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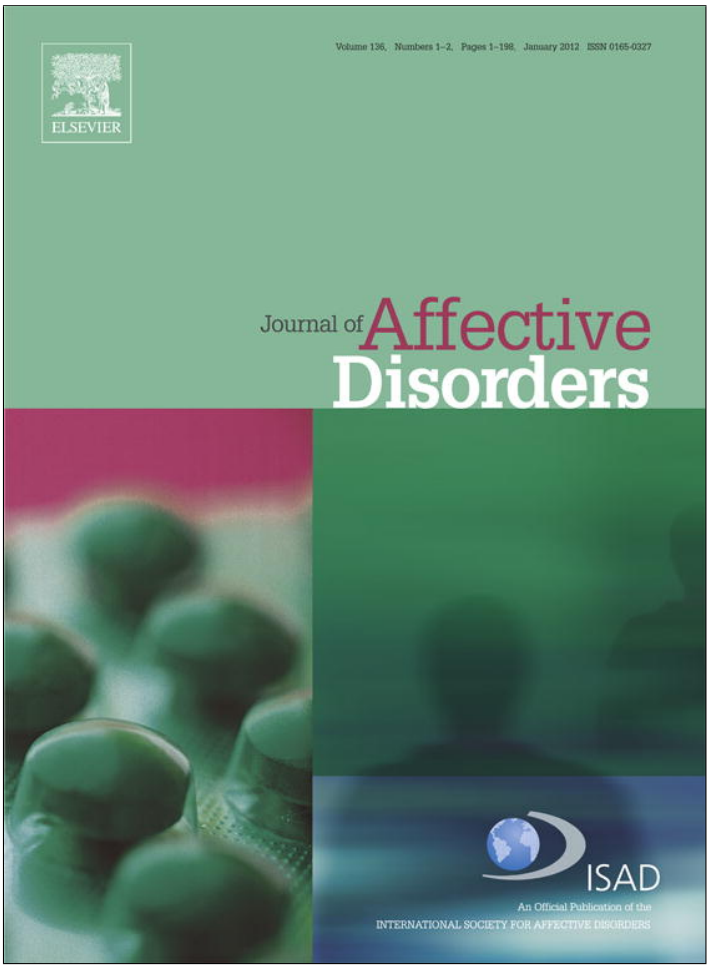


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Research report

# Depression among Brazilian adolescents: A cross-sectional population-based study

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ABSTRACT

*Background:* Depression is the most common mental disorder during adolescence. Mental disorders often begin between infancy and adolescence, persisting throughout the rest of life and even affecting the well-being of subsequent generations.
*Methods:* This was a cross-sectional population-based study, with two-stage, probability-proportional-to-size cluster sampling, conducted in the city of Pelotas, in southern Brazil. All individuals aged 10–19 years and living in the selected dwellings were invited to participate in the study. To identify depression, we applied the Patient Health Questionnaire-9. We defined minor depression as the presence of two or more depressive symptoms, at least one of which is depressed mood or anhedonia. The symptoms were considered valid only if reported to persist for a week or more or to occur nearly every day, the exception being suicidal thoughts, which was considered valid regardless of frequency.
*Results:* We interviewed 743 adolescents, among whom the prevalence of minor depression was 17.0% (95% confidence interval, 14.0–20.0), being higher among girls than among boys, as well as among individuals aged 14–15 years, those self-identifying as an ethnic minority, those who were smokers and those who lived with a depressed individual.
*Limitations:* The reverse causality bias that is a problem inherent to cross-sectional studies, which precluded the establishment of temporal relationships between exposures and the outcome of interest.
*Conclusions:* Our results illustrate the relevance of depression in adolescents, underscoring the need for mental health policies targeting this population, with the objective of minimising the short- and long-term effects of early-onset depression.

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## 1. Introduction

Mental disorders affect a large proportion of adolescents worldwide (Kieling et al., 2011), and depression is the most common such disorder in this population (World Health Organization, 2012). One systematic review found that the prevalence of depression among adolescents ranged from 2.2%, in the Netherlands, to 22.9%, in China (Bertha and Balazs, 2013).

In the international literature, there are two types of definitions for depression, one categorical and the other dimensional (Ayuso-Mateos et al., 2010). The categorical definition is based on the presence or absence of major depression, whereas the dimensional definition takes into consideration subtypes of depression, such as minor depression. Various authors have argued in favour of the use of the dimensional classification, with the objective of facilitating the identification of depression even in cases of lesser severity and promoting the early treatment of such cases, thus preventing the progression to greater severity (Andrews et al., 2007; Ayuso-Mateos et al., 2010). Minor depression, which is currently one of the diagnostic categories within the dimensional classification system, is characterised by the presence of two or more symptoms of depression over a two-week period, at least one of those symptoms being depressed mood or anhedonia (Ayuso-Mateos et al., 2010).

Many aspects of modern life are associated with an increase in the prevalence of depression among adolescents. Studies conducted in various countries have shown that, during adolescence, the prevalence of depression is higher among girls than among boys (Kessler and Walters, 1998; Sykes, 1987), as well as among ethnic minorities (Cuijpers et al., 2008), individuals between 14 and 16 years of age (Cooper and Goodyer, 1993), with less schooling (Cuijpers et al., 2008),

*Abbreviations:* DSM-IV, Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition; NEI, National Economic Indicator; PHQ-9, Patient Health Questionnaire-9; CI, confidence interval; PR, prevalence ratio; WHO, World Health Organisation

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from parents with mental disorders (Gonzalez-Tejera et al., 2005), with less social support (Gonzalez-Tejera et al., 2005) and who have ever suffered any form of physical or psychological violence (Gonzalez-Tejera et al., 2005). Studies evaluating individuals between 14 and 19 years of age in Brazil have shown that the prevalence of depression was higher among the females than among the males (Jatobá and Bastos, 2007; Menezes et al., 2013; Zinn-Souza et al., 2008), as well as among adolescents with family relationship problems (Zinn-Souza et al., 2008), smokers or alcohol consumers on a regular basis (Zinn-Souza et al., 2008), those not engaged in physical activity (Zinn-Souza et al., 2008) and among those who belong to families in the lowest income quintiles (Menezes et al., 2013). One such study also showed that depression among adolescents was associated with parental, intrauterine and early-life factors, including being the product of an unplanned pregnancy, as well as lack of support provided to the mother by her partner, maternal alcohol consumption during gestation, and *in utero* exposure to tobacco smoke from active or passive maternal smoking (Menezes et al., 2013). In a study of pregnant girls between 10 and 19 years of age in Brazil, the prevalence of depression was found to be highest among those with less schooling, who were employed, multiparous, who reported having experienced stressful life events, who had suffered any type of violence in the last year and those with only minimal social support (Coelho et al., 2013).

Mental disorders often begin between infancy and adolescence, persisting throughout the rest of life and even affecting the well-being of subsequent generations. Individuals who have depression early in life are at a higher risk for developing mental disorders, especially depression, in adulthood (Thapar et al., 2012). However, early mental health interventions could minimise the adverse effects that depression during childhood or adolescence has in adulthood (Copeland et al., 2013).

Cross-sectional studies are potentially important for the identification of high-risk groups, as well as for the planning of mental health interventions. The objective of the present study was to evaluate the prevalence of minor depression, as well as the associated demographic, socioeconomic and behavioural factors, among Brazilian adolescents.

## 2. Methods

### 2.1. Study site

Pelotas is a city in the Brazilian state of Rio Grande do Sul, located in the southern region of the country. According to the 2010 census, Pelotas has approximately 328,000 inhabitants, 93.3% of whom live in the urban area of the city. In 2010, individuals between 10 and 19 years of age—i.e., adolescents, as defined by the World Health Organisation (WHO)(WHO/UNFPA/UNICEF Study Group on Programming for Adolescent Health (1995: Saillon Switzerland) World Health Organization, 1999) accounted for 16% of the population of Pelotas, and 84% of those individuals were enroled in school (IBGE, 2012). The mean monthly household income *per capita* among residents living in permanent private housing in the urban area of the city in 2010 was approximately US$490 (median, US$271), and the local gross domestic product for the same year was US$5976, lower than the US$8161 reported for the country as a whole (IBGE, 2012).

### 2.2. Study design

This was a cross-sectional population-based study, conducted in the urban area of Pelotas between February and June of 2012. The study was designed to investigate various health outcomes.

### 2.3. Sample size calculation

Considering a level of significance of 5%, with a margin of error of 3%, and assuming a prevalence of major depression disorder of 7.5% in the target population (Zinn-Souza et al., 2008), we calculated the minimum sample size to be 296 subjects. Adding 10% to compensate for losses and considering a design effect of 1.2, we arrived at a final sample size of 392 subjects needed in order to study the prevalence of depression in adolescents.

For the association study, we calculated the *post-hoc* power to study the variables of interest. The size of the available sample ($n=743$) allowed us to determine, at a power $\geq 80\%$, whether depression in adolescence is associated with the variables age, sex, smoking and living with a depressed individual.

### 2.4. Sampling

The sampling was conducted in two stages, with probability proportional to size. The primary sampling units were 130 census tracts defined in the 2010 census. The secondary sampling units were the households. We created a list of all private permanent dwellings that were occupied within those census tracts in December 2011. We then systematically selected households to be included in the sample, with probability proportional to size. The present study is a part of a larger project in which all individuals $\geq 10$ years of age and living in the selected households were invited to participate. Individuals with cognitive impairment, as determined by the field supervisor of the project, were excluded, as were those who were institutionalised (in hospitals, nursing homes or other facilities). For the purposes of this study, we evaluated only individuals between 10 and 19 years of age.

### 2.5. Definition of depression

To identify minor depression in the adolescents under study, as well as in other residents of the selected households, we used the Patient Health Questionnaire-9 (PHQ-9). The PHQ-9 evaluates nine depressive symptoms listed in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV): depressed mood; anhedonia (loss of interest in or inability to gain pleasure from engaging in activities); sleep disturbances; fatigue or lethargy; changes in appetite or body weight; feelings of guilt or worthlessness; difficulty in concentration; feelings of being slow or restless; and suicidal thoughts. Various international studies have evaluated minor depression in children and adolescents, defining it as the presence of two or more depressive symptoms, at least one of which is depressed mood or anhedonia (Bertha and Balazs, 2013; Wesselhoeft et al., 2013). In the present study, we used that same approach, employing an algorithm by which an adolescent who reports two or more depressive symptoms is classified as testing positive for minor depression, assuming that at least one of those symptoms is depressed mood or anhedonia. An additional criterion was that each of the symptoms reported was considered valid only if reported to persist for a week or more or to occur nearly every day, the exception being suicidal thoughts, which was considered valid regardless of frequency.

### 2.6. Definition of exposures

We collected demographic data related to sex (male or female), age (in whole years completed, stratified as 10–11, 12–13, 14–15, 16–17 and 18–19), and self-reported ethnicity (categorised as White, Black or Indigenous/Asian/Mixed). We also collected data related to socioeconomic variables, including the level of education of the head of household (categorised as none/$<6$ years of schooling; 6–8 years of schooling; 9–11 years of schooling; $\geq 12$ years of schooling, with or without some college; or college completed), the National Economic Indicator (NEI) and employment status. The NEI was determined through a principal component analysis based on assets (televisions, automobiles, radios, refrigerators, freezers, video players/recorders, clothes washers, microwave ovens, telephones, computers and air conditioners), characteristics of the dwelling (number of bedrooms

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and bathrooms) and the level of education of the head of household (Barros and Victora, 2005). Being employed (yes/no) was defined as working at least one hour per week and being compensated for that work, be it in money, housing, food, clothing or some other tender. Doing household chores was not considered employment, although babysitting for another family was. The behavioural variables evaluated were smoking status and nutritional status. Individuals were classified as smokers if they had smoked at least one cigarette per day in the last month (yes/no). Nutritional status was categorised on the basis of the body mass index, determined by dividing the self-reported weight (in kg) by the self-reported height (in $m^2$), as underweight, normal weight, overweight and obese, in accordance with the WHO guidelines (De Onis and World Health Organization. Dept. of Nutrition for Health and Development, 2006). Another variable evaluated was whether or not the adolescent lived with a depressed individual (yes/no). Adult residents were classified as having depression if they scored $\geq 9$ on the PHQ-9 (Santos et al., 2013).

### 2.7. Data collection

Data were collected during home visits by trained interviewers. The instrument (PHQ-9) was programmed into the software Pendragon, version 6.1 (Pendragon Software Corporation, Chicago, IL, USA). The interviewers collected the data using netbooks, which made it possible to upload those data directly to a server and to analyse inconsistencies.

### 2.8. Statistical analysis

Statistical analysis was performed with the software Stata/IC, version 12.1 (StataCorp, College Station, TX, USA), the first step being the characterisation of the variables with descriptive statistics. Given the sample design, we used the *svyset* command in order to correct the estimates of variability for the intra-cluster correlation. We conducted crude and adjusted analyses using Poisson regression, with the prefix *svy*, the results being expressed as prevalence ratios (PRs). The adjusted analysis employed a previously established conceptual model in which there are four hierarchical levels for the analysis of determinants of depression: demographic variables (sex, age and ethnicity); socioeconomic variables (employment status, socioeconomic status and level of education of the head of household); behavioural variables (smoking status and nutritional status); and depression in the household. In that analysis, we considered the effect of each variable on the outcome of interest, controlling for confounding between variables of the same or preceding hierarchical level (Victora et al., 1997). Variables presenting $p < 0.20$ in the adjusted analysis were maintained in each hierarchical level.

**Table 1**
Description of the sample ($n = 743$) and the prevalence of depression in the city of Pelotas, Brazil, 2012.

| Variable | Total *n* (%) | Depression (%) | *p*-value[a] |
|---|---|---|---|
| Sex | | | 0.033 |
| Male | 359 (48.3) | 13.9 | |
| Female | 384 (51.7) | 19.8 | |
| Age (years) | | | 0.034 |
| 10–11 | 136 (18.3) | 13.2 | |
| 12–13 | 144 (19.4) | 16.7 | |
| 14–15 | 145 (19.5) | 25.5 | |
| 16–17 | 151 (20.3) | 13.3 | |
| 18–19 | 167 (22.5) | 16.2 | |
| Ethnicity | | | 0.039 |
| White | 561 (75.5) | 15.5 | |
| Black | 109 (14.7) | 17.4 | |
| Indigenous, Asian or Mixed | 73 (9.8) | 27.4 | |
| Level of education of the head of the household | | | 0.071 |
| No education or $<6$ years of schooling | 85 (11.6) | 20.0 | |
| 6–8 years of schooling | 226 (30.8) | 20.8 | |
| 9–11 years of schooling | 145 (19.8) | 18.6 | |
| $\geq 12$ years of schooling, with or without some college | 195 (26.6) | 12.8 | |
| College completed | 82 (11.2) | 9.8 | |
| Assets index (NEI quintiles) | | | 0.022 |
| 1 | 148 (20.2) | 18.2 | |
| 2 | 146 (20.0) | 21.9 | |
| 3 | 149 (20.4) | 21.5 | |
| 4 | 143 (19.5) | 12.6 | |
| 5 | 146 (20.0) | 10.3 | |
| Adolescent employment status | | | 0.232 |
| Employed | 110 (14.8) | 20.9 | |
| Unemployed | 633 (85.2) | 16.3 | |
| Current smoker | | | 0.004 |
| Yes | 42 (5.6) | 33.3 | |
| No | 701 (94.4) | 16.0 | |
| Nutritional status | | | 0.569 |
| Underweight | 8 (1.3) | 25.0 | |
| Normal-weight | 359 (59.2) | 15.3 | |
| Overweight | 151 (24.9) | 19.9 | |
| Obese | 88 (14.5) | 15.9 | |
| Depression in the household | | | $<0.001$ |
| Yes | 227 (30.5) | 39.2 | |
| No | 516 (69.5) | 7.2 | |

NEI = National Economic Index.

[a] chi-square test.

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### 2.9. Ethical aspects

The study was approved by the Research Ethics Committee of the Federal University at Pelotas School of Medicine (Protocol no. 77/2011). All participants (or their parents or legal guardians) gave written informed consent. Subjects who were diagnosed with severe depressive symptoms were treated in the home or were referred to primary care clinics or mental health treatment facilities.

## 3. Results

Of the 786 adolescents who were eligible for inclusion in our sample, 43 (5.5%) declined to participate or were not possible to find after two or more attempts to interview. Therefore, the study sample comprised 743 subjects. The group of adolescents that were not interviewed was comparable to the study sample in terms of sex and age ($p=0.094$ and $p=0.494$, respectively). In the study sample, the prevalence of minor depression was 17.0% (95% confidence interval [CI], 14.0–20.0).

Table 1 shows the characteristics of the sample. Of the 743 adolescents interviewed, 384 (51.7%) were female, 280 (37.7%) were between 10 and 13 years of age, and 182 (24.5) self-identified as an ethnic minority. From a socioeconomic perspective, 85 (11.6%) of the adolescents lived where the head of household had no or $<6$ years of schooling, and 110 adolescents (14.8%) were employed at the time of the interviews. Smokers accounted for 5.6% of the sample ($n=42$), and 88 adolescents (14.5%) were classified as obese. In addition, 227 (30.5%) of the adolescents lived with a depressed individual. Among the adolescents evaluated, depression was more common in girls than in boys, as it was in those between 14 and 15 years of age, in those belonging to ethnic minorities and in those who smoked. We observed an inverse relationship between socioeconomic status and the prevalence of depression. We also found that depression was more common among the adolescents who were employed. The prevalence of depression was nearly five times higher among the adolescents who lived with a depressed individual than among those who did not.

In the adjusted analysis (Table 2), the variables found to be associated with depression were sex, age, ethnicity, smoking and living with a depressed individual. The prevalence of depression was 40% higher among the girls than among the boys; nearly two times greater among the adolescents aged 14–15 years than among those aged 10–11 years (PR=1.89; 95% CI, 1.16–3.05); approximately 70%

**Table 2**
Crude and adjusted analysis of the associations that depression in adolescence showed with demographic, socioeconomic and behavioural variables in the city of Pelotas, Brazil, 2012.

| Variable | Crude PR | *p*-value | Adjusted PR | *p*-value[a] |
|---|---|---|---|---|
| LEVEL 1 | | | | |
| Sex | | 0.036 | | 0.046 |
| Male | 1 | | 1 | |
| Female | 1.42 (1.02–1.97) | | 1.41 (1.01–1.98) | |
| Age (years) | | 0.028 | | 0.026 |
| 10–11 | 1 | | 1 | |
| 12–13 | 1.26 (0.68–2.34) | | 1.21 (0.65–2.28) | |
| 14–15 | 1.93 (1.17–3.16) | | 1.89 (1.16–3.05) | |
| 16–17 | 1.00 (0.53–1.89) | | 0.96 (0.51–1.83) | |
| 18–19 | 1.22 (0.64–2.32) | | 1.19 (0.76–1.88) | |
| Ethnicity | | 0.017 | | 0.047 |
| White | 1 | | 1 | |
| Black | 1.12 (0.71–1.79) | | 1.19 (0.76–1.88) | |
| Indigenous, Asian or Mixed | 1.77 (1.19–2.63) | | 1.68 (1.12–2.54) | |
| LEVEL 2 | | | | |
| Level of education of the head of the household | | 0.161 | | 0.651 |
| No education or $<6$ years of schooling | 2.05 (0.88–4.79) | | 1.59 (0.63–3.82) | |
| 6–8 years of schooling | 2.13 (0.99–4.57) | | 1.53 (0.70–3.35) | |
| 9–11 years of schooling | 1.90 (0.87–4.21) | | 1.40 (0.63–3.09) | |
| $\geq 12$ years of schooling, with or without some college | 1.31 (0.59–2.91) | | 1.11 (0.51–2.40) | |
| College completed | 1 | | 1 | |
| Assets index (NEI quintiles) | | 0.047 | | 0.325 |
| 1 (lower) | 1.78 (0.92–3.43) | | 1.35 (0.69–2.65) | |
| 2 | 2.13 (1.21–3.75) | | 1.67 (0.95–2.93) | |
| 3 | 2.09 (1.14–3.83) | | 1.68 (0.92–3.07) | |
| 4 | 1.23 (0.63–2.37) | | 1.20 (0.63–2.28) | |
| 5 (upper) | 1 | | 1 | |
| Adolescent employment status | | 0.233 | | 0.123 |
| Employed | 1.28 (0.85–1.94) | | 1.46 (0.90–2.37) | |
| Unemployed | 1 | | 1 | |
| LEVEL 3 | | | | |
| Current smoker | | 0.006 | | 0.002 |
| Yes | 2.09 (1.23–3.52) | | 2.47 (1.41–4.35) | |
| No | 1 | | 1 | |
| Nutritional status | | 0.688 | | 0.764 |
| Underweight | 1.63 (0.45–5.91) | | 1.47 (0.38–5.70) | |
| Normal-weight | 1 | | 1 | |
| Overweight | 1.30 (0.82–2.04) | | 1.20 (0.78–1.85) | |
| Obese | 1.04 (0.61–1.77) | | 1.06 (0.62–1.83) | |
| LEVEL 4 | | | | |
| Depression in the household | | $<0.001$ | | $<0.001$ |
| Yes | 5.47 (3.92–7.62) | | 5.10 (3.64–7.14) | |
| No | 1 | | 1 | |

PR=Prevalence ratio; NEI=National Economic Index.

[a] Wald test for heterogeneity.

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higher among the adolescents who belonged to an ethnic minority than among those who did not (PR=1.68; 95% CI, 1.12–2.54); two-and-a-half times greater among smokers than among non-smokers (PR=2.47; 95% CI, 1.41–4.35); and five times higher among the adolescents who lived with a depressed individual than among those who did not (PR=5.10; 95% CI, 3.64–7.14). We found that depression in adolescence was not associated with the level of education of the head of household, the NEI, employment status or nutritional status.

## 4. Discussion

The prevalence of minor depression in adolescence observed in the present study is higher than that reported in studies conducted in other countries. Among the studies evaluating self-reported depressive symptoms within the last month, the prevalence of minor depression was found to range from 2.2% to 4.9% (Bertha and Balazs, 2013). Those studies evaluated samples of adolescents in a variety of age ranges, the samples varying among being hospital-based, school-based and community-based, as well as having, in some cases, specific characteristics such as including adolescents at high risk for mental disorders or comprising only girls. All of those characteristics, together with differences among the instruments employed, could explain the discrepancies across the studies analysed in that systematic review, in terms of the prevalence of depression. In Brazil, studies of depression in adolescence have also evaluated different age brackets and samples with different characteristics, as well as having used different instruments or different definitions of depression. We identified three such studies in which the PHQ-9 was used in the evaluation of depression. In the city of Salvador, which is in the north-eastern state of Bahia, Santana et al. (2007) evaluated 923 youths between 10 and 21 years of age and found the prevalence of major depression to be 10.4%, higher than the 7.5% reported by Zinn-Souza et al. (2008) in a study evaluating 724 students aged 14–18 years in the city of São Paulo, located in the eponymous south-eastern state. In the cities of Porto Alegre and Bento Gonçalves (both in Rio Grande do Sul), Manzolli et al., (2010) evaluated 627 pregnant females treated at primary care clinics, subject ages ranging from 13 to 42 years. The authors found that the prevalence of major depression among the subjects aged $\leq$19 years was 25.4%. Zinn-Souza et al. (2008) and Santana et al. (2007) both evaluated major depression, the definition of which requires the presence of five or more depressive symptoms, whereas we evaluated minor depression, defined by the presence of only two or more depressive symptoms. That distinction could explain the difference between our findings and the findings reported by those authors, in terms of the prevalence of depression, given that, among population-based studies, the use of a larger number of symptom criteria typically results in a lower prevalence of disease. Manzolli et al. (2010) evaluated a population of pregnant females who were treated at primary care clinics, which tends to result in overestimation of the prevalence of mental disorders. In the present study, we evaluated the entire age bracket of adolescence, as defined by the WHO. That puts our study in contrast with previous studies conducted in Pelotas, in which only subgroups of that population were evaluated. Lopez et al. (2011) used the Mini-International Neuropsychiatric Interview to evaluate 1560 youths between 18 and 24 years of age. The authors found the prevalence of major depression to be 12.6%. Souza et al. (2008) evaluated 1145 adolescents aged 11–15 years, using the Children's Depression Inventory, and reported a 2.1% prevalence of depression. However, it is of note that the authors of both of those studies evaluated only subgroups of the adolescent population.

In the present study, we observed an association between sex and depression. The prevalence of depression was 40% higher among the girls than among the boys. In a systematic review that included cross-sectional and longitudinal studies, the prevalence of depression was shown to be approximately two times higher among women than among men (Ferrari et al., 2013). Other studies involving adolescents in Brazil have also reported gender differences in the prevalence of depression. Zinn-Souza et al. (2008) and Lopez et al. (2011) both found that the prevalence of major depression was significantly higher among adolescent girls than among adolescent boys. Various hypotheses have been raised in order to explain the gender difference in the prevalence of depression. The fact that females are frequently exposed to adverse, traumatic situations in various social contexts, together with the different roles that men and women play in the culture, are thought to be factors that explain the higher prevalence of depression among women (Piccinelli and Wilkinson, 2000).

In the present study, we found that depression in adolescence was not associated with the NEI or with the level of education of the head of household. Nevertheless, our results suggest that the prevalence of depression is inversely associated with socioeconomic status. Studies of adults in various countries have demonstrated that the prevalence of depression increases in proportion to decreases in socioeconomic status (Lorant et al., 2003). Lorant et al. (2003) conducted a meta-analysis of 56 studies, in order to analyse the association between socioeconomic status and depression. The authors showed that the prevalence of depression is higher in populations of lower socioeconomic status. That finding was corroborated for the city of Pelotas by Lopez et al. (2011) and Souza et al. (2008).

We found that depression in the household (as previously defined) was associated with depression in adolescence. Unfortunately, the data collected were not sufficiently complete to allow us to determine the degree of relatedness among the residents of a given household, although it would be expected that the majority of the adolescents evaluated lived with their parents or close relatives. The mental health status of parents has been recognised as a major predictor of that of their children (Ramchandani and Psychogiou, 2009). There is evidence suggesting that the children of parents with depression are at a three to four times greater risk of developing depression in comparison with the children of parents without depression (Rice et al., 2002).

We found a positive association between smoking and depression in adolescence, as previously reported by Lopez et al. (2011), who observed a significantly higher prevalence of depression among adolescent smokers than among adolescent non-smokers. The most compelling evidence of an association between smoking and depression has come from longitudinal studies, in which it is theoretically possible to evaluate the temporality of associations. Chaiton et al. (2009) conducted a systematic review of longitudinal studies with the objective of evaluating the temporality of the association between smoking and depression in adolescents aged 13–19 years. The authors determined that association to be bi-directional, smoking increasing the risk of depression and depression in turn increasing the risk of smoking. The mechanisms proposed to explain why smoking is a predictor of depression include nicotine acting as a down-regulator of the hypothalamic–pituitary–adrenal axis and an up-regulator of cortisol in the brain (Koob and Le Moal, 2001). Those pathophysiological alterations are considered characteristic of depression (Juruena et al., 2004), and smoking can therefore increase susceptibility to the development of depressive disorders. Conversely, on the basis of the hypothesis that smoking functions as “self-medication” for depressive mood and fatigue, it has been suggested that depression precedes smoking (Vazquez-Palacios et al., 2005). Nicotine is thought to have antidepressant properties, acting in a manner similar to that of selective serotonin reuptake inhibitors (Vazquez-Palacios et al., 2005). In the present study, we found that the prevalence of depression was higher among smokers than among non-smokers, although no directionality of that association could be confirmed.

Some advantages of the present study were that the sample was representative of the population of adolescents in the city under study and that the interviews were conducted in the home. In addition, in comparison with population-based studies involving

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home-base interviews conducted in other countries, our losses were minimal, as was the proportion of missing data ( < 1%). It is also of note that we used DSM-IV criteria, which allows our results to be compared with those of studies conducted in other countries. In the context of cross-sectional studies, we also believe that multivariate analysis is an important tool, because it controls for potentially confounding factors that could alter the magnitude or the direction of the associations. We found no significant differences between the group of eligible non-participants and the study sample, in terms of sex or age, which demonstrates the internal validity of our study and makes it possible to generalise our results to the target population at large. One limitation of the present study is the reverse causality bias inherent to cross-sectional studies, which precluded the establishment of temporal relationships between exposures and the outcome of interest. Another limitation is the fact that we had no access to information regarding maternal psychopathology or regarding early exposures related to the birth process and the social environment, all of which are important factors in the development of mental disorders.

Our results indicate that depression is a major problem in the adolescent population, underscoring the need for mental health policies targeting this population. Such policies should have the objective of minimising the short- and long-term impact of early-onset mental disorders.

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**Conflict of interest**

We declare that we have no conflicts of interest.

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