Original article

Effect of dietary patterns on overweight and obesity in Uruguayan children aged 24 to 47 months

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Guadalupe Herrera[1]*, Cecilia Severi[2], Raquel de VC de Oliveira[3].

1,2. University of the Republic. Montevideo, Uruguay.
3. Oswaldo Cruz Foundation, Rio de Janeiro, Brazil.

*Correspondence
gherrera@higiene.edu.uy

1. 0000-0001-6888-2343
2. 0000-0003-0775-6436
3. 0000-0001-9387-8645

Efecto del patrón de consumo en el sobrepeso y obesidad en niños uruguayos de 24 a 47 meses

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Abstract

Introduction. Eating habits acquired in childhood influence future habits. Ultraprocessed products are increasingly occupying a significant place in the food consumption patterns of both adults and children, and are, in turn, related to the development of overweight and obesity. For this reason, among others, food consumption patterns are a public health concern. **Objective.** Evaluate food consumption patterns and their effects on nutritional status in two observation instances of a cohort of children in Uruguay. **Methodology.** Analytical cross-sectional study. A total of 969 urban children aged 24 to 47 months were included. Preterm infants and/or those who presented diseases that limit or prevent movement were excluded. Dietary patterns were constructed by cluster analysis using a non-hierarchical algorithm method, and their effects on nutritional status were estimated by multinomial logistic models. Between three and five consumption patterns were constructed, always identifying the existence of a healthier pattern with lower consumption of ultra-processed products and sugar-sweetened beverages. **Results.** The consumption pattern in the first instance influenced the prevalence of overweight, obesity, and a more than ten percent increase in the body mass index, with a positive interaction between consumption patterns in both instances. **Conclusion.** Consumption patterns in early life begin to show their impact, even before school age.

Keywords
Nutritional Status, Eating, Ultra Processed Foods.

Resumen

Introducción. Los hábitos alimentarios adquiridos en la infancia influyen en los hábitos a futuro. Los productos ultraprocesados ocupan un lugar creciente en los patrones de consumo de alimentos de las poblaciones, tanto en adultos como en niños y, a su vez, se relacionan con el desarrollo de sobrepeso y obesidad. Por ese motivo y entre otros, los patrones de consumo de alimentos constituyen una preocupación para la salud pública. **Objetivo.** Evaluar los patrones de consumo de alimentos y sus efectos sobre el estado nutricional en dos instancias de observación de una cohorte de niños de Uruguay. **Metodología.** Estudio transversal analítico. Se incluyó a 969 niños de áreas urbanas, de 24 a 47 meses de edad. Fueron excluidos los prematuros y/o quienes presentaron enfermedades que limitan o impiden el movimiento. Los patrones alimentarios se construyeron mediante el análisis de clúster por método no jerárquico del algoritmo y sus efectos en el estado nutricional fueron estimados por modelos logísticos multinomiales. Se construyeron de tres a cinco patrones de consumo identificándo siempre la existencia de un patrón más saludable con menor consumo de productos ultraprocesados y bebidas azucaradas. **Resultados.** El patrón de consumo en la primera instancia influyó en la prevalencia de sobrepeso, obesidad y en el aumento de más de diez puntos percentilares en el índice de masa corporal, con una interacción positiva entre los patrones de consumo de ambas instancias. **Conclusión.** Los patrones de consumo en los primeros años de vida comienzan a mostrar su impacto, incluso antes de la edad escolar.

Palabras clave
Estado Nutricional, Consumo de Alimentos, Productos Ultraprocesados.

Introduction

Childhood overweight and obesity are a public health concern due to their link with a wide range of non-communicable diseases in adulthood. Prevalence rates of overweight and obesity are showing upward trends worldwide, regionally, and locally. This trend affects both adults and children.[i] In the general population, it is estimated that between 1976 and 2016, the prevalance of obesity increased in all countries.[ii]

According to data from the World Health Organization (WHO), by 2022, one in eight people in the world was obese.[iii] For children, Panorama regional de la seguridad alimentaria (Regional Overview of Food Security and Nutrition report) 2023[iv] estimated that globally 5.6 % of children under the age of five were overweight. In Latin America and the Caribbean, this figure reached 8.6 %, and in Uruguay it reached 11.5 %. According to data from The Global Health Observatory,[v] in the Americas, the estimated prevalence of overweight and obesity in children aged five to nine years was 38.9 %. In Uruguay, between 2010 and 2018, the prevalence among children over five years of age was estimated at 25.2 % for overweight and 9.7 % for obesity.[vi] The Global Obesity Observatory of the World Obesity Federation projected an increase in prevalence from 14 % to 24 % between 2020 and 2035, representing increases in childhood obesity from 10 % to 20 % in boys and from 8 % to 18 % in girls.[vii]

Nutritional status (NS) is determined by a multiplicity of factors. These include genetic and epigenetic, behavioral and environmental factors[viii] (cultural, familial, political and economic). Early learning, especially from the immediate family environment, determines relationships and ways of interacting with food, as well as habits and food preferences.[ix,x] Among the multiple causes influencing the NS of individuals and populations, personal, family, and environmental habits, which can be modified, along with other contextual factors, should be the focus of public policies addressing this phenomenon (such as regulation of ultra-processed product marketing, food labeling laws, price regulation for recommended foods, educational interventions, support and promotion of breastfeeding, etc.).[xi-xiii]

Urban life is recognized as one of the environmental factors impacting NS. It involves the interaction of diverse factors that influence relationships with food, access and preparation possibilities, as well as opportunities for physical activity.[xiv] According to World Bank data, in 2021, 56 % of the global population lived in urban settings, and in Uruguay, this figure reached 96 %.[xv]

Regarding food, one possible way of classifying it is by using the NOVA system. This system groups foods according to their nature, purpose, and level of processing. Foods are categorized as unprocessed or minimally processed foods, processed culinary ingredients, processed foods, and ultra-processed products (UPP).[xvi-xviii] UPPs result from industrial procedures, using formulations based on substances extracted from foods, with the addition of additives and preservatives to enhance palatability and shelf life. They are characterized by low nutritional value, high caloric density (high amounts of fats, sugar, and/or sodium, low protein, fiber, and other micronutrients). Furthermore, these products do not usually require any cooking before consumption, making them an attractive option when time is scarce.

There is no consensus on how to define, evaluate, or classify food consumption patterns. However, they can be constructed based on the diversity of food groups present[xix] over a given period of time,[xx] or on the percentage contribution of each food group to household or population-level energy intake. This can be assessed through compliance with Food-Based Dietary Guidelines (FBDG), meeting nutritional requirements, expenditure, or evaluating the relative weight of ultra-processed products.[xvii-xxi] Approaches may be qualitative or quantitative. According to data from the Pan American Health Organization, the sale of ultra-processed products (including foods and beverages) continues to grow, increasingly dominating the diets of Latin American populations;[xxii] Uruguay is no exception. In that country, in childhood consumption, it has been found that 28 % of dietary caloric intake comes from ultra-processed products, with excess free sugars and/or sodium.[xxiii,xxiv] Results from the 2018 cohort of the Survey on Nutrition, Child Development, and Health (ENDIS) revealed low dietary diversity (based on inclusion of food groups), early addition of salt to meals, use of electronic devices, and sugary beverage consumption in 11-19 % of children over 24 months, varying by family income tertile.[xxv]

The impact of UPP consumption on health has been demonstrated in both adults and children. Eating habits in the early years of life lay the foundation for preferences that will persist throughout life. Habits acquired in early childhood are significantly associated with later overall consumption patterns.[x,xxvi,xxvii]

In the literature, research often focuses on school-aged children, as schools are convenient environments for data collection. Studies on preschool children's food consumption patterns are less frequent, and in the region, longitudinal studies in children under five are scarce. Therefore, the objective of this research was to evaluate food consumption patterns and their effects on NS in two waves of a cohort of children aged 24 to 47 months from urban areas in Uruguay.

Methodology

Study design

This is an analytical cross-sectional study based on the analysis of the Nutrition, Child Development, and Health Survey (ENDIS) database. This survey follows children longitudinally, collecting information from birth and at the time of each survey. Data collection was carried out in cooperation between the School of Economics at the University of the Republic, the Office of Planning and Budget, and the National Institute of Statistics, with the aim of "generating freely available longitudinal information to foster the study of early childhood in Uruguay and inform policy design".[xxviii] To ensure data quality and representativeness, the surveys were conducted by trained interviewers (psychomotor specialists and nutritionists), and the sample was random, with weighting calculated to minimize possible non-response bias.

The ENDIS databases include a wide range of information related to the socioeconomic context, NS (through anthropometric measurements, weight and height, of the child and mother), nutritional habits, health checkups, health status, adult caregiver's employment situation, educational level, psychomotor development (ASQ-3 scale), social competencies, behavioral problems, and food security (using the Latin American and Caribbean Food Security Scale, ELCSA). The sample was surveyed in the first two phases of the first ENDIS cohort, between 2013 and 2015[xxvii] (hereinafter referred to as "waves"), with a two-stage sampling design. The first stage corresponds to the sampling design of the Continuous Household Survey (carried out by the National Institute of Statistics), which was random and stratified in two or three stages with national representation. The second stage included all urban households (more than 5000 inhabitants) that had children aged zero to three years, between February 2012 and November 2013. A total of 2665 households were included in Wave 1 and 2310 in Wave 2, with weights constructed according to stratum capture to ensure representativeness and inferential value.

Children who participated in both waves and had anthropometric measurements were included. Premature births (<37 weeks of gestation, since their growth and development differ from those born at term) and cases with conditions limiting mobility and physical activity (as reported in the survey, without specifying the type of condition) were excluded.

Outcome

Anthropometric measurements were taken in both waves, repeatedly in both waves, by trained interviewers. The Instruments used for measurement included: (a) a Seca electronic floor scale, capacity of 200 kg, and a precision of 100 g; (b) stadiometers provided by the National Administration of Public Education, used for both weight and height. When discrepancies between repeated measurements occurred, the average was used. The nutritional indicator and category of NS were calculated from the body mass index (BMI = weight in kg/height in m^2) Z-score. The Z-score was calculated according to World Health Organization (WHO) growth standards.[xxix] NS categories were underweight/normal weight (UW/NW) or overweight/obese (OW/OB), where OW/OB was defined as BMI-for-age Z-score > 1.

Based on these nutritional indicators, the outcome was defined as the change in NS between waves, measured by changes in BMI-for-age percentiles. Using quartiles one and three of the percentile shift distribution, changes greater or less than ten percentile points were considered: "decreased by more than ten percentile points," "remained within ±10 percentile points between waves 1 and 2," and "increased by more than ten percentile points." The quantitative distribution of percentile change between Waves 1 and 2 is presented in Supplementary Material MS1.

Variables

The main exposure was the food consumption pattern in both waves. Dietary characteristics were collected using a food frequency questionnaire specifically developed for the survey, including both foods recommended by the FBDG[xxi] and UPP (the complete food list is provided in Supplementary Material MS2).

Adjustment variables included: sex, breastfeeding duration, screen time, maternal working hours, sleep duration, and internalizing disorders. Household income tertiles were used to describe the sample composition. The duration of breastfeeding was taken into account, regardless of whether it was exclusive or mixed; this information was collected in Wave 2, when most children had already completed breastfeeding. Sleep duration, as reported by mothers, was collected only in Wave 2 as a quantitative variable (hours of sleep), and later categorized as Adequate/Inadequate according to WHO recommendations (12-16 hours for children

4-11 months, 11-14 hours for children 1-2 years, and 10-13 hours for children three years and older).[xxx] Internalizing disorders (anxiety/depression) were assessed using the Child Behavior Checklist (CBCL/1.5-5) [xxxi] questionnaire, collected in Wave 2. This screening tool, applicable to children aged 1.5-5 years, sums the scores of 99 items to create a T-score and classifies children as "normal" (T < 60) or "borderline/clinical" (T ≥ 60). Screen time was categorized as <1 hour per day, 1-2 hours, 3-4 hours, or > 4 hours. Maternal weekly hours of work outside the home were grouped as follows: Does not work outside the home; <20 hours; 20-40 hours; > 40 hours.

Statistical analysis

An exploratory analysis of the data was performed using frequency distributions for qualitative variables and summary measures for quantitative variables. Normality of distributions was verified in all cases. Associations between adjustment variables and the presence of OW/OB in Wave 2 were assessed using the Wald test for categorical variables and the t-test for quantitative variables.

The main exposure variable (dietary pattern) was constructed through dimensionality reduction using a non-hierarchical clustering method, the Partitioning Around Medoids (PAM) algorithm, selected because dietary information was collected as categorical and ordinal variables. Individual contributions from each observation were used via a dissimilarity matrix based on Gower's coefficient. The optimal number of clusters was determined using silhouette plots.

For the second stage of analysis, crude and adjusted Odds Ratios (OR) with 95 % confidence intervals (CI) were estimated for the outcome, using multinomial logistic regression models (both simple and multiple) across waves. Proportional odds assumptions were tested by fitting two separate binary logistic models, comparing successive categories of the dependent variable, and plotting estimated coefficients (log-odds) for each predictor. The crossing of curves suggested that effects were not constant across outcome levels, indicating non-fulfillment of proportional odds. Therefore, a multinomial model was methodologically more appropriate. Entry into the multiple model was based on statistical criteria ($p < 0.2$ in simple models) and theoretical relevance (sex, breastfeeding duration, internalizing disorders, sleep hours, screen time, maternal working hours). Interaction between food consumption patterns across waves was also evaluated, represented by the effect of Wave 2 dietary pattern given the Wave 1 dietary pattern (Wave 2/Wave 1). Retention in the multiple model was based on statistical significance ($p < 0.05$) and theoretical relevance. Model selection was based on the Akaike Information Criterion (AIC). No sensitivity analysis was conducted.

Because the survey data came from a complex multistage sampling design, descriptive analyses and modeling were conducted accounting for weights and sampling strata, using the survey and svyVGAM packages in R software, version 4.0.2.

Ethical considerations

The data used are open, public, and anonymous, available on the Ministry of Social Development website.[xxxii] The study was conducted in compliance with the ethical principles of the Declaration of Helsinki and international guidelines for human research.

Results

A total of 956 children were included in the sample (Figure 1), aged 24 to 47 months in Wave 1 and 48 to 79 months in Wave 2.

The prevalence of OW/OB in Wave 1 was 12.82 % and 25.41 % in Wave 2. Age and sleep hours were significantly associated with OW/OB: children with OW/OB had a higher mean age and a greater proportion meeting the recommended hours of sleep compared with UW/NW children ($p < 0.01$). Maternal working hours outside the home were also significantly associated with NS in Wave 2, with higher OW/OB prevalence among children whose mothers worked more than 40 hours per week. Table 1 shows the characteristics of the children included in the study according to NS in Wave 2 of the survey.

Food consumption patterns

In Wave 1, five clusters were identified: "Healthy"; two intermediate clusters called "Moderate" (group with low variety of recommended foods and moderate UPP consumption); "Low CH" (group with low carbohydrate intake); and two groups with higher frequency of sweet or salty UPP consumption (called "Sweet UPP" and "Salty UPP"). In Wave 2, three clusters were identified: "Healthy," "Sweet UPP," and "Salty UPP."

In both waves, a "Healthy" pattern was identified, characterized by lower UPP and sugary drink consumption and higher frequency of fruit, vegetable, meat, egg, fish, and water intake. Other patterns showed a lower presence of unprocessed or minimally processed foods and a higher frequency of sweet or salty UPP consumption. Across all waves, fish and legumes were rarely consumed, and dairy consumption was high. It was not possible to establish clusters reflecting graduality in UPP consumption (low, moderate, high). Detailed descriptions of identified patterns are provided in Supplementary Material MS3, and frequency distributions by cluster and wave are presented in Supplementary Material MS4 and MS5.

Construction of the nutritional status change

The variable "change in percentile" between waves 1 and 2 presented a median of -0.31 points (IQR = -14.4; 11.4). Categorizing the variable, based on a cut-off point approximating quartiles one and three, in ten points, it was obtained that 31.16 % decreased by more than ten points; 41.89 % maintained (+/- ten points) and 26.99 % increased by more than ten points. The joint distribution of NS, in both waves and the modification of more than ten percentile points in BMI/age is shown in Table 2.

Table 1. Distribution of characteristics of 956 children aged 24–47 months, followed between 2013 and 2016 in Uruguay, by nutritional status in Wave 2 of the Nutrition, Child Development, and Health Survey.

		UW/NW%	Mean (SD)	OW/OB%	Mean (SD)	p-value
Sex						0.269
	M	49.8		54.9		
	F	50.2		45.1		
Age (months)			61.2 (6.7)		65.0 (5.7)	**< 0.001**
Income tertile						
	1	33.3		28.9		
	2	33.1		36		
	3	33.6		35.1		
Breastfeeding duration						0.197
	No breastfeeding	1.6		1.4		
	Up to 2 months	7.9		8.9		
	2–6 months	8.8		14.8		
	6+ months	81.7		75.0		
Screen time						0.823
	<1 hour	17.2		15.5		
	1–2 hours	46.1		47.0		
	3–4 hours	26.8		25.2		
	>4 hours	9.9		12.3		
Maternal work (weekly hours)						**0.027**
	Does not work outside home	35.8		31.5		
	≤20 hours	16.8		11.5		
	21–40 hours	28.0		25.8		
	>40 hours	19.4		31.2		
CBCL – Internalizing disorders						0,770
	Normal	88.4		87.5		
	Borderline/clínico	11.6		12.5		
Sleep hours						**<0.001**
	Inadequate	32.9		13.3		
	Adequate	67.1		86.7		

M = male, F = female, SD = standard deviation, UW/NW = underweight/normal weight, OW/OB = overweight/obesity, CBCL = Child Behavior Checklist. Note: Values are corrected by weights and sampling strata. P-values < 0.05 are shown in bold.

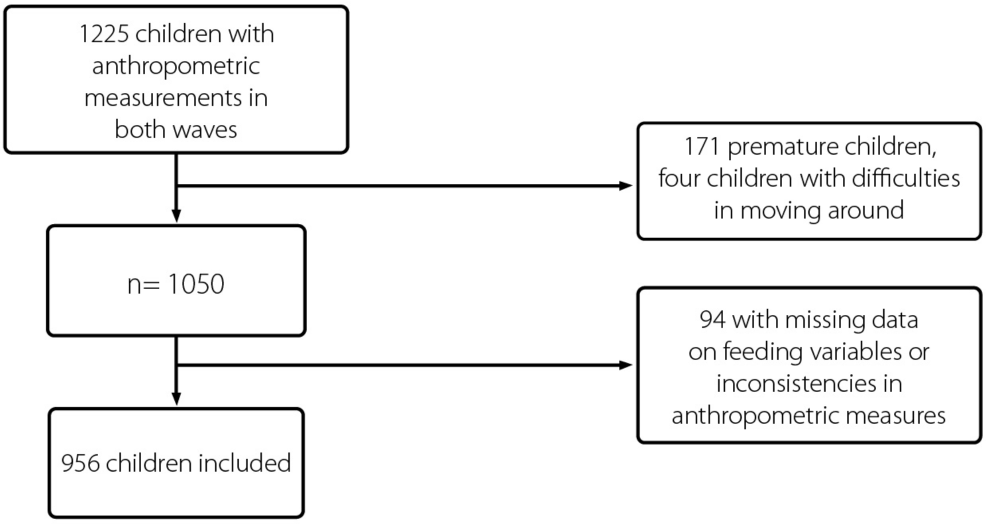

Figure 1. Flow diagram. Composition of the sample of 956 children aged 24–47 months.

Table 2. Distribution of nutritional status in Waves 1 and 2 of the Nutrition, Child Development, and Health Survey and change in BMI-for-age percentiles in 956 children.

Nutritional status		Total	Percentile change		
Wave 1	Wave 2		↓>10 points	Maintained ±10 points	↑>10 points
UW/NW	UW/NW	714	292 (40.9%)	252 (35.3%)	170 (23.8%)
UW/NW	OW/OB	149	3 (2%)	95 (63.8%)	51 (34.2%)
OW/OB	UW/NW	27	16 (59.3%)	11 (40.7%)	-
OW/OB	OW/OB	66	4 (6.1%)	62 (93.9%)	-

UW = underweight, NW = normal weight, OW = overweight, OB = obesity, ↓= decrease, ↑= increase.

Modeling

A significant association was found between the "Salty" consumption pattern in Wave 1 and an increase of more than ten percentile points between Waves 1 and 2 (Table 3), with an OR of 2.0 (CI 1.1-3.6). No effect was found for Wave 2 consumption patterns on changes in NS.

A significant interaction was found between Wave 2 consumption patterns, according to Wave 1 consumption patterns (Wave 2/Wave 1), and their effect on percentile change. Positive and significant interactions were found between the patterns Salty UPP/ Moderate, Salty UPP Salty, and Salty UPP/Sweet (calculated as the effect of Wave 2 pattern given Wave 1 pattern), with OR: 4.6 (CI 1.5-14.7), OR: 5.2 (CI 1.4-20.0), and OR: 3.5 (CI 1.1-11.4), respectively, for increasing by more than ten percentile points between waves, compared with the group that maintained a Healthy pattern in both waves (Figure 2 and Sulpplementary Material SM6).

Discussion

Dietary patterns were constructed for the first two waves of a population-based Uruguayan cohort, assessing the effect of exposure to these patterns on NS. The consumption patterns identified ranged from more to less healthy, with evidence of the effect of exposure to unhealthy patterns in Wave 2 of the survey.

Table 3. Crude and adjusted OR for percentile change between Waves 1 and 2, by Wave 1 consumption pattern, in 956 children aged 24–47 months, followed between 2013 and 2016 in Uruguay.

		Percentile change *			
		Crude OR (95% CI)		Adjusted OR (95% CI)**	
		↓ >10 points	↑ >10 points	↓ >10 points	↑ >10 points
Wave 1 consumption pattern	Healthy	1.0		1.0	
	Low CH	1.3 (0.7-2.3)	1.4 (0.7-2.7)	1.1 (0.6-2.0)	1.2 (0.6-2.4)
	Moderate	0.9 (0.6-1.5)	1.5 (0,9-2.7)	0.8 (0.5-1.4)	1.5 (0.8-2.7)
	Salty UPP	1.8 (1.0-3.3)	1.9 (1-3.7)	1.8 (0.9-3.7)	2.0 (1.1-3.6)
	Sweet UPP	0.9 (0.5-1.7)	1.1 (0.6-2.1)	0.7 (0.4-1.2)	1.1 (0.6-2.1)
Wave 2 consumption pattern	Healthy	1.0		1.0	
	Sweet UPP	1.3 (0.8-2.0)	1.1 (0.7-1.8)	1.6 (1.0-2.6)	1.2 (0.7-2.0)
	Salty UPP	0.9 (0.6-1.4)	1.1 (0.7-1.7)	0.9 (0.6-1.4)	0.9 (0.6-1.5)

Note: OR = Odds Ratio, CI = Confidence Interval, UPP = ultra-processed products, CH = carbohydrates, ↓ = decrease, ↑ = increase.
*Reference category: remained within ±10 points between Waves 1 and 2.

**Effect of consumption pattern adjusted for sex, breastfeeding duration, internalizing disorders, sleep hours, screen time, and maternal working hours. McFadden's pseudo R^2: 14. 03 % for Wave 1 consumption pattern, 14 .16 % for Wave 2 consumption pattern.

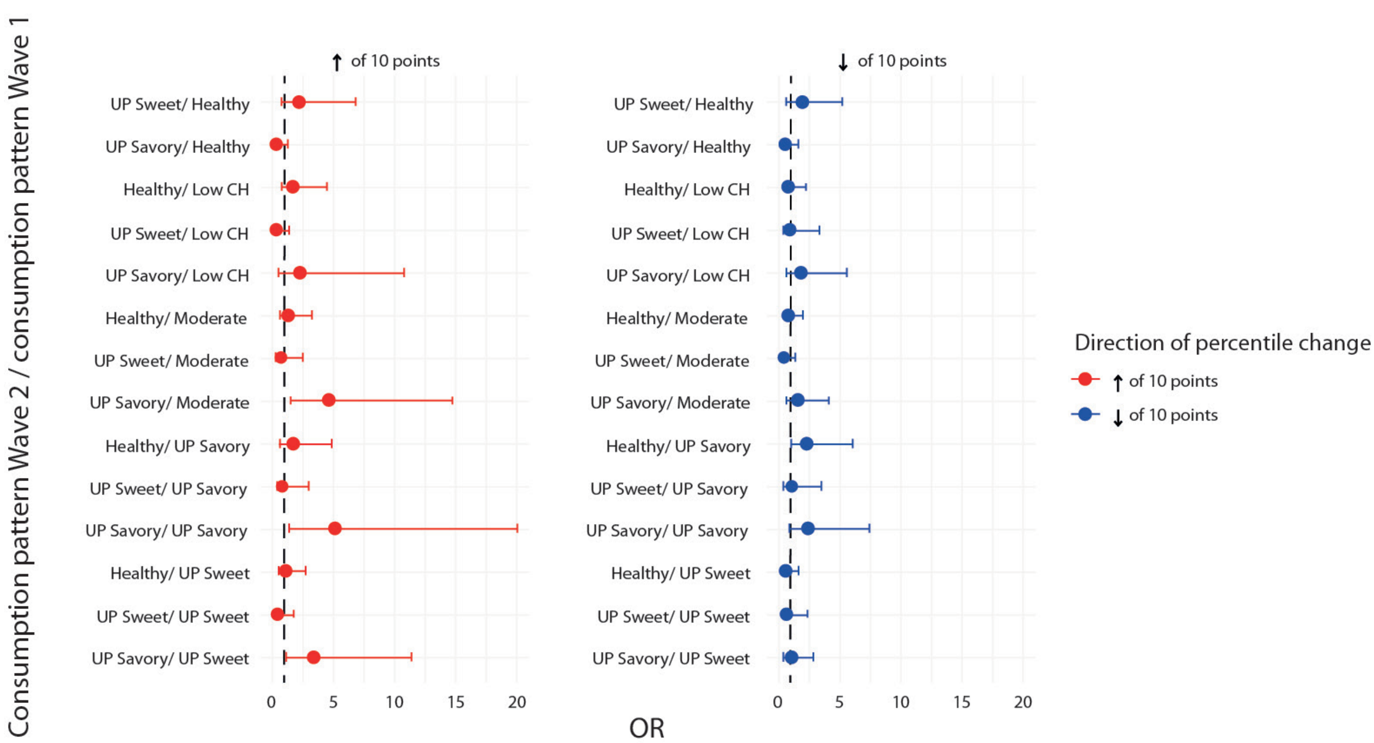

Figure 2. Adjusted OR and confidence intervals for percentile change between Waves 1 and 2, with interaction between Wave 1 and Wave 2 consumption patterns, in 956 children aged 24–47 months, followed between 2013 and 2016 in Uruguay.

Longitudinal studies of early childhood with the magnitude and representativeness of the ENDIS surveys are uncommon in Latin America,[xxxiii,xxxiv] making this a valuable source of information with significant potential.

It was found that OW/OB prevalence was higher in Wave 2 than in Wave 1. The OW/OB values found in Wave 1 were slightly higher than those estimated in the Regional Overview of Food Security and Nutrition[iv] for Uruguayan children under five years. In Wave 2, the prevalence found was lower than that reported for the Americas by The Global Health Observatory[v] (38.9 %). However, the OW/OB prevalence observed in ENDIS and the increasing trend with age were consistent with findings reported by Delfino *et al.*[vi] for the Uruguayan child population. In a literature review on childhood OW/OB in Uruguay, the authors reported that between 2010 and 2018, the weighted mean prevalence was 11.5 % among children under five years, and 25.2 % and 9.7 % for overweight and obesity, respectively, among those older than five.

Sleep duration in the first wave were linked to NS at the end of follow-up. This is consistent with previous literature, as inadequate sleep duration (particularly reduced hours of sleep) has been associated with increased risk of overweight and obesity. Two systematic reviews of longitudinal studies in children and adolescents found an inverse relationship between BMI and sleep duration.[xxxv,xxxvi] Maternal working hours outside the home were also associated with OW/OB in children. Several studies show that while women have greater participation in the labor market, meal planning and preparation remain both symbolically and practically tied to the female role, and men do not engage equally in these tasks.[xxxvii] Furthermore, long working hours have been associated with perceptions of lack of time, increasing the likelihood of choosing ready-made or more processed foods.[xxxviii]

The dietary patterns identified provide valuable insights into early childhood eating behaviors, particularly regarding their effects on NS from the earliest years of life. It is important to note that the results presented here correspond to a subgroup of the first ENDIS cohort. This cohort also includes children aged 0-24 months. However, when conducting the same analyses, the effect was confirmed only in the older subgroup, who had longer cumulative exposure and made up the sample analyzed in this study.

The patterns found in this study corroborate the identification of dietary patterns in early childhood observed in several studies worldwide. These patterns ranged from healthier to unhealthier, and between two and six or seven patterns were identified, although most studies typically reported three dietary patterns.[xxxix,xl]

A positive interaction was found between exposure to unfavorable dietary patterns in Wave 1 and Wave 2, increasing the likelihood of gaining more than ten percentile points between both waves, even after adjusting for confounders. Regarding changes in NS during childhood, two studies have used both quantitative approaches (change in Z-scores) and categorical approaches (change in category),[xli,xlii] establishing that exposure to diets lacking vegetables and with a higher share of UPP is associated with a greater risk of increases in BMI-for-age or weight-for-length Z-scores, as well as increased snack consumption with age. The greater impact observed from the "Salty" pattern may be explained by the fact that ready-to-eat meals are incorporated into family mealtimes, meaning that salty UPP consumption is more frequent and in larger amounts (as they replace whole meals).[xxiv,xliii]

As for the limitations of this study, it is possible that UPP consumption was underreported, with a lower reported frequency than actual consumption, due to social desirability bias or recall bias. Measuring childhood eating habits has inherent challenges, including reliance on caregiver reports and the quality of information depending on shared time. As children grow, they spend more time under the care of others or in educational institutions, limiting their ability to fully know their diet.[xliv] Difficulties were also encountered in recording exclusive breastfeeding, with inconsistencies in data quality; therefore, breastfeeding duration (exclusive or mixed) was used, which may have caused loss of significant effects associated with exclusive breastfeeding. In model evaluation, pseudo R^2 values around 14 % indicated that only a limited proportion of outcome variability was explained. This is expected in complex designs and may suggest that other variables should be considered in order to explain the phenomenon. Moreover, food frequency questionnaires used in this type of population study do not account for intake quantities.[xlv] It should also be noted that it was not possible to establish consumption patterns reflecting gradual levels of UPP intake, and that patterns differed over time. This poses challenges for longitudinal modeling, but also reflects that dietary patterns vary with children's age. It is recommended to continue longitudinal analysis of the cohort using approaches such as Latent Transition Analysis.

This study focused on Waves 1 and 2 of a representative cohort of the population. In ENDIS, data collection was conducted by trained interviewers in household settings. This approach promoted greater trust during interviews and improved data quality. Significantly, the construction of dietary patterns from early ages contributes to early detection and development of prevention strategies beginning soon after complementary feeding introduction. The percentile-change approach aimed to explore a sensitive strategy, proposing a cut-off point that may be useful in clinical practice, allowing detection of changes in the NS that are not necessarily reflected in categorical classifications. This tool can be valuable for individual monitoring in clinical practice, enabling early detection of growth variations. Additionally, the effects of consumption patterns remained statistically significant after adjustment for confounders, reinforcing the robustness of the findings.

The findings of this study are consistent with those from the 2018 ENDIS cohort Wave 1, which reported high consumption of UPP consumption among children aged 2-4 years,[xxiii] as well as with a cross-sectional study in 21 schools in Montevideo, where UPP consumption was found in almost all schoolchildren, with a large share of daily caloric intake coming from these products, along with excessive caloric intake.[xxiv] In the region, Argentina has shown a sustained increase in household UPP consumption, with decrease in the proportions of expenditure on minimally processed foods, processed foods, and culinary ingredients.[xviii] For the 2013 ENDIS cohort, further exploration of changes in dietary patterns through longitudinal approaches incorporating new waves would be valuable, as it would provide greater insight into early childhood eating behaviors in Uruguay and their medium-term effects.

Conclusion

In childhood, there is evidence of the coexistence of dietary patterns with higher and lower contributions from ultra-processed products (UPP). The effects of less healthy patterns on NS begin to emerge even before school age, particularly in cases where the consumption pattern involves a greater share of UPP in both observation periods. A significant impact of UPP consumption was detected, especially of patterns with high frequency of UPP consumption across both observation periods, on changes in NS.

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Supplementary material

The online version contains supplementary material available at:

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