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Socio-economic and reproductive concomitants of abdominal adiposity and hypertension: A study on Bengali-speaking Hindu women of Habra, North 24 Parganas, West Bengal, India

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ABSTRACT: Obesity and hypertension have become a global epidemic among the women, especially as they experience additional stressful events compared to men. The epidemiology of these two metabolic disorders is regulated by various biological, socio-economic, reproductive and lifestyle factors related to women. However, inconsistency in the nature and magnitude of the effects of these traits indicates exploring the areas where little emphasis has been given. In this context, the present study attempted to determine the effect of socio-economic and reproductive traits on hypertension and abdominal adiposity among women living in the North 24 Parganas district of West Bengal, India. Data on socio-demographic and reproductive traits were collected from 319 adult women from both rural and urban sectors of Habra block I. Anthropometric measurements and Blood pressure levels were measured following standard protocols. Results highlighted that the prevalence of obese individuals and hypertensive individuals were 73.4 and 50.5 per cent respectively. Women with low income (OR=0.51) were at lower risk and post-menopausal women (OR=1.71) were at higher risk of developing abdominal adiposity. The risk of developing hypertension increased with higher educational attainment (OR=2.43). Post-menopausal women (OR=0.46) and shifting workers (OR=0.40) were at lower risk of developing hypertension. The risk also decreased with increased age (OR=0.96). Present study revealed that menopause is a significant event to predict abdominal adiposity and hypertension among Bengali-speaking Hindu women.

KEY WORDS: Pre-menopause, Abdominal obesity, Binary logistic regression, Waist-hip ratio, Urban-rural difference

Introduction

In the recent era of globalization, both obesity and hypertension have become the primary causes of large-scale pre-mature death annually and difficult health challenges due to rapid changes in environmental and lifestyle factors (Bloch

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2016; Kjeldsen 2018; Ghosh et al. 2018). The prevalence of both these epidemics are also noticeable in low-middle income countries such as India together with its' common occurrence in high income countries (Cruickshank et al. 1991; Bhopal et al. 1999; Wittchen et al. 2006; Petrukhin and Lunina 2011; Peltzer and Pengpid 2018; Lemogoum et al. 2018). Hence, it is understandable that both abdominal adiposity and hypertension, are more than just economy-dependent events and largely influenced by several biological, socio-economic and lifestyle factors such as age, ethnicity, socio-economic condition, dietary habit, health-abusive behaviours (consumption of alcohol, tobacco use) and so on (Bell et al. 2002; Misra and Khurana 2008; Ghosh et al. 2018). Especially among women, occurrence of abdominal adiposity and hypertension is much higher compared to men due to some additional internal stressors experienced throughout reproductive career (Amole et al. 2011; Kumar et al. 2016; Krzesiński et al. 2016; Hu et al. 2017; Kabwana et al. 2018).

Women exclusively undergo major hormonal changes throughout their reproductive period (menarche to menopause) and experience several events that result in the redistribution of the body fat and increase susceptibility of abdominal fat accumulation. Factors related to women such as early menarcheal age (Laitinen et al. 2001), increased number of pregnancies (Theodoro et al. 2012), high parity (Gunderson et al. 2008; Blaudeau et al. 2006), and the event of menopause (Pasquali et al. 1994) were also found to be associated with increased intra-abdominal fat accumulation and increased waist circumference along with socio-economic factors like age (Sidik and Rampal 2009), educational status, occupational status (Lahmann et al. 2000; Wardle 2002; Reas et al. 2007), food habit (Dastgiri et al. 2006), etc. However, the studies of Singh et al. (2017) and Kumar and Jabamalar (2018) opined that adiposity may eventually act as the concomitant of the development of high blood pressure or hypertension. A considerable number of studies also found that hypertension in women are associated with several other traits such as hormonal transition (Maas and Franke, 2009), menopausal age (Song et al. 2018), parity (Giubertoni et al., 2013), in addition to a number of socio-economic traits such as food habit, income and so on (Rosenthal and Oparil. 2000; Wang et al. 2012; Yang et al. 2014). Therefore, women are becoming vulnerable to developing both the metabolic syndromes that may lead to pre-mature death. Nevertheless, there is a cluster of studies pointing out that the nature and magnitude of the causal-effect relationship between these epidemics and possible factors are inconsistent (Blair et al. 1984; Dasgupta et al. 2012; Sen et al. 2013; Kshatriya and Acharya 2016; Gupta et al. 2018; Karmakar et al. 2019; Kshatriya et al. 2019). Despite a significant number of studies worldwide, there is a dearth of knowledge on how socio-economic and reproductive factors determine abdominal adiposity and hypertension among the women living in the district of North 24 Parganas of West Bengal.

In this context, present study attempts to explore whether any socio-economic or reproductive traits related to women determines the development of metabolic syndromes (abdominal adiposity and hypertension). The study, hence, presents two hypotheses that abdominal adiposity and hypertension in women are associated with (a) socio-economic traits and (b) reproductive traits of the women.

Materials and methods

Study design

Present study was cross-sectional in nature. It was carried out for three months including both urban and rural sectors adjacent to each other. The study aimed for a total enumeration of the study participants and performed a purposive sampling in order to get utmost number of volunteers for the study.

Area and population

'Betpuli' was the selected village (Rural) under 'Machlandapur-I Gram Panchayet' and 'Habra' and 'Ashoknagar-Kayangar' were the selected localities (Urban) under respectively *Habra* and *Ashoknagar-Kalyangar Municipality* respectively. All the study areas fell under Habra-1 block under the district of North 24 Parganas, West Bengal. The study areas were chosen for the convenience of fieldwork due to prior rapport with the municipality authorities and local people. The study population included only Bengali-speaking Hindu adult women.

Selection of study participants

Statistical sampling was not performed to avoid suspicion among the local people. However, purposive sampling helped to engage maximum number of volunteers for the study. Study included adult ever-married women who birthed at least one child. Based on that, a list was prepared from the voter's list of selected areas to identify possible participants. At first, all the enlisted women (n=451) were informed about the purpose of the study. Approximately 72 women refused to participate. Hence, 379 women volunteered for the study with written consent and were told to report whether they are on any medication regarding blood pressure. Approximately 60 adult women reported positively and were excluded from the study. Finally, data collection started taking the rest 319 adult women (response rate = 70.7 per cent) as the final participants.

Data collection

Data were collected in two parts by a single investigator. The first part included a set of qualitative data on socio-demographic and economic traits of women viz. age (in completed years at the time of interview), marital status, educational status, occupational status and monthly household income and so on. Age of the women was verified by voter's list and/or cross-verified with reference to local events. Additionally, data on reproductive traits viz. age at menarche, age at marriage, age during first child birth, age at most recent pregnancy, age at most recent live birth, use of oral contraception and menopausal status, were collected.

The second part included a set of quantitative data viz. height, weight, waist and hip circumferences and blood pressure. The measurements were taken following standard protocols (Weiner and Lourie 1981). Height was measured to the nearest 0.01 cm using Martin's Anthropometer. Weight was (with light apparel) measured using a standard analogue weighing machine. Both waist and hip circumference were measured by a flexible steel tape. Waist circumference was measured at the most lateral contour of the body between ribs and intestine. Hip circumference was measured at the widest portion of hip following standard techniques (Weiner and Lourie, 1981)

Waist-hip ratio (WHR) was calculated following the equation:

$$Waist - Hip\ ratio = \frac{Waist\ circumference\ (cm)}{Hip\ circumference\ (cm)}$$

Standard protocol was also maintained during blood pressure measurement. A mercury sphygmomanometer and a stethoscope were used to take blood pressure measurement following auscultatory method. Measurements of Systolic blood pressure (SBP) and Diastolic blood pressure (DBP) were taken three times from each of the participants before they joined their daily work. The participants were asked to sit comfortably on a chair for at least ten minutes before taking measurements. All the records were written by the measurer herself to avoid error and the average SBP and DBP values of each participant were used in analysis. Categorization of individuals according to blood pressure level was done following JNC-VIII (2015) classification (Table 1).

Table 1. List of dependent and explanatory variables and their categories used in the study

Name of the variable	Categories
Dependent variable	
Abdominal adiposity[α]	'Obese' coded as '1' 'Normal' coded as '0'
Hypertension status[β]	'Hypertensive' coded as '1' 'Non-hypertensive' coded as '0'
Explanatory variable	
Age (in years)	Continuous
Educational status	(1) <High secondary (2) ≥High secondary
Marital status	(1) Widow, (2) Married
Occupational status	(1) Homemaker (2) Shifting worker
Monthly household income (in Rs.)	(1) >25000.00 (2) ≤25000.00
Residential area	(1) Urban (2) Rural
Menopausal status	(1) Pre-menopause, (2) Post-menopause
Age at menarche	Continuous
Age at marriage	
Age at first child birth	
Age at most recent pregnancy	
Age at most recent live birth	
Oral contraception use	(1) Yes (2) No

α 'obese' = WHR≥0.81; 'normal' = WHR<0.81; β 'Hypertensive' = (SBP ≥140 mmHg and/or DBP ≥ 90 mmHg); 'Non-hypertensive' = (SBP <140 mmHg and DBP < 90 mmHg).

Data analysis and plan

Descriptive statistics such as frequency, mean and standard deviation (SD) were calculated to find the nature and distribution of the socio-economic, reproductive and anthropometric data. Stepwise regression analysis with backward method was performed to find out the effect of socio-demographic and reproductive traits on the development of abdominal adiposity and hypertension. The analysis removed least useful explanatory variable, one-at-a-time, until only the significant predictors remain. Odds ratio (OR) values represented the probability of an individual of experimental group to be 'obese' or 'hypertensive' compared to the reference group. All the statistical analysis was done using statistical package PASW (Predictive Analytics Software) version 18.0.

Causal pathway for abdominal adiposity and hypertension

The casual pathways of abdominal adiposity and hypertension with explanato-

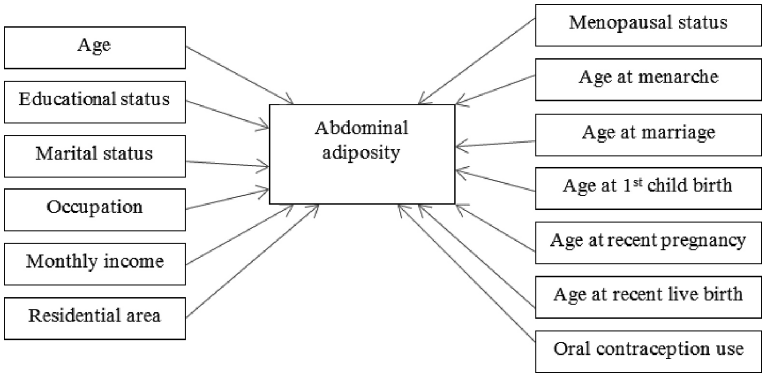

Fig. 1. Schematic diagram showing the pathway of relationship between abdominal adiposity and possible factors

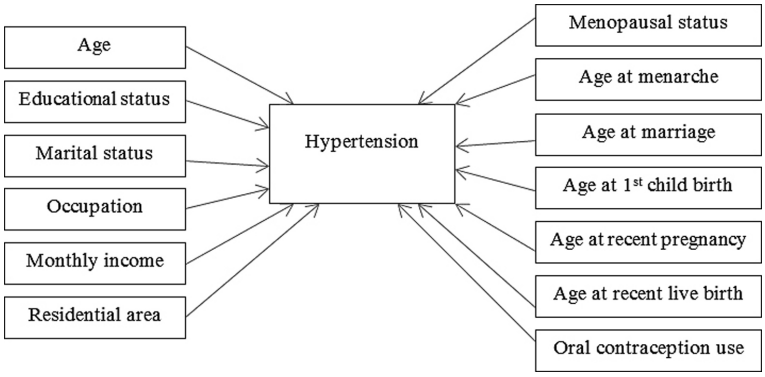

Fig. 2. Schematic diagram showing the pathway of relationship between hypertension and possible factors

ry variables collected in the present study have been explained in Figure 1 and 2. To identify the association, abdominal adiposity and hypertension have been separately used as dependent variables in analysis. A set of 6 socio-economic traits and another set of 7 reproductive traits were considered as explanatory variables for the analysis. Table 1 shows each of the variables and their categories.

Results

Socio-demographic, anthropometric and reproductive characteristics of study participants are presented in Table 2. Present study population had the mean age of 45.40 years. Around 74.0 per cent of the participants had educational qualification below higher secondary level (74.0%) and only 26 per cent had educational qualification above higher secondary. About 87.8 per cent of the participants were married while the other 12.2 per cent were widow. Only 20.7 per cent of the study participants pursued shifting works outside home. Around 75.2 per cent of them reported their monthly income to be below Rs. 25000. Around 67.7 per cent of the study participants were living in urban sector while 32.3 per cent of them were living in the rural sector.

The table also shows the mean values of anthropometric characteristics of the study participants. The mean value of height and weight of the participants were respectively 150.68 cm and 56.58 kg. Mean waist and hip circumference values were 82.58 cm and 97.23 cm, respectively. The mean systolic and diastolic blood pressure values were respectively 130.75 mmHg and 86.75 mmHg.

Finally, reproductive characteristics of the study participants are also presented in the same table. It shows that about 43.9 per cent of the study participants were post-menopausal women (PMW). Mean values of age at menarche was 12.94 years for the study participants. The mean age at marriage, age at first child birth, age at most recent pregnancy and age at most recent live birth were respectively 19.61 years, 21.63 years, 25.50 years and 25.48 years. Among the participants, only 16.9 per cent used contraceptive pills to prevent unwanted pregnancy.

Table 2. Socio-demographic, anthropometric and reproductive characteristics of adult females

Variables		Females (n=319)	
		n (%)	Mean±SD
Socio-demographic characteristics			
Age (in years)			45.40±7.24
Educational Status	<Higher secondary	236 (74.0%)	
	≥Higher secondary	83 (26.0%)	
Marital Status	Widow	39 (12.2%)	
	Married	280 (87.8%)	
Occupational Status	Homemaker	253 (79.3%)	
	Shifting Worker	66 (20.7%)	
Monthly household income (Rs.)	>25000	240 (75.2%)	
	≤25000	79 (24.8%)	
Residential Area	Rural	103 (32.3%)	
	Urban	216 (67.7%)	
Anthropometric characteristics			
Height (in cm)			150.68±5.77
Weight (in kg)			56.58±10.47
Waist Circumference (in cm)			82.58±10.51
Hip Circumference (in cm)			97.23±8.61
Systolic Blood Pressure in (mmHg)			130.75±12.72
Diastolic Blood Pressure in (mmHg)			86.75±10.54
Reproductive characteristics			
Menopausal Status	Pre-menopause	179 (56.1%)	
	Post-menopause	140 (43.9%)	
Age at menarche (in years)			12.94±1.37
Age at marriage (in years)			19.61±4.12
Age at first child birth (in years)			21.63±4.38
Age at most recent pregnancy (in years)			25.50±4.71
Age at most recent live birth (in years)			25.48±4.65
Oral contraception use	No	265 (83.1%)	
	Yes	54 (16.9%)	

The distribution of study participants according to their waist-hip ratio (WHR) and blood pressure is presented in Table 3. It shows that most of the study participants were centrally obese (73.4 per cent) whereas only 26.6 per cent of them were not. Around half of the study participants were hypertensive (50.5 per cent) while the 49.9 per cent of them were non-hypertensive.

Results of stepwise logistic regression of abdominal adiposity and hypertension in respect of socio-economic characteristics of the study participants are presented in Table 4. It shows that chance of developing abdominal adiposity was associated with only monthly income of the study participants (OR=0.51). Participants, who reported monthly income of less than 25000, were less likely to develop abdominal adiposity. Again, the chance of developing hypertension was associated with age (OR=0.96), educational status (OR=2.43) and occupational status (OR=0.40) of the study participants. Participants were less likely to be hypertensive with the increase in age. However, the chance increased in case of participants having above higher secondary educational attainment compared

Table 3. Prevalence of abdominal adiposity and hypertension in adult females with mean blood pressure level and waist-hip ratio

Variables		*n* (%)	Females (n = 319) Mean±SD		
			WHR[1]	SBP[2]	DBP[3]
Abdominal adiposity	Obese	234 (73.4%)	0.88±0.05	–	–
	Normal	85 (26.6%)	0.75±0.05	–	–
Hypertension status	Hypertensive	161 (50.5%)	–	138.96±10.55	94.08±8.93
	Non-hypertensive	158 (49.9%)	–	122.37±8.62	79.27±5.68

[1]WHR – Waist-hip ratio; [2] – Systolic blood pressure; [3] – Diastolic blood pressure.

Table 4. Logistic regression analysis of abdominal adiposity and hypertension in respect of socio-economic characteristics of the study participants

Independent variables		Stepwise logistic regression			
		Abdominal adiposity		Hypertension	
		OR[#] (95% CI)	*p*-value	OR[#] (95% CI)	*p*-value
Age (each additional year)		–	–	0.96 (0.93–0.99)	0.011
Educational status	<Higher secondary	Reference group			
	≥Higher secondary	–	–	2.43 (1.36–4.34)	0.003
Marital status	Married	Reference group			
	Unmarried/Widow	–	–	–	–
Occupational status	Homemaker	Reference group			
	Shifting worker	–	–	0.40 (0.22–0.75)	0.004
Monthly income (Rs.)	>25000	Reference group			
	≤25000	0.51 (0.27–0.97)	0.041	–	–
Residential area	Rural	Reference group			
	Urban	–	–	–	–
Model correctly predicted (%)		73.4		60.5	

[#]Odds ratio.

Table 5. Logistic regression analysis of abdominal adiposity and hypertension in respect of the reproductive characteristics of study participants

Independent variables		Stepwise logistic regression			
		Abdominal adiposity		Hypertension	
		OR# (95% CI)	*p*-value	OR# (95% CI)	*p*-value
Menopausal status	Pre-menopause	Reference group			
	Post-menopause	1.71 (1.02–2.93)	0.041	0.46 (0.29–0.72)	0.001
Age at menarche		–	–	–	–
Age at marriage		–	–	–	–
Age during first child birth		–	–	–	–
Age at most recent pregnancy		–	–	–	–
Age at most recent live birth		–	–	–	–
Use of oral contraception	No	Reference group			
	Yes	–	–	–	–
Model correctly predicted (%)		72.8%		59.7%	

#Odds ratio.

to their counterparts. Shifting workers had less chance to develop hypertension compared to homemakers.

In Table 5, logistic regression of abdominal adiposity and hypertension in respect to reproductive characteristics of the study participants is presented. It shows that menopausal status was the only factor associated with both the development of abdominal adiposity (OR=1.71) and hypertension (0.46). However, post-menopausal women (PMW) were at higher risk of developing abdominal adiposity but at lower risk of developing hypertension compared to pre-menopausal women.

Discussion

In recent decades, researchers found that women, compared to men, are extremely vulnerable for developing metabolic disorders such as abdominal adiposity and hypertension caused by additional biological stressors experienced during their reproductive career as well as their socio-economic, life style, psychological factors, etc. However, any generalization on the causal-effect relationship between these metabolic disorders and associated factors wasn't possible because of inconsistent findings. Therefore, present study is, perchance, the first to explore the association of socio-economic and reproductive factors with abdominal adiposity and hypertension among Bengali-speaking Hindu women of North 24 Parganas, where such issue has not been profoundly studied. The hypotheses, proposed earlier, were mostly rejected by the study findings. Following sections discuss the findings elaborately.

Effect of socio-economic traits on abdominal adiposity and hypertension

Majority of the women were found to be centrally obese with a mean WHR of 0.88 cm. This finding was in line with the previous findings by Cruickshank et al. (1991), Bhopal et al. (1999) and was much higher in proportion than the finding of Aoki and colleagues (2014).

The study found contradictory results compared to the studies of Zamboni et al. (1992), Sodjinou et al. (2008) and Luhar et al. (2018) showing no significant association of age, educational and occupational status with developing abdominal adiposity. Interestingly, study disclosed that monthly financial income was a significant predictor of women's chance of being centrally obese. Women with lower income had lower likelihood for developing abdominal fatness compared to their counterparts. This trend was however not in accordance with Yoon et al. (2006) as well as Sidik and Rampal (2009) who showed no association between income level and adiposity. Perhaps the reason women in the study area with lower income had lower risk to abdominal adiposity because it indicates women's involvement in wage earning through rigorous works for living. In case of hypertension, 50 per cent of the studied women were found to be hypertensive. Such high prevalence of hypertensive women was also reported by Suman and colleagues (2018) in a recent study. However, researchers like Todkar et al. (2009), Acharyya et al. (2014), Singh et al. (2017) as well as Cherfan et al. (2018) found otherwise. Socio-economic factors viz. age, educational status and occupational status were the significant predictors of hypertension among the women. These findings validated the works of Peltzer and Pengpid (2018) in reference to age and educational status but contradicted with Singh et al. (2017). Although Sobngwi et al. (2002) reported that urban women are at higher risk of developing hypertension, present finding found no association between residential area of women and development of hypertension.

Effect of reproductive traits on abdominal adiposity and hypertension

Present study population exhibited no association of reproductive traits with the development of abdominal adiposity and hypertension. Most of the reproductive characteristics of women showed no significant association with development of central abdominal adiposity. Women's age at menarche was a significant predictor neither for abdominal adiposity nor for hypertension among the women. Similarly, Liu et al. (2018) found no association between age at menarche and central abdominal adiposity. However, Roberta Ness (1991) in her study suggests that both early and late age at menarche were associated with fat accumulation in abdominal region. Even, several researchers showed significant association between early age at menarche and hypertension (Bubach et al. 2018; Liu et al. 2018; Guo et al. 2018) in their studies. Our study pointed out that neither marital age, nor age at child birth were significant predictors of abdominal adiposity and hypertension among the women. The findings were inconsistent with previous works of Kirchengast et al. (1999), Al Nsour and colleagues (2013) and Goli et al. (2015) who showed association of age at marriage and age at child birth with the development of abdominal adiposity among adult women. However, present study failed to incorporate any study showing association between marital age, age at child birth and hypertension.

Findings in the study revealed that menopausal status of women has a significant association with the development of both abdominal adiposity and hypertension. Consistent with the find-

ings of Zamboni et al. (1992), Tchernof and Poehlman (1998) as well as Toth et al. (2000) who pointed out that higher accumulation of visceral adipose tissue in post-menopausal women compared to pre-menopausal women is due to different hormonal changes, present study population also showed higher chance of developing central abdominal adiposity after attaining menopause. However, in case of hypertension, present study showed that post-menopausal women had lower chance of developing hypertension compared to pre-menopausal women. Although several scholars have postulated that post-menopausal women are comparatively more prone towards developing metabolic and cardio-vascular diseases due to hormonal transitions (Gordon et al. 1978; Staessen 1989; Rosano et al. 2007; Maas et al. 2010; Muka et al. 2016; Zhu et al. 2019), the work of Scuteri (2001) validates present finding. However, in some studies blood pressure level remained within normal range even after women attended menopause (Casiglia 1996; Luoto 2000). Lastly, present study tried to investigate if oral contraceptive use has any effect on abdominal adiposity and hypertension among women. The study, however, found no effect between them similar to Stampfer et al. (1988) but contradicted with the studies Chasan-Taber (1996) and Abdollahi et al. (2003).

Conclusion

The present study highlighted that few but not all the socio-economic and reproductive traits were responsible for the development of abdominal adiposity and hypertension among the studied population. Interestingly, menopause was found to be a significant event to determine the risk of these two metabolic disorders. The event of menopause is not a health risk itself but the women should be monitored regularly while attaining or going through the menopausal phase along with maintaining suitable lifestyle. It could reduce the chance of fat accumulation among them. Similar to an ample number of studies, present findings were sometimes in line with previous literatures and sometimes not. However, the prevalence of hypertension in present study comes as warning to policy makers as it exceeded the predicted prevalence (23.6%) of hypertension by 2025 (Anchala et al. 2014). Policy makers should introduce vital intervention programs to reduce the prevalence rate and ensure better health among women.

Limitations

We limit ourselves to draw any conclusion due to the cross-sectional nature of the study. The sample size is sufficient for this small-scale study. However, funding restrain and time limitation make it difficult to include larger sample size and follow purposive sampling which may also be responsible for some selection bias. It is further suggested to include several other potential concomitants such as physical activity, diet and so on to reveal more significant findings. Future studies should consider all lacuna in order to get better insight on the present issue.

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Authors' contribution

The concept and design of the study was initiated by ARB. SD solely collected the data. AM analysed and interpreted the data and participated with AG and IB in preparing the manuscript and prepared draft versions of the manuscript. All the authors went through the manuscript prior to the proceeding for publication.

Conflict of interest

The authors declare that there is no conflict of interest.

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