https://doi.org/10.1590/1980-549720210013.supl.1

ORIGINAL ARTICLE / *ARTIGO ORIGINAL*

Fruit and vegetable consumption, leisure-time physical activity and binge drinking in Belo Horizonte, Brazil, according to the Health Vulnerability Index

Consumo de frutas e hortaliças, prática de atividade física no tempo livre e consumo abusivo de bebida alcoólica em Belo Horizonte, Brasil, segundo Índice de Vulnerabilidade à Saúde

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ABSTRACT: ***Objective*:** To estimate the prevalence of fruit and vegetable consumption, practice of leisure time physical activity (LTPA) and binge drinking for small areas of Belo Horizonte, Minas Gerais. ***Methods*:** Ecological study conducted with data from the Surveillance System for Risk and Protection Factors for Noncommunicable Diseases by Telephone Survey (*Sistema de Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico* – Vigitel). The prevalence of risk and protection factors from 2006 to 2013 were estimated and the 95% confidence intervals calculated. "Small areas" corresponded to the municipality division into four strata of health risk classification given by the Health Vulnerability Index 2012 (*Índice de Vulnerabilidade à Saúde* – IVS). ***Results*:** The mean prevalences for the period were: about 42% of regular intake of fruit and vegetable, 34.7% of leisure time activity and 20.4% of binge drinking. The prevalence of fruit and vegetable consumption was higher in low-risk areas (58.5%; 95%CI 56.8 – 60.2) and lower in very high-risk areas (32.3%; 95%CI 27.7 – 36.9). The practice of LTPA was higher in low-risk areas (40.8%; 95%CI 38.9 – 42.8) and lower in very high risk (25.2%; 95%CI 20.6 – 29.9). Binge drinking was higher in low-risk areas (22.9%; 95%CI 21.7 – 24.2) compared to very high-risk areas (14.3%; 95%CI 11.4 – 17.3). ***Conclusion*:** It was identified a gradient in the distribution of risk and protection factors for noncommunicable diseases in Belo Horizonte according to the risk classification. This information can support programs aimed at reducing health inequalities, especially in the most vulnerable areas.

Keywords: Diet, Healthy. Exercise. Binge drinking. Noncommunicable diseases. Health surveys. Small-area analysis.

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Conflict of interests: nothing to declare. **Financial support:** Health Surveillance Secretariat, Ministry of Health, TED 148-2018, project "Inequalities in small geographical areas of indicators of noncommunicable diseases, violence and their risk factors" (*"Desigualdades em pequenas áreas geográficas dos indicadores de doenças crônicas não transmissíveis, violências e seus fatores de risco"*); National Council for Scientific and Technological Development (*Conselho Nacional de Desenvolvimento Científico e Tecnológico* – CNPq) (310679/2016-8 and 465518/2014-1); Minas Gerais State Research Support Foundation (*Fundação de Amparo à Pesquisa do Estado de Minas Gerais* – FAPEMIG) (PPM-00428-17 and RED-00081-16); and Coordination for the Improvement of Higher Education Personnel (*Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* – CAPES).

RESUMO: ***Objetivo:*** Estimar a prevalência de consumo de frutas e hortaliças, prática de atividade física no tempo livre (AFTL) e consumo abusivo de bebida alcoólica para pequenas áreas de Belo Horizonte, Minas Gerais. ***Métodos:*** Estudo ecológico realizado com dados do Sistema de Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico (Vigitel). Estimou-se a prevalência de fatores de risco e proteção para o período de 2006 a 2013 e intervalos de confiança de 95% (IC95%). Considerou-se como "pequenas áreas" a divisão do município em estratos de classificação de risco à saúde dada pelo Índice de Vulnerabilidade à Saúde (IVS) 2012. ***Resultados:*** As prevalências médias para o período foram: cerca de 42% de consumo regular de frutas e hortaliças, 34,7% de AFTL e 20,4% de consumo abusivo de bebidas. A prevalência de consumo de frutas e hortaliças foi maior nas áreas de baixo risco (58,5%; IC95% 56,8 – 60,2) e menor nas de risco muito elevado (32,3%; IC95% 27,7 – 36,9). A prática de AFTL foi maior nas áreas de baixo risco (40,8%; IC95% 38,9 – 42,8) e menor nas de risco muito elevado (25,2%; IC95% 20,6 – 29,9). O consumo abusivo de bebidas alcoólicas foi maior nas áreas de baixo risco (22,9%; IC95% 21,7 – 24,2) em comparação com as de risco muito elevado (14,3%; IC95% 11,4 – 17,3). ***Conclusão:*** Evidenciou-se gradiente na distribuição de fatores de risco e proteção em Belo Horizonte segundo o IVS. Essas informações podem apoiar programas destinados a reduzir as desigualdades em saúde, especialmente em áreas mais vulneráveis.

Palavras-chave: Dieta saudável. Exercício físico. Bebedeira. Doenças não transmissíveis. Inquéritos epidemiológicos. Análise de pequenas áreas.

INTRODUCTION

Noncommunicable diseases (NCDs) represent the major cause of morbidity and mortality in the world and in Brazil, in addition to resulting in premature deaths, disabilities, loss of quality of life, and important economic impacts[1]. It is estimated that, annually, NCDs are responsible for 41 million deaths worldwide (71% of all deaths)[2]. In Brazil, NCDs are the most frequent causes of death and accounted for 75% of them in 2015, followed by external causes[3].

Evidence indicates a proportional increase in NCDs due to the growth of the four main risk factors, which include smoking, unhealthy eating, physical inactivity, and excessive consumption of alcoholic beverages[4]. In addition, the burden of NCDs, as well as the risk factors mentioned, is distributed in a heterogeneous manner at the global and national levels. Low- and middle-income countries are the most affected and the poorest and most vulnerable populations are those most at risk and with least access to treatment[5].

The implementation of interventions on the risk factors for NCDs would result in a reduction in the number of preventable deaths worldwide[6-8]. In 2013, the World Health Organization (WHO) published the Global Action Plan for the Prevention and Control of NCDs 2013-2020, which includes a list of cost-effective interventions at national level on risk factors — the " Best Buys " — to support member countries in achieving the goal of reducing the number of premature deaths due to NCDs from the Sustainable Development Goals (SDG)[8]. It is estimated that each dollar invested in the "Best Buys" would generate an economic return of at least US$ 7 *per capita*[5], and that its global implementation would prevent 10 million deaths by 2025[9].

In this sense, the monitoring of NCDs and their risk factors, in order to verify progress in reaching national and global goals, is essential. However, it is worth noting that the analysis of health indicators that considers large spatial units may lose sight of the heterogeneity and inequality in the territories. Brazil has national surveys that make it possible to measure numerous health events. However, due to costs, the sampling used generally estimates large areas, such as the Federated Units, reaching up to the capitals at most, failing to estimate small areas, nor identifying intra-urban inequalities[10]. Thus, it is necessary to advance the knowledge of the differences in the distribution of health events in different population groups, aiming to support policies to reduce inequalities in health[11].

Estimation methods for small areas have been developed and tested in order to generate estimates with good precision for more disaggregated levels — *e.g.* intra-municipal regions, such as health districts or even census tracts —, for which the sample number is reduced or even non-existent[12].

Thus, the present article aimed to estimate the prevalence of consumption of fruits and vegetables (FV), leisure time physical activity (LTPA) and binge drinking for small areas of the city of Belo Horizonte, Minas Gerais.

METHODS

This is an ecological study conducted with secondary data related to adults (over 18 years of age) respondents from the Surveillance System for Risk and Protection Factors for Noncommunicable Diseases by Telephone Survey (*Sistema de Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico* – Vigitel), residing in the city of Belo Horizonte, Minas Gerais Gerais, from 2006 to 2013. Details on Vigitel's sampling process and data collection can be found in a specific publication. Vigitel consists of an inquiry through telephone interviews, carried out by the Ministry of Health, interviewing, annually, about 2 thousand adults over 18 years of age. Vigitel uses post-stratification weights according to gender, education, and age to adjust population estimates with demographic data from the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* – IBGE)[13].

This study focused on three of the main modifiable risk or protective factors for NCDs, namely: healthy diet, LTPA, and binge drinking.

Healthy diet was investigated based on the estimate of the prevalence of regular consumption of FV, based on the answers to the questions: "How many days of the week do you usually eat fruit?"; "How many days of the week do you usually drink natural fruit juice?"; and "How many days of the week do you usually eat at least one type of vegetable or legume (lettuce, tomato, cabbage, carrot, chayote, eggplant, zucchini — disregard potatoes, manioc or yams)? ". Regular consumption of FV was considered when the individual reported consuming these foods on five or more days of the week, regardless of the amount[14].

LTPA was investigated based on the answers to the questions: "In the past three months, did you practice any type of physical exercise or sport?"; "What is the main type of physical exercise or sport that you practiced?"; "Do you exercise at least once a week?"; "How many days a week do you usually practice physical exercise or sport?"; and "On the day that you practice exercise or sport, how long does this activity last?". Individuals who reported practicing at least 150 minutes a week of moderate intensity physical activity or at least 75 minutes a week of vigorous intensity physical activity were considered active in their free time[14].

Binge drinking, as a pattern of excessive alcohol use, was defined as five or more drinks for men or four or more drinks for women on a single occasion, at least once in the last 30 days[14]. This consumption pattern was assessed based on the answers to the questions: "In the past 30 days, did you consume five or more doses of alcohol on a single occasion?", For men; and "In the past 30 days, did you consume four or more doses of alcohol on a single occasion?", for women. A dose of alcohol is considered: a can of beer, a glass of wine or a dose of cachaça, whiskey or other distilled alcoholic drink[14].

This study used Vigitel data for the period 2006-2013 for the binge drinking indicator. For the recommended consumption of FV and practice of LTPA indicators, 2008 and 2009 were considered, respectively, as initial years, due to differences in the Vigitel questionnaire between some years.

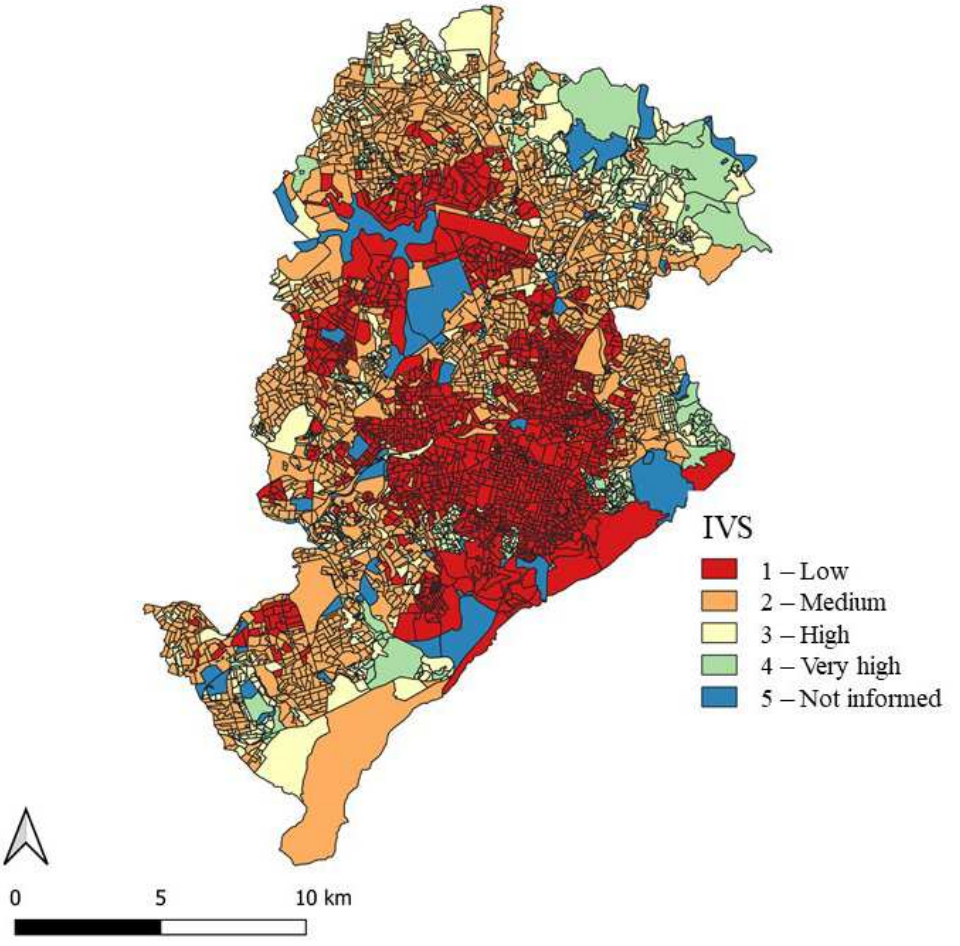
"Small areas" were considered to divide the municipality of Belo Horizonte into domains or strata according to the classification of health risk given by the Health Vulnerability Index (*Índice de Vulnerabilidade à Saúde* – IVS), which was developed by the Belo Horizonte Municipal Health Department in 1998 and updated in 2012, with the objective of guiding the planning of health actions. The IVS associates socioeconomic variables (residents per household, percentage of illiterate people, percentage of private households with *per capita* income of up to half a minimum wage, mean nominal income of the providers, percentage of people of mixed, black, and indigenous race) and sanitation (sewage, water supply, and destination of solid waste)[15] in a single indicator, which allows the analysis of the characteristics of population groups residing in the census tracts.

According to data from the 2010 Demographic Census, Belo Horizonte has 3,936 census tracts, of which 106 were not included in the calculation of the IVS 2012 because they have confidential data, are made up of collective households or have no resident population[15]. Thus, 3,830 census tracts in Belo Horizonte were grouped into four health risk clusters, defined as of low (1,330 tracts), medium (1,460 tracts), high (737 tracts), and very high risk (303 tracts). The distribution of tracts according to the four categories of vulnerability is illustrated in Figure 1.

In order to include the census tracts in the Vigitel databases, a link was made to the National Census of Address for Statistical Purposes (*Cadastro Nacional de Endereços para Fins Estatísticos* – CNEFE) of the 2010 Census by zipcode. Then, the information from the IVS by census sector was included. This procedure was performed in a data center with a high level of physical and virtual security.

The prevalences of regular consumption of FV, practice of LTPA and consumption pattern of alcoholic beverages named binge drinking, and the respective 95% confidence

intervals (95%CI) were estimated for the periods referred to above, according to IVS, using the direct method of estimate for small areas. This method consists of using the sample design variables to obtain estimates for smaller areas[16]. For the joint analysis of Vigitel data for the period from 2006 to 2013, it was necessary to calculate post-stratification weights adjusted for the 2010 population by IVS, using the rake method[17]. These weights were calculated in the STATA software using the SURVWGT[18] package, requiring the sample weight information to execute the package: $weight = \frac{number\ of\ adults\ in\ the\ household}{number\ of\ telephones\ in\ the\ household}$. More detailed information on the direct method of estimation for small areas employed can be obtained in another publication[10]. The difference in the prevalence of regular FV consumption, LTPA practice, and binge drinking between the IVS groups was statistically verified by the Student's *t*-test, with a significance level of 5%.



IVS: Health Vulnerability Index (*índice de vulnerabilidade à saúde*).

Figure 1. Spatial distribution of the census tracts in Belo Horizonte by category of Health Vulnerability Index. IVS 2012.

The present study was developed based on Resolution No. 466/2012 of the National Health Council and is integrated with the research project entitled "Inequalities in small geographical areas of indicators of noncommunicable diseases, violence and their risk factors" (*"Desigualdades em pequenas áreas geográficas dos indicadores de doenças crônicas não transmissíveis, violências e seus fatores de risco"*), approved by the Research Ethics Committee (CEP) of *Universidade Federal de Minas Gerais* (UFMG).

RESULTS

In this study, it was possible to identify the census tracts of 14,336 (90.5%) interviewees by Vigitel in the period from 2006 to 2013 in Belo Horizonte, out of a total of 15,833 respondents. Of the total of 3,830 census tracts in Belo Horizonte, 3,353 had an interview. The distribution of the number of interviews by census tract can be seen in Figure 2.

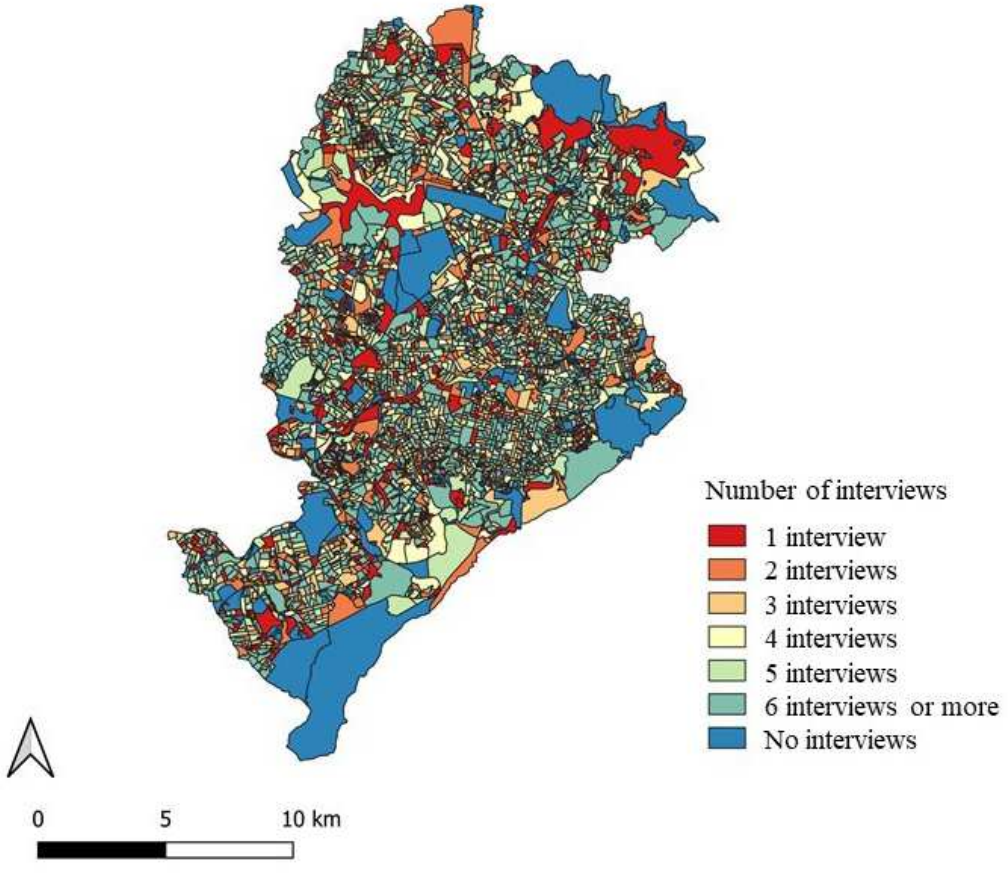


Figure 2. Spatial distribution of the interviews of the Risk and Protection Factors Surveillance System for Noncommunicable Diseases by Telephone Survey (*Sistema de Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico*) by census tracts in Belo Horizonte.

Considering the analyzed periods, Belo Horizonte had a mean prevalence of approximately 41.8% of regular FV consumption, just over a third of the respondents reported having LTPA (34.7%) and about a fifth, consuming alcohol in a binge drinking pattern (20.4%).

Analyzing the estimates for the small areas performed for the periods investigated (Table 1), it appears that the prevalences for the three indicators decrease as vulnerability to health increases. The prevalence of FV consumption was higher in low-risk areas (58.5%; 95%CI 56.8 – 60.2) and lower in very high-risk areas (32.3%; 95%CI 27.7 – 36.9). The practice of LTPA was higher in low-risk areas (40.8%; 95%CI 38.9 – 42.8) and lower in very high-risk areas (25.2%; 95%CI 20.6 – 29.9). With regard to the binge drinking, low-risk areas had a higher prevalence (22.9%; 95%CI 21.7 – 24.2), and the lowest consumption was in areas of very high risk (14.3%; 95%CI 11.4 – 17.3). There was no statistical difference between the high and very high risk areas with regard to the prevalence of FV consumption, the practice of LTPA and alcohol binge drinking (Table 2).

DISCUSSION

This study presented a methodology to generate estimates for small areas considering the intramunicipal scope, allowing to identify places with greater vulnerability and that demand the application of equity policies. The results revealed gradients in the prevalence of the health indicators investigated according to the IVS classification strata. In this sense, it can be said that population groups with more unfavorable living conditions (high and very high risk to health) had a lower prevalence of protective factors for noncommunicable diseases, such as FV consumption and physical activity. On the other hand, in the same municipality, population groups with better living conditions (low risk) had a higher prevalence of risk factors, in this case, alcohol binge drinking.

Table 1. Estimates of the prevalence of regular consumption of fruits and vegetables, leisure time physical activity, and binge drinking according to the Health Vulnerability Index (*Índice de Vulnerabilidade à Saúde*), Belo Horizonte, Minas Gerais. Vigitel 2006 to 2013. IVS 2012.

IVS	Regular consumption of fruits and vegetables[a]		Practice of leisure time physical activity[b]		Binge drinking[c]	
	%	(95%CI)	%	(95%CI)	%	(95%CI)
Low	58.5	(56.8 – 60.2)	40.8	(38.9 – 42.8)	22.9	(21.7 – 24.2)
Medium	42.2	(40.6 – 43.8)	33.9	(32.2 – 35.6)	18.8	(17.7 – 20.0)
High	34.3	(31.8 – 36.8)	29.8	(27.1 – 32.4)	14.9	(13.2 – 16.6)
Very high	32.3	(27.7 – 36.9)	25.2	(20.6 – 29.9)	14.3	(11.4 – 17.3)

IVS: Health Vulnerability Index (*Índice de Vulnerabilidade à Saúde*); 95%IC: 95% confidence interval; [a]prevalence rates for the period from 2008 to 2013; [b]prevalence rates for the period from 2009 to 2013; [c]prevalence rates for the period from 2006 to 2013.

These findings are in agreement with the results of a study that investigated intra-urban differentials in the distribution of risk factors for NCDs in Belo Horizonte. This study identified that the cluster with the worst sociodemographic indicators concentrated more risk factors, such as low regular consumption of FV and less LTPA, and the cluster with the best sociodemographic indicators showed a higher percentage of alcohol abuse[19].

Health-related behaviors are not evenly distributed across geographic spaces, as individuals behave differently in different historical, social and environmental contexts[20]. Corroborating the fact that middle and low income countries are affected to a greater degree[5,21-23], there is evidence that the prevalence of NCDs and their risk factors are associated with social determinants and have a more severe impact, therefore, on more vulnerable and poorest populations[6]. Population groups with lower income and less education, or worse socioeconomic status, are more exposed to risk factors for NCDs[7,23,24].

A study that assessed social inequalities in the dietary profile of the Brazilian population identified a higher prevalence of healthy food consumption among individuals with better socioeconomic status, whites and females, revealing that more favored social segments have a better quality diet[25]. One of the factors that would explain the lower frequency of consumption of fresh foods by low-income families concerns their higher cost in relation to ultra-processed foods and ingredients for culinary use, and their impact, therefore, on a restricted family budget[26].

The change in lifestyles observed nowadays has promoted a change in dietary patterns, corresponding to an insufficient consumption of fruits, vegetables, and other dietary fibers and an increase in the consumption of hypercaloric foods, rich in fats, sugars and sodium[27]. In Brazil, over the past two decades, processed foods and, above all, ultra-processed foods

Table 2. Estimates of differences in the prevalence of regular consumption of fruits and vegetables, leisure time physical activity, and binge drinking among the categories of Health Vulnerability Index (*Índice de Vulnerabilidade à Saúde*), Belo Horizonte, Minas Gerais. Vigitel 2006 to 2013. IVS 2012.

Diferences between the IVS	Regular consumption of fruits and vegetables[a]	Practice of leisure time physical activity[b]	Binge drinking[c]
	p-value*	p-value*	p-value*
Low and very high	< 0.001	< 0.001	< 0.001
Medium and very high	< 0.001	0.001	0.005
High and very high	0.458	0.093	0.753
Low and high	< 0.001	< 0.001	< 0.001
Medium and high	< 0.001	0.009	< 0.001
Low and medium	< 0.001	< 0.001	< 0.001

IVS: Health Vulnerability Index (*Índice de Vulnerabilidade à Saúde*); [a]prevalence rates for the period from 2008 to 2013; [b]prevalence rates for the period from 2009 to 2013; [c]prevalence rates for the period from 2006 to 2013; *p-value of Student's *t*-test, considering a statistically significant difference in the prevalences between Health Vulnerability Indexes (*Índices de Vulnerabilidade à Saúde*) if p <0.05.

have been occupying more space in the household availability of food, to the detriment of fresh or minimally processed foods[28]. There is evidence that FV consumption is associated with a reduced risk of developing cancer, cardiovascular disease, and all-cause mortality, indicating an inverse dose-response relationship between the amount consumed and the risk of falling ill or dying from noncommunicable diseases[29].

Regular physical activity is inversely associated with mortality from all causes[30], is a protective factor against noncommunicable diseases[31,32], and contributes to physical well-being and mental health[33]. LTPA, specifically, includes any body movement that substantially increases energy expenditure[34], performed during leisure time, that is, with the exception of essential daily activities, such as occupational, domestic, school, commuting or transportation[35]. LTPA is inversely associated with cardiovascular risk scores and there is a dose-response effect, especially in men, indicating that the longer the duration and intensity of physical activity, the lower the cardiovascular risk[36].

It is estimated that, in low-income countries, individuals perform less LTPA and more physical activity at work and in commuting[37]. Vigitel 2018 data indicated that the prevalence of LTPA in the adult population in the Brazilian capitals and the Federal District as a whole was 38.1% and that, in both genders, this proportion tended to decrease with increasing age and to increase with increasing level of education[38].

A Brazilian study pointed out that active commuting, whether on foot or by bicycle, was more frequent among the poorest, with less education, younger people, living in rural areas and in the Northeast region[39]. Research carried out with data from the National School Health Survey (*Pesquisa Nacional de Saúde do Escolar* – PeNSE) found that children of mothers with higher education had, on average, more LTPA than children of mothers with low education, a group that, in contrast, had a higher prevalence of active commuting to school[40]. These asymmetries seem to reflect inequalities related to worse material and economic conditions,[40] and not to the adoption of a healthy habit[36].

Regarding the consumption of alcoholic beverages, the indicator estimated in the present study refers to excessive alcohol use, which is generally associated with the male gender, the young population, and high schooling[41]. Global studies also point out that alcohol consumption tends to increase as the countries' socioeconomic development status increase[42]. Therefore, the higher prevalence of excessive alcohol use in low-risk regions of the city pointed out in this study is consistent with the literature and have, as a limitation, the indicator collected in the research, which measures binge drinking and not the chronic consumption and dependence of alcohol.

Among the limitations of the study, the exclusion of 9.5% of Vigitel's interviews due to the lack of identification of census tracts by linkage should be highlighted. It must be considered that the existence of census tracts without interviews can affect the calculation of the estimates. Due to changes in the Vigitel questionnaires, it was not possible to estimate the prevalences considering the same period for the three indicators. Therefore, prevalences for different time frames were presented. To estimate the prevalence of each indicator, aggregated data for sets of years were used, which reflects the estimation of the

periods, therefore, making it impossible to identify the temporal trend by IVS in this study. Finally, the IVS was built based on data from the 2010 Census and the period of analysis of the indicators investigated here also included years before and after the census.

The present study showed differences in the distribution profile of risk and protection factors according to the IVS in Belo Horizonte, with a higher prevalence of binge drinking in low-risk populations and a lower prevalence of FV and LTPA consumption in high-risk areas. This information can support programs designed to reduce health inequalities, especially in the most vulnerable areas.

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Received on: 10/20/2020
Reviewed on: 12/03/2020
Accepted on: 12/10/2020
Preprint on: 12/15/2020

Authors' contribution: DCM and RTIB designed the study. RTIB developed the method of data management and statistical analysis. LSMC, CSG, and ADM performed data analysis, interpretation of results and prepared the preliminary version of the manuscript. DCM, RTIB, and ALPR critically reviewed the manuscript and contributed to the interpretation of the results. All authors read, contributed to the final version of the manuscript, and approved it.