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ORIGINAL ARTICLE

Adiposity and muscle strength level in pre-scholars according to the educational level and socio-demographic characteristics of their parents

Nivel de adiposidad y fuerza muscular en pre-escolares según nivel educacional y características socio-demográficas de sus padres

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What do we know about the subject matter of this study?

In Latin America, the prevalence of overweight/obesity in preschoolers exceeds 30%, with new risk factors such as sleep duration, use of screens, and exposure to artificial light, but the educational level of parents has been little explored.

What does this study contribute to what is already known?

There are also socio-demographic factors such as parents' educational level, and children's eating time, which are related to obesity in preschoolers. Health professionals could consider these factors in parenting education.

Abstract

The educational level of the adult population is related to obesity, but there is little knowledge regarding the relationship of parents' educational level with the obesity and muscle strength of Chilean preschool children. **Objective**: To describe the levels of adiposity and muscular strength of pre-schoolers, according to the educational level and socio-demographic characteristics of their parents. **Patients and Method**: Descriptive, cross-sectional study with participation of pre-schoolers from kindergartens and their parents (n = 99). Variables studied were a) socio-demographic (survey with 4 items), b) anthropometry (weight, height, weight/height ratio, weight/height-z, and body mass index), c) body composition (fat mass in kg and %, muscle mass), and d) muscle strength (handgrip muscle strength). The association between the above factors and the educational level of the parents [mother or father] of "low" [Low-EL] or "high" educational level [High-EL] were analysed. **Results**: There were significant differences between the weight/height according to the parents' educational level (father Low-EL; 0.088 ± 0.170 *vs* High-EL -0.060 ± 0.163, P = 0.024), and in the percentage of fat mass (father Low-EL; 30.8 ± 0.8 *vs* High-EL; 28.7 ± 0.9%, P = 0.040). In the rest of the obesity markers, there were no significant differences according to the parents' educational level nor in strength and muscle mass. **Conclusions**: Pre-school children of parents with low educational level show significantly higher values of weight/height and percentage of fat mass than those peers with parents with high educational level. These findings require further and more complex research to be corroborated.

Keywords:
Educational Level;
Anthropometry;
Body Composition;
Pre-schoolers;
Obesity Markers

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Introduction

Obesity is probably considered to be one of the first post-industrialization pandemics, with significant health consequences for the population and enormous consequences for public health[1] and education systems[2]. In Latin American countries, the prevalence of overweight and obesity in preschool children is over 30%. Specifically, the cases of childhood obesity have tripled in the last 40 years[3], which has resulted in high morbidity and mortality in later life[4].

Although the etiology of obesity is multifactorial, including genetic aspects[4], there is evidence that mostly highlights the importance of factors associated with the environment such as physical inactivity/activity[5], sedentarism[6], cardiorespiratory fitness[7], and feeding styles at school (i.e. children 6-17 years of age)[8]. Unfortunately, other *risk factors* for the development of obesity have emerged, such as reduced quantity and quality of sleep[9], prolonged use of screens[11] (video games[10], internet[12]), and prolonged exposure to artificial light[13]. Recently, it has also been reported that neighborhoods with fewer green spaces may play a role in the development of obesity in the population[3].

On the other hand, considering the critical problem of childhood obesity in Latin America, the potential role of socio-demographic and/or family variables, such as the *educational level* of parents of preschool children[14], has been little studied. For instance, there is a marked association between high levels of obesity and low educational level of the adult population[14]. Considering the proven role of certain socio-demographic parameters concerning the prevalence of obesity in the adult population[15] and the limited evidence on other socio-demographic factors such as the *educational level* of parents that could potentially influence childhood obesity, the objective of this study was to describe the levels of adiposity and muscle strength of preschoolers, in addition, to describe socio-demographic characteristics of parents and preschoolers according to the educational level of the parents.

Patients and Method

Cross-sectional study, in which participated 141 parents/guardians of preschool children who attend two kindergartens associated with the National Kindergartens Board (JUNJI) of Chile (*Bosque de Colores* and *Semillas de Amor*) in Osorno, Los Lagos Region, Chile, who were invited to participate in the study. The study was developed according to the Declaration of Helsinki recommendations and approved by the Scientific Ethical Committee of the Valdivia Health Service.

The population was composed of (n = 141) preschoolers, of which (n = 42) were excluded due to i) non-attendance of the participant (n = 29), ii) participants with partially recorded measurements (n = 6), and iii) participants whose parents did not sign the informed consent document (n = 7), resulting in a final sample of (n = 99) preschool children along with their parents (mothers/fathers) who completed the survey.

Survey to measure socio-demographic variables and educational level of parents

The research instrument (i.e. survey) was elaborated by the authors and validated by different expert peers. The survey included the following items: Item 1) socio-demographic information of the preschooler's parents (mother and father), Item 2) information about the preschooler, Item 3) parent-child communication time, and Item 4) activities they do with their child in their free time.

The parents' educational level variable was categorized as low educational level (Low-EL) when the parents reported having completed primary and secondary education, and high educational level (High-EL) when the parents reported having completed higher education such as technical education, university education, and/or postgraduate education, similar to previous studies[16].

The *wage* variable was divided into different cut-off points of wage similar to previous studies in Chile[17]. *Sleeping time* was recorded in the hours/day that parents reported in item 3 of the survey, and *eating time* in minutes/day, which corresponded to the average daily eating time (i.e. main meals) of the child.

The instrument was applied in both JUNJI kindergartens, coordinating the actions of the research with each respective administration, in each educational establishment between 6 and 7 p.m. (Monday to Friday), and before the application of the survey, the study participants (parents) received verbal and explanatory instructions for completing it. Completing the survey took between 15 to 30 minutes, during which the research team provided feedback to the participating parents. By applying Cronbach's alpha reliability statistic, the survey reported a score of 0.894, which is very close to 1, indicating high reproducibility of the instrument.

Anthropometry

After the application of the survey and the signing of the informed consent of parents and the assent of the participating child, the anthropometric evaluation of the preschoolers was carried out at the educational establishment, in a room specially adapted for the purpose, and was performed between 9 am and 12 pm. Height was measured with a standard stadiometer with 0.1 cm of precision (SECA 700 and SECA 213i). Weight was also measured and body mass index (BMI)

was calculated. A nutritionist calculated the nutritional status and estimated the Z-weight/height and Z-BMI using the standard nutritional classification guideline "growth patterns for nutritional assessment of children" of the Chilean Ministry of Health (MINSAL)[18].

Body composition

To calculate body composition, the children's height was measured with a standard measuring device with 0.1 cm of precision (SECA Model 700). Subsequently, the body composition was analyzed with a digital bioelectrical impedance device (InBody120™, Biospace, Inc., Seoul, Korea) with a tetrapolar 8-point tactile electrode method, as reported in other similar studies[19]. Body composition variables such as fat mass in kg and %, as well as muscle mass in kg and %, were measured in each preschooler.

The measurement procedure was performed in the adapted room of the establishment, both with the research team and the staff of the institution. After having the usual breakfast of the kindergarten, each child stepped on the scale for 30 seconds, barefoot, and received a digital electronic device (Tablet Samsung™ Galaxy (A 2017, model SKU 535983999) with a game containing images and auditory stimuli to playfully promote the evaluation, and thus maintain their attention and standing position during this time.

Muscle strength measurement

Muscle strength was measured by the maximum grip strength of both the right arm and left one in each child. Subsequently, the average of both measures was calculated and reported as a continuous variable. Each participant was measured using a Jamar® Plus+ digital hand dynamometer (Sammons Preston, Patterson Medical, Bolingbrook, IL, USA), used in previous studies[20]. Before the measurement, the researchers explained to the participants how to perform the action, with emphasis on holding the instrument for 3 to 5 seconds in each hand (repeated 3 times), with a pause of 1 minute between each hand, and then the average measurement value in each hand (in kg) was recorded in an Excel® spreadsheet.

Statistical analysis

The tables, graphs, and figures present the data in mean (±) standard error. The categorical variables *wage*, *marital status* of the parents, and *nutritional status* of the participants are presented as (n =) and percentage (%). Using the variables weight and height, the variable weight/height ratio was obtained, which was subsequently calculated and expressed as Z score (Z-weight/height). To analyze the differences between the continuous independent variables of the groups of mothers and fathers with Low-EL or High-EL, a univariate analysis was performed using body mass index, height, and eating time as co-variables. To test for differences between categorical variables (*wage*, *marital status* of parents, *nutritional status* of participants) between the groups (Low-EL vs. High-EL), the Chi-square test was applied. All statistics were performed using the SPSS version 23 software (SPSS Inc., Chicago, IL), considering an alpha error of $P < 0.05$).

Results

Table 1 shows the socio-demographic data of the parents and their preschool children according to the educational level of the parents (mother/father). There were significant differences in mothers' wage according to educational level, where most of the mothers reported receiving the minimum wage income vs. mothers with a high educational level (Mother Low-EL 15 (68.2%) vs. Mother High-EL 6 (27.3%), $P < 0.0001$). Also, there were significant differences in the eating time of the preschoolers according to the educational level of the father (father Low-EL 21.0±7.0 vs father High-EL 30.0 ± 13.0 min). There were no significant differences in the other variables included in table 1.

There were significant differences in the markers of Z-weight/height obesity according to the educational level of the parents (father Low-EL 0.088 ± 0.170 vs father High-EL -0.060 ± 0.163, $P = 0.024$) (figure 1). No significant differences were recorded in the variables weight, weight/height ratio, Z-weight/height ratio, and BMI for mothers of different educational levels (figure 1). Similarly, there were no significant differences in the variables weight, weight/height ratio, and BMI for fathers of different educational levels (figure 1).

There were significant differences in the percentage of fat mass in preschoolers (father Low-EL 30.8 ± 0.8 vs. father High-EL 28.7 ± 0.9%, $P = 0.040$) (figure 2B). In the remaining markers of obesity (weight, height, weight/height ratio, Z-weight/height ratio, BMI) and fat mass in kg and %, there were no significant differences according to the educational level of the parents (figure 2). Meanwhile, there were no significant differences in the muscle mass (figure 2C-D) and the muscle strength (figure 2E-F) of preschoolers according to the educational level of the parents.

Discussion

Considering the objectives of this study to determine the association between the educational level of parents (mother/father) of preschoolers with markers of obesity and to relate other socio-demographic variables with the anthropometry, body composition, and

prehensile strength of the child, the main findings indicate that preschool children of parents with low educational level present a higher Z-weight/height ratio and percentage of body fat (anthropometric markers and body composition) than children of parents with a high educational level. Other results show that there are differences in the eating time of preschoolers between children of parents with a low educational level versus those of parents with a high educational level, with no differences between preschoolers according to the levels of prehensile strength.

It has been reported that the lower educational level of parents has been related to a poor knowledge in the selection of the type of food, thus affecting the energy balance of their children and, consequently, their nutritional and health status[21]. On the other hand, in an investigation that included data from (n = 14,426) children aged 2 to 9 years from eight European countries, it was reported that the low educational level of the parents was significantly associated with a higher intake of foods high in sugar and fat. In contrast, a high parental education level was associated with those participating children who reported a higher intake of foods low in sugar and fat[22]. Educational level has demonstrated previously to have an "indirect" role in the type of food consumed by preschool/school children, which in this study is confirmed by the association of this factor (educational level, specifically of fathers) with the gold standard markers of obesity, Z-weight/height, and by the percentage of fat mass.

Previous studies have reported that the association of low educational level of fathers (but not of mothers) could influence markers of obesity. For example, a study conducted with (n = 4,135) adolescents from schools in Spain showed that the children of fathers who had slightly lower percentages of educational le-

Table 1. Socio-demographic characteristics of the parents and their preschool children participants

	Educational level Mother		*P value*	Educational level Parent		*P value*
	Low-EL	High-EL		Low-EL	High-EL	
n =						
Parents Information						
Age (years)	30.0 ± 8.0	34.0 ± 6.0	*P* = 0.632	32.0 ± 9	37.0 ± 7.0	*P* = 0.721
Salary (thousands of pesos)¶						
< 350.000, n= / (%)	15 (68.2%)	6 (27.3%)	***P* < 0.0001**	11 (50.0%)	5 (22.7%)	*P* = 0.321
350.000-500.000, n= / (%)	9 (50.0%)	9 (50.0%)		11 (61.1%)	6 (33.3%)	
500.000-1.000.000, n= / (%)	6 (26.1%)	17 (73.9%)		7 (30.4%)	16 (69.6%)	
> 1.000.000, n= / (%)	0 (0%)	20 (100%)		2 (10.0%)	17 (85.0%)	
Civil status¶						
Single, n= / (%)	20 (43.0%)	24 (52.2%)	*P* = 0.813	23(50.%)	19 (41.3%)	*P* = 0.237
Married, n= / (%)	9 (27.3%)	23 (69.7%)		9 (27.3)	22 (66.7%)	
Widowed, n= / (%)	1 (100%)	0 (0%)		1 (100%)	0 (0%)	
Separated, n= / (%)	1 (33.3%)	2 (66.7%)		0 (0%)	2 (66.7%)	
Divorced, n= / (%)	1 (50%)	1 (50%)		1 (50.%)	1 (50.0%)	
Preschool Informations						
Time to eat (min)	21.0 ± 5.0	28.0 ±13.0	*P* = 0.079	21.0 ± 7.0	30.0 ± 13.0	***P* = 0.031**
Anthropometry						
Age (years, months)	3.1 ± 0.6	3.3 ± 0.6	*P* = 0.767	3.2 ± 0.6	3.1 ± 0.6	*P* = 0.833
Size (cm)	94.9 ± 6.4	94.8 ± 5.5	*P* = 0.921	95.2 ± 6.7	95.1 ± 5.3	*P* = 0.955
Nutritional Condition						
Normal, n= / (%)	13 (35.1%)	19 (51.4%)	*P* = 0.070	13 (35.1%)	20 (54.1%)	*P* = 0.064
Overweight, n= / (%)	9 (25.0%)	21 (58.3%)		11 (30.6%)	14 (38.9%)	
Obesity, n= / (%)	10 (38.5%)	21 (58.3%)		10 (38.5%	11 (42.3%)	
Body Composition						
Total body fat (kg)	5.0 ± 1.4	4.8 ± 1.6	*P* = 0.631	5.1 ± 1.4	4.7 ± 1.6	*P* = 0.161
Muscular strenght						
Grip strenght Right (kg)	2.8 ±1.5	2.8 ± 1.5	*P* = 0.977	2.9 ± 1.5	2.9 ± 1.7	*P* = 0.912
Grip strenght Left (kg)	2.6 ± 1.4	2.7 ± 1.2	*P* = 0.799	2.7 ± 1.5	2.6 ± 1.2	*P* = 0.813

Data are shown as mean and ± standard deviation. Groups are described as; (Low-EL) Low educational level (High-EL) High educational level of mothers / fathers. (Right) Right arm grip strength. (Left) Gripping force of the left arm. (Continuous variables between Low-EL vs. High-EL groups are compared with Univariate analysis using BMI, height, and eating time as co-variables. Categorical variables are analyzed with Chi-square test. Values in bold indicate statistically significant differences at the P <0.05 level between fathers / mothers of Low-EL vs. High-EL groups.

vel than their mothers prove that it is an indicator of a higher prevalence of greater adiposity in their children, whereas, as their academic training increased, their obesity percentages decreased[23].

Likewise, in our study, the variable Z-weight/height ratio and the percentage of fat mass could be related to different variables traditionally studied, such as a) low physical activity patterns (spaces for recreation and ac-

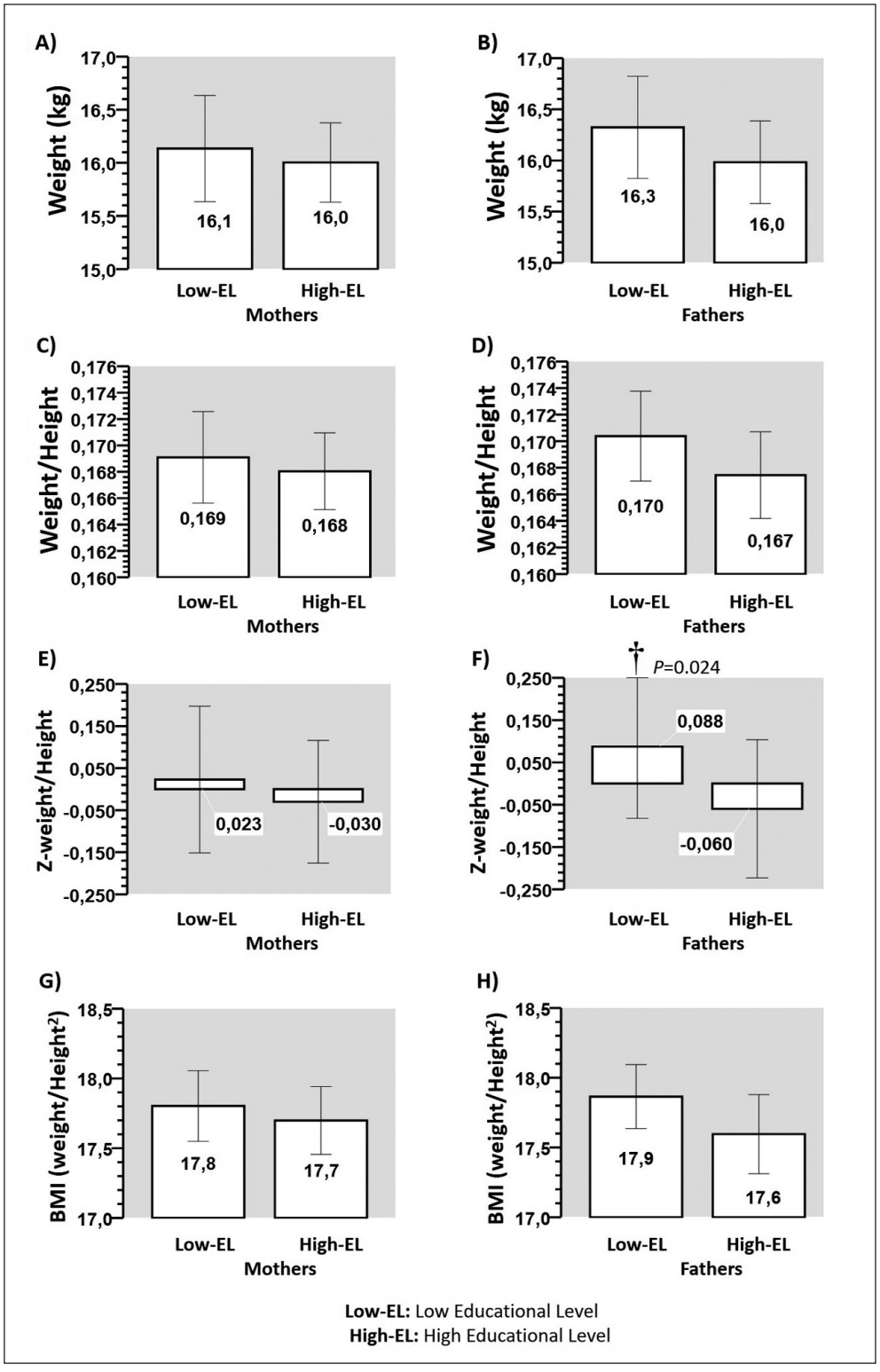

Figure 1. Anthropometric characteristics of the participating preschoolers. (BMI) Body mass index. (†) Denotes significant differences between Low-EL group vs. High-EL at the P < 0.05 level by Univariate analysis. EL: Educational Level.

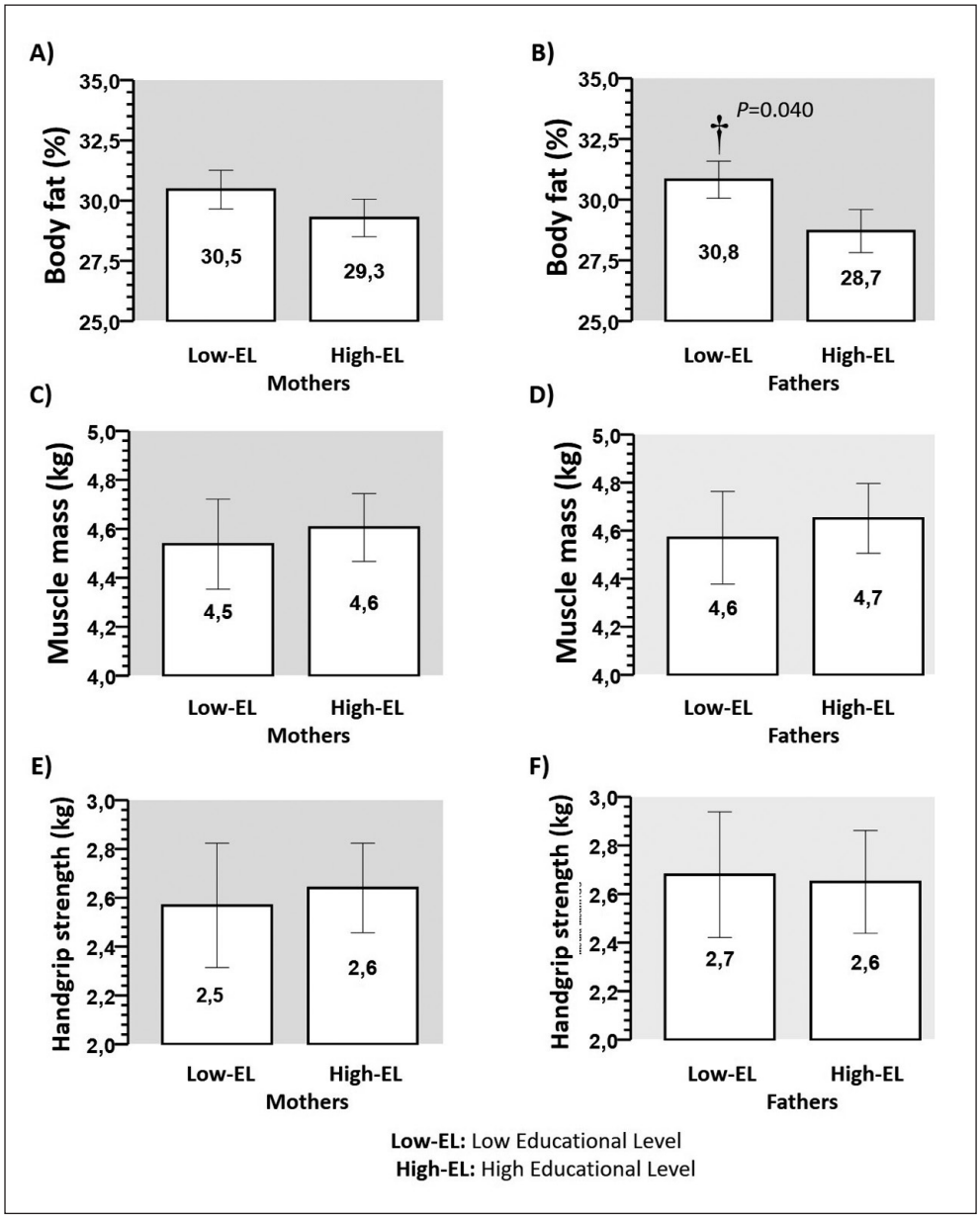

Figure 2. Characteristics of body composition and grip strength (average of both arms) in participating preschool children. (†) Denotes significant differences between Low-EL group vs. High-EL at the P < 0.05 level by Univariate analysis. NE: Educational Level

tive play, and less sedentary time in preschool), and b) diet (intake of foods high in sugars, sodium and fat, or reduced eating time) (table 1), but it is also speculated that an important part of the environmental behaviors of eating, physical activity, leisure time, and family life could be mostly linked to decisions that are mostly regulated/influenced by fathers than mothers[24].

Other studies show that obesity rates are higher in children whose mothers have not completed secondary education, where the father's university education is considered a protective factor for their children of obesity. In Chile, the low level of education of the mother also constitutes a risk for optimal child growth and development as has been previously reported[18], evidenced by the higher prevalence of obesity in preschool children of mothers with low educational level. Furthermore, our study showed similar results, in which the low educational level of the parents (primary and secondary education), was associated with malnutrition, and at the same time the high educational level of the parents (higher education), was associated with weight parameters closer to normal health cut-off points. Likewise, a study of 11 European countries reported that the risk of suffering from high adiposity is higher in children whose mothers have a low educational level[25].

Similarly, an Ibero-American study with a large sample (n = 322) carried out in adolescents showed that obesity is very closely linked to a low family educational level which was a factor already considered a marker of health inequity. This results in a higher risk of developing obesity in children from less favored socio-cultural and economic strata, increasing their likelihood of developing cardiovascular diseases such as hypertension and diabetes in adulthood.

In other South American studies, the variable eating time showed to be one of the predictors of increased BMI in preschoolers, which coincides with our study where it was also associated with a low educational level of the parents, and as a secondary variable, this study also confirms that children require a minimum and appropriate time to eat their main meals[27].

The educational level of parents can affect the health of their preschool children, through their decisions related to the type of foods consumed, or even when the preschoolers themselves influence their parents in the choice of food purchases[28]. Therefore, the educational level of parents can also have a significant impact on the prevention of malnutrition in their children, and care and prevention efforts should be focused precisely on the most vulnerable groups of parents with a low educational level, as this has a high correlation with the income received[29]. In this sense, the purpose of our country's national childhood health program is to contribute to the comprehensive development of children in their family and community context. Thus, health professionals could also consider the factor of the educational level of parents and the secondary variables included in this study, in order to increase the possibilities of preventing malnutrition in preschool children by providing preventive information to parents on health and lifestyle issues.

Regarding the limitations of this study, unfortunately, it did not include measurements of anthropometric variables/body composition of the same parents who responded to the survey, and as the strengths, the preschool population in this area of research has been little explored in Latin America and even more so in Chile where there is an increase in obesity from the preschool stage to primary education, and where this health goal has been little explored from the family point of view, and in particular from the educational level of the parents.

Conclusion

Preschool children of parents with low educational level present elevated anthropometric and body composition markers related to obesity compared with peers of parents with high educational level. These findings require further and more complex investigation.

Responsabilidades Éticas

Protección de personas y animales: Los autores declaran que los procedimientos seguidos se conformaron a las normas éticas del comité de experimentación humana responsable y de acuerdo con la Asociación Médica Mundial y la Declaración de Helsinki.

Confidencialidad de los datos: Los autores declaran que han seguido los protocolos de su centro de trabajo sobre la publicación de datos de pacientes.

Derecho a la privacidad y consentimiento informado: Los autores han obtenido el consentimiento informado de los pacientes y/o sujetos referidos en el artículo. Este documento obra en poder del autor de correspondencia.

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Conflicts of Interest

Authors declare no conflict of interest regarding the present study. present study.

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