International Journal of Population Studies

RESEARCH ARTICLE

Race, sex and depression-free life expectancy in Brazil, 1998–2013

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Abstract: Depression brings a great burden of disease to Brazil. This study investigates depression-free life expectancy (DFLE) between 1998 and 2013 in the country. We used data from Brazilian National Household Survey, National Health Survey and Life Tables provided by the Brazilian Institute of Geography and Statistics considering individuals 30 years and older. DFLE by race and sex was calculated using the Sullivan method. We observed improvements in DFLE over time, for all race/color groups. In general, men had a smaller share of years lived with depression when compared to women within the same race groups. Compared to whites, blacks/ browns and people of other races/colors had the highest DFLE for both men and women. White women had the lowest percentage of DFLE. Blacks displayed better estimates of DFLE and lower number of years living with depression than whites, despite the evidence of worse health outcomes depicted in the literature. Further research is needed to understand the lower depression prevalence found for blacks that reflects directly into a higher DFLE.

Keywords: race; health inequalities; healthy life expectancy; depression-free life expectancy; Brazil

ARTICLE INFO
Received: February 21, 2018
Accepted: April 3, 2018
Published Online: May 17, 2018

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CITATION
Alves LC and Pereira CC (2018). Race, sex and depression-free life expectancy in Brazil, 1998–2013. *International Journal of Population Studies*, 4(1): 412. doi: 10.18063/ijps.v4.i1.412

1. Introduction

Brazil has witnessed a rapid and accentuated process of demographic transition. Mortality in Brazil declined significantly since 1940. This reduction in mortality levels was much more rapid than that experienced by developed countries. In Brazil, life expectancy has increased by 30 years between 1940 and 2000 (Carvalho and Garcia, 2003). Brazilian Demographic Census in 2010 indicated that life expectancy reached 73.8 years (IBGE, 2010).

Simultaneously, a process of epidemiological transition was also verified, characterized by the increase in the contribution of chronic and degenerative illnesses to the total number of deaths, which to a certain extent, substituted the contribution of infectious diseases. This new situation resulted in important changes in the profile of the Brazilian population, characterized by a greater prevalence and incidence of chronic-degenerative diseases.

Race plays a key role in determining health. Race as a social definition that captures the reflexes of historical and cultural processes that ultimately translate themselves into different aspects of people's health and even in health disparities observed

(Keppel, 2007). The importance of the relationship between health and race has been demonstrated through continuous investigation and inclusion of race and skin color as study variables in a plethora of studies (Barr, 2008; Williams and Mohammed, 2009). As a matter of fact, racial inequalities in different health outcomes are persistent, especially in countries where Afro descendants have experienced the disadvantages and burden of injustices derived from historical structural processes in societies, such as slavery and racism (LaVeist, 2005). As an example, in the United States, the life expectancy at birth for whites was 3.4 years higher than for African Americans in 2014. This racial difference was even higher in men, 4.2 years (CDC, 2016).

Brazil has an intense race mixing. The Brazilian Demographic Census in 2010 showed a country divided between whites and non-whites, with 47.7% whites skin color, 7.6% blacks, 43.1% brown (pardos), 1.1% Asians, and 0.43% indigenous (IBGE, 2010).

In Brazil, race is directly associated with the individual's socioeconomic situation. Non-whites face severe socioeconomic disadvantages when compared to whites (Souza, Ribeiro, and Carvalhaes, 2010). Brazilian black and brown populations are poorer and have a lower educational attainment. In the latest census, approximately 66.7% of blacks and browns did not receive any education, whereas only 31.3% of whites did not have any years of schooling; whites earned an average higher monthly income than blacks: about 54.8% of blacks and browns did not have income compared to 43.6% of whites (IBGE, 2010).

Racial disparities as measured by different health indicators exist and persist in the country. Nevertheless, understanding the role of different diseases and pathways in the disparities is still a major research gap in Brazil. Methodological limitations have been cited as obstacles to studies on race and health. For example, in disease-specific mortality rates by race, the fact that the numerator and denominator come from different data sources purportedly limits the results accuracy (Chor, 2013). Furthermore, difficulties emerge in the measurement of race. Although death certificates contain a question about the race of the individuals, it is generally poorly completed, thus failing to provide a faithful account of deaths by race. For that reason, it is difficult to estimate life tables for different race categories. Among studies with relatively completed race data, a city-specific study, using data with up to 81% of completeness of race/color categories, showed the existence of unequal mortality by race, with higher mortality from mental disorders and external causes in blacks (Fiorio, Flor, Padilha *et al*., 2011). Furthermore, in Brazil, another alleged problem is the race variability with which some individuals classify themselves. As in other countries, racial identity in Brazil is not immutable, and its validity and reliability are low (Chor, 2013).

Depression is a common mental disorder affecting people's mental health worldwide. It has a great burden of disease also in Brazil, especially for women where is the leading cause of burden of disease (Leite, Valente, Schramm *et al*., 2015). The under-diagnosis of depression is a serious health problem, particularly in countries such as Brazil in which many residents lack adequate access to healthcare services for diagnosis and treatment (Andrade, Wu, Lebrão *et al*., 2016). One study found that depressive symptoms affect one in seven Brazilian adults, that one in 12 people over the age of 18 have a major depressive disorder, that the pooled prevalence of depression, considering a recall period of one year was 8%, and that the prevalence of depressive symptoms, including different recall periods for each study, ranged from 5% to 28% (Silva, Galvao, Martins *et al*., 2014). Results from the 2013 Brazilian National Health Survey (PNS), a nationwide household population-based survey, whose data were obtained through in-home visits, indicated that the prevalence of self-reported diagnosis of depression in adults was 7.6% (Stopa, Malta, de Oliveira *et al*., 2015). The prevalence of depressive symptoms in women is estimated to be twice as high as in men (Silva, Galvao, Martins *et al*., 2014). Depression can be a serious condition and could impact several dimensions of a person's quality of life, work, functioning, and even lead to suicide in more severe cases (WHO, 2016).

There is no consistent pattern among international studies about which race has a higher prevalence of depression and which has a lower prevalence (Riolo, Nguyen, Greden *et al*., 2005). Moreover, few studies have focused on race differences in specific chronic diseases, such as depression, especially in developing countries.

Healthy life expectancy is a measure that combines morbidity and mortality information into a single index. It presents a similar concept to life expectancy, but refers to the average number of years of life that a person of a certain age can expect to live healthy, given prevailing morbidity and mortality rates in a particular age (Jagger, Hauet, and Brouard, 2001). Bone *et al*. (1998) point out that healthy life expectancy can be used to observe population health trends and to monitor the impact of health and social policies, and allow comparison between different populations and subgroups.

There is growing body of literature about healthy life expectancy in Brazil (Alves and Arruda, 2017; Andrade, Wu, Lebrão *et al*., 2016; Camargos, Perpétuo, and Machado, 2005; Campolina, Adami, Santos *et al*., 2013; Romero, Leite, and Szwarcwald, 2005; Tareque and Saito, 2017; Zimmer, Hidajat, and Saito, 2015), however, we have not identified studies that explore race differences in health expectancy considering depression (depression-free life expectancy) and no studies

have estimated the length of life with depressive symptoms by race over time in the population. The goal of this study is to investigate racial disparities in the trend of depression-free life expectancy over a 15-year period (1998–2013).

2. Data and Methods

The study used the cross-sectional household data from 1998, 2008 and 2013. Data came from two surveys, *Pesquisa Nacional por Amostra de Domicílios* (PNAD – Brazilian National Household Survey) and *Pesquisa Nacional de Saúde* (PNS – National Health Survey), and also from *Tábuas de Mortalidade* (Life Tables) from IBGE (Brazilian Institute of Demographic Geography and Statistics) (IBGE, 2014). PNAD is a population-based survey with national representativeness, held annually, to obtain information about the household, the individuals residing in the household, migration, education, labor and fertility characteristics. In 1998, PNAD included a health supplement in its questionnaire that is collected every five years, and the 2008 wave was the most recent available information. In 2013, the National Health Survey (PNS), also a nationally representative household-based survey was carried and collected health information. It also replaced PNAD's health supplement (IBGE, 2014).

We used prevalence data from the 1998 and 2008 PNAD and from the 2013 PNS. The prevalence of depression was estimated based on self-reported depression (as diagnosed by a health professional). The demographic variables were: age, sex, and race (white, blacks and browns collapsed as a single category, and others). The decision to collapse blacks and browns comes from the fact the differentiation between the two categories is difficult given the level of miscegenation encountered in Brazil. Another factor we considered in our analysis is the fact that the word used for Blacks is "pretos" and it is sometimes used as a racial slur (Chiavegatto Filho, Beltrán-Sánchez, and Kawachi, 2014). This connotation may lead people to self-declare themselves as "pardos" instead of "pretos".

We estimated the depression-free life expectancy (DFLE) for the Brazilian population in 1998, 2008, and 2013 by constructing life tables which combine mortality information and prevalence of chronic diseases, in this case, depression, as proposed by the Sullivan method (1971). The Sullivan method is the most widely one to estimate healthy life expectancy (Imai and Soneji, 2007) or disease-free life expectancy (Alves and Arruda, 2017).

The expected years with and without depression were calculated by applying the age- and sex- specific cross-sectional prevalence rates of the disease, respectively, to the person-years lived in different age categories derived from period life tables (Jagger, Hauet, and Brouard, 2001), as follows:

$$DFLE_x = \frac{\sum [1 - {}_n\pi_{xi}]_n L_x}{l_x} \quad (1)$$

and

$$LED_x = \frac{\sum [{}_n\pi_{xi}]_n L_x}{l_x} \quad (2)$$

where $DFLE_x$ is the average number of years that an individual will live without depression (healthy), starting from exact age x; whereas life expectancy with depression (LED_x) is the average number of years that an individual will live with the disease given the current age-specific prevalence and mortality scheme, starting from exact age x. ${}_n\pi_{xi}$ is the proportion with depression in age group x to $x+n$, which is the prevalence obtained based on the PNAD and PNS. ${}_nL_x$ is the number of person-years lived in age interval and l_x is the numbers surviving to age x. Both are obtained from the life table generated based on estimates provided by Mortality Reporting System. $1-{}_n\pi_x$ is a proportion without depression in age group x to $x+n$. $[1- {}_n\pi_x] * {}_nL_x$ is the number of person-years lived in age interval without depression. $[{}_n\pi_x] * {}_nL_x$ is the number of person-years lived with depression in age interval x to $x+n$. $\Sigma[1- {}_n\pi_x] * {}_nL_x$ is the total years lived without depression from age x onward. It was obtained by the sum of the all $[1- {}_n\pi_x] * {}_nL_x$ from age x until the last age group (e.g., 80 years or more in the present study). $\Sigma[{}_n\pi_x] * {}_nL_x$ is years lived with depression from age x onward (Andrade, Corona, and Lebrão, 2014; Jagger, Hauet, and Brouard, 2001).

The total life expectancy (TLE) at each age x, e_x , is calculated by dividing the total number of years lived from that age by the numbers surviving at age x. Life expectancy with and without depression was estimated by race and sex. All statistical analyses were performed with the aid of the STATA/MP for Windows version 15.0 (STATA Corp., Inc., College Station, TX) and Microsoft Excel 2016.

3. Results

Table 1 shows the prevalence of depression by race among the Brazilian population in 1998, 2008, and 2013. These data reveal that the prevalence of depression increased for total population in the period, regardless of sex and race. On the

Table 1. Prevalence of depression among adults in Brazil by race: 1998, 2008 and 2013

Sex	White			Black and Brown			Other Races and Colors		
	1998	2008	2013	1998	2008	2013	1998	2008	2013
Total	5.4	5.1	9.0	4.6	3.4	6.5	3.7	4.5	5.2
Men	3.2	2.8	5.2	2.7	1.8	2.9	2.7	3.1	2.7
Women	7.4	7.1	12.3	6.5	4.9	9.8	4.8	5.6	6.9

Source: PNAD, PNS, IBGE, 1998, 2008, and 2013.

other hand, there was a slight decrease in depression in 2008 for all groups, except for the other races category. For men of other races category, there was a decline in the proportion of depression between 2008 and 2013. Depression was most prevalent among whites over the period 1998-2013 for both sexes, followed by blacks and browns. It was observed that women had a higher frequency of depression than men for all races. Moreover, white women had the highest proportion of depression when compared to men and other color categories, in all the years. For white women, the prevalence of depression increased significantly from 1998 to 2013 (7.4% vs 12.3%, respectively).

In **Tables 2 and 3**, we present results for Total Life Expectancy (TLE) and Depression-free life expectancy (DFLE) - the estimated number of years lived without depression, by race/color categories and broken down by sex. TLE has increased for the total Brazilian population from 1998 to 2013 as well as for men and women, separately. Since we did not have reliable life tables for each race category separately, the life expectancy used in our calculations was the same for all race categories. Overall, we observed improvements in DFLE in the 15-period covered in our analyses, for all race/color groups.

Among white women (**Table 3**), at age 30, the life expectancy (LE) was 47.1 years in 1998 compared to a DFLE of 40.6 years in the same year, which means that, on average, they lived 6.5 years with depression disability (86.2% of the years were depression-free). If we consider the 15-year period from 1998 to 2008 and then to 2013, the percentage of DFLE, went from 86.2% to 87.8% and then down to 86.3%. When we consider their black and brown counterparts, the percentage of DFLE was higher and rose slightly from 87.3% in 1998 to 88.7% in 2013.

When we consider men at age 30, those of other races/colors had the highest percentage of DFLE in 1998, 95.9%, while blacks and browns had 94.2% of the life-expectancy free of depression. This result means that white men at age 30 in 1998, could expect to live 38.4 years free of depression; the corresponding figures were 38.6 years for blacks and browns and 39.3 years for "others"(**Table 3**).

Among older adults at age 60, white women had the lowest DFLE, which was 84.1% of the TLE in 1998; whereas black and brown men and men of other races/colors had the highest percentage of DFLE, which were 98.0% and 99.5%, respectively, in 2013. In general, men had a smaller share of years lived with depression when compared to women within the same race groups, except for the category of others in 2008. In that race/color category, women were expected to live 95.1% of their TLE free of depression, as opposed to men, 92.1% (**Table 3**).

Table 2. Total life expectancy (TLE) by sex in Brazil: 1998, 2008 and 2013.

Age	Total			Men			Women		
	1998	2008	2013	1998	2008	2013	1998	2008	2013
30	44.0	46.3	47.5	41.0	43.3	44.6	47.1	49.3	50.4
40	35.1	37.3	38.5	32.5	34.7	35.8	37.8	39.9	41.0
50	26.8	28.7	29.7	24.5	26.4	27.4	28.9	30.9	31.9
60	19.2	20.8	21.7	17.4	19.0	19.9	20.8	22.5	23.4
80	7.6	8.6	9.2	6.9	7.8	8.3	8.2	9.2	9.8

Source: PNAD, PNS, IBGE, 1998, 2008, and 2013.

Table 3. Depression-free life expectancy (DFLE) and percentage of years with depression-free years by race and sex among adults in Brazil: 1998, 2008 and 2013.

Age	White						Black and Brown						Other Races and Colors					
	1998		2008		2013		1998		2008		2013		1998		2008		2013	
	DFLE	%	DFLE	%	DFLE	%	DFLE	%	DFLE	%	DFLE	%	DFLE	%	DFLE	%	DFLE	%
Total																		
30	39.4	89.5	42.1	90.9	42.6	89.7	39.8	90.5	43.3	93.5	44.0	92.7	41.5	94.3	43.3	93.5	45.3	95.4
40	31.0	88.3	33.5	89.8	34.3	89.1	31.5	89.7	34.7	93.0	35.4	91.9	33.2	94.6	34.8	93.3	36.7	95.3
50	23.4	87.3	25.6	89.2	26.5	89.2	23.9	89.2	26.6	92.7	27.5	92.6	25.2	94.0	26.8	93.4	28.3	95.3
60	16.7	87.0	18.6	89.4	19.5	89.9	17.1	89.1	19.4	93.3	20.2	93.1	18.1	94.3	19.6	94.2	21.0	96.8
80	6.6	86.8	7.7	89.5	8.6	93.5	6.8	89.5	8.1	94.2	8.9	96.7	7.2	94.8	8.3	96.5	9.2	100.0
Men																		
30	38.3	93.4	41.1	93.6	41.9	94.0	38.6	94.2	41.7	96.3	43.3	97.1	39.3	95.9	41.3	95.4	44.3	99.3
40	30.1	92.6	32.7	94.2	33.6	93.9	30.4	93.5	33.2	95.7	34.8	97.2	31.4	96.7	32.7	94.2	35.7	99.7
50	22.6	92.2	24.7	93.6	25.5	93.1	22.8	93.1	25.2	95.5	26.8	97.8	23.5	96.0	24.7	93.6	27.3	99.7
60	15.9	91.4	17.8	93.7	18.4	92.5	16.1	92.5	18.1	95.3	19.5	98.0	16.7	96.0	17.5	92.1	19.8	99.5
80	6.2	89.9	7.2	92.3	7.8	94.0	6.3	91.3	7.4	94.9	8.2	98.8	6.9	100.0	7.3	93.6	8.3	100.0
Women																		
30	40.6	86.2	43.3	87.8	43.5	86.3	41.1	87.3	44.9	91.1	44.7	88.7	43.9	93.2	45.4	92.0	46.6	92.5
40	32.1	84.9	34.5	86.5	35.0	85.4	32.6	86.2	36.1	90.5	36.0	87.8	35.2	93.1	36.7	92.0	38.0	92.7
50	24.4	84.4	26.5	86.8	27.4	85.9	24.9	86.2	27.9	90.3	28.1	88.1	26.9	93.1	28.6	92.6	29.4	92.2
60	17.5	84.1	19.3	85.8	20.4	87.2	18.0	86.5	20.5	91.1	20.8	88.9	19.4	93.3	21.4	95.1	21.9	93.6
80	7.0	85.4	8.0	87.0	9.1	92.9	7.1	86.6	8.5	92.4	9.4	95.9	7.6	92.7	8.9	96.7	9.8	100.0

Source: PNAD, PNS, IBGE, 1998, 2008, and 2013.

DFLE: Depression-free life expectancy; %: percentage of depression-free years.

4. Discussion

This study estimated the depression-free life expectancy for Brazilian adults, in the years of 1998, 2008, and 2013 by age, sex and race. In fact, improvements in DFLE were observed over time for all race/color groups. Our study corroborates with previous research in Brazil whose findings show that from 2000-2010, life expectancy without depression increased among older adults in São Paulo (Andrade, Wu, Lebrão *et al*., 2016). This may reflect living more years with higher quality of life, less disability, and better health status (Reynolds, Haley, and Kozlenko, 2008). Whites generally displayed the lowest DFLE.

Our results showed that depression was much more pronounced among white middle-aged women (between ages 40 and 60). Depression occurs most frequently in women aged 15 to 45 (Patten, Wang, Williams *et al*., 2006; WHO, 2017). At ages older than 65 years, both men and women show a decline in depression rates, and the prevalence becomes similar between them (Bebbington, Dunn, Jenkins *et al*., 2003; Patten, Wang, Williams *et al*., 2006). This age pattern is likely linked with the higher rate of antidepressant use among mid- or old-age adults, which suggests that young adults with depression may not always receive antidepressant treatment until many years after the onset of illness (Albert, 2015).

Depression has a great burden of disease in Brazil, especially for women. Our finding that the lower DFLEs were found in women than in men across all race/color groups supports such an argument. Gender is a critical determinant of mental health and mental illness. Depression is not only women's most common mental health problem but may be more persistent in women than men (WHO, 2017). Women had a higher prevalence of most affective disorders and non-affective psychosis and men had higher rates of substance use disorders and antisocial personality disorder (Kessler, McGonagle, Zhao *et al*., 1994). Women also have significantly higher rates of post-traumatic stress disorder (PTSD) than men (Kessler, Sonnega, Bromet *et al*., 1995). A comprehensive review of general population-based studies in the United States of America, Puerto Rico, Canada, France, Iceland, Taiwan, Korea, Germany, and Hong Kong, reported that women predominated over men in lifetime prevalence rates of major depression (Piccinelli and Homen, 1997).

Many elements in women may contribute to depression, including genetic and, biological factors, premenstrual dysphoric disorder, postpartum depression, postmenopausal depression, and anxiety that are associated with hormonal changes and could contribute to the increased prevalence in women. The fact that increased prevalence of depression correlates with hormonal changes in women, particularly during puberty, prior to menstruation, following pregnancy and at perimenopause, suggests that female hormonal fluctuations may be a trigger for depression (Albert, 2015). Social factors may also lead to higher rates of clinical depression among women, including stress from work, family responsibilities, economic pressures, unemployment, the roles and expectations of women and increased rates of sexual abuse and poverty. Another argument widely cited to explain gender differences is that women would be more likely to identify symptoms and seek help than men (Andrade, Viana, and Silveira, 2006).

In Brazil, race/color is directly associated with the individual's socioeconomic situation. As blacks and browns face severe socioeconomic disadvantages when compared to other racial categories, it is possible that they seek and use healthcare services less frequently and are less likely to be diagnosed. On the other hand, evidence suggests that blacks are somewhat more likely to be in better health than whites in advanced ages because blacks have a higher mortality rate at younger ages, leaving behind a heartier group of survivors (Jackson, Hudson, Kershaw *et al*., 2011). According to Albert (2015), the differential risk may primarily stem from biological sex differences and depend less on race, culture, diet, education and numerous other potentially confounding social and economic factors.

When compared to white men, black and brown men and men of other skin colors had higher average time of depression-free survival for all ages and in the entire period we studied. This result may be due to lower levels of depression diagnoses among them. This issue has been brought up in the literature in the United States, where studies have identified that black men do not usually seek routine medical care and could, in many instances, not be fully aware of any health issues, including depression (Ware and Livingston, 2004). Socioeconomic disparities are at the heart of racial inequalities in health in Brazil. Furthermore, racial discrimination and its impact on health are intimately related to these inequalities (Chor and Lima, 2005). Therefore, lower levels of health care seeking behavior could be related to racial discrimination. A comparative study between Brazil and the United States has shown that in both countries, black men report more discrimination than white men/women or black women (Bugard, Castiglione, Lin *et al*., 2017).

One big limitation of the present study is the application of cross-section data, which does not include the exposure time in the status of depression and dynamics in transitions of depression. Longitudinal datasets may improve this methodological issue. Also, the limited availability of research about race and depression at the population level in Brazil hinders the comparison of findings in other studies. Furthermore, we acknowledge that not using race-specific life tables (as they do not exist for Brazil) may have created biased estimates in results. We classified people into one of three mutually exclusive racial/ethnic groups, which may prevent comparisons with studies involving other categorizations. The small

sample size of other races and colors may be also a concern about the reliability of their low depression prevalence at high ages. Another difficulty is to compare this study with international studies that present a quite different definition and classification of race given their historical and contextual factors. An additional limitation refers to the use of secondary data, which may affect our results. Depression prevalence rate estimates could be biased, especially for small populations as other colors categories in Brazil, by underreporting of self-reported depression, age misreporting, lack of race-specific depression prevalence information and race misclassification, considering the problem of the classification variability of race/skin colors in Brazil. Finally, it is important to emphasize that our data from two different surveys (PNAD and PNS), which may affect comparability of depression prevalence due to different sampling method. However, we are confident that such an issue should be minor as both are nationally representative and questions related to depression in these two surveys are similar.

The present study contributed to a better understanding of depression by race in the Brazilian population using of the last three nationally representative household surveys and reveal areas where advances still need to be made to achieve the goal of reducing disparities. Our study has implications for policy and for future research. Regarding research, the method applied here can be used in subsequent studies to shine light on the factors producing gaps between races and depression within Brazilian regions as well as between races and other chronic diseases groups in the country.

5. Conclusions

This study demonstrated changes in HLE related to depression in the period between 1998 and 2013. For the most part, LE and DFLE increased and the difference between the two estimates decreased, indicating that the number of years lived with depression went down in the study period. We observed differences between men and women and among race groups. Paradoxically, blacks displayed better estimates of DFLE than whites, which goes against our expectation that blacks would be far worse than whites, granted that they have worse health outcomes than whites in a variety of other indicators in Brazil. Further study is needed to understand the lower depression prevalence found in blacks that reflects directly into a higher HLE.

Authors' Contributions

LCA and CP originated the study and contributed to the study design, analysis, writing and revisions of the article. This final version was approved by both the authors.

Ethics

This paper used publicly available data (PNAD and PNS) with no personal identifiers and therefore is in compliance with the Brazilian Research Ethics Resolution 466/12 (CEP/CONEP) that deems this kind of research exempt from human subjects review.

Acknowledgements

The authors would like to thank the UNICAMP and Fiocruz for institutional support. LCA would like to thank the CNPq (Process no.: 471517/2013-5) that support her work. CP would like to recognize FAPERJ and CNPq for research grants: E_10/2016/224553 (Jovem Cientista do Nosso Estado) and 307639/2015-0 (Produtividade em Pesquisa - PQ 2015) that support her work.

Conflict of Interest

The authors declare that they have no competing interests.

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