moderating effect of sex and mother's level of education, an interaction term of these variables (sex and mother's education level) was created with all other independent variables. This model was adjusted for all other variables. All analyzes considered the complex sample design by means of the STATA svy command.

The study was approved by the Human Research Ethics Committee of the State University of Ponta Grossa (protocol no. 40/07), according to Resolution no. 466/12 of the National Health Council.

RESULTS

The sample for analysis was 945 adolescents (58.6% girls, n=554), aged 15 to 17 years (85.9%, n=812), without occupation (82%, n=775), residents with parents (73.5%, n=695) and whose parents had at least eight years of schooling (41.1%, n=388, 40.2%, n=380). Approximately 64.5% (n=609) of the adolescents remained in front of the TV/computer for two or more hours per day, and most were considered active (boys 76.5%, n=299; girls 70.4%, n=390). There was an 88.3% (n=834) participation in Physical Education classes, being higher among boys (96.4%, n=377 versus 82.5%, n=457, $p<0.01$). The prevalence of excess weight was 18.8% (n=178; 95%CI 15.7-22.4), being higher in boys (21.7%, n=85). Other characteristics of the sample are presented in Table I.

Younger adolescents had a higher prevalence of excess weight (39.4% at 14 years), followed by a decrease up to the age of 16 years (14.6%), and then a further increase in excess weight at the ages of 17 and 18 years (18.2% and 20%). There was association between excess weight and the variables age and sedentary behavior (time watching TV/computer). However, when the estimates were adjusted for all other independent variables, only the ages of 15 and 16 years remained associated with excess weight (Table II).

When performing the sex-stratified analysis (Table III), the sedentary behavior was found associated with excess weight. Among boys, the longer the TV/computer time, the lower the prevalence of excess weight (p trend=0.013), but this association was only marginally associated among girls (p trend=0.09). The moderating effect of sex was significant (p trend=0.006), corroborrating the stratified analyses and indicating that the association between the time of exposure

Table I - Characteristics of high school adolescents according to sex (n=945). Ponta Grossa, PR, Brazil, 2014.

Variable	Total		Male (n=391, 41.4%)		Female (n=554, 58.6%)		p-value
	n	%	n	%	n	%	
Age							
14	33	3.5	13	3.3	20	3.6	0.98
15	263	27.8	109	27.9	154	27.8	
16	280	29.6	119	30.4	161	29.1	
17	269	28.5	111	28.4	158	28.5	
18	100	10.6	39	10.0	61	11.0	
Grade							
1st	363	38.4	167	42.7	196	35.4	0.06
2nd	292	30.9	116	29.7	176	31.8	
3rd	290	30.7	108	27.6	182	32.9	
Occupation/Job							
Yes	170	18.0	97	24.8	73	13.2	<0.01
No	775	82.0	294	75.2	481	86.8	
Housing							
Father or mother	174	18.4	73	18.7	101	18.2	0.56
Father and mother	695	73.5	291	74.4	404	72.9	
Others	76	8.0	27	6.9	49	8.8	
Father's education level							
< 8 years	557	58.9	221	56.5	336	60.7	0.20
≥8 years	388	41.1	170	43.5	218	39.4	
Mother's education level							
< 8 years	656	59.8	223	57.0	342	61.7	0.15
≥ 8 years	380	40.2	168	43.0	212	38.3	
Time in sedentary behaviors (TV/ computer)							
< 1 Hour	101	10.7	35	9.0	66	11.9	0.45
1-2 hours	235	24.9	97	24.8	138	24.9	
3-4 hours	291	30.8	131	33.5	160	28.9	
5-6 hours	201	21.3	82	21.0	119	21.5	
7-8 hours	117	12.4	46	11.8	71	12.8	
MVPA*							
Inactive/Insufficiently Active	256	27.1	92	23.5	164	29.6	0.04
Active	689	72.9	299	76.5	390	70.4	
Participation in Physical Education classes							
No	111	11.8	14	3.6	97	17.5	<0.01
Yes	834	88.3	377	96.4	457	82.5	
Nutritional status							
Normal	767	81.2	306	78.3	461	83.2	0.06
Overweight/Obesity	178	18.8	85	21.7	93	16.8	

* Moderate and vigorous physical activity. Active: ≥ 300 minutes/week.

Table II - Association between prevalence of excess weight and sociodemographic, health and behavioral variables in high school adolescents (n=945). Ponta Grossa, PR, Brazil, 2014.

Variable	Category	Excess weight (%)	Gross analysis			Adjusted analysis		
			PR	95%CI	p-value	PR	95%CI	p-value
Sex	Male	21.74	1.00			1.00		
	Female	16.79	0.77	(0.57-1.04)	0.08	0.79	(0.60-1.04)	0.09
Age	14	39.4	1.00			1.00		
	15	20.9	0.53	(0.31-0.91)	0.03	0.53	(0.31-0.89)	0.02
	16	14.6	0.37	(0.19-0.73)	0.01	0.37	(0.19-0.74)	0.01
	17	18.2	0.46	(0.23-0.95)	0.04	0.46	(0.21-1.03)	0.06
	18	20.0	0.51	(0.22-1.17)	0.10	0.52	(0.21-1.28)	0.13
Occupation/Job	Yes	20.0	1.08	(0.74-1.56)	0.70	1.01	(0.73-1.38)	0.96
	No	18.6	1.00			1.00		
Housing	Father or mother	20.69	1.00			1.00		
	Father and mother	18.99	0.92	(0.70-1.20)	0.48	0.90	(0.69-1.18)	0.40
	Others	13.16	0.64	(0.38-1.05)	0.07	0.63	(0.35-1.16)	0.12
Father's education level	<8 years	18.13	1.00			1.00		
	≥ 8 years	19.85	1.09	(0.85-1.42)	0.44	1.06	(0.78-1.46)	0.67
Mother's education level	< 8 years	18.76	1.00			1.00		
	≥ 8 years	18.95	1.01	(0.68-1.50)	0.96	0.99	(0.65-1.51)	0.96
Time in sedentary behaviors (TV/computer)	<1hour	23.76	1.00			1.00		
	1-2 hours	18.72	0.79	(0.51-1.21)	0.24	0.77	(0.50-1.20)	0.22
	3-4 hours	17.53	0.74	(0.49-1.12)	0.13	0.69	(0.44-1.08)	0.09
	5-6 hours	17.41	0.73	(0.55-0.98)	0.04	0.69	(0.46-1.03)	0.07
	> 7 hours	20.5	0.86	(0.43-1.73)	0.51	0.85	(0.39-1.86)	0.65
MVPA*	Inactive/ Insufficiently active	16.80	1.00			1.00		
	Active	19.59	1.17	(0.87-1.56)	0.26	1.20	(0.91-1.58)	0.18
Participation in Physical Education classes	No	15.3	1.00			1.00		
	Yes	19.3	1.26	(0.89-1.79)	0.19	1.17	(0.86-1.59)	0.27

* Moderate and vigorous physical activity. Active: ≥ 300 minutes/week. PR: Prevalence Ratio; 95%IC: 95% Confidence Interval.

in front of TV/computer and the prevalence of excess weight is specific for each of the sexes.

Table 4 shows that the association between sex and excess weight was statistically significant ($p<0.05$) for adolescents with mothers who had 8 years of schooling or more and who, therefore, presented a lower risk of excess weight. On the other hand, the sedentary behavior was associated with a lower risk of excess weight only among adolescents whose mothers had less schooling (<8 years of schooling). There was also a positive moderating effect of mother's education level on the association between age and prevalence of excess weight in adolescents. The results indicate that this association is significantly different ($p<0.05$), being valid only for adolescents whose mothers have less than eight years of schooling.

Table III - Association between excess weight and sociodemographic, health and behavioral variables stratified by sex and interaction test in high school adolescents. Ponta Grossa, PR, Brazil, 2014.

Variable	Category	Sex				Moderating effect of sex	
		Male		Female			
		PR	95%CI	PR	95%CI	PR	95%CI
Age	14	1.00		1.00		1.00	
	15	0.72	(0.27-1.90)	0.41	(0.16-1.02)	0.57	(0.11-2.83)
	16	0.42	(0.15-1.13)	0.34	(0.11-1.06)	0.82	(0.14-4.72)
	17	0.49	(0.24-1.02)	0.44	(0.14-1.40)	0.90	(0.21-3.91)
	18	0.67	(0.30-1.48)	0.41	(0.12-1.38)	0.61	(0.15-2.57)
Occupation/Job	Yes	0.98	(0.65-1.47)	1.06	(0.76-1.48)	1.08	(0.60-1.97)
	No	1.00		1.00		1.00	
Housing	Father or mother	1.00		1.00		1.00	
	Father and mother	1.03	(0.75-1.44)	0.83	(0.54-1.25)	0.80	(0.47-1.36)
	Others	0.51	(0.13-1.97)	0.72	(0.45-1.15)	1.42	(0.34-6.04)
Father's education level	<8 years						
	≥ 8 years	1.00	(0.77-1.31)	1.16	(0.75-1.80)	1.16	(0.70-1.92)
Mother's education level	< 8 years	1.00		1.00		1.00	
	≥ 8 years	2.75	(0.90-8.39)	0.81	(0.34-1.97)	0.30	(0.07-1.22)
Time in sedentary behaviors (TV/computer)	<1hour	1.00		1.00		1.00	
	1-2 hours	0.72	(0.41-1.28)	0.77	(0.24-2.48)	1.06	(0.24-4.62)
	3-4 hours	0.44	(0.22-0.87)	1.16	(0.55-2.41)	2.63	(0.87-7.99)
	5-6 hours	0.43	(0.20-0.93)	1.16	(0.54-2.49)	2.73	(0.70-10.61)
	> 6 hours	0.33	(0.12-0.92)	1.67	(0.50-5.61)	5.13	(0.96-27.43)
MVPA*	Inactive/ Insufficiently active	1.00		1.00		1.00	
	Active	1.23	(0.85-1.79)	1.08	(0.69-1.69)	0.88	(0.49-1.60)
Participation in Physical Education classes	No	1.00		1.00		1.00	
	Yes	3.12	(0.41-2.35)	1.02	(0.70-1.49)	0.33	(0.03-3.33)

* Moderate and vigorous physical activity. Active: ≥ 300 minutes/week. PR: Prevalence Ratio; 95%IC: 95% Confidence Interval.

DISCUSSION

The prevalence of excess weight among adolescents was 18.8% (95%CI: 15.7-22.4). These results are similar (13 to 23%) to that reported among adolescents from other countries[18-20] and the southern region of Brazil[21-23]. A systematic review to estimate the prevalence of excess weight and obesity in children and adolescents in Latin America found that 16.6% to 35.8% of adolescents aged 12 to 19 years presented excess weight and obesity[24].

There was a higher prevalence of excess weight among boys (21.7%). These results corroborate national[21,25] and international investigations[7,26,27]. In general, girls are less satisfied with body weight and suffer greater social pressure to maintain a "leanness" pattern, which may contribute to a greater control of body weight[28].

Younger adolescents had a higher prevalence of excess weight (39.4% at 14 years), followed by a decrease up to 16 years (14.6%), and a new increase later at 17 and 18 years (18.2% to 20%). This result can be attributed, in

Table IV - Association between prevalence of overweight and sociodemographic, health and behavioral variables stratified by mother's education level and interaction test in high school adolescents. Ponta Grossa, PR, Brazil, 2014.

Variable	Category	Mother's education level				Moderating effect of mother's schooling	
		< 8 years		≥ 8 years			
		PR	95%CI	PR	95%CI	PR	95%CI
Sex	Male	1.00		1.00		1.00	
	Female	0.99	(0.70-1.41)	0.53	(0.30-0.97)	0.54	(0.26-1.11)
Age	14	1.00		1.00		1.00	
	15	0.45	(0.27-0.76)	0.78	(0.34-1.79)	1.72	(0.84-3.53)
	16	0.26	(0.14-0.48)	0.74	(0.23-2.35)	2.87	(1.06-7.81)
	17	0.36	(0.18-0.73)	0.81	(0.35-1.86)	2.26	(1.18-4.35)
	18	0.32	(0.11-0.87)	1.11	(0.40-3.09)	3.51	(1.43-8.62)
Occupation/Job	Yes	1.30	(0.86-1.96)	0.77	(0.30-1.96)	1.69	(0.49-5.88)
	No	1.00		1.00		1.00	
Housing	Father or mother	1.00		1.00		1.00	
	Father and mother	0.85	(0.60-1.21)	1.01	(0.65-1.58)	1.19	(0.66-2.12)
	Others	0.53	(0.23-1.23)	0.84	(0.31-2.29)	1.58	(0.34-7.35)
Father's education level	< 8 years	1.00		1.00		1.00	
	≥ 8 years	0.98	(0.64-1.50)	1.31	(0.91-1.87)	1.34	(0.81-2.22)
Time in sedentary behaviors (TV/computer)	<1 hour	1.00		1.00		1.00	
	1-2 hours	0.62	(0.41-0.95)	1.18	(0.53-2.64)	1.90	(0.88-4.09)
	3-4 hours	0.78	(0.48-1.25)	0.72	(0.38-1.36)	0.93	(0.44-1.94)
	5-6 hours	0.62	(0.42-0.90)	0.98	(0.51-1.89)	1.59	(0.79-3.22)
	7 hours or more	0.84	(0.32-2.21)	0.98	(0.43-2.21)	1.17	(0.41-3.32)
MVPA*	Inactive/ Insufficiently active	1.00		1.00		1.00	
	Active	1.21	(0.81-1.81)	1.11	(0.67-1.82)	0.91	(0.47-1.76)
Participation in Physical Education classes	No	1.00		1.00		1.00	
	Yes	0.93	(0.73-1.19)	2.08	(0.62-6.97)	2.23	(0.62-8.01)

* Moderate and vigorous physical activity. Active: ≥ 300 minutes/week.

part, to the lower concern with physical appearance and, therefore, with excess weight in younger adolescents. Thus, younger adolescents tend to care less about health and aesthetic beauty standards, which may favor body weight gain at this stage. However, the increase in excess weight in older schoolchildren (17 to 18 years old) may be due to the decrease in physical activity and the increase in sedentary behavior, very common at this stage due to the increase in school engagements (university entrance), part-time jjob and, consequently, less concern with healthy habits in their routine[29,30].

In the analysis stratified by sex, greater exposure to sedentary behaviors was negatively associated with excess weight among boys; however, it was only marginally positively associated with excess weight among girls. These results indicate that the association between behavioral variables, such as sedentary behavior and excess weight in adolescents, may be specific for each sex. A similar pattern was observed in a representative sample of Australian adolescents. Among female adolescents there was no association between exposure to sedentary behaviors and the BMI; however, exposure to sedentary behaviors was

inversely associated with BMI[31]. It is noteworthy that, despite the sedentary behavior, the boys participated more in Physical Education classes (almost 100%) and also performed more moderate and vigorous physical activity. Therefore, despite the sedentary behavior, boys exhibit more active behaviors than girls.

Thus, girls appear to be more susceptible to excess weight when exposed to sedentary behaviors compared to boys (marginal association; p trend=0.09). One of the hypotheses to explain this fact is related to the lower levels of physical activity among girls[32], that is, the lower energy expenditure in girls is partly due to less exposure to moderate and vigorous physical activity. Thus, exposure to sedentary behaviors may further increase the odds of developing excess weight in this subgroup.

Although contrary to expectations, the inverse association between longer sedentary behaviors and excess weight observed in the present study was also observed in other studies[33]. Furthermore, reviews of this association have shown inconsistent results or a clinically irrelevant effect[34]. Such inconsistencies can be explained by the moderating effect of eating habits, especially during some sedentary behaviors, such as watching TV[35]. It is also emphasized that sedentary behaviors have been treated as a distinct behavior of physical activity, and these can coexist and independently affect health indicators such as metabolic indicators and excess weight.

There was a moderating effect of maternal level of education on the association between age and prevalence of excess weight for adolescents whose mothers have less than eight years of schooling. Thus, the children of mothers with lower levels of education tend to have lower prevalence of excess weight due to a less favored socioeconomic condition and, therefore, lower purchasing power of food products. Studies indicate that the high level of maternal schooling corresponds to a greater chance of excess weight and obesity in schoolchildren[36,37].

In the present study, the scope of the investigation and the size of the sample, sufficient to guarantee estimates of prevalence with reasonable accuracy, as well as a school-based design, with probabilistic selection that counted on the objective measure of weight and height, stand out. However, there are limitations that must be considered, such as the delimitation of high school students in the public network, which does not allow the extrapolation of the results to all adolescents in the city. The city where the study was conducted is relatively small (311,611 inhabitants), and may not represent cities with different characteristics. The cross-sectional design should also be considered, making it impossible to determine the causal sense of the observed associations. The use of a questionnaire as a form of data collection may be influenced by memory bias, mainly in relation to measures of physical activity and sedentary behavior; however, other studies have used similar instruments and demonstrated satisfactory results[38,39]. Finally, the availability of mensuration of eating habits could help in understanding the interrelations observed in the present study; however, such data was not collected and should be considered in the conclusion of the findings of this study.

Thus, interventions and further studies with a longitudinal design should be performed so that the results observed in cross-sectional studies can be confirmed, as well as for verification of possible causal relationships. Therefore, special attention should be given to sedentary behaviors in girls and adolescents whose mothers have more than eight years of schooling. Actions should be specifically targeted to these groups in order to reduce the prevalence of excess weight.

CONCLUSION

The prevalence of excess weight among adolescents was lower between 14 and 16 years. However, increasing age and presence of sedentary behaviors were associated with lower risk of excess weight among boys whose mothers had lower level of education. In the case of girls, a lower risk of excess weight was observed when mothers presented higher level of education (≥8 years of schooling).

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