

## A structural equation model of sports participation, body image and body fat rate in college students

Nan XU<sup>1</sup>, Fiona TIMMINS<sup>2</sup>, Yuexian TAO<sup>3</sup>

*Affiliations:*

<sup>1</sup> Hangzhou Normal University; Lecturer, Quzhou College of Technology, Quzhou, China.  
E-mail:13505701533@163.com. ORCID:0000-0001-7357-1806.

<sup>2</sup> UCD School of Nursing, Midwifery and Health Systems, UCD College of Health Sciences, Dublin, Ireland. E-mail: Fiona.timmins@ucd.ie. ORCID:0000-0002-7233-9412.

<sup>3</sup> Nursing School, Hangzhou Normal University, Hangzhou, China; E-mail: 934299381@qq.com.  
ORCID:0000-0003-3568-7423.

*Corresponding Author:*

\*PhD. Yuexian Tao, Nursing School, Hangzhou Normal University, No.2318 Yuhangtang Road, Hangzhou, China. Email: 934299381@qq.com.

### Abstract

**Introduction:** Being overweight is a global health concern, that is especially important for nursing and health students who need to role model healthy lifestyle. This study aimed to explore the relationship between the perceptions of body image, sports participation, and body fat rate among university students in China.

**Methods:** Biological measurements of body fat accompanying with a questionnaire survey was used. Data were collected at a university in the Zhejiang province of China. A convenience sample recruited 539 university students, mostly health sciences students. Body fat rate was estimated using a body composition analyser. Questionnaire included a multidimensional body-self relations questionnaire and a physical activity rating scale. 503 questionnaires were returned rendering a response rate of 93.32%.

**Results:** The structural equation model shows that body image and exercise participation have a direct effect on the body fat rate of college students, and the normalized values are -3.37 and -6.81 respectively. Positive body image and more exercise participation were found to be associate with lower body fat rate.

**Conclusion:** Rising obesity levels need consideration in terms of nursing students in the university environment. More attention needs to be given to health promotion interventions for this cohort.

**KEY WORDS:** Body fat rate; body image; college students; sports participation; structural equation model.

## INTRODUCTION

Personal health has historically been of significant importance to health care students. Nurse educators for example have long established standards in relation to health requirements. There are many historical reasons for this, for example a 'health and character requirement' [1–2] that demonstrate their suitability for their chosen career. Certainly nursing students with medical conditions or disabilities are not necessarily prevented from enrolling [3], rather there are certain mandatory health requirements to reduce or prevent unnecessary risks to the person or patients [1]. There is also a general concern in nursing with health and safety in relation to the acquirement of infections, or work related injuries [2, 4] either through personal ill health or acquired ill health through injuries or due to age [5]. In the past occupational health screening for nursing students upon entry was common and today many nursing schools internationally require either screening or a self-declara-

tion of health. Historically nurses needed to be strong enough to take on the physical burden of nursing work [6], and factors that might interfere with physical ability, such as obesity, were a frequent reason for not gaining a place on nursing programmes [7]. One retrospective study in the 1990s for example found that the most common reason for rejection prospective nursing students was a high BMI ( $>30\text{kg/m}^2$ ) indicating obesity [7]. Such practices would be likely deemed discriminatory in today's environment, given legislative and policy changes, unless there were impediments to practicing safely. Indeed these researchers did express concern with singling out obesity as barrier to enrolment, although the rationale for this exclusion was unclear. However they suggested it might relate to health risks and questioned why other risks such as smoking were overlooked [7]. However at the same time maintaining a healthy weight, exercising and keeping fit supports a fitness that is useful where physicality is a required as part

### TAKE-HOME MESSAGE

*This study showed that positive body image and increased exercise participation were found to be associated with lower body fat rate among health sciences students. To reduce the incidence of obesity in college students, encouraging them to become involved in exercise and positive body image events should be strategically introduced by the educators.*

**Competing interests** - none declared.

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of the job and this can serve to prevent musculoskeletal injuries [8]. Indeed recent interviews with nurses revealed 'weight' as a particular risk for developing musculoskeletal injuries [3, 9]. Certainly there is a great deal of discussion currently about obesity among nurses and how to prevent it [9]. At the same time there are global concerns about obesity [10]. Indeed an obesity epidemic is predicted, with rates having tripled since the 1970s. Obesity is a contributory factor in several health disorders including cardiovascular disease, diabetes and cancer [10]. It is largely preventable, and occurs as a result of increased intake of energy rich, high fat foods and reduced activity [10]. Increasingly there is concern about nurses' lifestyle and increasing obesity [10–12]. Examples of interventions are encouraging cycling, hosting exercise facilities and providing low fat foods and healthy eating choices at hospital sites [11]. It is estimated for example that a quarter of all UK nurses are obese and while not necessarily above the population average, there are concerns among nurses themselves particularly as they feel it conflicts with their role as health promoters educating others to eat healthy [9]. Indeed there is currently concern in the UK at a national level about nurses' obesity [13]. In 2018 the Nursing Standard survey confirmed these statistics and further blamed limited access to healthy food, especially those working at night or in the community, along with long working hours and short breaks (leading to rushing food) [14]. Earlier on Miller et al [15] and Han et al [16] found that more than half of their US nurse sample were obese. Working long hours appeared to be correlated with weight gain [16, 17]. Thus despite being an active job, factors within the healthcare environment serve to contribute to being overweight. Indeed it is an irony that healthcare environments may not necessarily be promoting the health of their staff. Being overweight is also stressful for nurses as they can find their duties overly demanding as a result [9] and they are known to frequently diet to try to

control this [14]. Work situations that contribute to this are also frustrating [18]. Additionally there is known prejudice towards obese people both within the profession, including nursing students [19, 20] and among the public, which could affect these nurses' self-esteem. Increased body fat leads to negative emotions, and poor self-image which can in turn increase food intake and thus raise body fat [21]. Therefore a vicious cycle occurs, which can be compounded by the negative attitudes of others. Recent weight management advice for nurses focuses on tackling these issues by encouraging nurses to recognise the issue, take a more relaxed eating style, take regular exercise, and calling for an increase in healthy workplace environments and 'becoming a healthy role model' [22]. Nurses are expected to be health educators and promote health, and this is one reason for this concern. Although these are expected competencies, developed throughout undergraduate nurse education programmes, the focus of these is on the demonstration of these competencies in relation to patients, and not on personal lifestyle. While there has been some attention within the literature to nurses' smoking habits, and their effectiveness as health promoters as a result [12], there is less focus on the implications for weight gain or obesity. However one nurse reported a turning point in her life when confronted by a patient (whom she was educating about the need to lose weight) about her obesity [23], thus highlighting the effect of such characteristics on patients and the possible need to address this issue. Worryingly despite public awareness of the risks associated with obesity, and the felt need for nurses to be strong role models in this regard, recent studies of nursing students revealed poor understandings of the risks associated with obesity and low personal exercise levels [24]. The literature reveals a great concern with promoting the role of nursing students as educators to prevent obesity [25], determining nursing students attitudes to obesity [26, 27], or redressing nursing students' negative attitudes

towards patient obesity [19, 20] and recognising the importance of education about obesity management and prevention in a non-biased way [28]. However, despite this evidence, robust interventions that educate nursing students about patient obesity management are sparse [29], with little health promotion initiatives for nursing students emerging. Of particular concern is that some studies of nursing students found that more than half were overweight and less than one quarter took regular exercise [30]. Similarly, exercise levels among qualified nurses is reported as low [31]. Nursing students face particular challenges in terms of lifestyle. In addition to being part of the healthcare workforce and thus possibly experiencing the rushed meal breaks and limited supply of health food options, they are also liable to the pressures of college life that can lead to unhealthy lifestyle. Weight gain for example is common, particularly among first year nursing students [32]. Indeed the physical activity level of college students is known to decline [33]. Improvements in nursing students' health behaviours have been demonstrated following a curriculum based health-focused intervention [32]. However more is needed to raise awareness about this issue for nursing students. Nursing students entering the university are challenged on several levels with regard to their health. They experience the challenges of university life, but also work the long hours that nursing practice requires. Often the demands of their programmes means that they cannot avail of the university exercise facilities [32]. At the same time some faculty staff are beginning to demonstrate concern: "Nursing students need to understand the importance of personal health and wellness, even before they enter the profession, allowing them to adopt healthy lifestyle behaviors and better prepare them for the demands of the nurse role. As a faculty member, you play an important part in this process and have the opportunity to model healthy behaviors" [34, p. 54]. While traditionally concerns about obesity

and weight gain were not common in China, recent improvements in the economy and living standard, has meant that increasingly young people in China experience obesity. Moreover Chinese students place an exceptionally high value on academic performance, rating physical achievements as somewhat inferior to this. These cultural features, along with growing concerns about weight gain, means that university students are at risk of weight gain, and potentially limited engagement with the rich variety of sports activities that university education provides. Little is known about this subject area and thus this research surveyed college students in one university in China in order to understand more about this topic.

## METHODS

### *Study population*

539 college students in a university in China were recruited through convenience sampling from May 2017 to March 2018. As the device to measure the body fat was located in the university and the full list of all students and their emails was not obtained, so a convenient sample was used.

### *Study design*

This mixed method study involved body fat measurement and completion of a survey, which included a general demographic questionnaire; a multidimensional body image scale and a physical activity rating scale. The questionnaires were distributed and collected by researchers within the university.

### *Study instruments*

#### *The body composition meter*

In this study, the body fat content was measured by an Inbody720 body composition meter. The meter is easy to operate and it is suitable and reliable for use to measure the body fat percentage of large sample population [35].



### *General information questionnaire*

A general information questionnaire was used to collect relevant demographic data.

### *Multi-dimensional body image scale*

The multi-dimensional body image questionnaire comprised five dimensions that were measured using a 5-point Likert scale (responses ranging from “strongly disagree” [1] to “strongly agree” [5]). This assessed participants’ responses to their perspectives on the importance of their personal appearance, body area satisfaction, overweight preoccupation, and self-reported overweight. The Multi-dimensional body image scale was developed by American psychologists as an holistic multidimensional measure of the self-attitudinal body-image construct that takes into account both cognitive and behavioral aspects in addition to affective components of body image [36]. The Chinese version, revised by Taiwan-based Chinese scholar Wang cheng-sung, was used to collect data in this study [37]. This survey comprised five subscale, with 33 items in total. The subscales were appearance evaluation; concern for appearance; satisfaction of body parts; attention for obesity; and self-consciousness of weight.

### *Physical activity rating scale*

This scale was used to measure the extent of sports participation. It was developed by a Japanese scholar [38]. There were three topics in total, exploring reported exercise intensity (EI), exercise time (ET) and exercise frequency (EF).

### *Data analysis*

SPSS 20.0 was used for the statistical analysis. Frequency, composition ratio, mean and standard deviation were used in the descriptive analysis to describe the general information of the respondents. One-way variance and t-tests were used to analyse the difference of body fat rate in different demographic variables. Statistical significance was taken at  $P < 0.05$ . Structural equation modelling (SEM) is a

methodology for representing, estimating, and testing a network of relationships between variables (measured variables and latent constructs). Amos20.0 software was used to support the SEM analysis.

### *Ethical approval*

Ethical approval to conduct the study was granted by the Local Research Ethics Committee. Before the survey, the investigator explained the purpose and significance of the survey to the respondents, they were told participation in the survey was voluntarily and submitting a completed questionnaire would be recognized as their consent to participation.

## **RESULTS**

### *Demographic information of participants*

539 questionnaires were distributed, 503 of which were returned, yielding a response rate of 93.32%. The respondents were aged between 18 to 28 years with an average age of 21 years old. The respondents were mostly female (80.12%). The largest cohort of respondents (40.56%) were from the medical school, which included the nursing student cohort. Most (63.42%) of the respondents did not have overweight parents. Most (61.83%) were from countryside and the majority of respondents (67%) came from families with an average monthly family income of between £350 and £1150 (RMB 3000 Yuan and 10,000 Yuan) (Table 1).

**Table 1.** General information of college students.

Indicates	Category	Number	Account (%)
Age	<20	125	24.85
	20≤age<24	333	66.20
	≥24	45	8.95
Gender	Male	100	19.88
	Female	403	80.12
Have any brothers or sisters	0	199	39.56
	1	250	49.70
	2	37	7.36
	≥3	17	3.38
Are parents overweight	Normal weight	319	63.42
	Overweight (one)	154	30.62
	Overweight (both)	30	5.96
Hometown Location	City	192	38.17
	Town ship*	311	61.83
Grade	Freshman	90	17.89
	Sophomore	160	31.81
	Junior	138	27.44
	Senior	56	11.13
	Graduate	59	11.73
	Liberal arts	28	5.57
	Science	191	37.97
Major	Engineering	35	6.96
	Medical	204	40.56
	Arts & Sports	34	6.76
	Others	11	2.19
Income*	≤3000	48	9.54
	3000-6000	163	32.41
	6000-10000	174	34.59
	≥10000	118	23.46

### *Measurement results of body fat rate of college students*

The average body fat rate of participants was 23.04±6.91. The average was 19.48±6.03 for males and 25.06±5.48 for females. The obesity rate was 20% among male college students and 27.54% among female college students (Table 2). There were significant relationships between age, gender,

family composition, grade, major, average family income and being overweight (Table 3). Home-town location had no significant effect on the body fat rate.

**Table 2.** The differences in Body Fat Rate between groups.

Classification	Low weight(N)	Normal(N)	Obese(N)	Mean±SD
Male (n = 100)	23	57	20	19.48±6.03
Female (n = 403)	29	263	111	25.06±5.48
Total (n = 503)	52	320	131	23.04±6.91

**Table 3.** Univariate analysis of the students body fat rate.

Demographic	Group	Body fat rate(%)	Test value	P
Age	<20	22.76±7.33	F=3.30	0.04*
	20≤age<24	23.46±6.69		
	≥24	20.72±6.99		
Gender	Male	14.89±6.03	t=-16.27	0.00**
	Female	25.06±5.48		
	0	21.96±6.85		
Have any brothers or sisters	1	23.89±5.04	F=2.94	0.03*
	2	23.25±5.04		
	≥3	22.68±7.48		
	Freshman	22.20±7.23		
Grade	Sophomore	23.80±6.92	F=2.54	0.04*
	Junior	23.50±6.97		
	Senior	23.43±6.11		
	Graduate	20.84±6.60		
	Liberal arts	20.83±5.66		
Major	Science	22.42±7.34	F=4.38	0.00*
	Engineering	20.43±6.81		
	Medical	24.62±5.93		
	Arts & Sports	21.86±8.84		
	Others	22.16±7.53		
Income	≤3000	21.64±7.68	F=2.82	0.04*
	3000-6000	24.08±7.18		
	6000-10000	23.16±6.33		
	≥10000	23.04±6.91		
Are parents overweight?	Normal weight	22.42±6.18	F=3.55	0.03*
	Overweight (one)	24.12±7.37		
	Overweigh (both)	24.10±8.25		
Hometown	City	23.05±6.74	t=0.03	0.98
	Township	23.03±7.02		

### Multi-dimensional body image questionnaire results

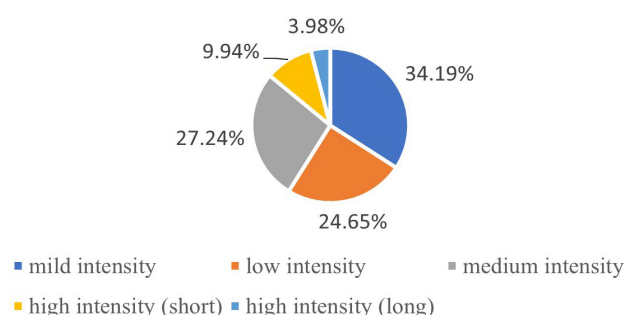
The results demonstrated that students largely agreed that they were concerned mostly with their appearance (Table 4). Participants were less concerned about their actual weight. Weight preoccupation received the lowest in score with an average score at 2.62 (Table 4).

**Table 4.** The results of five dimensions of the body image

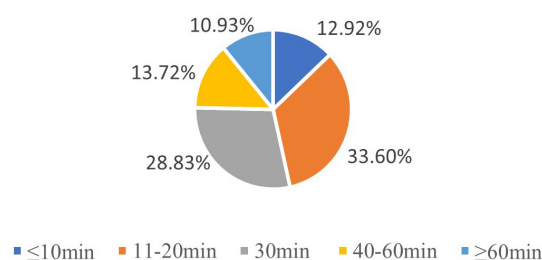
Body Image	Mean±SD	Min	Max
Appearance Evaluation	3.09±0.50	1.43	4.71
Appearance Orientation	3.49±0.47	1.75	4.83
Body Areas Satisfaction	2.95±0.53	1	5
Overweight Preoccupation	2.62±0.87	1	5
Self-Classified Weight	3.08±0.79	1	5

### The extent and frequency of sports participation of college students

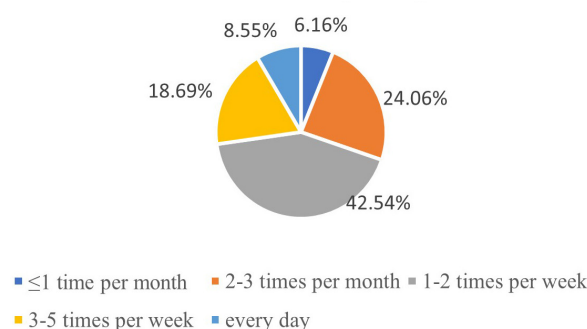
The survey showed that 58.84% college students engaged in mild and low intensity exercise, 27.24% students took part in medium exercise (Figure 1). Most exercised less than 30mins per day. Only 11% students undertook exercise for more than one hour (Figure 2). There were only 8.55% reporting exercising every day (Figure3).



**Figure 1.** Exercise intensity of students.



**Figure 2.** Exercise time of students.



**Figure 3.** Exercise frequency of students.



### *The original structural equation model of the body fat rate*

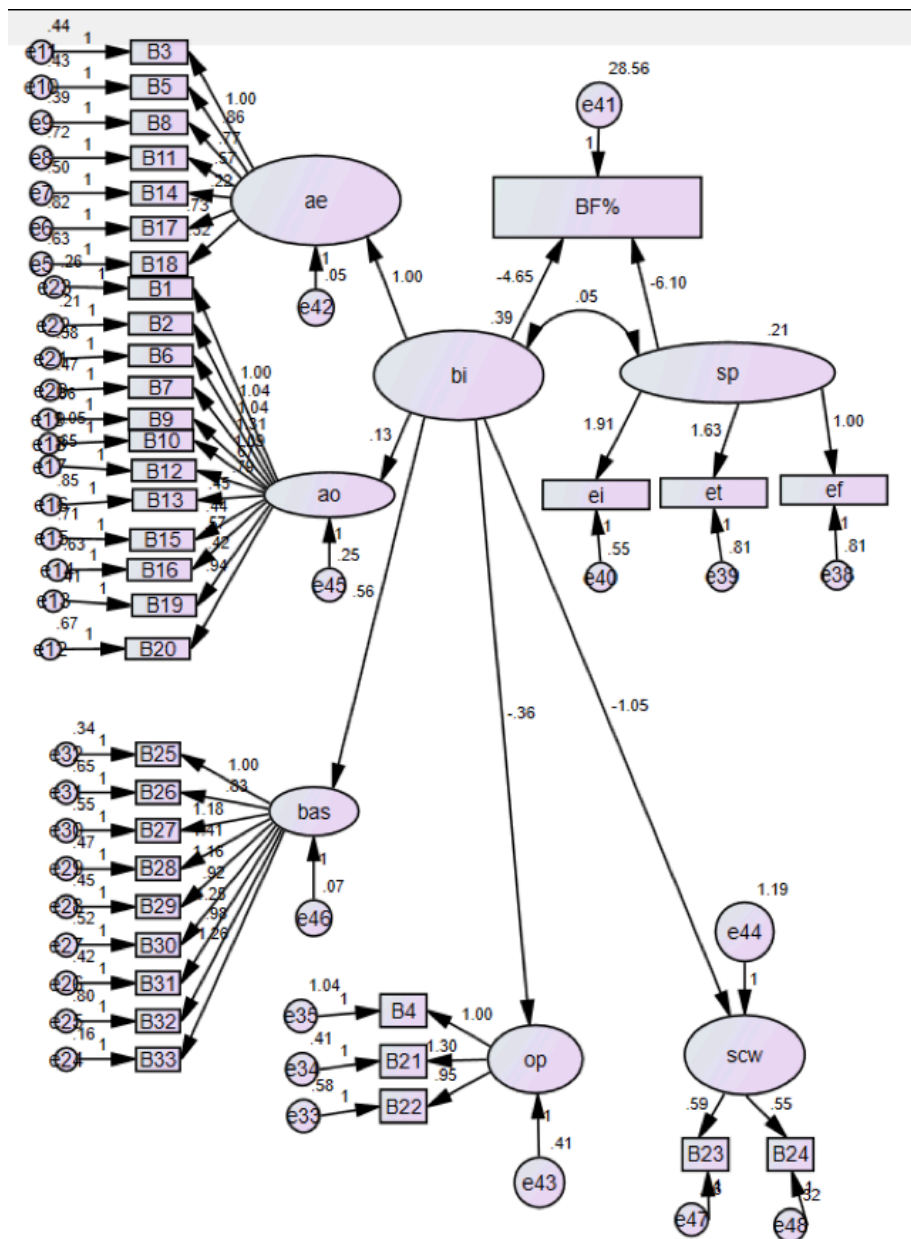
The survey found that perceptions of body image and reported participation in sports had a direct relationship to the body fat rate of participants. At first, the theoretical model for the body fat rate, body image and sports participation were built on the basis of measurement and in combination with work by Zhang [39] in this field of analysis. The model is outlined in Figure 4. The names and values of variables see the Table 5. In this model, there were seven exogenous latent variables, 36 exogenous and one endogenous measurement variables. There were 36 residual errors in exogenous measurement and the variability was estimated freely. Each measurement variable in the model is affected by only one latent variable, so there were 36, five and one factor load parameters for exogenous measurement variable, exogenous latent variable and endogenous measurement variable respectively. In this survey, the first factor load of each latent variable was set as one, which was used as the scale of potential variable.

**Table 5.** Names and values of the variables.

Item	Variable name	Value
Body image	AE\AO\BAS\OP\S CW	Measured value
Exercise time	ET	Mild=1,small intensity=2, medium intensity=3, high intensity(short)=4, high intensity(long)=5
Exercise intensity	EI	≤10min=1,11-20min=2, around 30min=3,40- 60min=4,≥60min=5
Exercise frequency	EF	≤1 time per month=1 2-3 times per month=2 1-2 times per week=3 3-5 times per week=4 every day=5

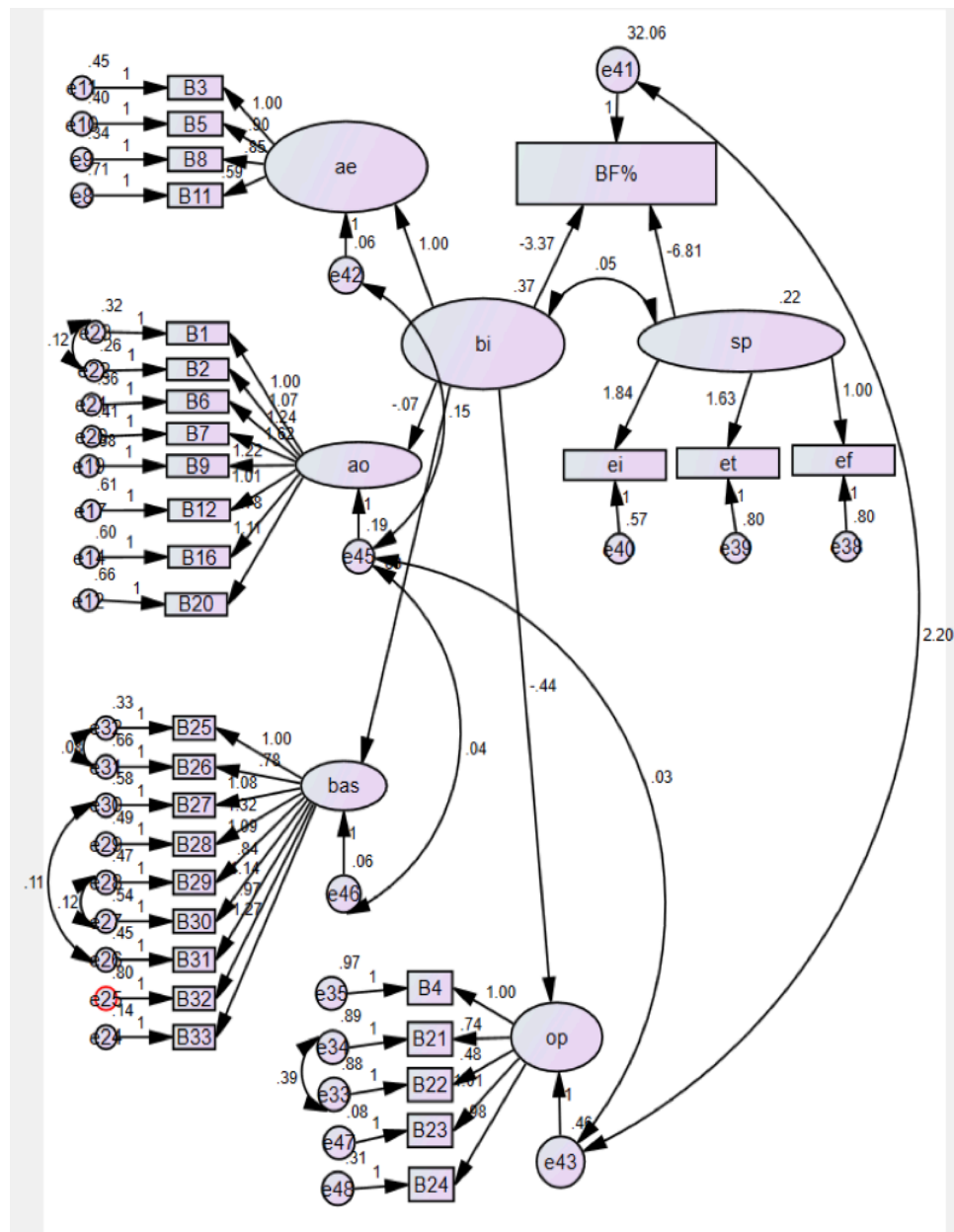
### *The modified model*

AMOS 20.0 software was used to verify the equation model. Using the original survey findings, and combined with professional knowledge, factor loading and model modification index (MI) the original model was modified. Three items were deleted from the dimension of appearance evaluation, and 4 items were deleted from the dimension of concern for appearance. The standardized path of the modified model is as shown in Figure 5. Through the building and the modification of the structural equation of body fat rate, body image and sports participation, the survey obtained the fitness test results and fitness standards of the structural equation model, as shown in Table 6. The indexes of the whole modified equation model had met or had basically met the adaptive standards. The Chi-square value was 1153.194,  $P < 0.05$ , which indicated the model was significant. The RMSEA value was 0.062, which showed the model fit well. The GFI value, AGFI value, NFI value, RFI value, IFI value, TFI value, CFI value all met the fitness standards. The simple fitted values PGFI, PNFI and PCFI all met or were close to the fitted value, whose numerical value was greater than 0.05. The Chi-square degree of the model was 2.957, indicating a good fitness. Upon analysis, the standardized effect values of body fat rate, sports participation and body image of the college students in the model were as shown in Table 7.



**Figure 4.** Theoretical Model of Structural Equation for Body Fat Rate, Body Image and Sports Participation of College Students- Original.

*Note:* B1-B33 were the item, there were a total of 42 labeled load parameters from e5 to e46 in this survey.



**Figure 5.** Theoretical model of structural equation for body fat rate, body image and sports participation of college students- modified.

**Table 6.** Structural equation adaptation index and standard.

Statistics	Before the correction	Fixed	Fit standards
Absolute fitness			
Chi-square Value	2501.448 (P = 0.00)	1153.194 (P = 0.00)	P >0.05 Not at significant level
RMSEA	0.078	0.062	<0.08 Good <0.05 Excellent
GFI Value	0.758	0.863	>0.90
AGFI Value	0.726	0.837	>0.90
Value-added adaptability index			
NFI Value	0.627	0.794	>0.90
RFI Value	0.601	0.771	>0.90
IFI Value	0.691	0.854	>0.90
TLI Value	0.667	0.836	>0.90
CFI Value	0.689	0.853	>0.90
Simple fit index			
PGFI Value	0.671	0.724	>0.50
PNFI Value	0.586	0.712	>0.50
PCFI Value	0.644	0.746	>0.50
CN Value	503	503	>200
CMIN/DF	4.022	2.957	<2.00 Excellent <3.00 Good

**Table 7.** The path factor of the model.

Dependent variables	Variable	Standardized effect values
Body fat	Body image	-3.37
Body fat	sports participation	-6.81
Body image	sports participation	0.05

## DISCUSSION

Although Asian populations are generally found to be less prone to overweight and obesity [40] in keeping with concerns about growing obesity levels in China, this study found a high level of obesity, particularly among women. Levels of obesity were reflective of the level at which concern is

expressed for the UK nursing population (25%) [9]. There is also concern for nursing students where more than half of some samples were found to be overweight [30]. Similarly exercise levels among qualified nurses is reported as low [31]. This indicates a need for Chinese nursing schools to begin to consider health promotion initiatives for nursing students. Concern with nursing students' health

and providing curricular interventions serves to improve their health and well-being, including mental health [32], but also may help reduce musculoskeletal injury risk in practice [4]. Encouraging nursing students to adopt healthy lifestyle behaviors is something that is encouraged in the literature [34] although it is under-researched in terms of specific interventions to address this issue [32]. This study found that the body fat rate of the college students was influenced by multiple factors. From the perspective of gender the body fat rate of female students was significantly higher than that of male students, a finding which confirms previous research in this topic with multi-ethnic groups [40]. It was clear that the average body fat rate of students aged between 20 and 24 years old was higher than those who aged below 20 or above 24 years old, perhaps indicating, as outlined by McSharry and Timmins [32] that university students are prone to weight gain. Another finding is that students of different majors differed significantly in their body fat content. Surprisingly, of all the majors involved in this survey students majoring in medicine had the highest body fat rate. This indicated that medical students may fail to apply what they are learning about healthy lifestyle to their daily life and are not taking time to promote their own health and regulate their behaviors. On the other hand, it might also be because medical students had more academic study tasks compared with other students [41]. Certainly specialising in medicine doesn't necessarily mean that the students simultaneously live in a healthy life and they may need additional encouragement to take part in exercise. It is also possible that the working life of medical students affects their participation in such activity. This study revealed that the students had more concern about their appearance rather than for their weight or obesity risk. They seemed to use their perception of their appearance to judge their own body fat. Indeed, the survey found that there was no direct influence between perception of body image and sports participation for example. In fact students who paid close attention to

their body image were not necessarily active participants in sports. This is supported within the literature where researchers reported the correlation between physical exercise and body image was not significant [42, 43]. Resultantly in this study, students appeared to exercise very little and failed to meet the recommended amount of exercise. This is disappointing as research shows that sports play a positive role in improving body composition, enhancing the individuals' aerobic endurance, muscular strength and body image [44]. Moreover people aged between 18-65 need moderate intensity of aerobic exercise with exercise time of more than 30 minutes for at least five days per week, or more than 20 minutes' high intensity aerobic exercise for at least 3 days per week [45]. The limited exercise time is concerning as studies indicate that the fat oxidolytic enzyme in our body only starts to be active after 20 minutes of exercise and thus more fat is broken down with increased exercise time [46]. Low personal exercise levels were found among nursing students [24, 30]. Encouraging students to attend more sports are crucial to prevent the vicious cycle of negative body image that can accompany obesity and being overweight. However, this reduction in exercise levels appears to be a phenomenon of modern society, and certainly other studies have found reduced activity levels among students [47, 48]. Along with the rapid development of the Internet, students now spend a large amount of time on mobile phones and computers and show a decreasing amount of exercise. Another factor related to modernity is income. In this study increased family income meant an increase in the risk of obesity, which is a finding reflective in the literature [49]. The survey also showed that the percentage of body fat of students with overweight parents was higher than those whose parents were not overweight, which might lead to conclusions about genetic relationships, but also possibly intergenerational lifestyle habits, which could be reversed through additional education and interventions. From the structural equation model we know that sports participation is a predictive



factor of body fat rate, and has a direct negative predictive effect on the amount of body fat. Body image had a direct negative effect on body fat rate, which was similar to the research of Cagas [50]. Our structural equation model could provide the basis for encouraging students to take exercise to reduce their body fat rate and enhancing their health. It is necessary to guide college students to pay attention to the function of their body instead of the appearance, and begin to develop an increased awareness of the need for healthy lifestyle, particularly in the context of modernity which despite its benefits presents many challenges to keeping healthy.

### *Study limitations*

There are some limitations of this study. It was not possible, under the circumstances, to obtain a random sample of students, so this study relied on convenience sampling methods. Thus representative of the results must be interpreted with caution. Because the limit of time and funding, only a cross-sectional study was carried out, which lacked the ability to track and explore its growth dynamics of the group students. However, this is a large sample with a very high response rate, far greater than observed in many studies of university students, and a robust, objective approach was used. Therefore, the results do serve as a useful basis upon which to contribute to this discussion and to base further research upon. The methods used in particular are useful to researchers. Therefore, random sampling with longitudinal follow would explore and these strengthen findings, to determine if these patterns are indeed reflective of a wider population by tracking the trajectory of change in body fat rate and sports participation in a more representative sample over time.

## **CONCLUSIONS**

Overall our findings reveal that a positive body image together with sports participation are strong predictors of low levels of body fat and attention to these matters could help

reduce body fat. Rising obesity levels need consideration in terms of nursing and healthcare students in the university environment, particularly in China where this is a relatively new phenomena. More attention needs to be given to health promotion interventions for university students, health care students in particular, globally.

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