

PHYSICAL ACTIVITY AND MEDICATION IN THE CONTROL OF BLOOD PRESSURE: SECONDARY ANALYSIS OF THE BRAZILIAN NATIONAL HEALTH RESEARCH

Atividade física e medicação no controle da pressão sanguínea: análise secundária da pesquisa nacional de saúde

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ABSTRACT

AIM: To test the effectiveness of different physical activities (PA) in controlling blood pressure. The dependent variable was controlled and uncontrolled blood pressure (BP). **METHODS:** This is a secondary analysis of a cross-sectional, observational, descriptive and analytical study from the Brazilian National Health Research (PNS) database. The PNS was conducted by the Brazilian Institute of Geography and Statistics (IBGE) in 2013, in partnership with the Ministry of Health. Total PA was calculated in minutes per week (MPS) with the sum of 3 activities, physical exercise, time spent walking to work, and heavy work activity. Sociodemographic variables and the use of hypertension medications were analyzed as possible associated factors. **RESULTS:** The chances of having controlled BP were calculated by logistic regression. Among the 10199 participants aged 40 years and older, who reported hypertension, 5398 (53%) had controlled BP, being higher among the women (56%), within the age range of 40-59 years-old (56%), and on medication for hypertension (54%). The controlled-BP group performed 64 ± 146.1 MPW of PA while the uncontrolled-BP spent 46 ± 150.7 MPW in PA ($p < 0.001$). Work activity was also higher among the controlled-BP group ($p = 0.019$). Participants who performed total PA between 90-149 MPW had 21% higher odds of controlled-BP ($p = 0.024$) and those who performed 150 MPW or more, 22% ($p = 0.001$). Medication increased the chance of BP control by 18% ($p = 0.003$). The odds of having controlled-BP were higher in physical exercise: 42% on 90-149 MPW ($p = 0.001$) and 40% on 150 MPW or more ($p < 0.001$). **CONCLUSION:** Physical exercise was significantly associated with better BP control than just total PA. Both exercise and total physical activity were significantly associated with better BP control than medication. **KEYWORDS:** physical exercise; population; arterial pressure.

RESUMO

OBJETIVO: Testar a efetividade de diferentes atividades físicas (AF) no controle da pressão arterial. A variável dependente foi a pressão arterial (PA) controlada e não controlada. **MÉTODOS:** Trata-se de uma análise secundária de um estudo transversal, observacional, descritivo e analítico de um banco de dados da Pesquisa Nacional de Saúde (PNS). A PNS foi conduzida pelo Instituto Brasileiro de Geografia e Estatística (IBGE), no ano de 2013, em parceria com o Ministério da Saúde. A AF total foi calculada em minutos por semana (MPS) com a soma de três atividades, exercício físico, tempo gasto na caminhada para o trabalho e atividade laboral pesada. As variáveis sociodemográficas e o uso de medicamentos para hipertensão foram analisados como possíveis fatores associados. **RESULTADOS:** As chances de controlar a PA foram calculadas por regressão logística. Entre os 10.199 participantes, com 40 anos ou mais, que relatam hipertensão, 5.398 (53%) controlavam a PA, sendo maior entre as mulheres (56%), com idade entre 40 e 59 anos (56%) e em uso de medicamentos para hipertensão (54%). O grupo PA controlado realizou $64 \pm 146,1$ MPS de AF, enquanto o PA não controlado passou $46 \pm 150,7$ MPS em AF ($p < 0,001$). A atividade laboral também foi maior no grupo PA controlado ($p = 0,019$). Os participantes que executaram AF total entre 90-149 MPS tiveram chances 21% mais altas de pressão controlada ($p = 0,024$) e 150 MPS ou mais, essa probabilidade foi de 22% ($p = 0,001$). A medicação aumentou a chance de controle da PA em 18% ($p = 0,003$). As chances de ter PA controlada foram maiores no exercício físico: 42%, em 90-149 MPS ($p = 0,001$) e 40% em 150 MPS ou mais ($p < 0,001$). **CONCLUSÃO:** O exercício físico esteve significativamente associado a um melhor controle da PA do que somente a prática de AF total. Tanto o exercício físico quanto a atividade física total mostraram-se significativamente associados a um melhor controle da PA do que a medicação. **PALAVRAS-CHAVE:** exercício físico; população; pressão arterial.

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INTRODUCTION

The World Health Organization set as a goal to be achieved by developing and developed countries, in the coming decades, to commit to combating and controlling long-term noncommunicable diseases (NCD) by adopting the paradigm “compression of morbidities”.¹ Hypertension is a high prevalence health condition with significant increase in recent years. The condition was raised from the 16th position in the global mortality ranking in 2000 to the 10th position in 2012.² The Brazilian Institute of Geography and Statistics (IBGE) estimates that 21.4% of Brazilian adults are hypertensive. This estimate is higher among people over 40, with low education, living in urban areas and in the Southeast Region.³ Data from the Brazilian Ministry of Health’s Hypertension and Diabetes Registration and Monitoring System also point out as risk factors for hypertension in the Brazilian population: advanced age, obesity, smoking, alcohol consumption, and ethnicity (Afro-Brazilians). The diagnosis of this condition is basically established by the association of permanently elevated BP levels above normal (140 mmHg by 90 mmHg).⁴ Therefore, the most important diagnostic criterion in the routine verification of blood pressure (BP).

Hypertension is characterized as a silent disease, since in most cases it is asymptomatic. The main goal of treatment of high BP is to reduce cardiovascular mortality by maintaining BP within normal limits. The Brazilian Society of Cardiology and the Brazilian Ministry of Health consider 4 major lifestyle modifications for controlling BP: weight reduction, smoking cessation, healthy eating, moderate consumption of alcohol, and physical activity (PA).^{5,6}

Caspersen et al. distinguish the terms physical activity and physical exercise. It is common to classify as PA the movement resulting from the contraction of skeletal muscles causing energy expenditure above resting levels, including work and leisure activities.⁷ Exercise is a planned, structured and repetitive PA that has as a final goal the improvement of components of physical fitness.⁷ The Brazilian Health Survey (BHS), conducted by IBGE in partnership with the Ministry of Health in 2013, observed different aspects of lifestyle, including PA, and the characteristics of NCD, including hypertension.⁸ Through the BHS microdata, which is freely available at the IBGE website, it is possible to identify the participants with diagnostic of hypertension, different types of PA (including physical exercise, time commuting on foot, and heavy labor activity) and the BP measured 3 times during the survey. Thus, the data allows the identification of those hypertensive participants who have controlled blood pressure (CBP) and their lifestyle.

In this sense, it is important to know, through the analysis of a population-based data, the possible effect of different PA

in the control of BP, adjusting for sociodemographic characteristics and medication use. Then, this would provide Public Health Policies for hypertension treatment and control.

This is a secondary analysis, a cross-sectional, observational, descriptive and analytical study from a National Health Research (PNS) database. The PNS was conducted by the Brazilian Institute of Geography and Statistics (IBGE), in 2013, in partnership with the Ministry of Health.

METHOD

The project of PNS was approved by the National Committee for Ethics in Research of the National Health Council by Opinion number 328159.

Participants were randomly selected by census sectors in the North, Northeast, South, Southeast, and Midwest regions of Brazil. Initially, IBGE researchers visited more than 60 thousand households, selecting an 18-year-old resident for a comprehensive health evaluation. Details on the sampling methodology and evaluation instrument were published by the IBGE in 2015.⁸⁻¹⁰ For the present analysis, we included the data of all interviewees, aged 40 years or over, who reported having a diagnosis of hypertension (answered, “yes” for the question Q002 — “Have any doctors diagnosed arterial hypertension?”). The dependent variable was the presence of CBP: systolic < 140 mmHg and diastolic < 90 mmHg, dichotomously classified as Yes or No. Physical activities were divided into physical exercise, performed at leisure time (walking, gym, cycling, swimming, and sport); commuting (time spent for walking or cycling to work, round trip); heavy labor activity (time spent on heavy labor activity). Total PA computed as the sum of the 3 activities — physical exercise, commuting, and heavy labor activity — expressed in minutes per week (MPW). Sociodemographic variables were analyzed as possible associated factors (gender, age, race, schooling, and marital status) and the use of hypertension medication. The Epi Info™ 7 statistical software was used for the analyses. Initially, descriptive analyses (Chi-square and Student’s *t* tests) observed the possible significant associations or differences between controlled or not controlled blood pressure participants. Significant factors in the descriptive analyses were included in 2 different Logistic Regression models: with total physical activity level and with physical exercise level. Significance was established at $p < 0.05$.

RESULTS

Among the 10199 participants, who reported having received the diagnosis of hypertension in the BHS, 5398 (53%) had CBP (Table 1).¹¹ Among the 6,556 hypertensive

women (64%), 3,656 (56%) had CBP, a percentage that was higher than the percentage of men (48%). This association was significant ($p < 0.001$). Participants aged 40 to 59 years had a

higher percentage of CBP (56%), and those participants aged 80 or older, the lowest percentage (46%, $p < 0.001$). There was a significant association between skin color and CBP ($p < 0.001$).

Table 1 Distribution of demographic, life-style, and treatment characteristics between hypertensive participants with controlled and uncontrolled blood pressure.

	No	Yes	Total	p
Sex				
Female	2,900 (44.2%)	3,656 (55.8%)	6,556 (64.3%)	< 0.001
Male	1,901 (52.2%)	1,742 (47.8%)	3,643 (35.7%)	
Age group (years-old)				
40-< 59	2,209 (44.1%)	2,804 (55.9%)	5,013 (49.2%)	< 0.001
60-< 79	2,203 (49.3%)	2,268 (50.7%)	4,471 (43.8%)	
80 and older	389 (54.4%)	326 (45.6%)	715 (7.0%)	
Color				
White	2,005 (41.8%)	2,457 (45.5%)	4,462 (43.7%)	< 0.001
Brown	2,163 (47.7%)	2,372 (52.3%)	4,535 (44.5%)	
Black	556 (52.3%)	506 (47.7%)	1,062 (10.4%)	
Other	77 (55.0%)	63 (45.0%)	140 (1.4%)	
Marital Status				
Married	2,559 (46.0%)	3,001 (54.0%)	5,560 (54.5%)	0.0474
Divorced	633 (46.8%)	719 (53.2%)	1,352 (13.3%)	
Single	638 (48.0%)	691 (52.0%)	1,329 (13.0%)	
Widowed	971 (49.6%)	987 (50.4%)	1,958 (19.2%)	
Schooling				
Illiterate	1,028 (55.3%)	832 (44.7%)	1,860 (18.2%)	< 0.001
Incomplete Elementary	2,214 (48.5%)	2,348 (51.5%)	4,562 (44.7%)	
Complete Elementary	496 (47.5%)	549 (52.5%)	1,045 (10.3%)	
High School	706 (41.1%)	1,013 (58.9%)	1,719 (16.9%)	
College or higher	357 (35.2%)	656 (64.8%)	1,013 (9.9%)	
Medication for Hypertension				
No	794 (51.1%)	760 (48.9%)	1,554 (15.2%)	< 0.001
Yes	4,007 (46.3%)	4,638 (53.7%)	8,645 (84.8%)	
Physical Exercise (min/w)	45.8 ± 150.67	63.8 ± 146.12	55.3 ± 148.54	< 0.001
Labor Activity (min/w)	61.8 ± 244.18	65.9 ± 225.15	64.0 ± 234.30	0.019
Walk to work(min/w)	16.7 ± 38.20	15.5 ± 34.47	16.0 ± 36.28	0.637
Physical activity level				
Inactive	2,300 (50.1%)	2,293 (49.9%)	4,593 (45.0%)	< 0.001
1-89 min/w	1,082 (48.8%)	1,136 (51.2%)	2,218 (21.8%)	
90-149 min/w	301 (42.8%)	402 (57.2%)	703 (6.9%)	
≥ 150 min/w	1,118 (41.6%)	1,567 (58.4%)	2,685 (26.3%)	
Total	4,801 (47.1%)	5,398 (52.9%)	10,199 (100%)	

Min/w: minutes per week.

Source: NHS (2013).¹¹

The highest percentage of CBP was for afro-descendants (52%) and the lowest percentage was for white individuals (46%) and the other skin colors (45%). Marital status had a significant association ($p = 0.04$), married participants presented the highest percentage of CBP (54%) and widowers presented the lowest percentage (50%). We observed a progressive increase of the percentage of CBP according to the rising of the school level ($p < 0.001$). Illiterate had the lowest percentage of CBP (45%). Among participants using medication for Hypertension, 54% had CBP, while for those without medication this percentage was 49% ($p < 0.001$).

Among the different physical activities studied, physical exercise was the one that presented the greatest difference between hypertensive participants with and without CBP. On average, participants with CBP performed on average 64 ± 146.1 minutes of physical exercise per week and those without CBP, the mean was 46 ± 150.7 minutes per week ($p < 0.001$). The mean of minutes of heavy labor activity was also higher among those with CBP ($p = 0.019$). The average time spent on walking to work was not significantly different between the 2 groups ($p = 0.637$). Among the levels of total physical activity (sum of all weekly activities), the higher the weekly time spent in activity, the greater was the CBP ($p < 0.001$). While 50% of the inactive group presented CBP, among those performing 150 minutes or more per week this frequency was 58%.

Table 2¹¹ presents the odds of presenting CBP, adjusted for socio-demographic factors, total physical activity level, and use of hypertension medications. The chance of CBP was 30% lower in males than females ($p < 0.001$). Compared with participants aged 80 years and over, younger age groups had significantly higher rates of CBP. In participants within the age range 40–59 years, adjusted odds of presenting CBP were 30% higher ($p = 0.003$), and in those within the age range 60–79, the odds were 14% higher, but not significant ($p = 0.127$). Although the White participants presented lower percentage of CBP than the other skin-colors in the descriptive, unadjusted analysis; in the adjusted analysis the other races showed less chances of CBP. Both Black (odds ratio = 0.80, 95%CI 0.70–0.92, $p = 0.002$) and the other skin-colors (0.67, 95%CI 0.47–0.94, $p = 0.019$), presented significantly lower odds of CBP than the White. Compared to married participants, those with other marital statuses had lower chances of CBP, but none remained significant in the adjusted analysis. All schooling levels presented significantly higher odds of having CBP compared to illiterate participants. Higher education level was a factor associated with a 2-fold increase in the chances of CBP, compared to illiterate participants in the adjusted analysis. Compared to the inactive participants, the other levels of physical activity

had greater chances of CBP. The odds of CBP for participants who performed between 90 and 149 minutes per week were 21% ($p = 0.024$) and those with 150 minutes or more of physical activity were 22% ($p = 0.001$). Medication use increased the chance of CBP by 18% ($p = 0.003$).

The distribution of participants with and without CBP and weekly exercise levels is presented in Table 3.¹¹ As in total physical activity, participants with higher levels of weekly physical exercise had a higher percentage of CBP ($p < 0.001$). Participants who practiced between 90 and 149 min/w and 150 min/w or more of physical exercise presented respectively 61 and 62% of CBP.

Table 4¹¹ presents the results of the logistic regression model for CBP adjusted for sociodemographic characteristics, physical exercise level, and the use of hypertension medications. The odds of CBP remained significant for sex, age, skin color,

Table 2 Odds of presenting controlled blood pressure by sociodemographic characteristics, physical activity, and the use of medication for hypertension.

	Odds Ratio	95%CI	p
Sex (Reference: Female)			
Male	0.70	0.64–0.76	< 0.001
Age group (Reference: ≥ 80 years old)			
40–< 59 years old	1.30	1.10–1.55	0.0027
60–< 79 years old	1.14	0.96–1.34	0.1272
Color (Reference: White)			
Brown	0.94	0.87–1.03	0.1778
Black	0.80	0.70–0.92	0.0015
Other	0.66	0.47–0.94	0.0193
Marital Status (Reference: Married)			
Divorced	0.91	0.81–1.03	0.1473
Single	0.91	0.81–1.03	0.1537
Widower	0.90	0.80–1.06	0.0896
Schooling (Reference Illiterate)			
Incomplete Elementary	1.23	1.10–1.37	0.0003
Complete Elementary	1.24	1.07–1.45	0.0078
High School	1.59	1.38–1.83	< 0.001
College or higher	2.02	1.71–2.38	< 0.001
Physical Activity (Reference: Inactive)			
1–89 min/w	1.04	0.94–1.15	0.4787
90–149 min/w	1.21	1.02–1.42	0.0244
≥ 150 min/w	1.22	1.10–1.35	0.0001
Medication for Hypertension	1.18	1.06–1.32	0.0031

Source: NHS (2013).¹¹

95%CI: 95% confidence interval; min/w: minutes per week.

schooling, and medication use. Marital status also maintained statistical non-significance. When compared with the adjusted model for the level of total physical activity, the adjusted odds of presenting CBP were higher using physical exercise levels. Participants, performing less than 90 minutes per week of physical exercise, had 12% higher adjusted odds of having CBP, although not significant ($p = 0.258$). For other levels of physical exercise, the adjusted odds were 42% for participants with dedication from 90 to 149 min/w ($p = 0.001$) and 40% higher for participants with dedication of 150 min or more per week ($p < 0.001$). The chance of having CBP for the use of hypertension medication decreased in this model to 16% ($p = 0.008$).

DISCUSSION

Over the past 5 decades, the enhancement of physical fitness and exercise management for hypertension was relevant. Studies showed that BP significantly decreases with the practice of dynamic exercises. However, few studies demonstrate the possible difference between exercise and physical activity.^{10,12} The main results obtained by this analysis showed that, for hypertensive participants, physical exercise and physical activity are related to CBP. The longer the weekly time spent on activity, the greater the chances of having CBP. In addition, both physical exercise and physical activity showed a greater tendency for CBP than medication use, and this chance is even greater through physical exercise. The analyses also found that being a woman, being young, using hypertension medications, and having a high level of education increased the odds of CBP.

An active lifestyle has been described as a protective factor for hypertension. As shown in experimental studies in hypertensive patients, regular aerobic exercise results in a significant decrease in BP. In the present study, among the different physical activities studied, exercise was the one that presented the greatest difference between hypertensive participants with and without CBP. Paffenbarger et al.¹³ and Fagard¹⁴ demonstrated that less active people seem to be at an increased risk of 30 to 50% for high BP. The American College of Sports Medicine

recommends the practice of 150 minutes of regular physical activity per week at a moderate intensity of 40 to 60% of maximum capacity for hypertensive and diabetic patients as well as those with metabolic syndrome. This recommendation is related

Table 4 Odds to present controlled blood pressure by sociodemographic characteristics, Physical Exercise, and the use of medication for hypertension.

	Odds ratio	95%CI	p
Sex (Reference: Female)			
Male	0.69	0.6284–0.7469	< 0.001
Age group (Reference: ≥ 80 years old)			
40–< 59 years old	1.31	1.1041–1.5620	0.002
60–< 79 years old	1.13	0.9559–1.3295	0.155
Color (Reference: White)			
Brown	0.95	0.8699–1.0338	0.228
Black	0.80	0.6984–0.9204	0.002
Other	0.67	0.4761–0.9447	0.022
Marital Status (Reference: Married)			
Divorced	0.91	0.8070–1.0307	0.140
Single	0.93	0.8180–1.0480	0.223
Widowed	0.90	0.8009–1.0126	0.079
Schooling (Reference Illiterate)			
Incomplete Elementary	1.22	1.0907–1.3635	< 0.001
Complete Elementary	1.22	1.0409–1.4268	0.014
High School	1.56	1.3528–1.7929	< 0.001
College or higher	1.91	1.6095–2.2569	< 0.001
Physical Exercise (Reference inactive)			
1–89 min/w	1.12	0.9211–1.3575	0.258
90–149 min/w	1.42	1.1455–1.7683	0.001
≥ 150 min/w	1.39	1.2376–1.5634	< 0.001
Medication for Hypertension	1.16	1.0393–1.3005	0.008

95%CI: 95% confidence interval; min/w: minutes per week. Source: NHS (2013).¹³

Table 3 Distribution of blood pressure controlled and uncontrolled participants with hypertension and the level of weekly Physical Exercise.

	No	Yes	Total	p
Inactive	3,854 (49.4%)	3,943 (50.6%)	7,797 (76.5%)	< 0.001
1–89 min/w	201 (44.9%)	247 (55.1%)	448 (4.4%)	
90–149 min/w	200 (39.0%)	313 (61.0%)	513 (5.0%)	
≥ 150 min/w	546 (37.9%)	895 (62.1%)	1,441 (14.1%)	
TOTAL	4,801 (47.1%)	5,398 (52.9%)	10,199 (100%)	

Min/w: minutes per week. Source: NHS (2013).¹¹

to a reduction of cardiovascular events and stroke¹⁵. In fact, as observed in this study, the adjusted chances of presenting CBP were higher among those who practiced any physical activity at a frequency ≥ 150 min/w. However, protective responses have already been shown to be significant at 90 min/w. It is important to point out that these responses result in 20 and 22% higher odds adjusted for CBP, in those who practiced between 90 and 149 and 150 min/w, respectively. These chances were higher than the use of hypertension medication in this same analysis.

As mentioned previously, physical activity is characterized as body movement above resting level, which comprises both labor movements and daily activities. The purpose of the activity is the accomplishment of a task, as well as leisure activities or intentional planned activities. Physical exercise is characterized as this second concept, whose ultimate goal is the accomplishment of this activity. Therefore, in the present study we analyzed the physical exercise related to leisure activity separately. Time spent on physical exercise showed a greater impact on CBP. We observed an even greater increase in the chances of CBP attributed to physical exercise levels compared to the levels of all physical activities. Monteiro et al.¹⁷ demonstrated that 20–30 minutes of daily regular physical activity is effective for CBP in some hypertensive patients. According to the results of the present analysis, we suggest that the type of physical activity in which individuals are involved may influence a higher protective effect and CBP. Physical activity characterized as physical exercise requires structure, planning, intensity, duration, frequency and continuity. Participants who performed 90 minutes per week of physical exercise or more had 42% higher adjusted chance of having CBP, reaching a level of significance. Similar responses were not obtained for the practice of regular physical activity less than 90 minutes per week. Other factors were important in CBP. In this same model, the chance of presenting CBP with the use of medication was significant but much lower (16%) than with engagement in physical activity at least 90 minutes a week.

In this study, younger age groups, compared to participants aged 80 years or older, were significantly more likely to have CBP. This phenomenon remained significant, even adjusting for activity and physical exercise. In this context, in a cohort of men aged 20 to 90 followed longitudinally for 3 to 28 years, showed that increased physical fitness reduced the incidence of hypertension over time and delayed the onset of hypertension.¹⁷

Hypertensive men presented lower chances of CBP. Although the literature observes that women have a higher prevalence of hypertension, they seem to adhere more to treatment and to lifestyle changes than men, as observed in the literature.^{18–20} All skin colors other than white, presented lower chances of CBP, but differences are found in the literature. Hypertension is more

prevalent in African Americans and with a worse prognosis in African Americans.^{21,22} In the present analysis the classification “other” in the skin color includes both Indian and Asian, not including Afrodescendants.²³ There are few studies about the prevalence of hypertension between indigenous and Brazilian Asians. Rocha et al.²⁴ observed an increased prevalence of hypertension, as a component of the Metabolic Syndrome, in indigenous Brazilian from the state of Rio Grande do Sul.

In the present study, other levels of marital status were compared to married participants to calculate the odds of presenting CBP. Only widowers presented lower odds of CBP than married participants, reaching an indicative degree of significance. Cesarino et al. found a higher prevalence of hypertension among married men than our analysis.²⁵ Studies investigating this theme are still few and seem contradictory. According to the study by Holt-Lunstad et al.²⁶ and the meta-analysis by Robles et al.²⁷ individuals with a high-quality marriage presented lower BP levels than singles, but people who consider themselves unhappy in marriage did not get this advantage over single people. Schooling also has an important influence on BP control. The scientific literature reports that the highest the level of schooling, the greater opportunities for access to health services and health education.²⁸ Corroborating with previous findings, all levels of education compared to illiteracy had a statistically higher chance of having CBP. For those with a higher level of education, the chance of control was twice as high compared to illiterates.^{28,29}

The present study has limitations. Since it is a national health survey, the BP measurements reported by the participants were obtained by self-care, so it did not allow a more careful assessment of BP measurements by evaluators. As it is a cross-sectional study, the findings allowed us to know a possible association between physical activity levels and better CBP control in a Brazilian population older than 40 years.

However, it is a merit study because it has a very interesting sample and an approach little explored in other studies. In addition, it will serve for future studies to explore this information with new work and other methodologies.

CONCLUSION

According to the findings, the relevance of this study is that physical exercise was significantly associated with better CBP than just total PA. However, both exercise and total physical activity were significantly associated with better CBP compared to medication.

CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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