Mediating effect of health consciousness in the relationship of lifestyle and suboptimal health status: a cross-sectional study involving Chinese urban residents

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ABSTRACT
Objective Suboptimal health status (SHS), a third state between good health and disease, can easily develop into chronic diseases, and can be influenced by lifestyle and health consciousness. No study has surveyed the intermediation of health consciousness on the relationship between lifestyle and SHS. This study aimed to analyse the association of lifestyle and SHS, and intermediation of health consciousness in Chinese urban residents.

Design A cross-sectional face-to-face survey using a four-stage stratified sampling method.

Participants We investigated 5803 Chinese urban residents aged 18 years and over. We measured SHS using the Sub-Health Measurement Scale V1.0. We adopted a structural equation model to analyse relationships among lifestyle, health consciousness and SHS. We applied a bootstrapping method to estimate the mediation effect of health consciousness.

Results Lifestyle had stronger indirect associations with physical ($\beta = 0.185$, 95% CI $-0.228$ to $-0.149$), mental ($\beta = 0.224$, 95% CI $-0.265$ to $-0.186$) and social SHS ($\beta = 0.216$, 95% CI $-0.257$ to $-0.179$) via health consciousness than direct associations of physical ($\beta = 0.144$, 95% CI $-0.209$ to $-0.081$), mental ($\beta = 0.146$, 95% CI $-0.201$ to $-0.094$) and social SHS ($\beta = 0.130$, 95% CI $-0.181$ to $-0.077$). Health consciousness has a strong direct association with physical ($\beta = 0.360$, 95% CI $0.295$ to $0.427$), mental ($\beta = 0.452$, 95% CI $0.392$ to $0.510$) and social SHS ($\beta = 0.434$, 95% CI $0.376$ to $0.490$). Ratio of mediating effect of health consciousness to direct effect of lifestyle with physical, mental and social SHS was 1.28, 1.53 and 1.66, respectively.

Conclusions Health consciousness was more important in preventing physical, mental and social SHS than lifestyle. Therefore, it might be useful in changing unhealthy lifestyle and reducing the influence of poor lifestyle on physical, mental and social SHS.

INTRODUCTION
In 1946, the WHO1 defined health as ‘a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity’. It is reported that non-communicable diseases (NCDs) account for an estimated 80% of the total deaths and 70% of the total number of disability-adjusted lifeyears in the early twentieth century.² Moreover, NCD increase steadily with urbanisation and ageing,³ being attributed with more than 88% of total deaths in China in 2019.⁴ Furthermore, a study pointed out that NCDs accounted for 18 of the 20 leading causes of age-standardised years lived with disability on a global scale.⁵ The preclinical status of NCDs and its early detection have become major issues in the promotion of basic health service in the reform of healthcare.⁶

Suboptimal health status (SHS), an intermediate status between chronic disease and health, is believed to be a subclinical and reversible stage of chronic disease.⁷ People in SHS, although without a diagnosable condition, are characterised by a decline in vitality and physiological function, ambiguous health complaints, general weakness and lack of vitality. In fact, it has become a new public health challenge in China.⁸⁹

Strengths and limitations of this study

- The participants, who were recruited through a cross-sectional survey using a four-stage stratified sampling method, were representative of Chinese urban residents.
- To the best of our knowledge, this is the first representative analysis of the mediating effect of health consciousness on the association of lifestyle with physical, mental and social suboptimal health status.
- Although we used a four-stage stratified sampling method, sampling errors are still inevitable.
- This study only included the seven most common lifestyle factors.
It is reported that SHS can be measured objectively using microbiome, telomere length, plasma stress hormones, plasma metabolites and glycans. However, these objective measures are not easily accessible, and sometimes may not be obvious, especially when people have uncomfortable feelings without abnormal symptoms. A self-rated method that uses a questionnaire is widely applicable in assessing SHS. In China, the Sub-Health Measurement Scale (SHMS V1.0), Suboptimal Health Status Questionnaire (SHSQ-25) and Chinese Sub-Health Scale (CSHES) were widely used for assessing SHS. However, compared with the other questionnaires, SHMS V1.0 assesses of the physical, mental and social aspects of SHS, which is in accordance with the health concept proposed by WHO in 1947.

SHS has a prevalence of above 65% in China, and has become an increasingly concerning problem in many countries. Moreover, its prevalence may be severely underestimated since many individuals are not aware that they suffer from SHS. For instance, in an investigation involving 6000 Chinese self-reported ‘healthy people,’ 72.8% were in ‘suboptimal health status.’ Thus, identifying the influencing factors of SHS is important in preventing it, and would provide important information for first-level prevention of NCD. In accordance with the definition released by the WHO, SHS has three dimensions: physical, mental and social adaption. SHS concept is mainly based on Transitional Chinese Medicine and prevention is important.

Lifestyle is an important factor associated with SHS. This includes smoking, alcohol use, skipping breakfast, poor nutrition, lack of exercise and sleep problems. The first SHS study on urban Chinese population pointed that SHS was associated with risk factors of chronic diseases and contributed to the development of them. In SHS, individuals can prevent a chronic disease by modifying their poor lifestyles, as supported by China’s Blue Book on Self-Care. Although, it is a given fact that individuals ought to change their bad lifestyles when experiencing adverse health issues, this is difficult to achieve in practice. Studies revealed that better knowledge and strong beliefs improve the adherence to lifestyle changes and prevent chronic diseases, better knowledge and strong beliefs are important expressions of health consciousness.

Health consciousness is a psychological construct that corresponds to the awareness about one’s health, and the willingness to change one’s behaviours in order to improve it. Moreover, it is related to anxiety, stress, depression and non-treatable diseases. However, to our knowledge, there are no studies on the association of health consciousness to SHS. People may present different suboptimal health states in their physical, mental and social adaptation; thus, it is necessary to analyse SHS separately. We aimed to investigate whether improved health consciousness is associated with better lifestyle and less physical, mental and social SHS. Moreover, we aimed to discover the possible mediating effect of health consciousness on the association of lifestyle with physical, mental and social SHS. Thus, we used structural equation models to clarify these questions, on the basis of a representative sample of Chinese urban residents.

METHODS

Study design and population

We conducted a cross-sectional survey using a four-stage stratified sampling method from December 2017 to October 2018. In the first stage, we chose one province each from five administrative divisions in China; we selected Guangdong province, Heilongjiang province, Sichuan province, Gansu province and Tianjin city. Second, we chose three to four cities from each province by considering their level of economic development and regional distribution. Subsequently, we randomly selected two to four streets in the selected urban areas. Lastly, we investigated the urban residents who conveniently qualified from each street.

This study included individuals aged 18 years and older, who lived in an urban area for more than 6 months, and volunteered in our investigation. We excluded individuals who had a confirmed disease in the last 2 months, were unable to complete the questionnaire due to visual or hearing impairment and with missing values in lifestyle, health consciousness and SHS items. We investigated a total of 6578 individuals and excluded 775. Thus, we analysed a total of 5803 urban residents. Among them, 1704, 1328, 954, 925 and 892 participants were from Guangdong, Heilongjiang, Sichuan, Gansu and Tianjin provinces, respectively. All participants that volunteered provided their verbal consent prior to data collection, and were given the option to cease from participating anytime. They were also invited to give advice regarding the questionnaire. All data were kept strictly confidential.

Patient and public involvement

The participants were not involved in the development of the research question or design of this study. However, we disseminated the results of this analysis through public conferences, including summarised statements and open access to the published reports.

Survey instrument

We used a self-designed questionnaire for investigation, which is comprised of four parts: general demographic characteristics, which included age, gender, marital status, highest education level, per capita monthly household income and insurance; lifestyle, which included smoking, bad diet habit, alcohol intake, breakfast consumption, physical exercise, early to bed (before 11 p.m.) and sleep time; health consciousness, which included health knowledge, care for health and effect of leisure promoting health; and SHMS V1.0. Each volunteer completed the questionnaire within 30 min. Verbal consents were deemed to be sufficient because the participants had volunteered for the study and could refuse to take part if
they wished. The objective of the survey was to study the health status of the participants rather than intervene. All data were kept strictly confidential. The ethics committee approved the consent procedure.

**SHS assessment**
We performed SHS assessment using SHMS V1.0, which was developed by our research group. It comprised of 39 items that were proven to have high reliability and validity in a Chinese population. SHS V1.0 consists of three subscales: physical suboptimal health status (PS), mental suboptimal health status (MS), and social suboptimal health status (SS). PS consists of 14 items that comprises four factors: physical condition, organ function, body movement function and vigour. MS consists of 12 items that comprises three factors: positive emotion, psychological symptoms and cognitive function. SS consists of 9 items that comprises three factors: social adjustment, social resources and social support. For each item, there are five response categories (1=none, 2=occasionally, 3=sometimes, 4=constantly and 5=always) that correspond to the frequency of occurrence of each symptom. We asked the participants regarding the uncomfortable symptoms that they had during the previous month. We then calculated the total scores. A low total score represents a low estimate of SHS (ie, poor health). The cut-off value for suboptimal health assessment referred to norms of SHMS V1.0 for Chinese urban residents were established by our research group.

**Lifestyle evaluation**
Smoking was comprised of none smokers, past smokers and current smokers. Bad diet habit was divided into ‘yes’ (if any one of the following seven situations exist: irregular eating time, dieting, overeating, dietary bias or pickiness, salty tasty, spicy tasty and using snacks instead of meals), and ‘no’. Alcohol intake was divided into ‘never’, ‘occasionally’, ‘little everyday’ and ‘much everyday’. Breakfast consumption was comprised of ‘never’, ‘occasionally’ (ie, 1 or 2 days a week), ‘sometimes’ (ie, 3 or 4 days a week) and ‘everyday’. Physical exercise was divided into ‘everyday’, ‘frequently’ (ie, 5 or 6 days a week) and ‘occasionally’ (ie, 1 or 2 days a week, and no physical exercise). Sleep time were divided into three groups, ‘<7 hours/day’, ‘7 to 9 hours/day’ and ‘≥9 hours/day’.

**Health consciousness evaluation**
Health knowledge and attention to health consisted of ‘very few/low’, ‘few/low’, ‘general’, ‘much/high’ and ‘very much/high’. Effect of leisure on health consisted of ‘no effect’, ‘some effect’ and ‘very effective’.

**Quality control and data management**
The investigators for each site were trained through face-to-face, video conferencing and telephone. Before the conduct of the investigation, we made sure that its purpose and importance were explained to the participants in detail, and obtained their verbal informed consent. The respondents answered the questionnaires independently and according to their own understanding, while missing data were re-answered after checking by the investigators. Before data coding and entry, suspicious duplicate questionnaires, which are those with a repetition rate higher than 80% and completion rate lower than 80% were excluded. All questionnaire data were double-entered using EpiData 3.1 software. The two data sets were cross compared for validity and errors.

**Statistical analysis**
Description was using means (SD) and proportions. We used a one-way analysis of variance (ANOVA) with least significant difference test for multiple comparisons. Cluster effect nested within sampling regions was examined by using interclass correlation coefficient (ICC) calculated in a two-level linear multilevel model. We used structural equation modelling (SEM) to analyse the complexity of associations between lifestyle, health consciousness and SHS (Model 1: SEM model of lifestyle, health consciousness and PS; Model 2: SEM model of lifestyle, health consciousness and MS; Model 3: SEM model of lifestyle, health consciousness and SS). Mediating effect of health consciousness was the same with indirect association of lifestyle and SHS via health consciousness. Ratio of mediating effect of health consciousness to direct effect of lifestyle (indirect effect divided by direct effect) and proportion of mediating effect of health consciousness to total effect (indirect effect divided by total effect multiply by a hundred) of lifestyle with physical, mental and social SHS were also calculated. We used the relative χ² minimum discrepancy per degree of freedom (CMIN/DF), root mean-square error of approximation (RMSEA), comparative fit index (CFI), goodness-of-fit index (GFI), and adjusted goodness-of-fit index (AGFI) to assess the model fit. We applied the bootstrapping method of repeat sampling by 2000 times to verify statistical significance and calculate the CIs for the direct, indirect and total effects. Participants with missing data were deleted from analysis. All p values were two-sided, with values <0.05 considered as statistically significant. We used IBM SPSS Statistics 20.0 for descriptive analysis. Lastly, we conducted SEM analysis with AMOS (SPSS Statistics V.20-0, SPSS Inc, Chicago, Illinois, USA).

**RESULTS**
**Participants’ demographic characteristics**
Baseline characteristics of all study participants are presented in table 1. Of the 5803 participants, 2772 (47.77%) were men and 3031 (52.23%) were women. The mean age was 40.90±15.46 years. Most of the participants (65.98%) were married. Moreover, 3320 (57.21%) of the participants have a per capita monthly household income (RMB) of less than 5000 RMB. Participants with compulsory school (up to grade 9), high school, junior college and university degree and above were 1343 (23.14%),
Table 1  Participant’s demographic characteristics (n=3535)

| Characteristic                        | N   | %    |
|---------------------------------------|-----|------|
| Gender                                |     |      |
| Man                                   | 2772| 47.77|
| Woman                                 | 3031| 52.23|
| Married status                        |     |      |
| Unmarried                             | 1556| 26.81|
| Married                               | 3829| 65.98|
| Divorced or widows                    | 386 | 6.65 |
| Information missing                   | 32  | 0.55 |
| Per capita monthly household income (RMB) |     |      |
| <5000                                 | 3320| 57.21|
| >=5000                                | 2419| 41.69|
| Information missing                   | 64  | 1.10 |
| Highest education level               |     |      |
| Compulsory school (through grade 9)   | 1343| 23.14|
| High school graduation                | 1298| 22.37|
| Junior college degree                 | 1374| 23.68|
| University degree and above           | 1786| 30.78|
| Information missing                   | 2   | 0.03 |

1298 (22.37%), 1374 (23.68%) and 1786 (30.78%), respectively.

Association of lifestyle, health consciousness and SHS

The mean (SD) of the overall SHS, PS, MS and SS transformed scores were 66.15 (11.99), 70.92 (12.67), 67.01 (14.55) and 61.46 (15.56), respectively. The ANOVA results showed that various groups of lifestyle and health consciousness differed on physical SHS, mental SHS and social SHS (table 2). People who never smoked had the highest physical and social SHS scores; however, participants who quit smoking had lower physical, mental and social SHS scores than participants who were still smoking. People who had bad diet habits and consumed the most alcohol had the lowest physical, mental and social SHS scores. Physical, mental and social SHS scores were higher for participants who regularly consumed breakfast, engaged in regular physical exercise, had early bedtimes (ie, before 11 p.m.) and longer sleep duration.

SEM analysis of lifestyle, health consciousness and SHS

Because we used the multistage sampling method in this study, there might be a cluster effect nested within sampling regions. We examined ICC and its significance using a two-level linear multilevel model. For physical, mental and social SHS, there was no cluster effect in the regions, while the ICC was 0.028, 0.01 and 0.035, with p values of 0.085, 0.103 and 0.084, respectively. Thus, traditional SEM models could be used in the analysis of the association of lifestyle, health consciousness and SHS (figure 1). Three models fit reasonably well to the data. As shown in the models: (1) all indicator variables that we hypothesised as predictors were significantly related to their respective latent factors, p<0.001; (2) lifestyle had a direct negative association with PS (β −0.144, p<0.001), MS (β −0.146, p<0.001) and SS (β −0.130, p<0.001); (3) health consciousness had direct positive association with PS (β 0.360, p<0.001), MS (β 0.452, p<0.001) and SS (β 0.434, p<0.001), and mediating effects on the association of lifestyle with PS, MS and SS.

The association paths of lifestyle and health consciousness on SHS are presented in table 3. Although lifestyle and health consciousness were both associated with SHS, health consciousness had larger associations with PS (β 0.360), MS (β 0.452) and SS (β 0.434) than lifestyle (β −0.329, −0.370 and −0.345 respectively). Association of lifestyle and PS could be direct (β −0.144, 95% CI −0.209 to −0.081) and indirect (β −0.185, 95% CI −0.228 to −0.149), with faintly larger indirect association than direct association. However, the indirect association (β −0.224, 95% CI −0.265 to −0.186) of lifestyle and MS was obviously higher than direct association (β −0.146, 95% CI −0.201 to −0.094). The same higher indirect association (β −0.216, 95% CI −0.257 to −0.179) was found in the association of lifestyle and SS than direct association (β −0.130, 95% CI −0.181 to −0.077). Ratio of mediating effect of health consciousness to direct effect of lifestyle with physical, mental and social SHS was 1.28, 1.53 and 1.66, respectively. Proportion of mediating effect of health consciousness to total effect of lifestyle with physical, mental and social SHS was 56.23%, 60.54% and 62.61%, respectively.

DISCUSSION

In this large cross-sectional study involving a representative sample, we found that lifestyle health consciousness showed significantly mediating effects on the association of lifestyle with PS, MS and SS. The direct associations of PS, MS and SS with health consciousness were all significantly higher than lifestyle. However, the indirect associations of lifestyle with PS, MS and SS were higher than indirect associations via health consciousness.

SHS is a subjective feeling that lacks objective clinical diagnostics; thus, a self-assessed questionnaire is the most appropriate method of determining it. SHMS V1.0 is a multidimensional scale that includes physical, mental and social dimensions that correspond to the WHO’s more comprehensive definition of health. Moreover, it is widely used in China for assessing SHS in urban residents, workers and students. We found that Chinese urban residents had low scores in PS, MS and SS, which means that they are at high risk to SHS in physical, mental and social adaption. This result is in accordance with other studies involving young and middle-aged intellectuals in Guangzhou, Chinese migrant workers and Scottish-Canadian studies showed the same SHS rate.

To the best of our knowledge, this is the first representative analysis of the mediating effect of health consciousness on the association of lifestyle with physical, mental and social SHS.
Table 2  Group comparisons of lifestyle, health consciousness and suboptimal health status

| Variates             | N     | PS mean (SE) | MS mean (SE) | SS mean (SE) |
|----------------------|-------|--------------|--------------|--------------|
| Smoking              |       |              |              |              |
| Never                | 3987  | 71.56 (12.48)†, ‡ | 67.13 (14.46)† | 62.15 (15.16)†, ‡ |
| Quit                 | 614   | 68.32 (13.49)*, †, § | 65.41 (15.11)*, †, § | 58.38 (17.2)*, † |
| <20 cigarettes/day   | 1027  | 70.31 (12.67)*, † | 67.4 (14.44)† | 60.93 (15.53)*, † |
| ≥20 cigarettes/day   | 164   | 70.85 (12.90)† | 68.26 (15.44)† | 61.02 (17.86) |
| Bad diet habits      |       |              |              |              |
| No                   | 3357  | 73.1 (12.52)† | 70.2 (14.14)† | 64.19 (14.77)† |
| Yes                  | 2446  | 67.92 (12.25)* | 62.64 (13.97)* | 57.71 (15.84)* |
| Alcohol intake       |       |              |              |              |
| Never                | 2077  | 71.93 (13.13)†, †, §, ¶ | 68.18 (14.66)†, †, §, ¶ | 62.61 (15.78)†, †, §, ¶ |
| Occasionally         | 3099  | 70.86 (12.06)†, †, §, ¶ | 66.55 (14.21)†, †, §, ¶ | 57.15 (15.11)*, †, §, ¶ |
| Little everyday      | 421   | 68.85 (13.65)†, † | 66.29 (15.75)† | 59.93 (16.69)*, † |
| Some everyday        | 106   | 68.35 (12.88)†, † | 65.17 (13.79)† | 60.27 (14.29)† |
| Much everyday        | 72    | 63.47 (14.37)*, †, ‡, ¶ | 60.1 (16.45)*, †, ‡, ¶ | 53.97 (20.69)*, †, ‡, ¶ |
| Breakfast consumption|       |              |              |              |
| Never                | 139   | 67.93 (15.07)§, ¶ | 62.4 (17.25)§ | 53.46 (19.83)†, †, §, ¶ |
| Occasionally         | 600   | 66.88 (12.63)§, ¶ | 62.69 (14.12)§, ¶ | 57.59 (16.70)§, ¶ |
| Sometimes            | 830   | 68.03 (11.99)§, ¶ | 61.81 (13.07)§, ¶ | 56.37 (15.38)§, ¶ |
| Frequently           | 1539  | 71.07 (11.94)*, †, ‡, ¶ | 66.48 (14.01)*, †, ‡, ¶ | 61.75 (15.52)*, †, ‡, ¶ |
| Everyday             | 2671  | 72.91 (12.73)*, †, ‡, ¶, § | 70.22 (14.46)*, †, ‡, ¶, § | 64.69 (14.75)*, †, ‡, ¶, § |
| Physical exercise    |       |              |              |              |
| Never                | 848   | 68.55 (13.27)†, †, §, ¶ | 64.24 (14.4)† | 58.21 (15.68)†, †, §, ¶ |
| Occasionally         | 2338  | 70.43 (11.78)*, †, §, ¶ | 65.54 (13.92)*, †, §, ¶ | 60.36 (14.45)*, †, §, ¶ |
| Sometimes            | 1373  | 71.26 (13.11)*, †, § | 67.54 (14.53)* | 61.51 (16.75)*, †, ¶, ¶ |
| Frequently           | 608   | 71.77 (13.03)*, †, § | 68.72 (14.85)* | 64.57 (15.24)*, †, ¶, ¶ |
| Everyday             | 627   | 74.73 (12.73)*, †, ‡, ¶, § | 73.53 (14.82)*, †, ‡, ¶, § | 67.12 (15.11)*, †, ‡, ¶, § |
| Early to bed         |       |              |              |              |
| Never                | 947   | 70.29 (12.36)§, ¶ | 64.8 (14.74)§ | 59.72 (15.61)§, ¶ |
| Occasionally         | 1512  | 70.3 (11.94)§, ¶ | 65.57 (13.71)§, ¶ | 60.08 (15.33)§, ¶ |
| Sometimes            | 1224  | 70.01 (12.84)§, ¶ | 65.84 (14.46)* | 60.47 (15.99)§, ¶ |
| Frequently           | 997   | 71.49 (12.76)*, †, ‡, ¶ | 68.36 (14.46)*, †, ‡, ¶ | 63.07 (14.79)*, †, ‡, ¶ |
| Everyday             | 1113  | 72.98 (13.39)*, †, ‡, ¶, § | 70.99 (14.84)*, †, ‡, ¶, § | 64.52 (15.49)*, †, ‡, ¶, § |
| Sleep time           |       |              |              |              |
| <3 hours/day         | 35    | 62.96 (12.11)†, §, ¶ | 58.87 (13.81)† | 49.68 (20.42)†, §, ¶ |
| <5 hours/day         | 145   | 62.44 (12.88)†, §, ¶ | 56.97 (14.78)* | 48.51 (18.88)†, §, ¶ |
| <7 hours/day         | 1377  | 67.89 (12.34)*, †, §, ¶ | 64.88 (14.09)* | 59.86 (15.83)*, †, §, ¶ |
| <9 hours/day         | 3748  | 72.47 (12.29)*, †, ‡, ¶ | 68.14 (14.38)*, †, ‡ | 62.65 (14.82)*, †, ‡ |
| ≥9 hours/day         | 492   | 71.09 (13.67)*, †, ‡, ¶ | 68.15 (15.30)*, †, ‡ | 61.95 (16.59)*, †, ‡ |
| Health knowledge     |       |              |              |              |
| Very few             | 1332  | 70.27 (12.55)§, ¶ | 65.17 (14.79)†, §, ¶ | 58.31 (15.43)†, †, §, ¶ |
| Few                  | 1794  | 70.38 (12.51)§, ¶ | 65.77 (14.27)*, †, §, ¶ | 60.13 (15.41)*, †, §, ¶ |
| General              | 1913  | 70.71 (12.52)§, ¶ | 67.54 (14.37)*, †, §, ¶ | 62.55 (15.13)*, †, §, ¶ |
| Much                 | 628   | 74.11 (12.58)*, †, ‡ | 71.47 (13.79)*, †, ‡ | 67.2 (14.62)*, †, ‡ |
| Very much            | 120   | 74.65 (15.97)*, †, ‡ | 75.26 (15.28)*, †, ‡ | 70.61 (18.46)*, †, ‡ |

Care for health

Continued
social SHS. All variables included in lifestyle and health consciousness were accordingly significantly associated. Urban residents who engage in unhealthy lifestyle practices, such as smoking, alcohol intake, bad diet habits, irregular breakfast consumption, less physical exercises, less frequent early to bed and short sleep time were more likely to get into PS, MS and SS. A study revealed that breakfast eating habits are significantly associated with lifestyle, and appear to be a useful predictor of a healthy lifestyle; people who skip breakfast are prone to unhealthy behaviours, such as limited exercise. Moreover, insufficient sleep is associated with several health-risk behaviours, such as not meeting physical activity recommendations, using cigarettes and alcohol, and feeling sad or hopeless. Furthermore, poor diet was the third greatest influencing factor for physical and social health, which was in line with previous studies.

This study investigated the significant associations of health consciousness with PS, MS and SS, which were relatively more significant than those of lifestyle. Moreover, in this study, health consciousness, included health knowledge, attention to health and effect of leisure on health. As the internal power of healthy behaviour, health consciousness is the most important and fundamental factor in promoting health. In fact, individuals who had more health knowledge believed that they had control over their health. The most important finding was that health consciousness played a mediating effect in the relationship of lifestyle with physical, mental and social SHS, which was higher than direct effect of lifestyle. Studies have shown that health consciousness is correlated with health behaviour, information seeking and health coping. Modifying the attitudes is effective in promoting changes in health behaviour, since health-conscious people are attentive to health warnings regarding the risks of having an unhealthy lifestyle.

### Table 2 Continued

| Variates    | N   | PS mean (SE)          | MS mean (SE)          | SS mean (SE)          |
|-------------|-----|-----------------------|-----------------------|-----------------------|
| Very low    | 329 | 67.73 (14.32)‡, §, ¶  | 61.09 (16.65)‡, §, ¶  | 55.25 (17.71)‡, §, ¶  |
| Low         | 789 | 67.61 (13.11)‡, §, ¶  | 62.33 (14.42)‡, §, ¶  | 56.1 (16.47)‡, §, ¶   |
| General     | 2485| 69.5 (11.9)*, †, §, ¶ | 65.37 (13.69)*, †, §, ¶ | 59.76 (14.35)*, †, §, ¶ |
| High        | 1752| 73.66(12)*, †, ‡, ¶  | 70.3 (13.74)*, †, ‡, ¶ | 65.28 (14.44)*, †, ‡, ¶ |
| Very high   | 437 | 76.86 (13.36)*, †, ‡, ¶ | 76.27 (14.12)*, †, ‡, ¶ | 70.57 (15.73)*, †, ‡, ¶ |

Transformed scores were analysed here. Statistical analysis included a one-way analysis of variance followed by least significant difference multiple comparisons test.

*p< 0.05 as compared to answer code 1.
†p<0.05 as compared to answer code 2.
‡p<0.05 as compared to answer code 3.
§p<0.05 as compared to answer code 4.
¶p<0.05 as compared to answer code 5.
MS, mental suboptimal health status; PS, physical suboptimal health status; SS, social suboptimal health status.

### Figure 1
Structural equation model of lifestyle, health consciousness and PS (model 1), MS (model 2) or SS (model 3). All the standardised regression coefficients are presented as single-headed arrows, and statistically significant at 0.05 significance level. AGFI, adjusted goodness-of-fit index; CFI, comparative fit index; CMIN/DF, minimumdiscrepancy per degree of freedom; GFI, goodness-of-fit index; MS, mental suboptimal health status; PS, physical suboptimal health status; RMSEA, root mean-square error of approximation; SS, social suboptimal health status.
Table 3  Influencing path of lifestyle and health consciousness on SHS

| SHS  | Pathway | Mean standardised effects | 95% CI | Lower bound | Upper bound | P value |
|------|---------|---------------------------|--------|-------------|-------------|---------|
| PS   | Lifestyle—PS (total) | −0.329 | −0.385 | −0.278 | <0.001 |
|      | Lifestyle—PS (direct) | −0.144 | −0.209 | −0.081 | <0.001 |
|      | Lifestyle—health consciousness—PS (indirect) | −0.185 | −0.228 | −0.149 | <0.001 |
|      | Health consciousness—PS | 0.360 | 0.295 | 0.427 | <0.001 |
| MS   | Lifestyle—MS (total) | −0.370 | −0.408 | −0.330 | <0.001 |
|      | Lifestyle—MS (direct) | −0.146 | −0.201 | −0.094 | 0.001 |
|      | Lifestyle—health consciousness—MS (indirect) | −0.224 | −0.265 | −0.186 | <0.001 |
|      | Health consciousness—MS | 0.452 | 0.392 | 0.510 | <0.001 |
| SS   | Lifestyle—SS (total) | −0.345 | −0.383 | −0.308 | <0.001 |
|      | Lifestyle—SS (direct) | −0.130 | −0.181 | −0.077 | 0.001 |
|      | Lifestyle—health consciousness—SS (indirect) | −0.216 | −0.257 | −0.179 | <0.001 |
|      | Health consciousness—SS | 0.434 | 0.376 | 0.490 | <0.001 |

MS, mental suboptimal health status; PS, physical suboptimal health status; SHS, suboptimal health status; SS, social suboptimal health status.

**Limitations**
This study has some limitations. First, although we used face-to-face interviews, all data were collected from a respondent-completed questionnaire; thus, responses may have a level of inherent inaccuracy or bias. Second, although we used a four-stage stratified sampling method, sampling errors are still inevitable. Lastly, this study only included the seven most common lifestyle factors.

**CONCLUSION**
In this large representative cross-sectional study of Chinese urban residents, we found that direct association of lifestyle with physical, mental and social SHS were smaller than direct association and mediating effect of health consciousness. Moreover, health consciousness was more important in preventing physical, mental and social SHS than lifestyle, and might be useful in changing unhealthy lifestyle and reducing the influence of poor lifestyle on physical, mental and social SHS.

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