PARENTAL PHYSICAL ACTIVITY AND EDUCATION INFLUENCE THEIR CHILDREN'S LIFESTYLE BEHAVIOURS. A CROSS-SECTIONAL STUDY IN EARLY YEARS EDUCATION IN SOUTHERN SPAIN

LA ACTIVIDAD FÍSICA Y EL NIVEL EDUCATIVO DE LOS PADRES INFLUYEN EN LOS HÁBITOS DE VIDA DE SUS HIJOS: UN ESTUDIO TRANSVERSAL EN EDUCACIÓN INFANTIL EN EL SUR DE ESPAÑA

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Abstract

The aim of the present study was to examine children's health-related lifestyle habits as a function of sex, parental physical activity engagement and parental education in a sample of three-to-six-year-old children from Granada, Spain. A cross-sectional, non-randomised design was employed. Validated questionnaires were administered to evaluate children's physical fitness (IFIS), Mediterranean diet adherence (KIDMED) and eating behaviour (CEBQ). In the same way, an *ad-hoc* questionnaire was developed to collect data on sociodemographic variables, screen and sleep time, and parental PA engagement and education. Data were analysed using the IBM SPSS 25.0 statistical software package. Data were collected from 653 of the 2,250 three-to-six-year-old children attending 18 different schools. Children whose parents were both physically active exhibited greater Mediterranean diet adherence, more balanced eating habits and lower screen time. Similarly, children whose parents were both highly educated reported greater Mediterranean diet adherence and lower screen time compared to those with less educated or less active parents. The present study shows that children benefit from having both physically active and highly educated parents, which leads to healthier habits. Future interventions should focus on equipping parents to enhance their children's health.

Keywords: Eating behaviours, Mediterranean diet, physical fitness, parental education, pre-schoolers.

Resumen

El presente estudio examinó los hábitos de vida saludables de niños de tres a seis años de Granada, España, en función del sexo, la actividad física y el nivel educativo de los padres. Se empleó un diseño transversal no aleatorizado, y participaron 653 niños de 18 escuelas diferentes. Se utilizaron cuestionarios validados para evaluar la condición física (IFIS), la adherencia a la dieta Mediterránea (KIDMED) y el comportamiento alimentario (CEBQ). Además, a través de un cuestionario *ad hoc* se recopilaron datos sociodemográficos, tiempo de pantalla y sueño, y actividad física y nivel educativo de los padres. Los resultados mostraron que los niños con padres físicamente activos presentaron mayor adherencia a la dieta Mediterránea, hábitos alimentarios más equilibrados y menor tiempo de pantalla. Asimismo, los hijos de padres con un alto nivel educativo mostraron mayor adherencia a esta dieta y menor tiempo frente a pantallas, comparados con niños cuyos padres tenían menos estudios o eran menos activos. Este estudio destaca que los niños se benefician de tener padres activos y con un nivel educativo más alto, lo que se traduce en hábitos más saludables. Las intervenciones futuras deben centrarse en capacitar a los padres para fomentar la salud de sus hijos.

Palabras clave: Condición física, comportamientos alimentarios, dieta Mediterránea, nivel educativo de los padres, preescolares.

Introduction

Higher physical activity (PA) engagement limited sedentary behaviour and good sleep quality in young children benefits their physical and mental health. This, in turn, promotes their overall well-being. According to the World Health Organization (WHO) (2019), these practices play a crucial role in preventing childhood obesity and related diseases in the future. However, WHO reported that 37 million children under six years of age were overweight or obese (WHO, 2023). Additionally, recent studies report that preschool children obtain insufficient sleep, accumulate high levels of screen time and spend too much time sitting or restrained in chairs and strollers (WHO, 2019).

In addition to engaging in healthy habits such as regular PA, maintaining a healthy diet that avoids imbalances between energy intake and energy expenditure is also important (Moreno et al., 2008). In this sense, adequate Mediterranean diet (MD) adherence tends to be protective against obesity in preschool children living in Mediterranean countries (Moráis-López et al., 2012).

A MD is characterised by low levels of saturated fat and a high intake of plant-based foods, including fruits, vegetables, whole grains, nuts and seeds. The main source of fat is provided by olive oil, whilst the diet also comprises moderate portions of dairy products such as cheese and yoghurt, as well as fish and poultry. Red meat is consumed sparingly when following this dietary pattern (Willett et al., 1995). According to García-Hermoso et al. (2022), adherence to a MD tends to be associated with improved physical fitness, limited sedentary behaviour and better overall health from early childhood, throughout adolescence and into adulthood.

However, MD adherence involves more than just food selection and extends to other aspects such as social interactions during meals or cooking (Jiménez-Boraita et al., 2020). According to Scaglioni et al. (2018), socialisation during mealtimes with the television turned off, regular sharing of meals with family members, sharing breakfast together every day and other aspects such as exposure to a variety of foods, repeatedly offering children to try certain foods and allowing children to contribute towards decisions around food choices from an early age leads to improvements in children's eating behaviours and makes it more likely that they will follow a healthy diet.

Technological advances have significantly changed lifestyles across all age groups as they encourage a sedentary lifestyle. Particularly in young children, recreational and sporting activities are becoming neglected, leading to the development of obesity and psychomotor issues (Benavides-Villacriz & Morales-Coronel, 2023). In Spain, screen exposure in early childhood is of growing concern. Indeed, 84% of children aged one to three years and 88% of four-to-six-year-olds exceed expert-recommended maximum daily screen time (AIJU, 2023).

In this context, parental behaviours and practices influence their children's habits, including their eating behaviours (Gray et al., 2023) and engagement in PA and sedentary behaviours such as screen time, particularly during the early years of life (Xu et al., 2015). According to Vega-Díaz et al. (2023), parents can influence their children by setting an example through their own PA engagement and encouraging their children to either imitate them or facilitating joint involvement in exercise. This kind of parental involvement may help limit children's engagement in common sedentary behaviours typically inherent to modern lifestyles such as excessive screen time.

Turning attention to children's eating behaviours, food preferences also play a significant role. Eating behaviours are formed in the early years of childhood, though they can evolve over time under the influence of lived experiences (Qorbani et al., 2020). Similarly, a child's eating behaviour and food choices are primarily shaped by their parents' eating habits and the strategies employed for feeding (Scaglioni et al., 2018).

In line with that discussed above, the period from three to six years of age represents a critical stage for the physical and mental development of preschool children, including the formation of their eating behaviours (Ningning & Wenguang, 2023). It is also a time when family lifestyle patterns can be adapted to drive both present and future health gains (WHO, 2019). Findings reported by Scaglioni et al. (2018) agree that, in order to study the health-related habits of children, parental socioeconomic aspects and, particularly, education, must be considered.

As stated by Gray et al. (2023), further research is necessary to gain a deeper understanding about the way in which parents influence their children's eating habits. Addressing these factors might improve the success of nutritional interventions designed to alter children's dietary behaviours.

Current Study

Despite increasing interest in childhood health promotion, there remains a lack of research exploring the combined influence of parental education and PA engagement on children's lifestyle behaviours during early childhood. While previous studies have separately addressed dietary patterns, screen time and physical fitness in pre-schoolers, few have examined the way in which these health-related behaviours interact as a function of key parental factors, particularly in Mediterranean contexts such as southern Spain.

The present study seeks to address this gap by analysing health-related lifestyle habits, including MD adherence, physical fitness, eating behaviours, screen time, and sleep duration, in a large sample of three-to-six-year-old children. The investigation specifically considers the way in which these variables vary according to children's sex, and parental level of education and physical activity engagement.

Accordingly, the study was guided by the following research question: Do children whose parents are both physically active and more highly educated exhibit healthier lifestyle behaviours?

Thus, the aim of the present study was to examine children's health-related lifestyle habits as a function of sex and parental PA engagement and education in a sample of three-to-six-year-old children from Granada, Spain.

The following hypotheses were proposed:

Hypothesis 1: Children whose parents are both physically active will show greater Mediterranean diet adherence, higher physical fitness, longer sleep time, lower screen time, and healthier eating behaviours compared to those whose parents are less active.

Hypothesis 2: Children whose parents are both highly educated will show greater Mediterranean diet adherence, higher physical fitness, longer sleep time, lower screen time, and healthier eating behaviours compared to those whose parents are less educated.

Hypothesis 3: Differences in healthy habits will exist according to sex and these differences will be evident from an early age.

Methods and Procedures

Participants

A cross-sectional study was conducted with three-to-six-year-old children (mean age 4.78 years ± 0.93 years) in Granada, Spain, between April 2023 and April 2024. The initial sample comprised 659 children attending 18 public and private schools within the province of Granada. Six children were excluded from the study due to incomplete testing. The study sample was selected based on convenience, focusing on schools that were easily accessible. Invitations to participate were sent out to all children attending the 18 participating schools (2250 children). The present study adhered to the ethical standards laid out in the Declaration of Helsinki for Medical Research. Ethical approval was secured from the <Blinded for peer review> Ethics Committee with the reference number <Blinded for peer review>.

Instruments

MD adherence was assessed using the most recent version of the Mediterranean Diet Quality Index (KIDMED) (Altavilla et al., 2020). This tool comprises 16 binary (yes/no) questions related to Mediterranean dietary habits. Twelve questions are phrased positively, with a "yes" response being scored as +1, whilst four questions are phrased negatively, with a "yes" response being scored as -1. Further, negative responses receive a score of 0. Scores from all 16 questions were then summed to generate an overall score. As a result, the overall index ranges from −4 to 12 with higher scores indicating greater MD adherence.

Parental perceptions of their children's eating behaviours were assessed using the Child Eating Behaviour Questionnaire (CEBQ), translated and validated in Spanish (Jimeno-Martínez et al., 2022). This questionnaire comprises 35 items all of which are rated along a five-point Likert scale. These items are categorized into eight subscales with four subscales pertaining to interest in food (food responsiveness, emotional overeating, enjoyment of food, desire to drink) and four subscales pertaining to lack of interest in food (satiety responsiveness, slowness when eating, emotional undereating, food fussiness). For each subscale, item scores were summed and means, and standard deviations were calculated.

Physical fitness was assessed using the most recent Spanish version of the International Fitness Scale (IFIS) (Sánchez-López et al., 2023). This questionnaire comprises five items all of which are rated along a five-point scale ranging from 1 (very poor) to 5 (very good). Questions cover key aspects of self-perceived fitness, including cardiorespiratory fitness, muscular strength, balance, flexibility and overall physical fitness. Item scores were then summed to produce an overall score.

An *ad-hoc* questionnaire was created which comprised two sections to evaluate parental PA engagement and education. For PA engagement, one item was established to garner open-ended responses. This item assesses whether any type of PA is engaged in on a regular basis. Based on responses, a categorical variable was created with three groupings: 0 = neither parent engages in regular PA, 1 = one parent engages in regular PA, and 2 = both parents engage in regular PA.

In terms of education, participants were asked to report whether they possessed no academic studies, primary education, secondary education or higher education. However, due to the small numbers of participants reporting some response options, participants were reclassified according to compulsory education and higher education. As with PA engagement, a three-level categorical variable was created for parental education: 0 = neither parent has completed higher education, 1 = one parent has completed higher education, and 2 = both parents have completed higher education.

In addition, parents reported their children's sex, date of birth, height and weight. Body mass index (BMI) was later calculated from height and weight (BMI = weight [kg]/(height [m])^2). Age and sex standardized classifications of healthy weight, overweight and obese were calculated, according to ranking percentiles outlined by Sobradillo et al. (2004). Overweight and obese groups were grouped together due to the low percentage of children reporting overweight (4.9%) and obesity (6.3%).

Finally, parents provided information on their children's nightly sleep duration and daily screen time for both weekdays and weekends. Specifically, parents were asked to indicate the number of hours their child slept each night for weekdays and weekends, separately. Similarly, two open-ended items were used to record the number of hours children spent each day on screen-based leisure activities, such as watching television, playing video games, using a mobile phone, or using a computer. This question was also differentiated according to weekdays and weekends. It is important to note that screen time related to in-person or online classes was excluded from these measures. An overall summary score was derived by averaging the number of hours reported across the seven days assessed. Both sleep and screen time data were treated as continuous variables for subsequent analyses.

Procedure

Two separate information packs were produced to obtain informed consent, with one being designed for the directors of participating schools and the other being for the parents or legal guardians of potential participants. These packs comprised comprehensive details about the study purpose, design and process. Final questionnaires and accompanying instructions were sent to parents or guardians either on paper (via the child's school) or via email using Google Drive® (Alphabet, Mountain View, CA, USA), depending on the school's logistical preference. All questionnaires were completed exclusively by the parents or legal guardians of participating children.

Parents or legal guardians were given one week to complete and return questionnaires, either by sending them back through the school in paper format or submitting them online. Reminder messages were sent via teachers or email to improve response rates. Participation was entirely voluntary and was contingent upon receipt of prior consent.

Statistical Analysis

Mean and standard deviations are reported for all quantitative variables. Normality of the data was tested using the Kolmorov-Smirnov test. After verifying that the variables were not normally distributed, data were analysed according to the

Mann-Whitney U test for unrelated groups and the Kruskal Wallis test for multiple groups. Pairwise comparisons were then made to identify which groups significantly differed from one another. In cases in which Kruskal-Wallis outcomes indicated significant differences, pairwise post-hoc comparisons were conducted according to the Dunn-Bonferroni method to identify specific group differences. All statistical analyses were performed using version 25 of IBM-SPSS® for Windows. Statistical significance was established at .05.

Results

Data for age, BMI, screen time, sleep time, MD adherence, physical fitness and eating behaviours pertaining to the study sample are presented in Table 1. The sample was examined as a function of sex, parental PA engagement and parental education. In terms of sex, boys reported less sleep time (10.29 hrs ± 0.61 hrs vs. 10.41 hrs ± 0.70 hrs; p = .011) and scored lower for food avoidance (2.86 ± 0.56 vs. 2.94 ± 0.53; p = .019) and satiety responsiveness (2.75 ± 0.69 vs. 2.88 ± 0.64; p = .004) than girls. No sex-based differences were observed for any of the remaining study parameters. With regards to parental PA engagement, children whose two parents engaged regularly in PA reported greater MD adherence (7.64 ± 1.91 vs. 7.19 ± 1.99 vs. 6.79 ± 2.08; p < .001) and balance (4.19 ± 0.71 vs. 4.03 ± 0.68 vs. 4.04 ± 0.75; p = .038) and lower screen time than children who had at least one parent who did not engage in PA (1.68 ± 1.13 hrs vs. 1.83 ± 1.06 hrs vs. 1.81 ± 1.03 hrs; p = .043). Children for whom both parents reported higher education reported greater MD adherence (7.40 ± 2.04 vs. 6.87 ± 1.97 vs. 6.63 ± 1.89; p = .001) and lower screen time than children who had at least one parent who had not completed higher education (1.65 ± 1.01 hrs vs. 1.91 ± 1.12 h s vs. 2.14 ± 1.16 hrs; p < .001). With regards to children's eating behaviours, children who had at least one parent who had completed higher education reported lower food approach scores (2.49 ± 2.55 vs. 2.47 ± 0.55 vs. 2.69 ± 0.60; p = .027) than children for whom neither of their parents had completed higher education. In addition, children who had two parents who had completed higher education reported lower desire to drink scores (2.36 ± 0.79 vs. 2.52 ± 0.91 vs. 2.84 ± 1.05; p = .001) and higher emotional undereating scores (2.99 ± 0.57 vs. 2.96 ± 0.65 vs. 2.81 ± 0.58; p = .036) than children for whom neither of their parents had completed higher education. Finally, children for whom neither of their parents had completed higher education reported higher enjoyment of food scores (3.81 ± 0.76 vs. 3.46 ± 0.87; p = .021) than children with only one parent with higher education.

Table 1

Study Sample Characteristics as a Function of Sex, and Parental PA Engagement and Education

		Sex			Parent PA				Parent with Higher Education			
	Overall	**Boys**	**Girls**	***p***	**0a**	**1b**	**2c**	***p***	**0d**	**1e**	**2f**	***p***
n	653	317	336		223	266	164		76	174	403	
Age (years)	4.78±0.93	4.78±0.97	4.78±0.90	.892	4.66±0.93	4.85±0.91	4.83±0.95	.042 a-b; a-c	4.70±0.98	4.76±0.92	4.81±0.93	.475
BMI (kg/m2)	15.53±2.09	15.52±1.92	15.53±2.23	.691	15.65±2.26	15.38±1.89	15.59±2.14	.668	15.53±2.17	15.69±1.95	15.46±2.12	.373
Screen time (hours)	1.78±1.07	1.81±1.11	1.75±1.02	.604	1.81±1.03	1.83±1.06	1.68±1.13	.043 a-c; b-c	2.14±1.16	1.91±1.12	1.65±1.01	<.001 d-e; e-f
Sleep time (hours)	10.35±0.66	10.29±0.61	10.41±0.70	.011	10.31±0.70	10.37±0.62	10.38±0.64	.663	10.26±0.65	10.31±0.73	10.39±0.62	.158
MD adherence	7.17±2.03	7.18±2.09	7.16±1.97	.999	6.79±2.08	7.19±1.99	7.64±1.91	<.001 a-b; b-c; a-c	6.63±1.89	6.87±1.97	7.40±2.04	.001 d-f; e-f
Overall PF	4.11±0.57	4.14±0.59	4.08±0.55	.104	4.06±0.59	4.11±0.56	4.17±0.56	.243	4.04±0.59	4.09±0.56	4.13±0.57	.476
GPF	4.28±0.65	4.30±.067	4.26±0.62	.267	4.22±0.69	4.30±0.63	4.32±0.62	.325	4.22±0.72	4.28±0.66	4.29±0.63	.862
CF	4.05±0.75	4.09±0.76	4.02±.74	.203	3.99±0.80	4.08±0.71	4.09±0.73	.503	3.89±0.89	4.02±0.75	4.10±0.72	.225
MS	4.02±0.70	4.06±0.71	3.99±0.69	.223	3.96±0.74	4.02±0.67	4.11±0.67	.170	3.97±0.65	4.03±0.70	4.03±0.71	.677
SA	4.12±0.72	4.17±0.72	4.07±0.73	.074	4.09±0.72	4.13±0.73	4.15±0.72	.711	4.13±0.72	4.07±0.72	4.14±0.73	.432
B	4.07±0.71	4.08±0.74	4.07±0.69	.765	4.04±0.75	4.03±0.68	4.19±0.71	.038 b-c	3.99±0.77	4.04±0.70	4.10±0.71	.362
Food approach	2.51±0.56	2.50±0.56	2.51±0.56	.998	2.52±0.54	2.49±0.59	2.52±0.53	.767	2.69±0.60	2.47±0.55	2.49±2.55	.027 d-e; d-f
FR	2.22±0.84	2.17±0.80	2.27±0.87	.258	2.22±0.86	2.21±0.86	2.24±0.77	.685	2.31±0.94	2.16±0.82	2.23±0.83	.570
EO	1.76±0.64	1.74±0.65	1.78±0.64	.442	1.75±0.64	1.78±0.65	1.74±0.65	.777	1.79±0.64	1.75±0.65	1.76±0.65	.879
EF	3.59±0.80	3.60±0.82	3.58±0.78	.407	3.54±0.80	3.59±0.85	3.66±0.71	.412	3.81±0.76	3.46±0.87	3.61±0.76	.021 d-e
DD	2.46±0.87	2.48±0.91	2.43±0.84	.560	2.54±0.93	2.39±0.87	2.44±0.80	.198	2.84±1.05	2.52±0.91	2.36±0.79	.001 d-f
Food avoidance	2.90±0.55	2.86±0.56	2.94±0.53	.019	2.94±0.57	2.92±0.54	2.84±0.52	.173	2.84±0.49	2.93±0.63	2.91±0.52	.310
SR	2.82±0.67	2.75±0.69	2.88±0.64	.004	2.85±0.70	2.85±0.66	2.73±0.63	.100	2.74±0.64	2.86±0.73	2.82±0.64	.532
SE	3.08±0.79	3.02±0.81	3.13±0.77	.050	3.13±0.80	3.05±0.79	3.05±0.75	.488	3.01±0.78	3.08±0.84	3.09±0.76	.468
EU	2.96±0.60	2.94±060	2.98±0.60	.429	2.98±0.66	2.97±0.54	2.93±0.60	.647	2.81±0.58	2.96±0.65	2.99±0.57	.036 d-f
FF	2.76±0.84	2.73±0.86	2.80±0.81	.193	2.81±0.86	2.78±0.82	2.66±0.83	.096	2.80±0.77	2.81±0.93	2.74±0.81	.643

Notes. PF: physical fitness; GPF: general physical fitness; CF: cardiorespiratory fitness; MS: muscular strength; SA: speed/agility; B: balance; FR: food responsiveness; EO: Emotional overeating; EF: enjoyment of food; DD: desire to drink; SR: satiety responsiveness; SE: slowness in eating; EU: emotional undereating; FF: food fussiness. Statistical tests: Mann-Whitney U for two-group comparisons; Kruskal-Wallis for comparisons among three or more groups. Post-hoc pairwise tests performed as appropriate

Table 2 presents frequencies for food consumption as a function of sex, BMI, parental PA engagement and parental education. No sex differences were observed in eating patterns with the only exception being skipping breakfast, in which a higher proportion of girls exhibited this behaviour than boys (6.3% vs. 2.5%; p = .021). No differences were observed in eating patterns as a function of BMI with the only exception being that overweight or obese children exhibited a lower consumption of pulses than healthy weight children (86.3% vs 92.9%; p = .047). Children with two parents who engaged in PA tended to

exhibit a lower consumption of pastries for breakfast (25.6% vs. 27.4% vs. 40.8%; p = .001) and a higher consumption of a second daily serving of fruit (58.5% vs. 44% vs. 48.9%; p = .014), fresh or cooked vegetables (79.9% vs. 78.9% vs. 68.6%; p = .010), and more than one fresh or cooked vegetable per day (47.6% vs. 43.6% vs. 35.4%; p = .043). Children with two parents who had completed higher education tended to exhibit a lower consumption of fast food (6.9% vs. 6.9% vs. 15.8%; p = .028), sweets (3.5% vs. 4.6% vs. 14.5%; p < .001) and pastries for breakfast (28.8% vs. 31.6% vs. 46.1%; p = .012). They were also less likely to skip breakfast (3.2% vs. 4.6% vs. 10.5%; p = .018), reported a higher daily fruit consumption (88.8% vs. 75.9% vs. 72.4%; p < .001), were more likely to consume a second daily serving of fruit (54.6% vs. 38.5% vs. 46.1%; p = .002) and more often used olive oil (100% vs. 98.9% vs. 97.4%; p = .015).

Table 2

Food Consumption Frequencies as a Function of Sex, BMI, and Parental PA Engagement and Education

		Sex			BMI			Parents PA				Parent with Higher Education			
	Overall	Boys	Girls	*p*	Healthy	OW/Obese	*p*	0a	1b	2c	*p*	0d	1e	2f	*p*
n	653	317	336		580	73		223	226	164		76	174	403	
Fruit daily	83.5	83.6	83.3	.928	84.1	78.1	.190	81.2	83.1	87.2	.282	72.4	75.9	88.8	<.001d-f; e-f
Second serving of fruit daily	49.3	49.2	49.4	.961	50.0	43.8	.321	48.9	44.0	58.5	.014 b-c	46.1	38.5	54.6	.002 e-f
Fresh or cooked vegetables daily	75.7	77.6	73.8	.259	76.0	72.6	.520	68.6	78.9	79.9	.010 a-b; a-c	67.1	74.1	77.9	.114
Fresh or cooked vegetables >1 /day	41.8	42.3	41.4	.815	42.8	34.2	.165	35.4	43.6	47.6	.043 a-c	38.2	35.1	45.5	.055
Fish regularly (≥ 2-3 /week)	81.6	80.8	82.4	.579	81.9	79.5	.612	83.0	79.7	82.9	.575	82.9	78.7	82.6	.517
Fast food restaurants ≥1/week	8.0	10.1	6	.051	7.4	12.3	.144	9.9	6.4	7.9	.369	15.8	6.9	6.9	.028 d-f
Pulses >1 / week	92.2	90.5	93.8	.126	92.9	86.3	.047	91.0	91.4	95.1	.269	90.8	89.1	93.8	.137
Pasta or rice almost daily (≥ 5/ week)	14.5	12.9	16.1	.256	15.0	11.0	.356	17.5	12.0	14.6	.234	19.7	14.9	13.4	.351
Cereal or cereal product for breakfast	32.9	35.3	30.7	.204	32.4	37.0	.434	30.0	32.3	37.8	.267	27.6	36.2	32.5	.398
Nuts regularly (≥2-3 / week)	43.0	39.4	46.4	.071	43.3	41.1	.723	39.9	42.9	47.6	.323	50.0	43.7	41.4	.377
Use of olive oil at home	99.4	99.4	99.4	.953	99.3	100	.477	99.1	99.2	100	.499	97.4	98.9	100	.015 d-f
No breakfast	4.4	2.5	6.3	.021	4.8	1.4	.177	5.8	4.1	3.0	.403	10.5	4.6	3.2	.018 d-f
Dairy products for breakfast	94.2	95.0	93.5	.413	93.8	97.3	.233	94.2	94.0	94.5	.975	92.1	94.8	94.3	.691
Pastries for breakfast	31.5	32.2	31.0	.737	31.4	32.9	.795	40.8	27.4	25.6	.001 a-b; a-c	46.1	31.6	28.8	.012 d-f
Second serving of dairy products daily	57.6	61.2	54.2	.069	58.6	49.3	.130	54.3	59.0	59.8	.461	65.8	54.6	57.3	.254
Sweets and candies several times a day	5.1	4.7	5.4	.716	5.2	4.1	.696	7.2	3.4	4.9	.162	14.5	4.6	3.5	<.001 d-e; d-f

Notes. PA: physical activity; BMI: body mass index; OW: overweight. Statistical tests: Mann-Whitney U for two-group comparisons; Kruskal-Wallis for comparisons between three or more groups. Post-hoc pairwise tests performed as appropriate

Discussion

Parental Physical Activity and its Influence on Children

Consistent with existing literature (Gray et al., 2023; Scaglioni et al., 2018) examining health-related lifestyle habits in preschoolers, the influence of parental lifestyle habits and education must be considered. The main finding of the present study was that children with two parents who regularly engaged in PA had greater MD adherence, better balance and lower screen time than children with no parents or only one parent who regularly engaged in PA. In relation to this, children with two parents with higher education reported greater MD adherence and lower screen time and food approach than children with no parents or only one parent with higher education.

These findings align with previous research indicating strong associations between parental PA engagement and children's PA behaviours. For example, a systematic review conducted by Xu et al. (2015) identified eight studies that report strong relationships between parental PA engagement and pre-schooler's PA engagement. Similarly, another systematic review performed by Duch et al. (2013) observed positive correlations between parental TV viewing time and children's

screen time. Such relationships were established more than ten years ago by Dwyer et al. (2008) who reported that parental PA engagement acted as a key promoter of PA and sedentary behaviour in children.

Children's propensity towards imitating the actions of others and learning through observation, particularly with regards to their parents and caregivers, may explain these direct positive relationships (Zarychta et al., 2016). This reinforces the idea that parental modelling extends beyond physical activity to a broader range of lifestyle habits.

Parental Education and Dietary Patterns

In accordance with present findings, previous studies have indicated that a positive family system may play a crucial role in establishing and promoting beneficial health-related behaviours through modelling behaviours through the provision of healthy foods and supporting the adoption of healthy eating behaviours (Vandeweghe et al., 2016). In this sense, present findings reveal that children with parents who both engaged in PA exhibited greater MD adherence. Specifically, these children reported a lower consumption of pastries for breakfast and a higher consumption of a second serving of fruit daily, fresh or cooked vegetables and more than one serving of fresh or cooked vegetables per day. The PASOS study in Spain found parental PA to be associated with their children engaging in healthy lifestyle habits, such as greater MD adherence (Monserrat-Mesquida et al., 2023). Specifically, parental moderate PA engagement was positively associated with the daily consumption of raw or cooked vegetables by children. In addition, parental moderate and high PA engagement was related with a lower frequency of fast-food consumption in children, as well as a lower intake of sweets and rice or pasta, when compared with the children of less active parents. This suggests that, in addition to children imitating their parents' behaviour, parenting practices also indirectly influence children's dietary habits causing them to engage in healthy habits in general rather than just imitating specific practices.

Similarly, children with parents who both completed higher education showed greater MD adherence and lower screen time. Specifically, these children consumed fewer fast foods, sweets and pastries for breakfast, whilst also being more likely to consume fruit daily and a second serving of fruit daily and using more olive oil. These findings are in line with prior studies. For instance, Sotos-Prieto et al. (2015) observed that high parental education was associated with more children reporting daily consumption of fruit or juice, eating fresh or cooked vegetables daily, eating cereal or grains for breakfast and consuming a dairy product for breakfast. In contrast, low parental education was associated with a lower likelihood of consuming fresh cooked vegetables more than once a day, less frequent fish consumption, more regular visits to fast food restaurants and greater likelihood of eating industrial pastries for breakfast.

Generally, low levels of parental education have been linked to poorer diet quality, higher BMI (Østbye et al., 2013) and greater screen time in pre-schoolers (Bassul et al., 2021). Lower education may be related to lower income and, subsequently, to relatively lower availability of more expensive foods such as fresh fruit or olive oil. Similarly, parents with lower levels of education tend to work longer and have lower-paid jobs. As such, these parents may be less likely to spend time with their children, have fewer opportunities to model healthy eating and opt for less expensive, more filling and less healthy foods. In relation to this, parents with such lifestyles may have less time to monitor their children's screen time and have less capacity to set rules or limits. Indeed, other studies have observed that children with more highly educated parents tend to strongly or somewhat agree with the importance of screen time rules, resulting in lower screen time (Burnett et al., 2023). Thus, spending time in front of a screen is frequently paired with eating high-calorie foods and snacks that are loaded with fats and sugars. This has led to an unhealthy rise in BMI in children (Avery et al., 2017). However, regardless of socioeconomic status, higher education may be associated with the receipt of better training or easier access to it, as well as awareness of healthy lifestyle habits.

Eating Behaviours and Emotional Regulation

Turning attention to children's eating behaviours, children with parents who both report having completed higher education reported lower food approach, desire to drink and enjoyment of food scores, in addition to higher emotional undereating scores than children of parents who had not completed higher education. Generally, children who reporting lower food approach and desire to drink scores are characterized by having more restrained and moderate attitudes towards food (Cecil et al., 2005). Further, children reporting lower food approach scores also scored lower for enjoyment of food. This is consistent with Jimeno-Martínez et al. (2022) who reported a positive association between food approach and enjoyment of food, with both being positively associated with BMI in Spanish children aged three to six years.

In relation to this, children scored higher on emotional undereating. Both emotional overeating and emotional undereating have negative consequences for children's health, given that both are related to the management of stress and emotions (Sampige et al., 2023). Parents often calm their children's emotions by offering unhealthy snacks as an emotional regulation strategy. This increases tendencies towards overeating and promotes development of a link between food and pleasure, creating a dependence on food for emotional management, rather than favouring its consumption to meet nutritional needs (Braden et al., 2014). In this sense, parents are often advised to avoid such practices, as emotional overeating is directly related to increased BMI and the provision of unhealthy foods. Coinciding with Herle et al. (2017), such behaviours are learned and not hereditary.

This behavioural transmission aligns with Bandura's (1977) social learning theory, which highlights the way in which children learn emotional responses through observation and imitation of parental behaviours. Moreover, these findings can be interpreted within Gross's (1998) emotion regulation framework, which identifies maladaptive eating behaviours as strategies for managing negative affect when more adaptive skills are lacking.

In this regard, more highly educated parents may be more prone to avoid such practices, which can be a double-edged sword. In other words, since extreme emotions inevitably affect eating behaviours, children, instead of regulating their emotions through higher food consumption, might, instead, regulate their emotions by steering away from the consumption of food. While this may be intended as a protective strategy against emotional overeating, it may unintentionally hinder the development of healthy emotion regulation strategies, as posited in developmental psychology models such as attachment theory (Bowlby, 1969). For this reason, parents with a higher level of education may be more prone towards engaging in behaviours aimed at avoiding an increase in BMI, without realising that these practices may not always be healthy.

BMI and Food Consumption

Finally, in terms of variables related with BMI, the present study showed that overweight or obese children reported a lower consumption of pulses than healthy weight children. In this context, Wall et al. (2018) also observed an inverse association between BMI and the intake of vegetables, fruits, pulses and nuts in children and adolescents. This reinforces the idea that lower consumption of these healthy food groups may contribute to increased body weight, highlighting the importance of targeting dietary quality in obesity prevention strategies.

In the Spanish context, the ALADINO Study coordinated by the Spanish Agency for Food Safety and Nutrition (2023), has further revealed that a substantial number of families misperceive or underestimate their children's excess weight. This lack of awareness has been associated with poorer dietary habits, lower physical activity levels, increased sedentary behaviour and greater screen time. The Spanish Agency for Food Safety and Nutrition (2023) underscores the urgent need for family-based interventions aimed at improving parental awareness and promoting healthier lifestyle choices in the home environment.

Sex Differences in Eating Patterns

With respect to sex, girls reported greater food avoidance and satiety responsiveness than boys. These finding suggest that girls may tend to imitate their mothers' eating habits, generally and socially adopting eating behaviours that maintain a positive body image, whether healthy or not. This is supported by other studies that show that maternal education regarding nutrition directly influences young children's eating indicators (Tariqujjaman et al., 2022).

This suggests that gendered socialisation processes, potentially reinforced by parental modelling, play a role in shaping eating behaviours from a young age.

Limitations

The findings of the present study should be interpreted with caution due to several limitations. First, the cross-sectional design limits its ability to infer causality. Moreover, the use of self-reported data for certain measures introduces the possibility of measurement error. Despite this concern, it is important to note that both the KIDMED for children and the CEBQ have demonstrated strong validity and reliability in comparable populations, suggesting that any impact on outcomes is likely to be minimal. A further limitation concerns the use of *ad-hoc* questionnaires to assess parental physical activity engagement and educational level. While commonly used validated instruments exist, their length and complexity (e.g.,

IPAQ) may reduce comprehension and response accuracy across diverse social backgrounds. Thus, simpler tailored tools were employed to facilitate completion; however, this approach may limit direct comparability with other studies and potentially introduce measurement bias. Future research should aim to validate such brief instruments or balance brevity with established measures.

Additionally, the sample was not randomly selected, which might affect the generalizability of findings. Nevertheless, a substantial number of children were successfully recruited from 18 public and private schools across the province of Granada, helping to mitigate this issue. Another limitation is that the parents of participating pre-schoolers did not agree to provide data on their socioeconomic status. However, parental education was considered instead and this is typically associated with income in Spain (National Institute of Statistics of Spain, 2023). However, we acknowledge that relying solely on education may overlook other important SES dimensions such as occupational status or neighbourhood effects, which could moderate observed relationships. Findings should, therefore, be interpreted with caution. Future studies should strive to include comprehensive SES measures to better disentangle these complex interactions and more accurately assess their impact on children's lifestyle behaviours and health.

Future Perspectives

Present have several practical and research implications, particularly for the design of early interventions aimed at promoting healthy behaviours and preventing childhood obesity during the preschool years.

First, school-based health programmes should systematically integrate structured family engagement components. Given the strong influence of parental behaviours and education on children's health habits, interventions that extend beyond the child to actively involve caregivers are likely to be more effective. These could include family workshops on nutrition and screen-time regulation, take-home physical activity challenges that promote joint participation, and co-designed weekly meal plans developed collaboratively by educators and parents. Schools, as inclusive and accessible environments, represent an ideal setting for implementing and sustaining such initiatives. Healthy habits learned at school can be reinforced at home, creating a bidirectional loop of influence that supports lasting change.

Second, public health campaigns should be tailored to families with lower educational attainment, who may face structural and informational barriers. Simplified and visually oriented health messaging, subsidies for healthy food items (e.g., pulses, fruits and olive oil), and increased access to free or low-cost community-based physical activity opportunities may help reduce inequities and promote inclusive health promotion.

Third, these findings support the integration of health promotion into early childhood curricula. Play-based modules introducing food literacy and active lifestyles can be embedded into daily routines, while initiatives such as "family health nights" can reinforce learning through school-home collaboration. Additionally, teacher training on modelling and reinforcing healthy habits should be a core component of such programmes.

Finally, policies should consider family structure and levels of parental engagement when designing childhood obesity prevention strategies. Households with single caregivers or low parental involvement in physical activity may benefit most from targeted support through digital interventions, flexible formats, or personalised coaching.

Beyond its practical contributions, the present study represents a relevant step forward in assessing the influence of parental lifestyle habits and education on their children's health behaviours. It addresses a notable gap in the literature on preschool-aged populations, a group often underrepresented in research. Looking ahead, it would be valuable to conduct studies that examine the way in which the influence of parental healthy habits on children's behaviours may differ according to the sex of both parents and children. Additionally, analysis of the potential moderating role of both parental and child BMI could offer a deeper understanding of the mechanisms underlying the present findings.

Conclusions

The present study suggests that, in order to examine healthy lifestyle habits in three-to-six-year-old children, it is necessary to consider the influence of parental lifestyle habits and education. Children whose parents were both physically active and had completed higher education exhibited greater MD adherence, limited screen time and took a more balanced approach towards food consumption relative to children with less active or less educated parents.

The present study is novel in that it focuses on preschool children, which represents an understudied population in this context, and highlights the importance of engaging both parents, not only mothers, when shaping children's health behaviours. Thus, it is crucial that future interventions and public health strategies prioritise assessing and supporting the healthy habits of both parents, as this appears to be a key factor in promoting healthy behaviours in young children. Specifically, present findings can inform the development of early childhood education curricula, paediatric health guidance, and family outreach programmes that actively involve both parents to maximise effectiveness.

Statement of the Ethics Committee

The present study adhered to the ethical standards laid out in the Declaration of Helsinki for Medical Research. Ethical approval was secured from the University of Granada's Ethics Committee with the reference number 2794/CEIH/2022.

Conflicts of Interests

On behalf of all authors, the corresponding author states that there are no conflicts of interest.

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Author's Contributions

Conceptualization G.C.V. & J.J.M.; Methodology J.J.M.; Software G.C.V. & J.J.M.; Validation G.C.V., E.P.J., F.S.P. & J.J.M; Formal Analysis G.C.V & J.J.M.; Investigation G.C.V., E.P.J., F.S.P. & J.J.M; Resources G.C.V., F.S.P. & J.J.M.; Data Curation G.C.V. & J.J.M; Writing – Original Draft G.C.V.; Writing – Review & Editing G.C.V. & J.J.M.; Visualization J.J.M.; Supervision J.J.M.; Funding Acquisition G.C.V. All authors have read and agree with the published version of the manuscript.

Data Availability Statement

Data available on request from the corresponding author gcvillodres@ugr.es

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