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# Child labor hazard on mental health: evidence from Brazil

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# Child Labor Hazard on Mental Health: Evidence from Brazil[☆]

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**Abstract**

Child labor is usually alleged to negatively affect health. However, most of the studies which investigate this hypothesis only considered the physical health. As a unique contribution, we allege the hypothesis that the impact of child labor transcends physical to the mental health of individuals. Specifically, we investigate the probability of individuals who work or worked during childhood to develop symptoms of mental depression during adulthood. Moreover, this study innovates in that it accounts for possible genetic or maternal causal effect among family members. We used the 2008 PNAD and its special supplements to estimate probit models. Empirical results sustained the hypothesis that work during childhood is positively related to the risk of developing mental depression in adulthood. Alongside, we found that family health status and chronic physical illness in individuals play a substantial role in their risk of developing mental depression.

Key words: mental depression, child labor, work stress, chronic physical illness.
JEL classifications: J15, J18, J46.

## 1. Introduction

Depression is one of the global health challenges of the current generation. However, mental illness is yet to receive due attention compared to physical illness (The Economist, 2014). Particularly, basic health services to diagnose and treat mental illness are scarce and even non-existent in many developing countries. This mental disorder is characterized by depressed mood, loss of interest or pleasure, decreased energy, feelings of guilt or low self-worth, disturbed sleep or appetite, and poor concentration. In most chronic cases, depression comorbid with anxiety and impairs individuals of the ability to exercise their daily routines. Moreover, in worst cases, depression may lead to suicide (Marcus et al., 2012). According to The Economist (2014), mental disorders do not only affect the mood, intellectual and cognitive abilities of an individual but also provokes severe consequences to the society and economy as a whole through impaired human capital and cost of treatment.

According to Justus et al. (2012), the rate of mental depression in Brazil slightly reduced over time – from 4.96% in 1998 to 4.13% in 2008. Nevertheless, these figures are still high and worrying because depression morbidity continues high among Brazilians. Silva et al. (2014) added that one in seven Brazilians has symptoms of mental depression

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and one in twelve has a twelve-month chronic mental disorder. Notwithstanding, these figures are potentially underestimated due to undiagnosed depression. According to Gonçalves et al. (2012), alike in other OECD countries, depression has not been ranked among the major health concerns in Brazil.

There are numerous studies on the causes of depression in adults, but few concerning it causes in children and adolescents. However, Catani et al. (2009) pointed to a negative correlation between childhood trauma and cognitive abilities during adulthood of former child laborers. In 2014, about 4.5% of children and adolescents between age 5 and 15 worked as child laborers in Brazil. According to Kassouf (2015), this rate was about 14,6% in 1992 and higher in preceding years. In light of this observation, we pose the question: is the current rate of mental depression in adults related to past child labor rates? According to Guarcello et al. (2004), "the literature is richer in hypothesizing negative effects of child work on health than it is in testing these hypotheses". So far, there is no empirical study which tested the hypothesis of the alleged negative effect of child labor on mental health. Thus, we seek to provide the first empirical evidence concerning this relationship. Specifically, we aim to test the hypothesis that work during childhood increases the risk of individuals to develop depressive symptoms during adulthood. This hypothesis is rooted in the argument that work stress and pressure in very early stages in life as result of child labor may lead to mental disorder.

Given the uniqueness of the hypothesis which we seek to test in this study, no previous empirical studies was found concerning the impact of child labor on the probability of individuals to develop mental depression. Thus, we review the determinants of mental depression from Brazilian and international literature, emphasizing the role of work and working conditions.

According to WHO (2001), mental depression, alike most physical illness, is the aftermath of complex and interwoven combination of biological, psychological and socioeconomic factors. As per biological factors, Woodhead (2004) pointed that environmental pressures may significantly alter the level of hormones, immunity, and cortisol in individuals, which may lead to depressive symptoms, especially in children. Lohoff (2010) and Ledford (2015) added that genetics is a means through which mental depression may be transmitted from one generation of the same family to the other. As per psychological factor, Sokolova (2003) highlighted that children who had poor or insufficient nurture during childhood due to illness, separation, death or mental health problems of parents or caregiver have a high risk of developing mental dysfunctions, either during childhood or later in life. As per socioeconomic factors, Justus et al. (2012) found that income, urbanization, region of residence, level of education, work, gender and skin color influence the risk of developing depressive symptoms.

Numerous empirical studies are in consensus that work-related psychosocial stress increases the risk of mental depression (see Caplan and Jones (1975); Pikhart et al. (2004); Ylipaavalniemi et al. (2005); Pflanz and Ogle (2006); Shields (2006); Melchior et al. (2007); Siegrist (2008); Bonde (2008); Chen et al. (2009); Rao and Chandraiah (2012)). Specifically, Caplan and Jones (1975) found that role ambiguity (*proxy) for work stress* in working environments is positively related to anxiety, depression, and resentment among male users. A similar result was observed by Pikhart et al. (2004) concerning work stress for three countries of Central and Eastern Europe. Siegrist (2008) and Bonde (2008) complemented that the risk of mental depression is higher in individuals whose work is highly demanding but less controlled and in those who spend high effort in the combination of low-income rewards. Ylipaavalniemi et al. (2005) and Shields (2006) added that, apart from psychosocial factors, social interactions during

work in form of team climate also play a key role in the mental health of workers. These latter authors further concluded that the effect of job strain is equal among male and female worker. However, female workers have a higher risk of depression due to higher personal stress and low co-worker support. Furthermore, Rao and Chandraiah (2012) found that work workers in lower occupational positions (shop floor workers) experience more stress and lower mental health compared workers in higher positions (executives).

It is important to highlight that all reviewed studies concerning the effect of work on mental health focused on formal adult work. Given that neither the workload, income rewards, nor working condition of child labor is regulated, and that most children and adolescents combine work with schooling and occupy low positions, it is expected that stress and effort-reward ratio are higher. Therefore, the risk of mental depression is prone to be high.

Aside this introductory and background section, this study is organized as follows: Section 2 provides details concerning data and empirical model; Section 3 presents descriptive analysis; Section 4 presents the empirical results, and; Section 6 is conclusive.

## 2. Methodology

### *2.1. Data and Sample*

In this study, we used the 2008 Brazilian National Household Sample Survey data and its special supplements on health issues. In this year, the survey was composed by 391,868 individuals randomly selected in Brazilian territory. However, some observations were lost in the estimates due to missing observations in some variables. The sample was reduced to 313,389 observations. Moreover, to make the sample suitable for empirical modeling, and given the objective of this study, we had to filter the data sample (see Fig. 1).

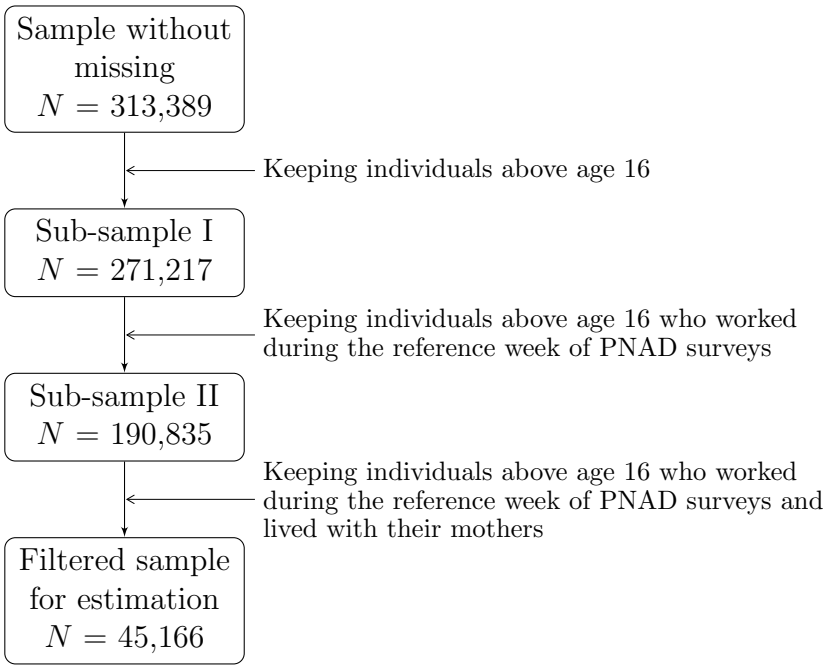


Figure 1: Sample filtration
Source: Prepared by author
Note: $N$ denotes number of observations

First, we excluded individuals below age 16 so as to focus on individuals at or above the minimum age for legal work and also to account for the childhood background of all individuals. With this age filter, about 86% of the overall sample was retained.

In order to obtain information concerning the child-labor background of individuals, we had to use data concerning the age at which they started working. This control engendered an undesired yet unavoidable filter to the database since it only covers individuals who were employed during the reference week surveys. As a result, about 30% of individuals were excluded from Sample I.

Furthermore, to control for family health characteristics using mother's variables as a *proxy*, we focused our essay on individuals who live with their mothers in the same household. The is because the PNAD surveys only register as family individuals who live in the same household and declare one another as a family. The cost of such filter was relatively high (about 57% of Sample II) since most of the adults and elderly individuals do not live with their parents. In other words, our final sample limits analyses to young adults.

Acknowledging that such filters may cause severe implication to analysis, we compare statistics from the overall and final samples in Table 1. All estimates were computed using the weights or sample expansion factors provided by the IBGE in the data files. Note that despite the expressive reduction of sample size, the mean and standard deviation of variables from the overall and final samples converge.

From this table, we observe that about 2,3% of the population contained in the sample were diagnosed with mental depression by a doctor or physician in 2008. Regarding the *proxy* variable to control for family genetics (`depmom`), approximately 10.1% of the individuals have mentally depressed mothers. It is interesting to note that about 44% of the individuals were child laborers. At this point, one perceives that child labor and, most likely, its long-run consequences may be largely present in the Brazilian society.

### *2.2. Empirical Model*

In this study, our response variable (`depress`), is a dummy that assumes the value of 1 if individuals affirmed to be diagnosed by a doctor or medical practitioner with mental depression and 0 if otherwise. Thus, probit models can be found in Cameron and Trivedi (2010).

The regressor of interest is `childlabor`, which is a dummy variable that takes 1 if the individual worked as child laborer and 0 if otherwise. This variable was replaced with six dummy variables to control for the age bracket at which individuals started work: `0-14` (reference group for child labor), `15-17`, `18-19`, `20-24`, `25-29` and `above30`. We controlled for mother's mental health status with a dummy variable which is 1 if the individual's mother was diagnosed with mental depression and 0 if otherwise (`depmom`). This variable served as *proxy* for family genetics since the PNAD data does not provide data concerning other members of the family. In addition, we control for mother's physical health status using a dummy variable which is 1 if the individual's mother has at least one chronic physical disease[3] diagnosed by a doctor and 0 if otherwise(`chronmom`).

The other control variables are: number of family members (`famsize`); average per capita family income (`famincome`); individual's mothers age (`agemom`); dummy variable which is 1 if the individual has at least one chronic physical disease and 0 if not (`chronic`); dummy variable which is 1 if the individual is enrolled in school and 0 if not (`study`); a dummy variable for individual's gender which is 1 if male and 0 if not (`male`); individual's age (`age`) and its square; dummy variable which is 1 if the

[3]The chronic physical diseases considered are: chronic back or spine problem, arthritis or rheumatism, cancer, diabetes, bronchitis or asthma, hypertension, heart disease, chronic renal dysfunction, tuberculosis, tendonitis or tenosynovitis, and cirrhosis

individual works and 0 if he/she doesn't (`work`); number of individual's weekly working hours (`hourwork`); dummy variable which is 1 if the individual lives in an urban area and 0 if he/she doesn't (`urban`); four dummy variables to control for skin color (`white` as base group, `asian`, `black` and `mulatto`)[4], and; five dummy variables to control for regional difference ( `south` as base group, `southeast`, `midwest`, `northeast` and `north`).

Some variables are suspected to be endogenous. For example, work factors (`work` and `hourwork`) can influence the likelihood of an individual to develop symptoms of mental depression due to work stress. However, a depressed individual is prone to be jeopardized in his/her working place as a result of productivity loss which, in turn, can cost his/her job. Similarly, `study` and `famincome` are also suspected to be endogenous. However, the endogeneity of the latter variable depends on the weight of individual's income in total family income. Justus et al. (2012) observed that the effect of family income on the risk of mental depression is not linear. For this reason, the average per capita family income was logarithmized. Furthermore, these authors point that the relationship between individual's age and his/her risk of developing symptoms of mental depression is non-linear. For this reason, the square of age is included in the model specification.

## 3. Descriptive Analysis

Fig. 2 presents the distribution of the incidence of mental depression by age at which individuals started working. Clearly, one perceives that the distribution is skewed left, i.e., most individuals who were diagnosed with mental depression started working at early ages. This indicates a positive correlation between child labor and mental depression. It is interesting to observe that the incidence of mental depression reduced expressively from the age bracket of 10-14 to 15-17 and from 18-19 to 20-24. This observation shows that the risk of mental depression reduces remarkably for individuals who started working after the minimum age for work as an apprentice (at age 14) and such reduction is more pronounced for those who started working after the minimum age for night, hazardous or unhealthy works (at age 18). In short, through this figure, we clearly observe a higher risk of mental depression in individuals who were child laborers.

Table 2 presents the cross-frequency between some regressors and mental depression. About 2.5% of the individuals who worked as child laborers were diagnosed with mental depression by a physician or health practitioner in the year 2008. Moreover, we also observe that the incidence is higher among these individuals compared to those who were not child laborers. As empirically verified by Justus et al. (2012), chronic physical illness such as cirrhosis, cancer, tuberculosis, renal or heart diseases, etc. may lead to mental depression through the psychological or biological channel. In the year 2008, approximately 6.9% of the individuals with chronic physical illness was diagnosed with mental depression. In line with this study, it is clear that the incidence of mental depression is higher among women (about 3.4%) compared to men (about 1.5%). Still on individual personal characteristics, Table 2 shows a higher incidence of mental illness among individuals who are neither enrolled in school nor employed. Moreover, a higher incidence was also observed among white-skinned population compared to mulattos, blacks, and Asians. Similarly to these authors, there were expressively more cases

[4]The Brazilian Institute of Geography and Statistics (IBGE) classifies race/skin color according to physical appearance which is self-declared by individuals. These categories are: white, black, yellow (Asian-Brazilians), brown (Mulatto) and indigenous. We excluded Indigenous population due to the small number of observations

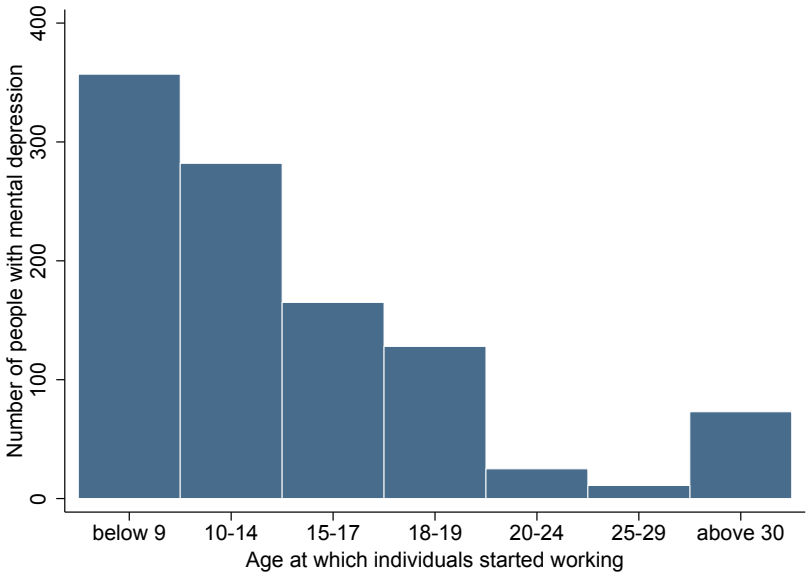


Figure 2: Number of people with mental depression by the age at which they started working
Source: Prepared using 2008 PNAD data

of mental depression in urban areas, compared to rural areas. In addition, regional variables show a greater incidence of mental depression in the Southern and Southeast region compared other regions. Intuitive analysis of the ranking of this regional distribution leads to think of higher incidence of mental depression in more developed and colder regions, which also corroborates the results of these authors.

The two family variables, `depmom` and `chronmum`, are considered to serve as control for biological (genetics) and psychological (affection) channel through which mental depression may be passed from parents to offspring. On the one hand, based on WHO (2001), individuals may develop symptoms of mental depression as a result of affection for loved ones who are diagnosed with mental depression or chronic physical illness. On the other hand, based on Lohoff (2010) and Ledford (2015), mental depression may stem as a result of family genetics. Quantitatively, about 2.1% of the individuals who were diagnosed with mental depression had mothers with chronic physical illness, while about 5.6% of the same individuals had mentally depressed mothers. This indicates that the relationship between mental depression among family members may be stronger than that of physical chronic illness with mental depression.

## 4. Analysis of Empirical Results

The hypothesis that we analyze in this section is that work during childhood increases the risk of individuals to develop depressive symptoms during adulthood. The empirical strategy used to reach this objective is the probit model estimated by maximum likelihood.

The marginal effects observed from the probit models are presented in Table 3. These effects were calculated for discrete changes in dummy variables and at means for continuous variables.

The first general perception from this table is that the standard errors observed for all variables are extremely small. Moreover, the signs obtained for statistically significant variables from all models corroborate the expectations which were set based on the literature survey presented in Section 1. In model I, all the specified variables were included. In model II, the same model was estimated without mother's variables

(depmom, agemom and chronmom). What we observe is that without these control variables, other coefficients are overestimated. Apart from this, the pseudo-$R^2$ dropped from 0.157 to 0.120 and the LR test indicated that Model I is better adjusted.

Subsequently, model III was estimated with all variables in Model I, except those which were suspected to be endogenous (study, famincome, work and hourwork) as justified in Section 2.2. Aside the estimates of other variables being slightly overestimated, the pseudo-$R^2$ and the LR test indicated that model I is better. Having that other coefficients were not severely affected after excluding these variables, we opted to continue with model I.

Lastly, we estimate model IV, which is a similar version of model I. However, the child labor variable was replaced with age groups which control for the age bracket at which individuals started working. This group dummy variable is more informative than childlabor since it provides the marginal effect concerning each age group. Comparing Model I to model IV, it is notable that there was a slight increase of the pseudo-$R^2$ and the LR test indicates that model V is better. Hence, analyses will be based on this model.

First, we analyze the effect of family health status. Results indicate that individuals who have mentally depressed mothers are more likely to develop symptoms of mental depression compared to individuals without mentally depressed mothers. The coefficient observed for depmom had the highest value in the model. Thus, this variable turns out to be the most important factor which determines the risk of mental depression among all controlled variables. Quantitatively, children with mentally depressed mothers have about 3.2 percentage points (p.p.) higher risk of presenting symptoms of mental depression. However, this incidence can be attributed to either biological factor (genetics) or psychological factors (grief, sadness, affection, etc.) that link mother to child. However, this effect is further disentangled by observing the coefficient for chronmum, which estimate is only about 0.3 p.p. Having that the marginal effect of mental depression of mothers (depmom) is about five times the effect of chronic physical illness in mothers (chronmom) and that both are considered chronic diseases/illness, one can suitably attribute the magnitude of depmom to genetics. In so doing, we corroborate previous evidence from Lohoff (2010) and Ledford (2015) concerning the role of genetics on the risk of developing mental depression.

As emphasized by Justus et al. (2012), chronic physical illness plays important role in the risk of developing mental depression. Aside from the direct impact on the psychological state of individuals, such illness also provoke a loss of productivity, restriction to certain physical leisure and sports activities and also social discrimination. The marginal effect found for chronchild indicates that individuals with any of the controlled chronic physical illness have a higher risk of being mentally depressed.

No empirical evidence was found at usual statistical significant levels concerning the effect of mother's age. However, it was observed that the risk of mental depression slightly increases as individuals grow in age, but is prone to reduce at old age. This is portrayed by the positive and negative signs found for age and age squared. This evidence supports results found by Justus et al. (2012) that the risk distribution of mental depression by age group is a downward facing parabola.

According to Baker and Ashbourne (2002) and Abela and Hankin (2008), the incidence of mental depression varies widely between the male and female gender. The empirical evidence found in this study corroborates the findings of these authors that females are more likely to develop depressive symptoms compared to males. Furthermore, our empiric results also corroborate the relationship between family income and the risk of mental depression in the sense that it points to a negative relationship

between both variables.

Results also show that residence in urban areas, skin color, family size and region of residence influence the risk of an individual to develop symptoms of mental depression. Regarding urban residence, results confirm higher incidence of mental depression in urban areas compared to rural areas, thus, corroborating findings of Justus et al. (2012). WHO (2001) reported that the nature of modern urbanization may have deleterious consequences on mental health as a result of the higher incidence of stress, pollution, overcrowding, dependence on a cash economy, discrimination, social class disparities and high violence. The group dummy variable for the region of residence upholds this finding, implying that the Southern Brazil, which is relatively highly urbanized, has a higher incidence of mental depression compared to the Southeast, Midwest, Northeast and North regions. Curiously, the estimates for this group variables are distributed among regions according to their urbanization rate.

As per skin color, our estimates upholds results from Justus et al. (2012) regarding the higher risk of mental depression among Brazilian white and Asian population compared to the mulatto and black-skinned population.

Inasmuch as stress and pressure from work may cause depressive symptoms, the marginal effects observed for the `work` and `hourwork` variables indicate that individuals who work, and inclusively, those who work more hours have a lesser risk of mental depression compared to those who do not work. Despite this result corroborates findings from literature, we suggest better specification concerning types of work. This is because, on one hand, work elevates self-esteem through social status and promotes more interpersonal interactions. The effect of higher interpersonal interactions is corroborated by the marginal effect found for `famsize` which implies that individuals from larger families have a lesser risk of mental disorders. On the other hand, excess work or work that involves high pressure can lead to stress, which is a potential cause of mental disorder. This is better portrayed when one considers the estimate for `childlabor` since it generally involves unregulated pressure and working conditions.

The coefficient observed for this variable, which is of primary interest, indicates that individuals who worked as child laborers have a higher risk of developing symptoms of mental depression compared to those who entered the labor market at adult age (corroborating observation from Fig. 2). Specifically, individuals who started working between the age group of `15-17` have about 0.6 p.p. lesser risk of developing mental depression compared to individuals who started working between the age group of `10-14`. Greater reduction is observed for individuals who started working within the age of `18-19`. Analogously, compared to child laborers, individuals who entered the labor market between age 20 and 24 have a lesser risk of mental depression. No statistical evidence was found regarding subsequent age brackets. Therefore, postponing entry into the labor market to the age of 14 is not enough to expressively reduce the risk of mental depression. This model suggests postponement to, at least, the age of 24, which is the average age at which most individuals finish undergraduate studies. Our finding here also corroborates that of Justus et al. (2015) concerning the best age for individuals to enter the labor market in Brazil.

In Table 4, we simulate the risk of developing mental depression using estimates from model I. Specifically, we vary regressors concerning child labor, gender, skin color, urbanization, and health status. Moreover, continuous regressors were fixed at means and other dummy regressors were fixed at zero during simulations. In other words, the average individual of our analysis is assumed to be 26 years old, who resides in the southern Brazil, not enrolled in school, but work for about 40 hours per week. Furthermore, this individual is from a family of four members with per capita income

of about R$ 604 and the mother is about 53 years of age.

For the first simulation exercise, we observed that, *ceteris paribus*, the risk of developing mental depression is about 0.9% for a white-skinned woman who resides in an urban area; was not a child laborer; does not have any chronic illness, and; her mother is neither chronically ill nor mentally depressed. However, we notice that this risk increases to 1.2% if the same woman worked during childhood. Curiously enough, this risk drops by half (about 0.5%) for a male individual with the same characteristics. For such a male individual, the risk of mental depression is about 0.7% if he resides in the urban area. Moreover, we confirm that white-skinned individuals have a greater risk than mulattos and these have a greater risk than blacks, despite all having identical characteristics regarding other aspects.

Having that majority of the individuals contained in the sample are mulattos, we continue the simulation exercise with these – a mulatto who is male; resides in an urban area, and; was a child laborer. As per physical health, our model indicates that such individual has the risk of about 2.4% if he has any chronic physical illness. This risk increases expressively to about 7.6% if, aside from such illness, the individual's mother is mentally depressed. Moreover, if his mother is not only mentally depressed but also has a chronic physical illness, the risk increases to about 10.1%.

For subsequent simulation exercises, we predicted all possible combinations of variables and sorted by their respective risk values. In Table 5, we present combinations which resulted in mental depression risk above 10%. The objective here is to observe the characteristics of individuals who have the highest risk of developing mental depression.

Curiously, all cases of highest risks of mental depression have co-existence of chronic physical illness of individuals and mental depression of mothers. Still, we sustain that high risk of mental depression is common among women, child laborers and individuals whose mothers have a chronic physical illness.

## 5. Implications and Contribution

In short, our findings permit not to reject the hypothesis that individuals who worked during childhood have a higher risk of developing symptoms of mental depression during adulthood. Moreover, we provide empirical evidence concerning the significant role of family biological and psychological linkages on the mental health of individuals. Still, our results also corroborate previous literature concerning the preeminence of mental depression among women and the adverse impact of chronic physical illness on the mental health of an individual.

## 6. Concluding Remarks

In this study, we investigated the relationship between child labor and the mental health of individuals. The hypothesis alleged was that individuals who venture into the labor market at early ages are more likely to develop mental depression during adulthood. The reason for this is that individuals who venture into the labor market at early ages accumulate childhood stress due to early labor, which in most cases is conciliated with studies. Consequently, during adulthood, such individuals may suffer psychological fatigue that, in turn, may sprout depressive symptoms. This hypothesis was tested using 2008 PNAD data and its supplements to estimate probit models. The empirical evidence found sustains the alleged hypothesis of a positive relationship between child labor and probability of mental depression. Specifically, individuals who

started working at or before the age of 14 have a higher probability of developing depressive symptoms compared to those who started at subsequent ages.

The mental health of individuals, especially children, continues to be an issue which has not gained due attention in Brazil alike in most developing countries. The first suggestion we offer, in line with WHO (2001) and The Economist (2014) is that mental disorders should not be faced exclusively as a biological or psychological problem, but also as a socioeconomic problem. Only this way it will be clear that child labor plays a role in the risk of developing mental depression.

Again, emphasizing the political suggestion concerning minimum age for work, results uphold that the risk of mental depression reduces if individuals defer the age at which they enter the labor market. One major reason for this that most children, adolescent, and youths who work end up also studying, and this may intensify their level of stress compared to adults who only work. During adulthood, these individuals who already internalized stress from early ages tend to be more prone to develop mental disorders. Furthermore, we suggest that basic mental health care should be provided for child laborers withdrawn from work. Particularly, those engaged in the worst forms such as, for example, agriculture, prostitution, drug trafficking and other activities that involve slavery and exposure to toxic substances. The reason for this is that, in such cases, mere conditional cash transfer programs may leave the psychological hazard of child labor unsolved.

Empirical results also indicated that children from mentally depressed parents are more likely to develop depressive symptoms either through genetic or maternal bond. However, we are more convinced that the effect found is mainly attributed to family genetics because of the expressively lower effect found for other chronic physical illness in mothers. In this sense, we suggest that public health policies also pay attention to the offspring of individuals who are diagnosed with mental depression. This measure may help to anticipate and detect potential cases of depression at early stages.

We add that health specialists should provide, at least, basic education concerning mental depression to individuals who have a chronic physical illness and also suggest therapeutic activities to the same. This is because, depending on the type of illness in question, individuals may become psychologically unbalance when they overcontemplate their physical incapabilities and/or internalize inferiority complex due to social discrimination.

Inasmuch as we acknowledge that the political suggestions offered here require substantial government expenditure, we believe that such expenses will earn not only health and social benefits but also economic benefits.

Last but not least, we emphasize that the main empirical challenge to identify the effect of child labor on mental depression in adulthood is influence of unobserved variables, such as childhood poverty, that also directly affect the risk of mental depression in adulthood. Thus, the findings of this study reflect the association between mental depression and socioeconomic factors, especially child labor. However, although the robustness of our estimates was checked in the light of different model specifications, any inferences of causality are only suggestive and tentative. Therefore, further empirical studies conducted with other data sets are needed to validate or invalidate the evidence found in this study for Brazilian citizens.

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Table 2: Percentage of mentally depressed and non-depressed individuals by category of variables

| Variable | | Mentally depressed (%) | | Number of observations |
|---|---|---|---|---|
| | | No | Yes | |
| Child labor | No | 97.94 | 2.06 | 25,196 |
| | Yes | 97.50 | 2.50 | 19,970 |
| Chronic illness | No | 98.66 | 1.34 | 37,680 |
| | Yes | 93.13 | 6.87 | 7,486 |
| Gender | Female | 96.62 | 3.38 | 18,388 |
| | Male | 98.52 | 1.48 | 26,778 |
| Enrolled in School | No | 97.43 | 2.57 | 33,047 |
| | Yes | 98.60 | 1.40 | 12,119 |
| Employed | No | 96.59 | 3.41 | 4,779 |
| | Yes | 97.88 | 2.12 | 40,387 |
| Skin color | white | 97.13 | 2.87 | 20,887 |
| | black | 98.37 | 1.63 | 3,307 |
| | mulatto | 98.26 | 1.74 | 20,972 |
| | Asians | 98.19 | 1.81 | 221 |
| Mother with chronic illness | No | 98.95 | 1.05 | 17,114 |
| | Yes | 97.01 | 2.99 | 28,052 |
| Mother with mental depression | No | 98.33 | 1.67 | 40,493 |
| | Yes | 92.70 | 7.30 | 4,673 |
| Urbanization | urban | 97.64 | 2.36 | 38,818 |
| | rural | 98.42 | 1.58 | 6,348 |
| Region | Midwest | 97.95 | 2.05 | 4,685 |
| | Northeast | 98.36 | 1.64 | 14,480 |
| | North | 99.01 | 0.99 | 5,156 |
| | Southeast | 97.23 | 2.77 | 14,344 |
| | South | 96.37 | 3.63 | 6,501 |
| Number of observations | | 44,148 | 1,018 | 45,166 |

Note: Prepared using 2008 PNAD data.

Table 1: Summary statistics

| | Variable | Description | Filtered sample | | Sample without missings | |
|---|---|---|---|---|---|---|
| | | | Mean | Std.Dev | Mean | Std.Dev |
| Variables of interest | depress | 1 if depressed and 0 otherwise | 0,0225 | 0,1484 | 0,0462 | 0,2099 |
| | childlabor | 1 if he/she is or was a childlaborer and 0 otherwise | 0,4421 | 0,4966 | | |
| | 0--14 | 1 if he/she worked at age 10–14 and 0 otherwise | 0,3333 | 0,6813 | | |
| | 15--17 | 1 if he/she worked at age 15–17 and 0 otherwise | 0,3263 | 0,4689 | | |
| | 18--19 | 1 if he/she worked at age 18–19 and 0 otherwise | 0,1996 | 0,3997 | | |
| | 20--24 | 1 if he/she worked at age 20–24 and 0 otherwise | 0,1204 | 0,3254 | | |
| | 25--29 | 1 if he/she worked at age 25–29 and 0 otherwise | 0,0167 | 0,1281 | | |
| | 30 above | 1 if he/she worked at age 30 or above and 0 otherwise | 0,0038 | 0,0612 | | |
| | depmom | 1 if mother is depressed 0 otherwise | 0,1035 | 0,4851 | | |
| | chronmom | 1 if mother has physic. Chronic disease and 0 otherwise | 0,6211 | 0,4851 | | |
| Control variables | male | 1 if male and 0 if female | 0,5929 | 0,4913 | 0,4837 | 0,4997 |
| | yellow | 1 if skin color is yellow and 0 otherwise | 0,0049 | 0,0698 | 0,0049 | 0,0701 |
| | white | 1 if skin color is white and 0 otherwise | 0,4624 | 0,4986 | 0,4554 | 0,4980 |
| | black | 1 if skin color is black and 0 otherwise | 0,0732 | 0,2605 | 0,0783 | 0,2687 |
| | brown | 1 if skin color is brown and 0 otherwise | 0,4643 | 0,4987 | 0,4663 | 0,4989 |
| | urban | 1 if he/she resides in urban area and 0 otherwise | 0,8595 | 0,3476 | 0,8467 | 0,3603 |
| | midwest | 1 if he/she resides in the Midwest and 0 otherwise | 0,1037 | 0,3049 | 0,1102 | 0,3131 |
| | northeast | 1 if he/she resides in the Northeast and 0 otherwise | 0,3206 | 0,4667 | 0,3182 | 0,4658 |
| | north | 1 if he/she resides in the North and 0 otherwise | 0,1142 | 0,3180 | 0,1254 | 0,3312 |
| | southeast | 1 if he/she resides in the Southeast and 0 otherwise | 0,3176 | 0,4655 | 0,2951 | 0,4561 |
| | south | 1 if he/she resides in the South and 0 otherwise | 0,1439 | 0,3510 | 0,1511 | 0,3581 |
| | chronic | 1 if he/she has physic. Chronic disease and 0 otherwise | 0,1657 | 0,3719 | 0,3337 | 0,4715 |
| | study | i if he/she is enrolled in school | 0,2683 | 0,4431 | 0,2491 | 0,4325 |
| | age | Age | 26.36 | 8.99 | 36.18 | 18.25 |
| | age(square) | Age square | 775.89 | 257.87 | 600.07 | 1576.64 |
| | work | 1 if he/she currently works | 0,8942 | 0,3076 | 0,5780 | 0,4939 |
| | hourwork | Weekly working hours | 39.90 | 16.93 | 22.73 | 22.27 |
| | famincome | Average per capita family income (in reais – R$) | 635.83 | 835.66 | 633.90 | 1088.93 |
| | famsize | Family size | 4.13 | 1.62 | 3.71 | 1.59 |
| | mothereduc | Mother's level of education (in years of studies) | 6.75 | 4.56 | | |
| | agemom | Mother's age | 53.26 | 11.50 | | |

Note: Number of observations for overall and filtered samples are 313,389 and 45,166, respectively.

Table 3: Marginal effects for discrete changes in dummy variables and at means for continuous variables

Response variable: `depress`

| Category of regressors | | I | II | III | IV |
|---|---|---|---|---|---|
| Family's variables | log(`famincome`) | −0.00215** | −0.00254*** | | −0.00193** |
| | | (0.001) | (0.001) | | (0.001) |
| | `famsize` | −0.00159*** | −0.00201*** | −0.00140*** | −0.00161*** |
| | | (0.001) | (0.001) | (0.001) | (0.001) |
| Mother's variables | `depmom` | 0.0400*** | | 0.0405*** | 0.0398*** |
| | | (0.003) | | (0.004) | (0.003) |
| | `agemom` | 0.00000917 | | 0.0000260 | 0.00000546 |
| | | (0.000) | | (0.000) | (0.000) |
| | `chronmom` | 0.00757*** | | 0.00778*** | 0.00754*** |
| | | (0.002) | | (0.002) | (0.002) |
| Individual's variables | `chronic` | 0.0338*** | 0.0405*** | 0.0343*** | 0.0337*** |
| | | (0.003) | (0.003) | (0.003) | (0.003) |
| | `study` | −0.00158 | −0.00173 | | −0.00151 |
| | | (0.002) | (0.002) | | (0.002) |
| | `age` | 0.00115*** | 0.00122*** | 0.00106*** | 0.00112*** |
| | | (0.000) | (0.000) | (0.000) | (0.000) |
| | `male` | −0.0126*** | −0.0125*** | −0.0139*** | −0.0129*** |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| | `urban` | 0.00335 | 0.00468** | 0.00302 | 0.00433* |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| | `black` | −0.00894*** | −0.00948*** | −0.00809*** | −0.00901*** |
| | | (0.002) | (0.002) | (0.003) | (0.002) |
| | `mulatto` | −0.00436** | −0.00510*** | −0.00332** | −0.00448*** |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| | `work` | −0.00855** | −0.00981** | | −0.00882** |
| | | (0.004) | (0.004) | | (0.004) |
| | `hourwork` | −0.000173** | −0.000162** | | −0.000174** |
| | | (0.000) | (0.000) | | (0.000) |
| | `Midwest` | −0.00783*** | −0.00985*** | −0.00764*** | −0.00787*** |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| | `Northeast` | −0.0106*** | −0.0144*** | −0.00909*** | −0.0106*** |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| | `North` | −0.0145*** | −0.0172*** | −0.0141*** | −0.0144*** |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| | `Southeast` | −0.00483** | −0.00767*** | −0.00485** | −0.00465** |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| | `childlabor` | 0.00386** | 0.00462*** | 0.00443*** | |
| | | (0.002) | (0.002) | (0.002) | |
| | `15-17` | | | | −0.00616*** |
| | | | | | (0.002) |
| | `18-19` | | | | −0.00671*** |
| | | | | | (0.002) |
| | `20-24` | | | | −0.00564** |
| | | | | | (0.002) |
| | `25-29` | | | | −0.00559 |
| | | | | | (0.004) |
| | `above30` | | | | 0.00157 |
| | | | | | (0.009) |
| Number of observations | | 45172 | 45172 | 45172 | 45172 |
| Pseudo $R^2$ | | 0.159 | 0.126 | 0.152 | 0.160 |
| Log likelihood | | −4271.0 | −4435.8 | −4306.6 | −4265.0 |
| LR $\chi^2$(degree of freedom) | | 1157.5 (20) | 1020.2 (17) | 1130.5 (16) | 1170.1 (24) |

Note: Standard errors calculated using the delta method is in parentheses; ***, ** and * denote significance at 1%, 5% and 10%, respectively.

Table 4: Prediction of mental depression risk

| Indivudual characteristics | | | | | | Family health status | | |
|---|---|---|---|---|---|---|---|---|
| childlabor | male | urban | black | mulatto | chronic | depmom | chronmum | $p$(depress) |
| no | no | no | no | no | no | no | no | 0.0099 |
| yes | no | no | no | no | no | no | no | 0.0123 |
| yes | yes | no | no | no | no | no | no | 0.0062 |
| yes | yes | yes | no | no | no | no | no | 0.0074 |
| yes | yes | yes | yes | no | no | no | no | 0.0046 |
| yes | yes | yes | no | yes | no | no | no | 0.0063 |
| yes | yes | yes | no | yes | yes | no | no | 0.0241 |
| yes | yes | yes | no | yes | yes | yes | no | 0.0759 |
| yes | yes | yes | no | yes | yes | yes | yes | 0.1011 |

Note: $p$depress is the risk of mental depression; continuous variables which are not included in this table were fixed at means and other dummy variables were fixed at zero.

Table 5: Combinations of variables for mental depression risk above 10%

| Indivudual characteristics | | | | | | Family health status | | |
|---|---|---|---|---|---|---|---|---|
| childlabor | male | urban | black | mulatto | chronic | depmom | chronmum | $p$(depress) |
| yes | no | yes | no | no | yes | yes | yes | 0.1645 |
| yes | no | no | no | no | yes | yes | yes | 0.1578 |
| no | no | yes | no | no | yes | yes | yes | 0.1487 |
| yes | no | yes | no | yes | yes | yes | yes | 0.1424 |
| no | no | no | no | no | yes | yes | yes | 0.1417 |
| yes | no | yes | no | no | yes | yes | no | 0.1358 |
| yes | no | no | no | yes | yes | yes | yes | 0.1357 |
| no | no | yes | no | yes | yes | yes | yes | 0.1299 |
| yes | no | yes | yes | no | yes | yes | yes | 0.1274 |
| yes | no | no | no | no | yes | yes | no | 0.1225 |
| no | no | yes | no | no | yes | yes | no | 0.1219 |
| no | no | no | no | yes | yes | yes | yes | 0.1218 |
| yes | yes | yes | no | no | yes | yes | yes | 0.1170 |
| yes | no | yes | no | yes | yes | yes | no | 0.1164 |
| yes | no | no | yes | no | yes | yes | yes | 0.1159 |
| no | no | yes | yes | no | yes | yes | yes | 0.1106 |
| yes | no | yes | yes | yes | yes | yes | yes | 0.1096 |
| no | no | no | no | no | yes | yes | no | 0.1078 |
| no | no | yes | no | yes | yes | yes | no | 0.1045 |

Note: $p$(depress) is the risk of mental depression; continuous variables which are not included in this table were fixed at means and other dummy variables were fixed at zero.