



## Effects of clustering of multiple lifestyle-related behaviors on blood pressure in adolescents from two observational studies



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### ABSTRACT

**Background.** Several lifestyle-related behaviors are associated with cardiovascular health outcomes in adolescents. To examine the associations between clustered lifestyle-related behaviors and blood pressure (BP) levels in adolescents.

**Methods.** Participants were recruited by multistage random cluster in two cross-sectional studies; one conducted in 2006 and 2007 in ten cities from nine European countries: Athens and Heraklion in Greece, Dortmund in Germany, Ghent in Belgium, Lille in France, Pécs in Hungary, Rome in Italy, Stockholm in Sweden, Vienna in Austria, and Zaragoza in Spain; and another conducted in 2007 one city in Brazil (Maringá/PR). Systolic BP (SBP) and diastolic BP (DBP) (outcomes) and clustered behaviors (weekly consumption of fruits and vegetables, weekly consumption of sugar-sweetened beverages, sleep duration, screen time and physical activity) were analyzed.

**Results.** The *Healthy Eating* cluster was negatively associated with DBP in European girls,  $\beta = -2.46$  ( $-4.62$ ;  $-0.30$ ), and with SBP in Brazilian boys,  $\beta = -2.79$  ( $-3.10$ ;  $-0.15$ ). Furthermore, the *Unhealthy Eating* cluster was associated with increased SBP in European girls,  $\beta = 4.54$  ( $1.29$ ;  $7.79$ ), and in Brazilian boys,  $\beta = 4.10$  ( $0.80$ ;  $7.40$ ).

**Conclusion.** The *Healthy Eating* cluster was associated with lower blood pressure, whereas the *Unhealthy Eating* cluster was associated with increased SBP in adolescents.

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### Introduction

Cardiovascular disease (CVD) remains the main source of disease burden worldwide, and it represents one of the major public health problems of the 21st century (Go et al., 2014). Obesity and high blood pressure in adolescence have been shown to be predictors for CVD in

adulthood (Oikonen et al., 2013; Pahkala et al., 2013). Indeed, childhood overweight and obesity tend to track from childhood into adulthood (A.S. Singh et al., 2008). The increasing rates of childhood obesity in the last decade (Wabitsch et al., 2014), might be responsible for the increased prevalence of high blood pressure in adolescents (Din-Dzietham et al., 2007; ACF de Moraes et al., 2014a).

Although genetic factors may influence the susceptibility of some adolescents to develop high blood pressure, lifestyle-related changes seem to be the main cause for the prevalence of high blood pressure (ACF de Moraes et al., 2014b). Among adolescents, some specific lifestyle-related behaviors have been shown to be associated with

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high blood pressure and should thus be an important target for preventing adulthood hypertension and obesity (Pälve et al., 2014). Some of these behaviors include dietary factors such as fruit and vegetable consumption, sugar-sweetened beverage intake, usual sleep duration, sedentary activities and physical activity levels (Brug et al., 2012; Gopinath et al., 2012).

Though the majority of the literature has focused on each behavior separately, analyzing the co-occurrence of several lifestyle-related behaviors could help identify subgroups that are at an increased risk of developing high blood pressure. The clustering of several lifestyle-related behaviors refers to combinations of behaviors that are more prevalent than expected based on the prevalence of each behavior separately (Fernández-Alvira et al., 2013). Adolescence is a critical period for the acquisition of healthy behaviors. Therefore, the study of several indices and their co-occurrence should be a priority.

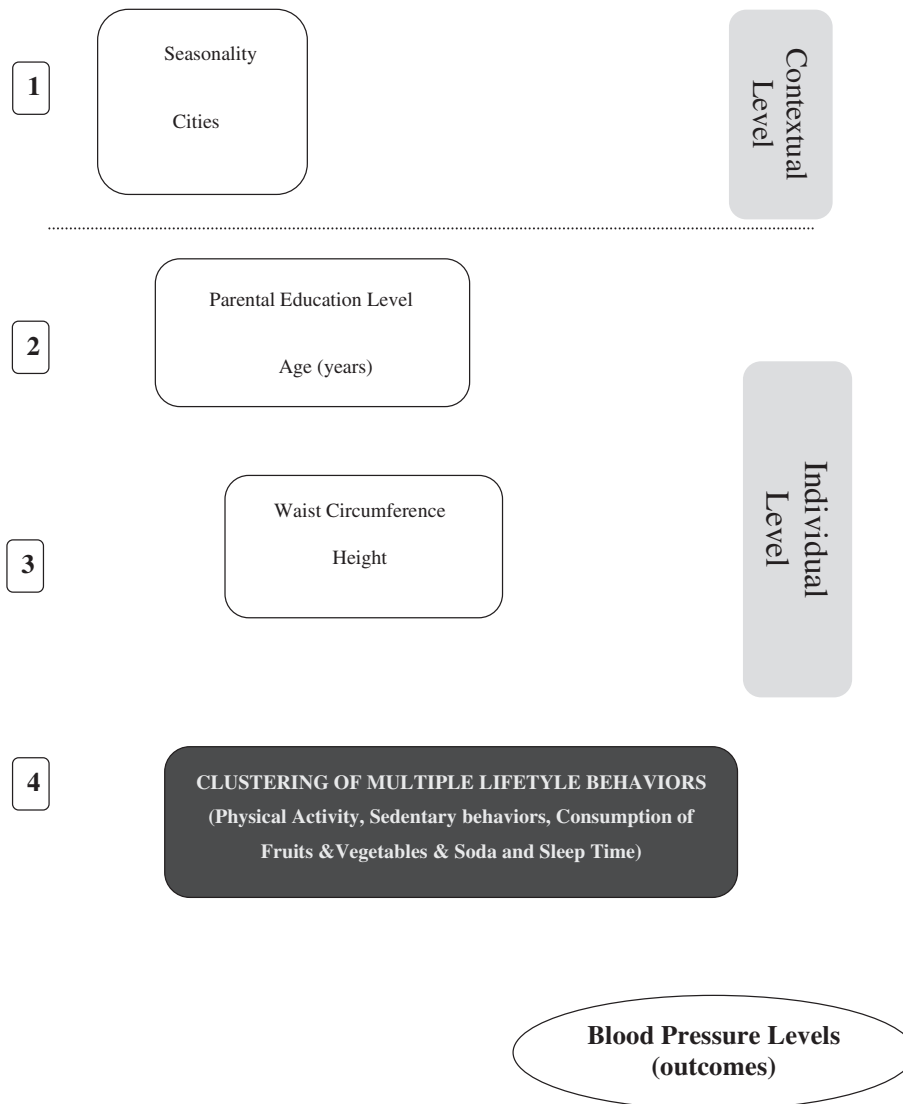
The aim of the present study was to investigate whether the clustering of several lifestyle-related behaviors (i.e., fruit and vegetable consumption, sugar-sweetened beverage intake, sleep duration, screen time and physical activity) was associated with systolic (SBP) and diastolic (DBP) blood pressure levels, considering other important correlates in adolescents from two different studies carried out in Brazil [Brazilian

Cardiovascular Adolescent Health (BRACAH) study] [Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) study].

**Methods**

*Study populations*

The HELENA study was based on data from a random sample of European adolescents who were tested on a wide range of nutrition and health-related parameters. The data were collected in 2006 and 2007 in ten cities from nine European countries: Athens and Heraklion in Greece, Dortmund in Germany, Ghent in Belgium, Lille in France, Pécs in Hungary, Rome in Italy, Stockholm in Sweden, Vienna in Austria, and Zaragoza in Spain. Participants were recruited at schools. To ensure that the heterogeneity of the social background of the population would be represented, schools were randomly selected after stratification by school zone or district. In cases where the selected schools refused to participate, a second list of substitute schools was drawn up. Up to three classes from two grades were selected per school. A class was considered eligible if the participation rate was at least 70%. The general inclusion criteria for the HELENA study were being in the age range of 12.5–17.5 years, not participating simultaneously in another clinical trial, and being free of any acute infection during the previous week. A detailed description of the HELENA sampling and recruitment



**Fig. 1.** Theoretical conceptual model of the association between contextual and individual variables on adolescents' blood pressure levels. The effect of each variable on the outcome was adjusted for other variables in the same model or above in the hierarchical model. Variables with  $p > 0.2$  were not included in the subsequent adjustment models. \*For girls. The principals' independent variables are described in level 4.

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