

## Behavioral risk factors for noncommunicable diseases associated with depression and suicide risk in adolescence

Fatores de risco comportamentais para doenças não transmissíveis associados à depressão e ao risco de suicídio em adolescentes

Factores de riesgo comportamentales para las enfermedades no comunicables asociadas con la depresión y el riesgo de suicidio en la adolescencia

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doi: 10.1590/0102-311X00055621

### Abstract

Noncommunicable diseases (NCDs) and mental disorders cooccur in adulthood, which is why their determinants and common risk factors should be addressed at an early age. Therefore, we estimated the association of the major risk factors for NCDs with depression and suicide risk by structural equation modeling considering pathways triggered by social vulnerability or mediated by obesity. This population-based study included 2,515 Brazilian adolescents. The following exposures were the major risk factors for NCDs: substance use behaviors (variable deduced from alcohol, tobacco, and drug use), physical inactivity, and components of unhealthy eating markers (added sugar and saturated fat). Obesity was assessed using the fat mass index. The outcomes were depression and suicide risk. Depression was associated with substance use behaviors (SC = 0.304;  $p < 0.001$ ), added sugar (SC = 0.094;  $p = 0.005$ ), and females (SC = 0.310;  $p < 0.001$ ). Suicide risk was also associated with substance use behaviors (SC = 0.356;  $p < 0.001$ ), added sugar (SC = 0.100;  $p = 0.012$ ), and females (SC = 0.207;  $p < 0.001$ ). In adolescents, these associations may help explain the cluster of NCDs and mental disorders in adulthood.

Noncommunicable Diseases; Risk Factors; Diet; Depression; Suicide

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## Introduction

Mental disorders often coexist with noncommunicable diseases (NCDs). Depression tends to be classified as a mental NCD <sup>1</sup> and have a bidirectional association with other NCDs <sup>2</sup>. Social determinants of poverty act primarily on depression and increase the future risk of other NCDs <sup>3</sup> whereas side effects of antidepressants may cause weight gain <sup>2</sup>. Moreover, NCDs can increase morbidity and drugs used for their treatment could aggravate psychiatric symptoms <sup>4</sup>, especially in adulthood.

Considering the bidirectional relationships between depression and other NCDs, obesity emerges as a metabolic risk factor for NCDs of physical scope <sup>5</sup> which is consistently associated with depression <sup>6</sup>. Common risk factors could therefore be involved in the complex relationships between obesity, depression, and NCDs in adolescents.

According to the World Health Organization (WHO), NCDs are mostly driven by four major risk factors: unhealthy diet, physical inactivity, smoking, and the harmful use of alcohol <sup>7</sup>. These factors increase metabolic risk and are associated with mental disorders, depression, and suicide risk <sup>8</sup> in individuals, including adolescents <sup>9</sup>. They can also induce inflammation, which is an underlying mechanism of all of these diseases <sup>10</sup>, and thus triggering or aggravating depression and suicide risk <sup>11,12</sup>.

The cooccurrence of risk factors for NCDs characterizes an unhealthy lifestyle <sup>8,13,14</sup>. The cross-sectional, nationwide, school-based study found that 5.7% of adolescents smoked <sup>15</sup>, 21% had consumed alcohol on at least one occasion in the last 30 days <sup>16</sup>, and 52.4% were physically inactive <sup>17</sup>. Data from the *Brazilian Household Budget Survey (POF) 2017/2018* <sup>18</sup> show that adolescents have lower nutritional quality diet markers per capita and a higher consumption of sandwich biscuit, soft drinks, dairy beverages, chips, sandwiches, and pizzas.

Risk factors associated with depression and suicide risk in complex relationships must be further investigated. Regarding limitations, previous studies often selected only one risk factor as exposure without adjusting for the other risk factors for NCDs. Furthermore, many studies based on self-reports or symptoms and not on diagnostic measures could make inconsistent associations between major risk factors for NCDs and depression or suicide risk <sup>8,13</sup>.

Depression is a known risk factor for suicide risk and the second leading cause of death among young people aged from 15 to 29 years worldwide <sup>19</sup>. Death rates are increasing among adolescents and suicide has become a major preventable public health problem. Adolescents aged 10 to 19 years in Brazil have a 8.25% <sup>20</sup> prevalence of suicide and 17% prevalence of depression <sup>21</sup>. We hypothesize that the major risk factors for NCDs are associated with depression and suicide risk in adolescence, which could cause clusters of NCDs and mental health disorders in adulthood. Therefore, this study estimated the association of the major risk factors for NCDs with depression and suicide risk by structural equation modeling (SEM) considering pathways triggered by social vulnerability or mediated by obesity.

## Methods

### Study design

This cross-sectional study was conducted using a population-based sample derived from the RPS Brazilian Birth Cohorts Consortium (Ribeirão Preto, Pelotas and São Luís) follow-up at 18-19 years old. This study used data from the 1997 São Luís Birth Cohort obtained during the follow-up of adolescents (18-19 years old) from January to November 2016.

The sample included all participants from the original cohort who participated in the follow-up (n = 687). At that time, more adolescents born in São Luís (Maranhão State) in 1997 were included to increase sample power and prevent future losses (n = 1,828). These adolescents were selected from a random sample (n = 1,133) using the Brazilian Information System on Live Births (SINASC) database or among volunteers identified in schools and universities (n = 695), as long as they were in the SINASC database. This population-based study included 2,515 Brazilian adolescents.

### **Data collection procedures**

The following information was collected using questionnaires: adolescent's sex, schooling level, economic class, monthly household income, cigarette smoking, illicit drug use, consumption of alcoholic beverages, physical activity, food intake, and diagnosis of depression and suicide risk, and schooling level of the head of household.

Sex was dichotomized into male and female. The schooling level of the head of household and of the adolescent was categorized into elementary school, high school, and higher education. The economic class was categorized into A, B, C, and D/E based on the Brazilian Economic Classification Criteria (CCEB) <sup>22</sup>. Monthly household income was based on the Brazilian minimum wage in 2016 (USD 270.76).

Cigarette smoking was dichotomized into no and yes. Substance use (never used, previously used, or currently using) and consumption of alcoholic beverages were evaluated using the *Alcohol Use Disorders Identification Test* (AUDIT) and divided into low and high risk <sup>23</sup>.

Physical activity was assessed by the *Self-Administered Physical Activity Checklist* (SAPAC) <sup>24</sup>. The adolescents were classified as physically active ( $\geq 150$  minutes of physical activity/week) or physically inactive ( $< 150$  minutes of physical activity/week).

Food intake was obtained with a validated food frequency questionnaire (FFQ) containing 106 items <sup>25</sup>. Details of the FFQ methodology were published by Sousa et al. <sup>26</sup>. Unhealthy eating markers were added sugar and saturated fat consumption. Added sugar intake was the percentage of calories from sugar of the total daily energy intake, found in soft drinks, fruit-flavored juice, chocolate drinks, energy drinks, and in a wide range of food groups, including dairy products, bread, cookies, breakfast cereals, desserts, chocolate, mayonnaise, salty snacks, and cold cuts. Saturated fat intake was also estimated as the percentage of calories from saturated fat of total daily energy intake, found in fast food, salty snacks, sweets, meat, chicken, fish, eggs, and milk and dairy products. Added sugar and saturated fat intake were analyzed as continuous variables.

Fat mass was determined by dual-energy X-ray absorptiometry (DXA) and height was measured with a stadiometer (Altura Exata; <http://www.alturexata.com.br/>). The fat mass index (FMI), corresponding to fat mass (kg) calculated by DXA and divided by the height in square meters (m<sup>2</sup>), was used to measure obesity.

Depression and suicide risk were diagnosed by the *Mini-International Neuropsychiatric Interview* (MINI) <sup>27</sup>. Participants were diagnosed with depression based on the occurrence of major depressive and recurrent major depressive episodes. Suicide risk was categorized as low (score ranging 1-5) and high (score  $\geq 6$ ).

### **Latent variables**

The following latent variables were used:

Socioeconomic status: deduced from the shared variance of the head of household's and the adolescent's schooling level, economic class according to CCEB criterion, and monthly household income;

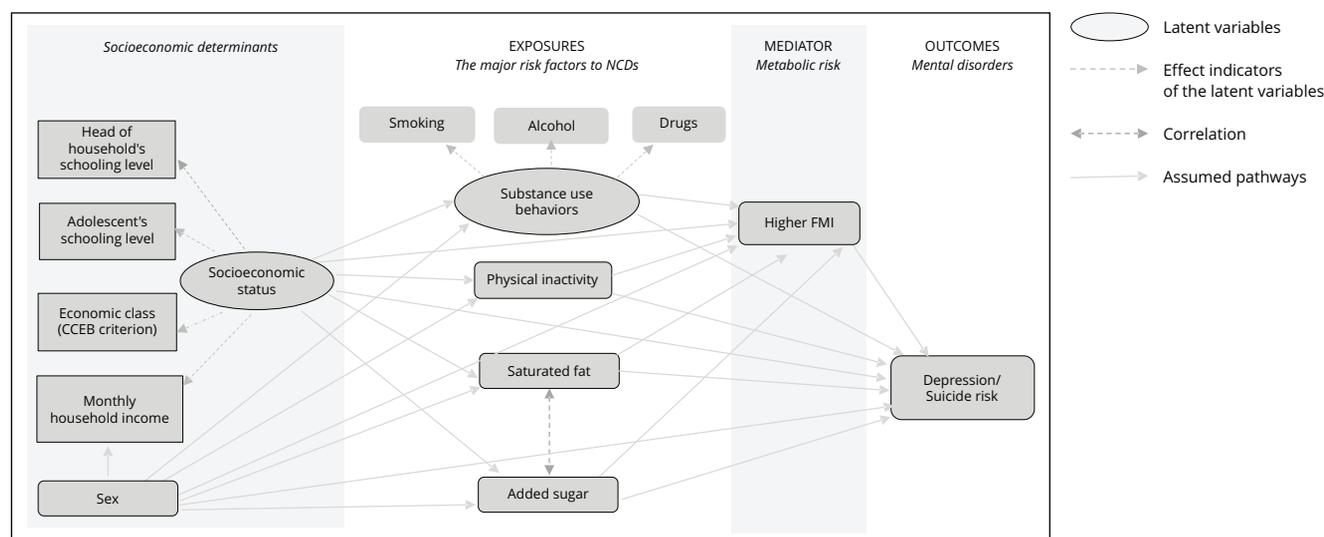
Substance use behaviors: deduced from the shared variance of cigarette smoking, illicit drug use, and consumption of alcoholic beverages.

### **Proposed theoretical model**

The latent variable socioeconomic status was considered as a more distal determinant that affects other variables of the model. Sex also affects socioeconomic status, substance use behaviors, physical inactivity, added sugar, saturated fat, FMI, depression, and suicide risk. The following exposures of interest were the major risk factors for NCDs: substance use behaviors, physical inactivity, and unhealthy eating markers. Obesity – represented by FMI – was considered a mediator since it could be chain linking the risk factors for NCDs to depression or suicide risk (Figure 1).

**Figure 1**

Theoretical model proposed to analyze the association between risk factors for noncommunicable diseases (NCDs) and mental disorders in adolescents. São Luís, Maranhão State, Brazil.



CCEB: Brazilian Economic Classification Criteria; FMI: fat mass index.

### Statistical analysis

The descriptive data were analyzed using the Stata software, version 14.0 (<https://www.stata.com>). Categorical variables were described by absolute and relative frequencies. Depression and suicide risk were assessed in separate models by SEM. Factor loadings  $> 0.5$  were considered as an indication that the factor influences the variable in the confirmatory factor analysis. The root mean square error of approximation (RMSEA) with an upper limit of the 90% confidence interval (90%CI)  $< 0.08$  and a comparative fit index (CFI) and Tucker-Lewis index (TLI)  $> 0.95$  were considered as indicators of adequate model fit. The weighted least squares means and variance adjusted (WLSMV) estimator and theta parameterization were used. The goodness-of-fit of the structural equation model was assessed based on the same estimates as described for the confirmatory factor analysis<sup>28</sup> using the Mplus 7.0 software (<https://www.statmodel.com/>).

Firstly, to represent the unhealthy diet, added sugar and saturated fat consumption was analyzed, considering that these are the main components of the investigated diet associated with mental disorders<sup>8,14,29,30</sup>. Then, sugar was analyzed as a separate component of diet because of its addictive potential in the central nervous system<sup>31</sup>. Furthermore, latent variables of healthy diet components (fiber [g], fruits [g], and vegetables [g]) and unhealthy diet components (fast food [g], salty snacks [g], sweet foods [g], and sugar-sweetened beverages [g]) were tested as analyses of consistency, replacing added sugar and saturated fat consumption in the theoretical model associated with depression and suicide risk, and analyzed by SEM (Supplementary Material; [http://cadernos.ensp.fiocruz.br/static//arquivo/suppl-e00055621\\_6499.pdf](http://cadernos.ensp.fiocruz.br/static//arquivo/suppl-e00055621_6499.pdf)).

This project was approved by the Research Ethics Committee of the University Hospital of the Federal University of Maranhão (HU-UFMA; approval n. 1,302,489, on October 29, 2015) and all participants signed an informed consent form.

## Results

Among the 2,515 adolescents included in the study, 3.6% (n = 89) smoked, 19.4% (n = 489) consumed high levels of alcohol, 18.1% (n = 450) were using or had used illicit drugs before, and 44.9% (n = 1,123) were physically inactive. Regarding mental disorders, 11.8% (n = 296) of the adolescents were diagnosed with depression and 5.5% (n = 139) had a high suicide risk (Table 1). The mean percent of total calories per day from added sugar consumption was 8.76%Kcal (SD±4.66) and the mean percent of total calories per day from saturated fat was 8.82%Kcal (SD±2.18).

**Table 1**

Socioeconomic characteristics, substance use behaviors, physical inactivity, depression, and suicide risk of adolescents. São Luís, Maranhão State, Brazil, 2021.

Characteristics	n	%
Sex		
Male	1,196	47.5
Female	1,319	52.5
Adolescent schooling level		
Elementary school	83	3.3
High school	1,758	69.9
Higher education	672	26.8
Head of household schooling level		
Elementary school	593	26.3
High school	1,339	59.3
Higher education	325	14.4
CCEB		
A	94	4.2
B	566	25.4
C	1,116	50.2
D/E	450	20.2
Household income (minimum wages *)		
≤ 1	802	31.9
1-2	1,085	43.1
3-4	341	13.6
≥ 5	287	11.4
Smoking		
No	2,414	96.4
Yes	89	3.6
Alcohol		
Low risk	2,026	80.6
High risk	489	19.4
Illicit drugs		
Never used	2,031	81.9
Used before or currently using	450	18.1
Physical inactivity		
No	1,379	55.1
Yes	1,123	44.9
Depression		
No	2,219	88.2
Yes	296	11.8
Suicide risk		
Low	2,382	94.5
High	139	5.5

CCEB: Brazilian Economic Classification Criteria.

\* USD 270.76 (2016).

Both the depression model (RMSEA = 0.043; 90%CI: 0.039-0.048; CFI = 0.988; TLI = 0.981) and the suicide risk model (RMSEA = 0.043; 90%CI: 0.039-0.048; CFI = 0.988; TLI = 0.980) showed good fit (Table 2). All effect indicators of the latent variables (socioeconomic status and substance use behaviors) showed good convergent validity, with factor loadings higher than 0.5 in the two models (Table 3).

In the depression model, a better household socioeconomic status was inversely associated with depression (standardized coefficient [SC] = -0.110;  $p = 0.006$ ) whereas substance use behaviors (SC = 0.304;  $p < 0.001$ ), higher added sugar consumption (SC = 0.094;  $p = 0.005$ ), and females (SC = 0.310;  $p < 0.001$ ) were positively associated with depression. Saturated fat consumption was not associated with depression (Table 4). Socioeconomic status increased the values of FMI (SC = 0.116;  $p < 0.001$ ) and of saturated fat consumption (SC = 0.097;  $p < 0.001$ ), but was not associated with added sugars (SC = -0.019;  $p = 0.441$ ) (data not shown).

**Table 2**

Goodness-of-fit measures of the structural equation models. São Luís, Maranhão State, Brazil, 2021.

Goodness-of-fit measure	Expected	Observed	
		Depression	Suicide risk
$\chi^2$		280.691	282.033
Degrees of freedom		49	49
p-value $\chi^2$		< 0.0001	< 0.0001
RMSEA	< 0.06	0.043	0.043
90%CI	< 0.08	0.039-0.048	0.039-0.048
CFI	> 0.95	0.988	0.988
TLI	> 0.95	0.981	0.980

90%CI: 90% confidence interval; CFI: comparative fit index; RMSEA: root mean square error of approximation; TLI: Tucker-Lewis index.

**Table 3**

Factor loading, standard error, and p-values of the indicators of latent variables (household socioeconomic status and substance use behaviors). São Luís, Maranhão State, Brazil, 2021.

Latent characteristic	Depression			Suicide risk		
	SC	SE	p-value	SC	SE	p-value
Socioeconomic status *						
Head of household schooling level	0.640	0.019	< 0.001	0.641	0.019	< 0.001
Economic class	0.885	0.020	< 0.001	0.883	0.019	< 0.001
Adolescent schooling level	0.527	0.023	< 0.001	0.527	0.023	< 0.001
Monthly household income	0.520	0.020	< 0.001	0.522	0.020	< 0.001
Substance use behaviors **						
Smoking	0.818	0.044	< 0.001	0.824	0.044	< 0.001
Illicit drugs	0.665	0.040	< 0.001	0.654	0.040	< 0.001
Alcohol	0.775	0.043	< 0.001	0.782	0.044	< 0.001

SC: standardized coefficient; SE: standard error.

\* Household socioeconomic status: latent variable defined by the schooling level of the head of household, economic class, adolescent's schooling level, and household income;

\*\* Substance use behaviors: defined by cigarette, illicit drug, and alcohol use.

**Table 4**

Standardized coefficient (SC), standard error (SE), and p-values of the total and direct effects of the explanatory variables on multiple outcomes. São Luís, Maranhão State, Brazil, 2021.

Explanatory characteristics	Effect	Depression			Suicide risk			
		SC	SE	p-value	Effect	SC	SE	p-value
Household socioeconomic status *	Direct	-0.110	0.040	0.006	Direct	-0.090	0.044	0.040
	Total	-0.102	0.039	0.008	Total	-0.075	0.043	0.081
Added sugar	Direct	0.094	0.034	0.005	Direct	0.100	0.040	0.012
	Total	0.094	0.034	0.006	Total	0.098	0.040	0.014
Higher FMI	Direct	0.003	0.026	0.904	Direct	0.049	0.031	0.112
Substance use behaviors **	Direct	0.304	0.048	< 0.001	Direct	0.356	0.058	< 0.001
Physical inactivity	Direct	0.024	0.048	0.612	Direct	0.057	0.061	0.343
Sex	Direct	0.310	0.044	< 0.001	Direct	0.207	0.060	0.001
	Total	0.263	0.031	< 0.001	Total	0.188	0.041	< 0.001

FMI: fat mass index.

\* Household socioeconomic status: latent variable defined by the schooling level of the head of household and the adolescent's economic class, schooling level, and household income;

\*\* Substance use behaviors: defined by cigarette, illicit drug, and alcohol use.

Similarly, in the suicide risk model, a better household socioeconomic status was inversely associated with suicide risk (SC = -0.090;  $p = 0.040$ ) whereas substance use behaviors (SC = 0.356;  $p < 0.001$ ), higher added sugar consumption (SC = 0.100;  $p = 0.012$ ), and the female sex (SC = 0.207;  $p < 0.001$ ) were positively associated with suicide risk. Saturated fat consumption was not associated with suicide risk (Table 4). Socioeconomic status increased the values of FMI (SC = 0.116;  $p \leq 0.001$ ) and of saturated fat consumption (SC = 0.097;  $p \leq 0.001$ ), but was not associated with added sugars (SC = -0.019;  $p = 0.441$ ) (data not shown).

The unhealthy eating markers were correlated with each other in the depression (SC = 0.408;  $p \leq 0.001$ ) and suicide risk model (SC = 0.408;  $p < 0.001$ ).

During consistency analyses, we regressed the model using the healthy diet and unhealthy diet latent variables and found that unhealthy diet was associated with depression (SC = 0.142;  $p = 0.004$ ) and the risk of suicide (SC = 0.207;  $p = 0.010$ ) (Supplementary Material; [http://cadernos.ensp.fiocruz.br/static//arquivo/suppl-e00055621\\_6499.pdf](http://cadernos.ensp.fiocruz.br/static//arquivo/suppl-e00055621_6499.pdf)). Then, we analyzed each component of unhealthy diet (fast food, salty snacks, sweet foods, sugar-sweetened beverages) in the proposed model, replacing added sugar and saturated fat, and found that they were all associated with depression ( $p < 0.05$ ) and suicide risk ( $p < 0.05$ ). However, when fast food and salty snacks were assessed in the model using a correlation command to sugar consumption, neither were associated to depression and suicide risk (Supplementary Material; [http://cadernos.ensp.fiocruz.br/static//arquivo/suppl-e00055621\\_6499.pdf](http://cadernos.ensp.fiocruz.br/static//arquivo/suppl-e00055621_6499.pdf)).

## Discussion

The major risk factors for NCDs (substance use behaviors and added sugar consumption) were associated with both depression and suicide risk in adolescents. Regarding unhealthy eating markers, only added sugar consumption was associated with mental disorders. The female sex was also associated with depression and suicide risk. As a more distal determinant, a better socioeconomic status protected individuals against both depression and suicide risk.

Substance use behaviors composed a latent variable deduced from the shared variance of cigarette smoking, illicit drug use, and consumption of alcoholic beverages. This variable was strongly associated with both depression and suicide risk in adolescents. The early use of psychoactive substances

has also been shown to be related to depression and suicide risk<sup>13,32,33</sup>. One explanatory mechanism is that smoking leads to dysregulation of the hypothalamic-pituitary-adrenal axis and to hypersecretion of cortisol, which can induce depression<sup>34</sup>. However, we cannot rule out a reverse causality, in which depressed individuals are at higher risk of cigarette smoking and psychoactive substance use<sup>35</sup>.

Our study found that added sugar consumption was associated with depression and suicide risk, corroborating with previous reports<sup>8,9,36,37</sup>. Consuming added sugars induces addiction and is correlated with other addictive behaviors, including alcoholism, smoking, and illicit drug use<sup>38</sup>; the exposure to these addictive substances is, in turn, associated with depression and suicide risk<sup>32,33,35</sup>.

A meta-analysis indicated that the higher the frequency of sugar-sweetened beverages consumption, the higher the risk of having depression; however, this analysis found inconsistencies in the diagnosis of depression and emphasized the need to better adjust for confounders<sup>8</sup>. A population-based study involving adolescents found an association between a higher frequency of sugar-sweetened beverages consumption and suicidal behavior<sup>9</sup>. Our study corroborates with the topic since depression and suicide risk outcomes were measured using a validated diagnostic instrument MINI<sup>27</sup>. Moreover, SEM allowed adjusting for confounders, including other diet components and direct path analysis.

Added sugar consumption could be associated with depression and suicide risk in adolescents because the fructose in these beverages affects the hypothalamus-pituitary-adrenal axis<sup>39</sup>. Furthermore, sugar-rich diets can increase inflammation and neurodegeneration<sup>40</sup>. Persistent hyperglycemia can lead to the synthesis of reactive oxygen species that exert neurotoxic effects on the brain<sup>41</sup>. The consumption of added sugar can cause insulin resistance, which is also a known risk factor for depression<sup>42</sup> and suicidal behavior<sup>43</sup>.

Saturated fats, fast foods, and salty snacks were not associated with depression or suicide risk when the model adjustment included added sugar consumption. These findings are contrary to previous studies, which show that the consumption of food rich in trans and saturated fats are associated with symptoms of depression<sup>29</sup> and suicide risk<sup>30</sup>. One study grouped foods to reduce the correlation among unhealthy items (sweets, cake/cookies, snacks, and fast food) in multiple logistic regression models to depression<sup>29</sup>. Another study included soft drink adjustment in the association between foods rich in trans/saturated fats with suicide risk<sup>30</sup>, without considering the correlation among these components. A high correlation between added sugar consumption and saturated fat consumption was observed in the depression model (SC = 0.408;  $p < 0.001$ ) and in the suicide risk models (SC = 0.408;  $p < 0.001$ ) (data not shown). Altogether, these findings allowed us to speculate that added sugar consumption is the main component of an unhealthy diet associated with depression and suicide risk.

Studies have shown that physical activity is a protective factor against depression<sup>44</sup> and suicide risk in youngsters<sup>45</sup> which adjusts to smoking but not to other behavioral risks, including unhealthy diet and alcohol. In depressed individuals, physical activity can increase neurogenesis and hippocampal volume<sup>46</sup> and balance anti-inflammatory and proinflammatory markers<sup>47</sup>. However, physical inactivity in adolescents was not associated with depression and suicide risk in our study. This could be because of the model adjustment to components of unhealthy lifestyle and the correlation among them in adolescence. A study which showed that physical activity protects against the risk of suicide<sup>45</sup> did not adjust the model to unhealthy diet, alcohol consumption, and smoking.

Higher body fat levels were not associated with depression or suicide risk in adolescents. Other studies showed that obesity was associated with depression<sup>48</sup> and suicide risk<sup>49</sup> since visceral fat increases the levels of inflammation<sup>11,12</sup> and because obese adolescents with depression had insulin resistance and lower hippocampal volume<sup>50</sup>. However, common causes of insulin resistance, including added sugar consumption and alcohol abuse, were consistently associated with depression and suicide risk in our results and could precede the association between obesity and mental disorders.

A better household socioeconomic status protected individuals against depression and suicide risk. The effect of socioeconomic status was direct and not mediated by the major risk factors for NCDs. Other untested paths could explain the association between social vulnerability and increased depression and suicide risk, including a greater exposure to violence and epigenetic inflammatory mechanisms that can occur in deprived environments throughout life.

This study has some limitations. The cross-sectional design of the study does not allow us to affirm temporality between the major risk factors for NCDs and mental disorders nor to rule out reverse causality or bidirectionality in the associations found. However, to the best of our knowledge, this is the first study to analyze all the major behavior risk factors for NCDs according to WHO, showing that substance use behaviors and added sugar intake already affect depression and increase suicide risk in adolescents, regardless of the social vulnerability. These findings could help explain the clustering of mental health disorders and NCDs in adulthood. A strong point of our study is the use of fat mass index, and not body mass index, to measure obesity.

The major risk factors for NCDs, including substance use behaviors and added sugar consumption, were associated with depression and suicide risk behavior in adolescents. Our results indicate that coordinated actions are essential to surveil, to prevent, and to control NCDs and mental disorders according to the WHO Cluster of Noncommunicable Diseases and Mental Health (NMH)<sup>51</sup>, including the behavior risk factors for NCDs and beginning at the earliest possible age. Further studies must explore the extent to which modifications on the risk factors for NCD can affect mental disorders.

## Contributors

J. M. A. Barbosa, C. C. C. Ribeiro, R. F. L. Batista, and A. A. M. Silva contributed to the study conception and design, data analysis and interpretation, and writing. M. A. Brondani and H. Bettiol contributed to the article review. V. M. F. Simões and M. A. Barbieri contributed to the study conception and design, data analysis and interpretation, and article review. S. J. D. D. A. C. Coelho contributed to the data analysis and interpretation of data and article review. All authors approved the final version of the manuscript.

## Acknowledgments

This work was supported by the Brazilian Ministry of Health/Department of Science and Technology (DECIT), Maranhão State Research Foundation (FAPEMA), São Paulo State Research Foundation (FAPESP), Brazilian National Research Council (CNPq), and Brazilian Graduate Studies Coordinating Board (CAPES).

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## Resumo

As doenças não transmissíveis (DNT) e transtornos mentais podem ocorrer simultaneamente na vida adulta, razão pela qual seus determinantes e fatores de risco comuns devem ser abordados em idade precoce. Portanto, estimamos a associação entre os principais fatores de risco para DNT e a depressão e risco de suicídio através da modelagem de equações estruturais, considerando os caminhos desencadeados pela vulnerabilidade social ou mediados pela obesidade. Este estudo de base populacional incluiu 2.515 adolescentes brasileiros. As exposições foram os principais fatores de risco para DNT: comportamento de risco viciante (variável latente deduzida a partir do uso de álcool, tabaco e drogas), inatividade física e componentes da dieta não saudável (açúcar de adição e gordura saturada). A obesidade foi avaliada pelo índice de massa gorda. Os desfechos foram depressão e risco de suicídio. Comportamento de risco viciante ( $CP = 0,304$ ;  $p < 0,001$ ), açúcar de adição ( $CP = 0,094$ ;  $p = 0,005$ ) e sexo feminino ( $CP = 0,310$ ;  $p < 0,001$ ) estiveram associados à depressão. Comportamento de risco viciante ( $CP = 0,356$ ;  $p < 0,001$ ), açúcar de adição ( $CP = 0,100$ ;  $p = 0,012$ ) e sexo feminino ( $CP = 0,207$ ;  $p < 0,001$ ) também estiveram associados ao risco de suicídio. Comportamento de risco viciante e açúcar de adição estiveram associados à depressão e ao risco de suicídio em adolescentes, fato este que pode ajudar a explicar o agrupamento de DNT e transtornos mentais na vida adulta.

*Doenças Não Transmissíveis; Fatores de Risco; Dieta; Depressão; Suicídio*

## Resumen

Las enfermedades no comunicables (ENTs) y los desórdenes mentales ocurren en la etapa adulta, un hecho que da impulso para dirigirse a sus determinantes y factores de riesgo comunes a una edad temprana. Por ello estimamos la asociación de los mayores factores de riesgo para ENTs con la depresión y riesgo de suicidio mediante un modelo de ecuación estructural, considerando trayectorias derivadas de la vulnerabilidad social o mediadas por la obesidad. Este estudio basado en población incluyó a 2.515 adolescentes brasileños. Las exposiciones fueron los mayores factores de riesgo para las ENTs: comportamiento en el uso de sustancias (variable latente deducida del alcohol, tabaco y consumo de drogas), inactividad física y componentes de marcadores de consumo de comida insana (azúcar añadido y grasas saturadas). La obesidad fue evaluada usando el índice de masa grasa. Los resultados fueron depresión y riesgo de suicidio. Los comportamientos en el uso de sustancias ( $CE = 0,304$ ;  $p < 0,001$ ), azúcar añadido ( $CE = 0,094$ ;  $p = 0,005$ ), y sexo femenino ( $CE = 0,310$ ;  $p < 0,001$ ) estuvieron asociados con depresión. Comportamientos en el consumo de sustancias ( $CE = 0,356$ ;  $p < 0,001$ ) y azúcar añadido ( $CE = 0,100$ ;  $p = 0,012$ ) y el sexo femenino ( $CE = 0,207$ ;  $p < 0,001$ ) estuvieron también asociados con el riesgo de suicidio. Los comportamientos en el consumo de sustancias y de azúcar añadido, estuvieron asociados con la depresión y el riesgo de suicidio en adolescentes, un hecho que puede ayudar a explicar la concentración de ENTs y desórdenes mentales en la etapa adulta.

*Enfermedades No Transmisibles; Factores de Riesgo; Dieta; Depresión; Suicidio*

Submitted on 03/Mar/2021

Final version resubmitted on 14/Sep/2021

Approved on 24/Sep/2021