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Protocol

Influence of home/school environments on children's obesity, diet, and physical activity: the SUECO study protocol

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ABSTRACT

Objective: The SUECO study examines the relationship between urban obesogenic environments and health outcomes among school-age children in the city of Madrid, Spain. We will study how features of the urban environment (related to the food- and the physical activity environment) associate with children's anthropometrics, eating habits, and physical activity levels.
Method: We describe the study protocol of this multilevel study in a representative sample of school-age children in the city of Madrid (2017; n = 5,961 children ages 3-12). Main outcome variables include anthropometrics (body mass index, waist circumference, and body fat), healthy and unhealthy consumption measures, and physical activity measures. The primary explanatory variables are grouped into food environment (e.g., unhealthy food retailers' density) and physical activity environment (e.g., walkability, physical activity opportunities) variable categories. Multilevel models will be used to calculate the associations between each indicator and obesity and physical inactivity.

Impacto del entorno residencial/escolar en la obesidad, la dieta y la actividad física en población infantil: protocolo del estudio SUECO

Palabras clave:
Obesidad
Índice de masa corporal
Población infantil
Centros educativos
Barrios
España

RESUMEN

Objetivo: El estudio SUECO evaluará la relación entre el entorno urbano obesogénico y los resultados en salud en la población infantil escolarizada en Madrid. El estudio explorará cómo influyen las características del entorno urbano (relacionadas con la alimentación y con la actividad física) en las variables antropométricas, los hábitos alimentarios y la actividad física.
Método: Se presenta el protocolo de este estudio multinivel, realizado con una muestra representativa de población infantil escolarizada en la ciudad de Madrid (2017; n = 5961 escolares de 3 a 12 años). Las principales variables de resultado incluyen antropometría (índice de masa corporal, circunferencia de cintura y porcentaje de grasa corporal), hábitos alimentarios (saludables y no saludables) y actividad física. Las principales variables independientes son contextuales (del entorno alimentario y del entorno de actividad física). Se utilizarán modelos de regresión multinivel para evaluar las asociaciones entre cada indicador contextual, la obesidad y la inactividad física.

Introduction

Malnutrition (undernutrition, overweight/obesity, and poor diets) is a major health and social problem worldwide.[1] Moreover, malnutrition during childhood and adolescence is associated with adverse health consequences. The estimated prevalence of childhood overweight and obesity is about 25% in Europe; however, the burden is not homogeneously distributed across the region.[2] Indeed, estimated prevalences range from about 11% in Belgium to about 40% in Greece.[2] According to the most recent national health survey in Spain, about 25% of children (aged 2 to 17 years) presented overweight or obesity in Madrid in 2017.[3] These

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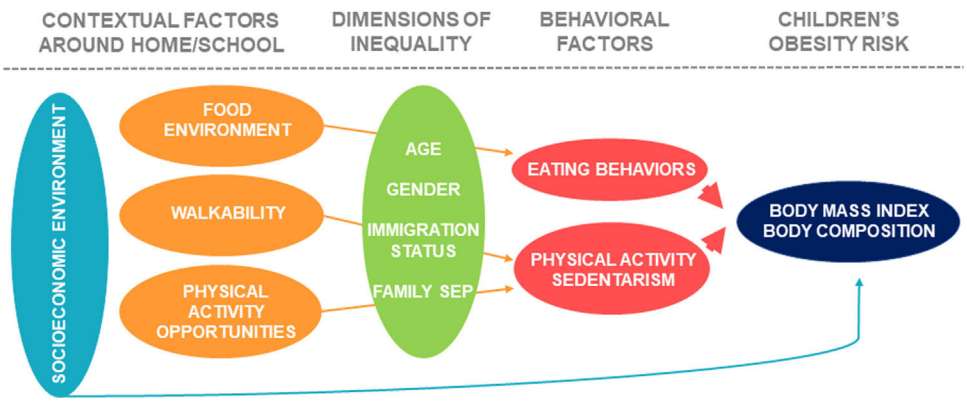

Figure 1. Flow-chart of the study population.

prevalence rates are partially attributed to a gradual shift in these countries, from a Mediterranean Diet to a more Westernized diet. Thus, at the forefront of malnutrition and poor children's health is the obesogenic environment.[4]

Swinburn et al.[4] defined the obesogenic environment as "the sum of the influences that the surroundings, opportunities, or conditions of life have on promoting obesity". This obesogenic environment contributes to overweight/obesity by encouraging unhealthy diets and sedentarism.[5] For children, this corresponds to an increased access to unhealthy food and sugar-sweetened beverages.[6] Furthermore, accessibility to recreational facilities (e.g., playgrounds), walkability, sports facilities, and active school transportation opportunities are associated with increased physical activity.[7,8]

Yet, scarce research has simultaneously examined more than one dimension of the obesogenic environment concerning children's obesity.[9,10] Also, most supporting evidence comes from the US, Australia, and the UK; however, the structure of the built and the food environment differ across geographic contexts.[11–13] Despite the recognition that childhood obesity in Europe is highest within Mediterranean countries, no study has been conducted in this context.[14,15] This lack of evidence is hindering effective translation into policy.

The SUECO study aims to assess the relationships between residential- and school-level urban environment features and individual-level anthropometrics, eating behaviors, physical activity among young children in Madrid, Spain.

Method

Study design

This is a multilevel study conducted in Madrid, Spain. We will use de-identified individual data from the 2017 dataset of the *Encuesta del estado nutricional de la población infantil de la ciudad de Madrid,* a city-wide survey commissioned by the city council to assess the nutritional status of Madrid school-age children (3 to 12 years).[16] Contextual measures will be developed based on earlier work (fig. 1).[6,17,18]

Participants and sample

Participants were selected using a stratified cluster sampling design (see fig. I in online Appendix). First, schools were stratified according to area-level factors, and 84 were randomly selected. Out of these, 60 agreed to participate (response rate: 71.4%). Second, school classes were randomly selected in each school. The study population comprised 7,740 children from which 6,157 provided parental consent to participate in the study (recruitment rate: 79.5%).

The actual number of children for each analysis will vary because individuals could consent to single components of the study (e.g., 5298 for anthropometrics) while abstaining from others (e.g., 5201 completed the survey).

Table 1
Variables included in the study.

Outcomes	Measures
Anthropometrics	Age- and sex-standardized body mass index (BMI z-scores), overweight, obesity
	Waist circumference
	Body fat percentage
Healthy and unhealthy consumption measures	Fruit and vegetables intake
	Sweet-sweetened beverages
	Sweets
	Fast-food intake
Physical activity measures	Active travel to school
	Physical activity
Exposures	**Measures**
Food environment	Unhealthy food retailers' density
Walkability	Walkability index
Surrounding physical activity opportunities	Density of playgrounds
	Density of and proximity to exercise facilities
	Green spaces' density

Study variables

Table 1 shows an overview of the study variables. The main outcome variables encompass anthropometrics, healthy and unhealthy consumption measures, and physical activity measures.

Main outcome variables

1) Anthropometrics

Objectively measured heights and weights were used to calculate body mass index (BMI, weight in kg / height in m^2) for each child. To allow for international comparisons, this study will use the WHO BMI growth reference which is an age-sex specific BMI z-score to classify overweight and obesity.[19] We will also use as adiposity measures waist circumference and body fat percentage.

Measurements were made by trained staff using standard procedures and regularly calibrated instruments: height was measured with a stadiometer (MZ 10042) and weight with a digital weight scale (TANITA UM-076), both without shoes and with light

clothing. Waist circumference was measured to the nearest 0.1 cm in a standing position with the use of a measuring tape.

2) Healthy and unhealthy consumption measures

We will calculate fruit and vegetable intake based on the sum of two questions from the questionnaire. Consumption of sugar-sweetened beverages will include carbonated sugar-sweetened drinks and non-carbonated sugar-sweetened drinks. Fast-food consumption will include hamburgers and pizza. Possible answer categories were: never, 1–3 times a week, 4–6 times per week, 7 times a week. Consumption frequencies will be then summed to calculate consumption measures as frequencies per week. Eating at fast-food outlets will be calculated based on the specific question "In a normal week, how many times does your visit a fast-food outlet?". Possible answer categories were: never, less than one time a week, and one or more times per week.

3) Physical activity

Moderate-to-vigorous physical activity levels will be estimated based on a measure of weekly moderate-to-vigorous physical activity (total amount in minutes) that includes all types of activity out of school hours. We will measure active travel to school based on the following question; "On a typical day is the main part of your child's journey to school made by walking/bicycle, bus/train/subway, car/motorcycle or other means?" Response "walking/bicycle" was coded 1 signifying active travel, and all other responses coded 0.

Main exposure variables

We will construct a geodatabase using Geographic Information Systems, which will allow us to geocode children's home and school addresses, and estimate exposure measurements (e.g., food environment, walkability, and exercise opportunities) around both home and school environment. Data will be spatially joined to census tracts to merge databases obtained at different geographic unit levels.

1) Food environment

Assessment of the retail food environment will be based on earlier work[6]. We will measure the density of food retailers offering unhealthy food and sugar-sweetened beverages within a 400 m shortest network path buffer around each children's residence and school address. Buffers of 800m will be considered in sensitivity analyses. Retailers' addresses will be collected (as of 2017) using a publicly available administrative dataset (*Censo de locales y actividades*) which was previously validated.[20]

2) Walkability

We will measure area-level walkability, at the census tract level, using a previously validated walkability index.[18] This index comprises four indicators: residential density, population density, retail destinations, and street connectivity. Data will be obtained from different secondary sources.

3) Surrounding physical activity opportunities

We will use three measures: 1) density of surrounding playgrounds; 2) density of green spaces,[21] and 3) density of exercise facilities (including both free outdoor sports courts and public sports centers). We obtained green spaces data combining all green land use cover categories from the City Council of Madrid for the year 2016 and all green spaces under mainteinance by the Madrid City Council in 2020.

Potential confounders

We will identify potential confounders for each of the environmental exposures and include individual sociodemographic variables and area-level characteristics: age (years), sex (male or female), country of origin, household composition, Family Affluence Score (FAS)[22] as a measure of the family's socioeconomic status, area-level socioeconomic status,[18] and population density.

Statistical analysis

The study has a multilevel structure, where children are nested within schools (fig. 1). Therefore, multilevel regression models will be used to examine the cross-sectional associations between each outcome measure and each areal level factor. All regression models will be adjusted for a common set of potential confounders and checked for effect modification (e.g., by sex to obtain sex-specific estimates). Effect modification will be tested by including interaction terms in the models. We will design sensitivity analyses to test the robustness of our findings to different model specifications.

Ethical considerations

The study will be conducted according to the guidelines laid down by the Declaration of Helsinki and ethical approval was granted by the Ethics Committee of the Universidad de Alcalá (CEI/HU/2019/35). Participants were assured of anonymity and confidentiality and written consent was obtained from the parents or legal guardians of all children. All data exchanges will adhere to the most up-to-date EU and national data protection regulations.

Discussion

To the best of our knowledge, no research projects on this topic have been conducted or are in progress in Spain. Thus, it will provide significant evidence. First, its multi-level study design will allow for assessing possible area-level effects over and above individual-level effects. Second, it focuses on school-age children which is a current priority given the magnitude of excess body weight, physical inactivity, and sedentarism among this population group. Third, it will measure the obesogenic environment across several domains and locations (both residence and school location).[10] Fourth, it will assess the impact of individual- and area-level SES, which are potentially important covariates of eating habits and physical activity and potential effect modifiers of the associations between environmental determinants and eating habits or physical activity.

This study presents several methodological limitations. First, eating and physical activity data are based on self-report, which is prone to bias and measurement error (e.g., parents may be reluctant to disclose the frequency at which their children consume sugar-sweetened beverages). Second, it may be the case that fast-food retailers preferentially locate in areas with greater demand resulting in a causal pathway that is in the opposite direction to that hypothesized.

Conclusions

The study offers a unique opportunity to evaluate the health consequences of obesogenic environments for school-age children in a large Southern European city like Madrid. This study will also provide relevant evidence to influence urban policies to promote children's well-being while addressing social inequities.

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Authorship contributions

J. Díez, JM Díaz-Olalla and M. Franco designed the overall framework of the project protocol. All project investigators have participated in different phases of the project, contributed to this manuscript, and gave final approval. J. Díez prepared a first complete draft of this manuscript; all authors critically reviewed it and contributed with significant and important suggestions. All authors have participated in writing the manuscript, its critical review, and have approved the final version. All of them are jointly responsible for adequate revision and discussion of all aspects included in the manuscript.

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Conflicts of interests

None.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.gaceta.2021.04.005

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