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The associations between BMI, body appreciation, body image flexibility, sleep duration and loneliness in workers in southern China

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Abstract

Background Loneliness is a growing public health problem worldwide that can affect mental and emotional health and increase mortality. This study examined the relationship between body mass index (BMI), body image flexibility, body appreciation, and loneliness among Chinese workers, aiming to propose effective measures for reducing loneliness and promoting mental health.

Methods A total of 464 workers were recruited for this study. Participants completed the Chinese version of the Body Image Acceptance and Action Questionnaire, the BMI measure, a Standard Chinese translation of the Body Appreciation Scale, and the Chinese version of the short-form UCLA Loneliness Scale (ULS-8). Statistical analyses were performed using SPSS.

Results There were gender differences in body appreciation and body image flexibility scores were observed. Loneliness levels were higher among female workers than male workers. Male workers scored higher than female workers in body appreciation. Female workers scored significantly higher than male workers in body image flexibility and loneliness. Based on multiple regression analyses of the factors affecting loneliness scores, body image flexibility score ($\beta = -0.19, p < 0.01$) and body appreciation score ($\beta = -0.25, p < 0.01$) were significant predictors of loneliness.

Conclusion As middle-aged individuals exhibit higher levels of loneliness. Policymakers should prioritize workplace mental health programs that combine body positivity workshops, sleep hygiene education, and peer support networks. For example, incorporating body image flexibility training into existing employee wellness programs to reduce isolation. In addition, public campaigns to combat weight stigma, such as media literacy programs, are urgently needed to address the social factors that contribute to loneliness.

Keywords BMI, Loneliness, Body appreciation, Body image flexibility

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Background

With economic development and an accelerated pace of life, loneliness is gradually becoming a serious threat to human mental health [1]. To date, the largest study to assess loneliness—the BBC Loneliness Experiment—surveyed approximately 55,000 people aged 16–99 years, in 237 countries, islands, and regions. The results showed that 40 per cent of 16–24 year-olds felt lonely, with the proportion reaching 27 per cent among those aged 75 years and older [2]. Another study with 26,342 Dutch adults found that the prevalence of loneliness among 19–65-year-olds was between 40 and 48 per cent [3]. Loneliness is also widespread among Chinese adults. A survey of loneliness and mortality among 14,072 adults aged 65 years and older found that approximately 28 per cent of older Chinese people reported feeling lonely [4]. Loneliness can have several negative outcomes, including increased risk of physical deterioration [5], and increased rates of mental illness [6] and mortality [7]. Therefore, reducing loneliness is particularly important in the context of a fast-paced life.

Loneliness, as a subjective experience, generally arises when one perceives one's relationships as inadequate in some way [8]. Loneliness is also associated with a negative body image. A negative body image may reduce people's desire and confidence in going out and communicating with others [9]. Additionally, people with a negative body image may feel ashamed to express themselves to others [10]. Therefore, promoting a positive body image may have important implications for reducing loneliness.

Similar to body image, body image flexibility must be considered. Body image flexibility is a positive body image component of one's ability to openly experience thoughts or feelings about one's body without acting on or attempting to avoid or change those thoughts [11]. A recent meta-analysis explored body image flexibility and its relationship with 19 psychological factors. Significant positive correlations were found between body image flexibility and general psychological constructs such as psychological flexibility, self-esteem, and well-being. Further, significant negative correlations were found between body image flexibility and general psychopathology (i.e., depression/anxiety symptoms and general psychological distress) [12]. These findings suggest that people who are better able to cope with negative internal experiences related to their bodies are less likely to suffer from psychological problems. Thus, body image flexibility may be an important predictor of loneliness.

Likewise, body size may be an important predictor of loneliness. Previous studies have shown that individuals with obesity are more likely to have a negative body image. A study of body mass index (BMI) and body image among 313 middle-aged and older adults in China

showed that individuals with obesity had higher levels of body dissatisfaction and were more likely to develop a negative body image [13]. Another study among 687 adult Instagram users showed that a positive body image affects body exposure, such that individuals with obesity or those who are overweight, who care more about evaluating and appreciating their own bodies, and are more likely to have a negative body image than those who are underweight or of normal weight [14]. Moreover, individuals without obesity may have better body image flexibility than those with obesity. A study on the relationship between self-compassionate regulation of BMI, eating disorder pathology, and body image flexibility in 153 adult Canadian women, the found a negative correlation between BMI and body image flexibility [15].

Sleep is a fundamental biological process critical to human health and performance. Recent evidence suggests that sleep deprivation is associated with loneliness. A study on bidirectional associations between sleep and psychosocial functioning found a strong relationship between loneliness and sleep quality over time [16]. Another study showed that being socially active is associated with better sleep quality [17]. Therefore, we speculated that psychosocial functioning, such as loneliness, may be correlated with sleep quality. In an experiment with 18 healthy adult participants, the results suggest that sleep deprivation causes individuals to become more socially withdrawn and maintain greater social distance from others, leading to a higher sense of loneliness [18]. These findings provide a theoretical and practical basis for the current study, making our results more reliable. According to a recent study by the CDC, over one-third of American adults do not sleep sufficiently on a regular basis [19]. In China, a survey on the health and nutrition of the population in nine provinces showed that both adolescents and adults have a high rate of sleep deprivation, which is increasing [20]. Although sleep deprivation is a global problem with serious public health implications, its severity is often not recognised. Therefore, we investigated sleep deprivation not only to better alleviate feelings of isolation but also to emphasise the adverse impacts of sleep disorders.

Loneliness predominantly affects adolescents and older adults. A large body of research focuses on the prevalence and negative consequences of loneliness among these demographics [21, 22]. However, middle-aged individuals have not been adequately studied. Middle age is an important stage in the development of individuals' efforts to establish and maintain a community with family members. A study of loneliness in China among 3,899 respondents showed an inverted U-shaped trend between age and loneliness, with loneliness peaking at 47 years and declining thereafter. Thus, middle-aged individuals are more likely to be at greater risk of loneliness

as society often undergoes rapid change, such as starting a job and shaping a career or professional identity [23]. Therefore, reducing loneliness among middle-aged individuals has become an urgent public health concern. This study's primary aim was to investigate the current status of loneliness, body image, and body image flexibility among factory workers in southern China, and analyse their impact on workers' sense of loneliness.

Methods

Participants

We sent an invitation letter to a factory in a district of Ganzhou City, Jiangxi Province, China, and 523 workers (77 men and 446 women) agreed to participate in the study. All participants provided informed consent for the required measurement and survey completion procedures.

Body image flexibility

The Body Image Acceptance and Action Questionnaire [24] was used to investigate factory workers' body image flexibility. The scale comprises 12 questions assessing body image flexibility. Respondents rate each item on a 7-point Likert scale ranging from 1 (never true) to 7 (always true). Items are reverse-scored, with higher scores indicating higher levels of body image flexibility. The Chinese version of the Body Image Acceptance and Action Questionnaire (C-BI-AAQ) was translated and validated following established protocols. First, three bilingual health psychologists independently translated the original English BI-AAQ into Mandarin. A fourth translator, blinded to the original scale, performed back-translation. Discrepancies were resolved through consensus. The final version was pilot-tested with 10 psychology undergraduates to assess clarity and cultural relevance. Psychometric validation confirmed a unidimensional structure (CFI = 0.95, TLI = 0.94) and high internal consistency ($\alpha = 0.95$). This process ensured linguistic accuracy and conceptual equivalence to the original instrument.

Body appreciation

The 10-item Body Appreciation Scale [25] was used to assess participants' body appreciation scores. All items are rated on a 5-point scale ranging from 1 (never) to 5 (always). The overall body appreciation score is calculated as the mean of all 10 items.

BMI

BMI was calculated based on measured weight and height, that is, the square ratio of weight to height (kg/m^2). Weight was measured using a calibrated digital scale. Height was measured using participants' heels and backs on a height scale. The body measurements were

performed by MH who is experienced in experience. These instruments have been widely used in the world.

Loneliness

Loneliness was assessed using the UCLA Loneliness Scale [26], a 8-item self-report measure of loneliness. Items 1, 2, 4, 5, 7, and 8 are scored as never (1 point), rarely (2 points), sometimes (3 points), and always (4 points). Items 3 and 6 are reverse scored as never (4 points), seldom (3 points), sometimes (2 points), and always (1 point). The total loneliness score, ranging from 8 to 32, is the sum of the scores of all items, with higher scores indicating greater loneliness.

Results

Figure 1 presents the differences in loneliness scores according to body size ($p < 0.05$). Table 1 presents participants' characteristics. Participants' mean age was 50.2 years. Body appreciation and body image flexibility scores differed based on gender (Table 2). Loneliness levels were higher among women than men. Men scored higher than women in body appreciation. Women scored significantly higher than men in body image flexibility and loneliness.

Multiple regression analyses of the factors affecting loneliness scores revealed that body image flexibility ($\beta = -0.19$, $p < 0.01$) and body appreciation ($\beta = -0.25$, $p < 0.01$) scores were significant predictors of loneliness (Table 3).

Discussion

A previous cross-sectional survey among 1,979 Chinese workers showed that 18.3 per cent of the workers felt lonely on a regular basis [27]. This is similar to our results. Another study on the increased prevalence of loneliness and associated risk factors during the pandemic found that the adjusted prevalence of loneliness increased to 50.5 per cent during the pandemic, which is higher than our findings [28]. The likely reason for this is gender bias due to differences between Chinese and Western cultures, with men often hesitant to report loneliness [29]. Exposure to unfavourable work stressors, which can negatively affect mental health, may also affect loneliness risk [30]. Therefore, the risk of loneliness can be reduced by managing and reducing work stressors, improving work quality, and addressing the negative impacts of perceived work stressors.

Our findings suggest significant differences in loneliness levels at different BMIs, with higher loneliness scores for those with higher BMIs. This is consistent with the results of previous studies that have revealed associations between higher BMI and increased loneliness [31]. However, it is straightforward to note that while higher BMI is associated with loneliness, this relationship is likely to be mediated by weight-related stigma rather

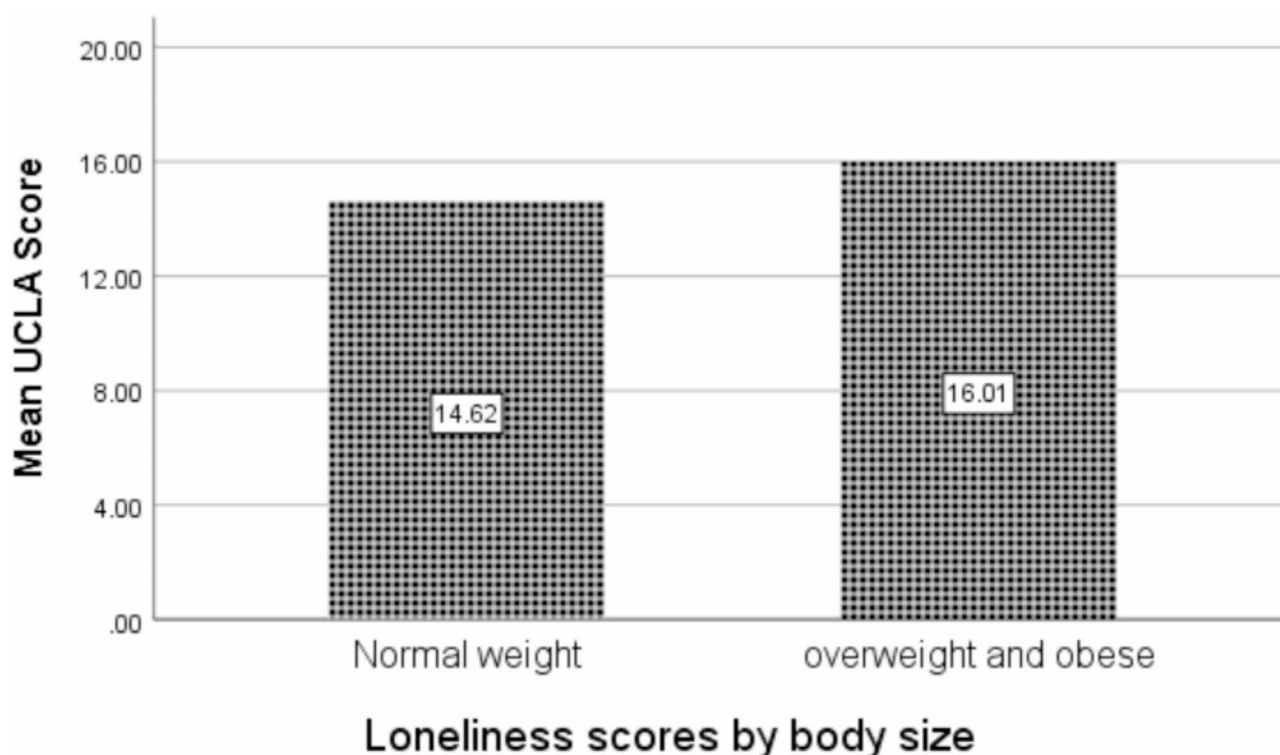


Fig. 1 Loneliness scores by body size. * t-test, $P < 0.05$

Table 1 Characteristics of the study subjects

	Mean	SD
Boys ($n = 72$)		
Age	57.3	1.5
BIAAQ score	64.3	2.4
BA score	3.9	0.1
BMI	23.8	0.4
Loneliness score	16.0	0.5
Girls ($n = 392$)		
Age	48.5	0.5
BIAAQ score	66.1	0.7
BA score	3.7	0.4
BMI	24.0	0.2
Loneliness score	16.8	0.2

Table 2 Gender differences

	Mean \pm SD	
	Boys ($n = 72$)	Girls ($n = 392$)
BIAAQ score	64.3 \pm 2.4	66.1 \pm 0.7**
BA score	3.9 \pm 0.1	3.7 \pm 0.4**
BMI	23.8 \pm 0.4	24.0 \pm 0.2
Loneliness score	16.0 \pm 0.5	16.8 \pm 0.2

** t-test, $P < 0.01$

than BMI itself. Loneliness is exacerbated by the fact that people with a higher BMI often face social exclusion and discrimination [32]. For example, due to cultural differences between East and West, commenting on another

Table 3 Factors that contributed to loneliness ($n = 464$)

	β	t	VIF	P
BIAAQ score	-0.19	-3.79	1.09	< 0.01
BA score	-0.25	-5.11	1.05	< 0.01
Ideal weight (kg)	-0.17	-3.20	1.28	< 0.01
Actual weight - ideal weight	-0.11	-1.71	1.93	> 0.05
BMI(Normal 0 Obese 1)	0.20	3.00	2.02	< 0.01
Usual actual sleep time (hours) per night in the last 1 month	-0.17	-3.53	1.03	< 0.01
Age	0.02	0.25	2.21	> 0.05
Sex (Man: 0; Female: 1)	-0.10	-1.23	2.27	> 0.05

R²: 0.2; $P < 0.01$; RMES: 3.81.

person's body size is seen as a form of harassment in the West, whereas in Asia weight-based teasing is culturally normalized and directly affects self-esteem and social participation [33]. Therefore, interventions should target societal attitudes towards weight, not just BMI. At the same time, people with higher BMI are more vulnerable to psychological harm and develop low self-esteem and anxiety than those with normal weight due to their lower levels of body appreciation and self-esteem [34], which undoubtedly affects their ability to establish and maintain interpersonal relationships, which can lead to feelings of loneliness. Obesity and loneliness appear to be linked through negative synergistic effects on physical and emotional health. Some studies have suggested that loneliness may increase obesity by negatively affecting sleep quality.

Specifically, sleep quality may be disturbed by eating too much at night and waking up during the night owing to food intake, a symptom that also occurs in obesity [35]. Therefore, predicting weight as an intervention influencing loneliness should be further explored. A survey of Chinese university students' attitudes towards body image showed that only 12.9 per cent of participants were satisfied with their bodies [36], suggesting that most Asian people are not satisfied with their current body shape, which forces them to be more demanding and creates pressure. Additionally, in China, the definition of beauty has gradually shifted, with some defining beauty as 'paper thin' [37]. This seems to have derailed the Chinese standard for ideal body type. This shows that BMI is not the direct cause of increased loneliness in most cases, but may be due to a variety of reasons such as social weight stigma, self-esteem, and social pressure. Therefore, social support and attention to obese people should be increased to better reduce the level of loneliness in this population.

The results of this study indicate that higher body appreciation scores are associated with less loneliness. This is consistent with the results of a meta-analysis of 240 papers published worldwide that found that body appreciation was negatively correlated with general psychopathology and positively associated with better mental health [38]. A study of body image issues among 11,620 men and women from different countries showed that higher body weight was negatively associated with body image satisfaction [39]. Another cross-sectional survey of 353 older adults aged over 59 years in the United States revealed that body image satisfaction exhibits a strong negative relationship with loneliness, and that middle-aged and older adults are likely to experience greater loneliness, which may indicate that this population may be more aware of age-based stigma [40]. Higher levels of stigma may reduce the amount of time a person spends outdoors and their subjective willingness to interact with others, thereby increasing loneliness [41]. However, few studies have been conducted on this topic in China. Thus, we examined Chinese middle-aged and older adults and found results consistent with those in Western countries.

Overall, the findings suggest that people who can face and accept negative body-related inner feelings are less likely to exhibit general psychological problems and more likely to exhibit adaptive thinking and pursue healthier behaviours [42]. Individuals with high levels of body appreciation are more resistant to sociocultural stressors [43]. One study suggested that higher body appreciation is a protective factor against body dissatisfaction [44]. New research data also suggests that physical appreciation may lead to better mental health outcomes over time [12], suggesting that body appreciation may be an

appropriate target for intervention. Therefore, increasing levels of body appreciation can be an effective intervention for reducing loneliness.

A meta-analysis of 62 studies on body image flexibility and its correlates found that body mass may influence the relationship between body image flexibility and psychological constructs, and that it is worse in people with higher body weights. In many Western cultures, lower body weight is glorified and often conflated with health and well-being, whereas higher body weight is often stigmatised, punished, and equated with ill health [45]. Another study interviewed 258 female participants using a web-based survey, and found that greater body image flexibility was a protective factor against eating disorders for those with low BMIs [46]. These studies explain our experimental findings. As body image flexibility is an important factor influencing loneliness, our findings reveal a potential target for early intervention in populations at risk of lower body image flexibility.

Many studies have shown that body dissatisfaction may also negatively impact body image flexibility. A recent meta-analysis explored body image flexibility and its relationship with 19 different psychological correlates [12] and found a significant positive correlation between body image flexibility and positive general mental constructs. Additionally, body image flexibility exhibited significant negative correlations with body image concerns, desire to be thin and general psychopathology, consistent with our findings. Thus, body image flexibility can be controlled by mediating body intention, diet, and obesity to reduce loneliness. An analysis of the results from the German Ageing Survey showed that loneliness increases owing to obesity episodes [47]. Another study on the relationship between obesity and social withdrawal syndrome in 103 adults showed that loneliness was higher in individuals with obesity [48]. Body image dissatisfaction is also associated with increased loneliness [49]. Therefore, improved body image, diet, and obesity can be used to reduce the negative effects of reduced flexibility of body image.

From our findings, we can see that males have higher body appreciation scores, which is consistent with previous research [50]. Interestingly, however, we also found that females had higher body image flexibility scores. There has been a significant amount of research showing that body image flexibility is usually positively correlated with self-esteem [51], as well as significant differences in societal standards and expectations of body image for men and women. Under the influence of the mainstream cultural concept of thinness as beauty, women have been in a long-term comparison of appearance [52], as well as the fashion media and advertisements that constantly instill a single aesthetic standard in women, which makes women perceive their own bodies more dynamically in

order to cater to external expectations, and thus show higher body image flexibility [53, 54]. However, this process does not raise women's level of self-esteem, but rather puts them in a cycle of constant critical thinking about their own bodies. Because no matter how hard they try, there will always be a gap between reality and the standard of perfection portrayed by the outside world, this may lead to increased dissatisfaction with their own bodies and lower levels of body appreciation among women. Men, on the contrary, are encouraged to show strength and confidence. This gender role expectation prompts them to view their bodies as symbols of strength and competence, which contributes to higher self-esteem [55] and also leads to higher levels of body appreciation. This suggests a complex interactive relationship between body appreciation, body image flexibility and self-esteem, and subsequent studies could further explore the mechanisms of action between these factors in order to gain a more comprehensive and in-depth understanding of the differences between men and women in body appreciation and body image flexibility. The contradiction between female body image flexibility and body appreciation may imply that there are moderating factors for the positive relationship between body image flexibility and self-esteem across genders, and future studies may consider incorporating socio-cultural factors, gender role concepts, etc., as moderating variables to further explore the complex relationship between body image flexibility, self-esteem and body appreciation.

The results of our analyses suggest that those who feel lonely often experience sleep problems, and sleep duration is negatively correlated with loneliness. This is consistent with results of previous studies. In a study using a repeated-measures counterbalanced design to assess the effects of sleep deprivation on social behaviour and loneliness, an experiment with 18 healthy adults showed that sleep deprivation leads to the expression of loneliness behaviours, such as avoiding social interaction and maintaining a greater social distance from others. Moreover, when individuals with sleep deprivation interact with healthy individuals, even through brief one-minute interactions, healthy individuals feel lonelier, which is similar to a viral transmission that greatly increases the loneliness and rejection of individuals with sleep deprivation [18]. A 4-year study on the correlation between sleep problems and duration and loneliness in 5,698 older people aged 50 years and over showed that increased loneliness was strongly associated with increased odds of reporting sleep deprivation and subsequently triggered more sleep problems [56]. Thus, sleep deprivation can adversely affect both individuals and others, and that these harmful effects worsen the longer they persist. On the other hand, excessive loneliness may in turn lead to decreased sleep quality. For example, Cacioppo et al.'s

model of loneliness hypothesizes that lonely individuals perceive the world as more threatening. Consequently, lonely individuals are likely to also experience higher levels of perceived stress and more trouble in their daily lives, which may affect the subsequent quality of sleep [57], while suffering from prolonged social isolation may also lead to circadian dysregulation by lowering melatonin levels [58].

Bidirectional causality is therefore plausible and greatly enriches our understanding of the complex relationship between sleep duration and loneliness. On the one hand, sleep deprivation may lead to poor social performance and gradual isolation, which in turn exacerbates loneliness; on the other hand, psychological stress and physiological problems associated with social isolation may, in turn, affect sleep quality. Future longitudinal studies are needed to clarify these relationships, while improving sleep hygiene and social connectedness could extend the effects of interventions.

With China's socioeconomic development, the work pressure on adults is increasing. This study's sample primarily comprised ordinary factory workers who are under even more pressure from family and society and represent the majority of the Chinese population. Most current research is devoted to exploring the relationship between sleep quality and loneliness. Studies on loneliness and sleep in young people have revealed associations of only subjective sleep quality and daytime dysfunction with loneliness [59, 60]. However, the dimensions of the PSQI scale have not been explored among middle-aged and older adults in China. This study filled this research gap by exploring sleep duration among this demographic. A previous study was conducted in China on the associations of perceived stress with loneliness and depressive symptoms and the mediating role of sleep quality; cross-sectional data from 734 participants (aged 18–87 years) were analysed, and the results suggest that stress is positively associated with loneliness among Chinese adults, and that sleep quality mediates these associations to some extent [61].

Limitations

This study has some limitations. Firstly, the sample size of the study was small and included only a portion of the middle-aged population. In addition, since this is a cross-sectional study, causal inferences cannot be made. In addition, this study only investigated the South China region. Therefore, future work should investigate and compare the population size in northern China.

Conclusion

This study provides important clues to the behavioural mechanisms underlying the relationship between stress and loneliness, and suggests that interventions should

focus on sleep duration to reduce loneliness and promote psychological well-being among those who are stressed. It also highlights the representativeness of our participants and supports the development of mental health promotion strategies for the Chinese population.

Abbreviations

BMI Body mass index
BIAAQ The Body Image Acceptance and Action Questionnaire
BA Body appreciation

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Author contributions

JCZ: Data collection, data analysis, and manuscript writing; CMW: Data collection, Study design and data analysis; YFG: Study design, and data analysis; MH: Study design, data collection, data analysis, manuscript writing, and funding acquisition; XKZ: Study design, data collection, and funding acquisition.

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Data availability

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the ethics committee of the Gannan Medical University, China, No: 2021110. This study was conducted according to the guidelines in the Declaration of Helsinki, and all study participants provided informed consent, agreeing to the required measurement and survey completion procedures. All methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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