Association of short sleep duration with cardiometabolic risk factors in a population of rural Nigerian women: A cross-sectional study

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Original Article

Association of Short Sleep Duration with Cardiometabolic Risk Factors in a Population of Rural Nigerian Women: A Cross-Sectional Study

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ABSTRACT

Background: Short sleep duration of less than 5.5 h a day has been associated with cardiometabolic risk factors. Epidemiological evidence suggests a rising trend in the prevalence of cardiovascular diseases in Nigeria. **Objective:** The aim of this study was to determine the relationship between traditional cardiometabolic risk factors, prediabetes, and short sleep duration in a group of rural Nigerian women. **Subjects and Methods:** Five hundred and thirty-eight women living in Ihuokpara, a rural community in Southeast Nigeria, participated in the study. A structured questionnaire was administered to the participants to obtain demographic information and self-reported nighttime sleep duration. Anthropometric measurements and blood pressure were recorded. Participants underwent a 75 g Oral Glucose Tolerance Test using standard protocols. Prediabetes was defined using the World Health Organization criteria (fasting plasma glucose 110–125 mg/dL or 2 h post-glucose 140–199 mg/dL) and hypertension was defined using the Joint National Committee (JNC-7) criteria. **Results:** The mean age of the subjects was 49.9 ± 16.2 years and 280 (52%) had no formal education. Hypertension was present in 238 (44.2%), prediabetes was present in 120 (22.3%), generalized obesity in 32 (5.9%), and increased waist circumference (>88 cm) in 116 (21.6%) women. Average sleep duration of less than 5.5 h per night was reported in 182 (33.8%) women. Short sleep duration was significantly associated with prediabetes and hypertension but not obesity or older age in the subjects. **Conclusion:** More than a third of the women had short sleep duration and this was a significant risk factor for prediabetes and hypertension in them.

Keywords: *Cardiovascular disease, hypertension, Nigeria, prediabetes, rural, sleep, women*

Introduction

Sleep is a recurrent state of reduced awareness. It usually occurs nightly and is characterized by closed eyes and reduced brain activity. There is also relaxation of the skeletal muscles. Body remodeling and repair largely occur during sleep, revitalizing the body's organs.[1]

The normal sleep-wake cycle is controlled by the circadian rhythm which is an internal homeostatic "timepiece" that determines when an individual falls asleep and when he wakes up. This largely 24-h cycle rhythm is approximately similar among individuals, though some gender disparity has been noted.[1] The average male circadian cycle is roughly 6 min longer than that of females, as females have a cycle that is shorter than a 24-h cycle. The tendency, therefore, is for females to awaken earlier than males, making them

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inclined to early-waking sleep disturbances such as insomnia, with attendant adverse cardiometabolic consequences.[1-3]

Short sleep duration (SSD) has multiple direct repercussions of sympathetic system excitation: induction of oxidative stress and activation of systemic inflammation, culminating in endothelial dysfunction, systemic hypertension, and impaired glucose metabolism.[4] Additionally, chronic sleep deprivation has been shown to affect the secretion of hormones of the hypothalamic–pituitary axes adversely, with loss of inhibition of the release of corticotropin-releasing hormone resulting in abnormally elevated plasma cortisol levels which contributes to dysglycemia and systemic hypertension.[5,6]

Sleep duration varies across age groups and is particularly affected by the lifestyle and overall health of the individual. The Expert Panel of the National Sleep Foundation recommended age-specific sleep duration for all age groups for optimal health and productivity. In general, adults require between 7 and 9 h of sleep per night.[1]

A cohort of medical students in the University of Nigeria Teaching Hospital, Enugu, reported median hours of night sleep of 6 h on weekdays and 7 h on weekends.[7] Adolescents in Enugu, however, had longer sleep hours of 7.84 (1.9) and 8.65 (2.07) h on weekdays and weekends, respectively.[8] As many as 29.4% of older women reported sleep duration of less than 7 h in a study conducted in urban-dwelling Nigerian women.[9] The women with shorter sleep reported higher rates of obesity and clinically significant depression. In a study on a nationally representative sample in the Netherlands, general sleep disturbance was reported in 32.1% of the population, while 42.1% had insufficient sleep.[10] The prevalence of insufficient sleep in females in a Finnish cohort was 23.9%, which was higher than that of the males which was reported in 16.2%.[11] Insufficient sleep duration has been described as an unrecognized and poorly reported public health epidemic with a resultant increase in cardiovascular morbidity, increased incidence of diabetes and prediabetes, poor cognition, and also other social costs such as increased vehicular accidents.[12] In particular, prediabetes has been associated with sleep duration of less than 5.5 h a night.[13]

The recent increase in cardiovascular disease burden, especially in low-income countries, will have dire consequences for their fragile health systems. Prediabetes, which consists of impaired fasting glucose (IFG) and impaired glucose tolerance (IGT), predates type 2 diabetes (T2DM) and is significantly associated with increased risk of cardiovascular diseases such as stroke and myocardial infarction.[14] In a rural community in Enugu State, Nigeria, the prevalence of prediabetes was reported to be as high as 21.5%.[15] Several cardiometabolic risk factors have been described such as increasing age, obesity, sedentary lifestyles, hypertension, dyslipidemia, and abnormal glucose metabolism.

Hypertension is a major risk factor for cardiovascular disease. The prevalence of hypertension has also been reported to be on the increase in our communities, and this has been related to increased obesity, adoption of the western diet, and sedentary lifestyle among others.[16] Longitudinal analyses of the first National Health and Nutrition Examination Survey also showed that self-reported sleep duration of 5 h or less per night was associated with a significantly increased risk of hypertension.[17] It is postulated that SSD contributes to the development of hypertension by disturbing circadian rhythms and autonomic balance.[17]

Sleep disturbances such as poor sleep quality, sleep apnea, and sleep deprivation result in adverse cardiovascular outcomes by increasing the risk of cardiovascular disease and are also linked with increased mortality.[17] A 29% higher risk of cardiovascular disease was reported in individuals who had insomnia or short sleep compared to a reference group in the Sleep Heart Study.[17]

This study was conducted to investigate the relationship between SSD and prediabetes as well as some cardiometabolic risk factors such as hypertension and obesity in a population of rural-dwelling women in Southeast Nigeria.

Subjects and Methods

Study area

The study was carried out in Ihuokpara, a rural community in the Nkanu East Local Government Area of Enugu State, Nigeria, about 40 km from the state capital city. The community that has scarce social amenities such as modern roads and portable water is predominantly inhabited by peasant farmers and petty traders.

Study participants

Adult female subjects aged 18 years or older were recruited consecutively over 1 week, during a free rural medical outreach screening program, after giving both verbal and written informed consent. Pregnant women were excluded. The study was approved by the health research and ethics committee of the University of Nigeria Teaching Hospital Ituku/Ozalla, Enugu. The participants were told about the study and advised to come fasting on the study day.

Study design

The study was cross-sectional and descriptive and all eligible female subjects who turned up for the free screening program were enrolled consecutively, during the week-long program.

Study procedure

A pretested, validated modified WHO's STEPS questionnaire[18] was employed by trained study investigators and assistants, to collect data on the subjects' demography, physical activity levels, and some anthropometric indices including weight, height, and waist circumference were measured. Blood pressure was also measured and recorded using a mercury sphygmomanometer. Two blood pressure readings were taken at least 5 min apart and the average of the two readings was recorded as the blood pressure. Subjects who had a prior history of hypertension were also noted.

Self-reported habitual nighttime sleep duration (≥5 days/week) was obtained from each participant. This was done by using a simple questionnaire whereby the participant answered the simple question: "How many hours of sleep do you usually get a night on at least 5 nights in a week?" Other sleep parameters such as sleep apnea, number of nocturnal awakening, and detailed sleep quality data were not obtained. SSD was defined as the average nighttime sleep of less than 5.5 h a day on three or more days of the week.[13]

Fasting plasma glucose (FPG) and oral glucose tolerance test (OGTT) were carried out on the study participants. Plasma glucose was estimated using capillary blood, following a fingertip prick with sterile disposable needles, and results were obtained with the aid of pre-standardized Accu-Check Active glucose meters and test strips, manufactured by Roche Diagnostics GmBH, Germany. The precalibrated test strips employed the hexokinase method for plasma glucose estimation, with results complying with glucose concentration in venous plasma as recommended by the International Federation of Clinical Chemistry and Laboratory Medicine. Subsequently, each participant undertook a 75 g OGTT and a second finger-prick capillary blood sample was collected after 2 h and plasma glucose estimated. The WHO definitions for IFG, IGT, and diabetes were used to classify the glycemic status of the study population.[19] IFG was reported when fasting blood glucose was 110–125 mg/dL, IGT was recorded for 2 h post-glucose load levels of 140–199 mg/dL with normal fasting levels, while diabetes was reported for subjects with either fasting glucose 126 mg/dL or more and/or 2 h glucose load value of 200 mg/dL or more. Subjects with previous diabetes or diabetes mellitus recognized during the study were excluded from further analysis.

Data analysis

Data analysis was done using SPSS, V. 23 (IBM Inc., New York, USA). Variables such as age, body mass index (BMI), and blood pressure were summarized as means and standard deviation. The proportion of participants who had prediabetes was reported in percentages. The proportion of those with normal or reduced sleep duration was also recorded in percentages. Clinical characteristics of the women with sleep duration less than 5.5 h were compared with those who had sleep duration more than 5.5 h using the χ^2 test for categorical variables, while the Student's *t*-test was used for continuous variables. Logistic regression was done in a stepwise fashion to determine predictors of prediabetes and hypertension. SSD as well as age, physical activity, and obesity were entered as possible predictors in the regression model. A *P* value of less than 0.05 was regarded as being statistically significant and 95% confidence intervals were recorded.

Results

Socio-demographic parameters

A total of 575 women were recruited and gave informed consent; however, only 538 women completed the study. Of the 37 women who dropped out, 21 did not stay for the second blood glucose measurement and 16 were found to not have been properly fasted. Their mean age was 49.9 ± 16.2 years. The age distribution showed that 188 (34.9%) women were 18–44 years, 242 (45%) were 45–65 years, and 108 (20.1%) were older than 65 years [Table 1]. In terms of their educational status, 280 (52%) had no formal education, 204 (37.9%) had only primary level of education, 52 (9.7%) attained up to the secondary level of education, and only 2 (0.4%) were educated up to the tertiary level. Farming was the predominant occupation for 405 (75.3%) women and only 38 (7.1%) were housewives. The main socio-demographic parameters are further described in Table 1.

Cardiometabolic risk factors in the study population

Hypertension

Hypertension was present in 238 (44.2%) women and 84 (15.6%) women had a prior history of hypertension. The mean age of the women who had hypertension was

55.3 ± 12.9 years, with a mean BMI of 23.9 ± 4.5 kg/m². Prediabetes was present in 57 (23.9%) women with hypertension, whereas 181 (76.1%) of them did not have prediabetes, $P = 0.24$. Further comparisons were made between women with hypertension and those without hypertension and provided in Table 2.

Obesity

The mean BMI of the women was 23.6 ± 3.9 kg/m². Although 94 (17.5%) women were overweight, obesity was present in 32 (5.9%) women. A waist circumference of more than 88 cm was present in 116 (21.6%) women. Among the women who were obese or overweight, 26 (21.7%) had prediabetes, whereas 100 (78.3%) did not have prediabetes, $P = 0.19$.

Prediabetes

The mean FPG of the women was 95.2 ± 17.0 mg/dL, while the mean 2 h post-glucose load value was 122.8 ± 37.1 mg/dL. IFG was present in 50 (9.3%) women, whereas 78 (14.5%) had IGT. Prediabetes (either IFG, IGT, or both) was present in 120 (22.3%) women, whereas 14 (2.6%) had diabetes. The mean age of women with prediabetes was 52.2 ± 14.9 years, whereas those without prediabetes had a mean age of 49.2 ± 16.5 years, $P = 0.07$ [Table 2]. Further comparisons between women with and without prediabetes are provided in Table 2.

Table 1: Baseline characteristics of the study population

Variable	Number (%), $N = 538$
Age group (years)	
18–44	188 (34.9)
45–64	242 (45.0)
≥65	108 (20.1)
Educational status	
No formal education	280 (52.0)
Primary	204 (37.9)
Secondary	52 (9.7)
Tertiary	2 (0.4)
Occupation	
Unemployed	78 (14.5)
Farmer	410 (76.2)
Non-farmer	50 (9.3)
Marital status	
Single	60 (11.2)
Married	266 (49.4)
Widowed	212 (39.4)

Sleep duration and cardiovascular risk factors

Average sleep duration of less than 5.5 h per night was reported in 182 (33.8%) women. The mean age of women who slept less than 5.5 h was 59.0 ± 11.7 years. Among the 50 women with IFG, 30 (60%) reported SSD, whereas 20 (40%) had enough sleep ($P < 0.001$, odds ratio [OR] = 0.3). In the women with prediabetes, 61 (50.8%) had SSD, whereas 59 (49.2%) had normal sleep duration ($P < 0.001$, OR = 2.54). In those with hypertension, 138 (58.0%) had SSD, whereas 100 (42.0%) had normal sleep ($P < 0.001$, OR = 8.03). In terms of their BMI, 48 (38%) of 126 women who were either obese or overweight had poor sleep duration, whereas 78 (62%) had normal sleep ($P = 0.28$). The mean waist circumference was also higher in persons who had shorter sleep duration [Table 3].

SSD was the only significant predictor of the presence of prediabetes, after adding other variables such as age, hypertension, and obesity into a stepwise logistic regression model [Table 4].

SSD was also the only significant predictor of being hypertensive in a logistic regression model, with prediabetes, age, and the presence of obesity as variables [Table 5].

Discussion

SSD has been associated with prediabetes, hypertension, and cardiovascular disease. Studies to investigate the relationship between insufficient sleep and cardiometabolic risk factors are not readily available in our environment; however, SSD has been previously reported to be common in Nigerian women. Correction

Table 2: Characteristics of women with hypertension and prediabetes

Characteristic	Hypertension present	Hypertension absent	P	Prediabetes present	Prediabetes absent	P
Mean age (years)	55.3 ± 12.9	45.6 ± 17.2	<0.001*	52.2 ± 14.9	49.2 ± 16.5	0.07
Farmer	200 (48.8%)	210 (51.2%)	<0.001*	86 (21.0%)	324 (79.0%)	0.23
Unemployed	20 (25.6%)	58 (74.4%)		18 (23.1%)	60 (76.9%)	
Non-farmers	18 (36.0%)	32 (64.0%)		16 (32.0%)	34 (68.0%)	
No formal education	162 (57.9%)	118 (42.1%)	<0.001*	71 (25.4%)	209 (74.6%)	0.047*
Formal education	76 (29.5%)	182 (70.5%)		49 (19.0%)	209 (81.0%)	
Mean BMI (kg/m²)	23.9 ± 4.5	23.4 ± 3.4	0.17	24.2 ± 4.4	23.4 ± 3.8	0.07
Mean waist circumference (cm)	81.2 ± 12.5	79.2 ± 9.0	0.03*	81.9 ± 10.6	79.6 ± 10.7	0.04*
Total	238	300		120	418	

*Significant

of poor sleep practices may, therefore, contribute to preventing the development of prediabetes and hypertension in our population, ameliorating the persistent rise in the prevalence of these and other cardiovascular diseases.

In this study, the prevalence of self-reported SSD (less than 5.5 h per night) in a cohort of rural-dwelling women was estimated and its relationship with the presence of prediabetes, hypertension, and other cardiometabolic risk factors was assessed. More than a third of the study subjects reported that they regularly slept less than 5.5 h on at least three nights a week. As many as 43.2% of individuals in the Netherlands cohort reported that they regularly experienced insufficient sleep.[10] Insufficient sleep has also been said to be more common in women (23.9%) than men (16.2%) in a Finnish study.[11]

It was observed that more than half of the women (52%) had not received any form of formal education, whereas 37.9% had attained primary school education. This is quite worrisome considering the existence of the Universal Basic Education program of the Nigerian government launched in 1999, to provide "free, universal and compulsory basic education for every Nigerian child" up to the junior secondary school level, with special programs targeted specifically girls and women.[20] Attainment of formal education has been linked to a better quality of life measures, as it leads to increased income and better health-seeking behavior.[21,22] In this study, lack of formal education was significantly associated with SSD and thus with increased prevalence of hypertension and prediabetes. The majority of the subjects (75.3%) in our study were subsistence farmers and likely belonged to the lower socioeconomic class with attendant adverse social, economic, and health outcomes. Also, more than a third of the rural women were widows and as such, have to bear the brunt of single-handedly providing

Table 3: Relationship between participants' characteristics and sleep duration

Parameter	Sleep <5.5 h (*n* = 182)	Sleep >5.5 h (*n* = 356)	*P*
Age (years)	59.0 ± 11.7	45.3 ± 16.2	<0.001*
BMI (kg/m^2)	24.0 ± 4.4	23.4 ± 3.6	0.07
Waist circumference (cm)	82.1 ± 12.2	79.1 ± 12.8	0.005*
FPG (mg/dL)	97.5 ± 15.6	94.0 ± 17.6	0.023*
PPG (mg/dL)	126.9 ± 36.5	120.7 ± 37.2	0.065
Impaired fasting glucose (*n* = 50)	30 (60.0%)	20 (40.0%)	<0.001*
Prediabetes (*n* = 120)	61 (50.8%)	59 (49.2%)	<0.001*
Hypertension (*n* =238)	138 (58.0%)	100 (42.0%)	<0.001*
Married	58 (21.8)	208 (71.2)	<0.001*
Single	0 (0)	60 (100)	
Widowed	124 (58.5)	88 (41.5)	
No formal education	148 (47.1%)	132 (52.9%)	0.002*
Formal education	34 (13.2%)	224 (86.8%)	
Farmers	158 (38.5%)	252 (61.5%)	<0.001*
Unemployed	16 (20.5%)	62 (79.5%)	
Non-farmers	8 (16.0%)	42 (84.0%)	

PPG = postprandial glucose. *Significant

Table 4: Independent predictors of prediabetes in the study population

Parameter	*B*	SE	*P*	Confidence interval
Age ≥49 years	−0.45	0.26	0.08	0.39–1.06
Hypertensive	0.39	0.25	0.12	0.9–2.41
Short sleep duration	−1.39	0.29	<0.001*	0.14–0.44
BMI ≥25 kg/m^2	−0.18	0.25	0.47	0.52–1.35

*Significant

Table 5: Independent predictors of hypertension in the study population

Parameter	*B*	SE	*P*	Confidence interval
Age ≥49 years	0.28	0.22	0.20	0.86–2.02
Short sleep duration	−2.09	0.24	<0.001*	0.08–0.20
BMI ≥25 kg/m^2	−0.12	0.22	0.59	0.57–1.38
Prediabetes	0.39	0.25	0.12	0.41–1.10

*Significant

for the rest of their families including children and in many instances, extended relatives, thus perpetuating the cycle of poverty. The women who were widows had significantly shorter sleep than those who were married. Magee *et al.*[23] in a study of an Australian cohort found that SSD was associated with lower education level, being single rather than married, and working longer hours. Similarly, Buxton and Marcelli,[24] in their study, reported an association between SSD and several risk factors for prediabetes including belonging to a low socioeconomic class.

Farming in this rural setting is a highly physical activity carried out manually and as such it is expected to be associated with a lower risk of hypertension and obesity, which are usually associated with sedentary lifestyles. However, those who were farmers tended to also sleep less than the others. This may be attributed to the association of highly manual labor with physical stress; thus, they still had higher rates of hypertension (but not prediabetes) than the non-farmers and the unemployed.

In this cohort of rural women, hypertension was found to be highly prevalent at 44.2% though only 15.6% of the women were already aware of their hypertension status. This is worrisome as approximately two-thirds (64.7%) of those who were found to have hypertension were unaware of their condition and hence did not seek medical attention. This increases their risk of developing the damaging consequences of uncontrolled long-standing hypertension. This daunting trend was also reported by Ulasi *et al.*[25] in their study of an urban market population in Enugu, Southeast Nigeria, where 62.1% of the women who were found to be hypertensive were unaware of their status. A similar trend (64.3%) was also found in a community-based study in Ibadan, Southwest Nigeria.[26]

Judging by their BMI, approximately a quarter of the women (23.4%) were either overweight or obese while approximately one-fifth of them (21.6%) had truncal obesity, evidenced by increased waist circumference. These findings are in consonance with a prior systematic review on the prevalence of overweight and obesity in Nigeria where the prevalence of obesity ranged between 8.1% and 22.2%.[27] Overweight and obesity, especially in a background of a low cardiopulmonary reserve, are associated with other chronic, debilitating conditions such as diabetes, hypertension, atherosclerotic cardiovascular diseases, and even some cancers.[28,29] Truncal obesity rather than BMI was more significantly associated with SSD, hypertension, and prediabetes.

Approximately one-tenth of the subjects had IFG at 9.3%. While 14.5% of the women had only IGT, 22.3% had either IFG and/or IGT. This high prevalence value suggests that the prevalence of diabetes, especially T2DM, is likely to increase among these rural women soon, as these abnormal states (IFG and IGT) predict future T2DM.[14]

SSD was strongly associated with prediabetes and also with hypertension. It was found to be associated with IFG, as 60% of the women who had IFG reported regularly sleeping less than 5.5 h a night on most nights. In a similar vein, SSD was also significantly associated with prediabetes (P < 0.001). Indeed, several studies have reported the association between SSD and altered glucose metabolism/dysglycemia.[24,30-32] In a crossover study, three nights of sleep restriction (4 h per night) resulted in decreased insulin sensitivity when compared with three nights of adequate sleep (9 h) in healthy male adolescents.[33]

Byberg *et al.*[31] suggested that sleep deprivation may result in hormonal dysregulation, evidenced by high growth hormone levels and elevated nighttime cortisol levels, both of which lead to altered glucose homeostasis. Also, nocturnal sleep disruption has been reported to be associated with a reduction in melatonin secretion, low levels of which are independently associated with a higher risk of developing T2DM.[32]

Besides, SSD was also found to be associated with hypertension in this study as more than half of the women with hypertension reported having SSD as compared to 42% with normal sleep duration (P < 0.001). The above finding is in keeping with previous studies elsewhere, as SSD has consistently been found to be associated with hypertension. In a longitudinal study that looked at the relationship between self-reported SSD and a diagnosis of hypertension during an 8- to 10-year follow-up of the first National Health and Nutrition Examination Survey, a higher percentage of those who reported sleeping less than 7 h per night were diagnosed with hypertension during the period. However, Li *et al.*,[34] in their study, found this significant association among subjects aged 18–44 years. Though the exact pathophysiologic mechanism linking SSD and hypertension is yet to be unraveled, an increased and sustained sympathetic nerve activity to the blood vessels during the rapid eye movement stage of sleep, compared to the waking hours, is thought to contribute to this. Therefore, chronic sleep disturbances such as SSD and poor sleep quality may then lead to a loss of the usual nocturnal drop ("dipping") in blood pressure as a result of decreased peripheral vascular resistance. The above, over time, may then result in prehypertension and subsequently hypertension.[35,36] Other pathways that may be activated with sleep disorders also seem to have direct consequences and include induction of oxidative stress via heightened production of myeloperoxidases and the action of activated neutrophils, interleukin-6, and tumor necrosis factor which are elaborated during a concomitant systemic inflammatory process.[4] These processes then eventually trigger other pathways that culminate in endothelial dysfunction, systemic hypertension, and dysglycemia.[4]

From our study, SSD emerged as the only significant predictor of prediabetes after other variables including age, systemic hypertension, and obesity were entered into a logistic regression model. Likewise, SSD again emerged as the only significant predictor for hypertension when other variables such as prediabetes, age, and obesity were subjected to logistic regression analysis. This suggests that SSD may be a more important risk factor for cardiovascular disease than obesity and even older age. Indeed, the proportion of women who were obese in the study was low (5.9%) and did not explain the relatively high prevalence of hypertension and prediabetes in them.

The strength of this study was that it was a community-based study carried out in a large population of rural women. The main limitation of the study was that the duration of sleep was self-reported by the women as they were asked by the interviewer to estimate how many hours of sleep they had on average in a night; a standard validated questionnaire was not used. This may have resulted in errors of estimation of actual hours of sleep due to poor recall. However, good agreement has been found in previous studies between self-reported sleep durations and those obtained through actigraphic monitoring.[37] The study was a cross-sectional study and as such cannot demonstrate causation. The lack of formal education in the majority of the respondents might have also affected recall. As it was only a 1-week recall, the self-reported SSD may be too short to be termed chronic and may, therefore, be difficult to link it up with chronic disorders.

This study has demonstrated SSD in more than a third of a cohort of rural-dwelling Nigerian women and it was a significant risk factor for the high prevalence of hypertension and also prediabetes in them. Further studies will be needed to include other sleep parameters including sleep quality to further define this risk in our population.

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Conflicts of interest

There are no conflicts of interest.

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