Observational Study

Medicine®

OPEN

Reliability and validity of SHMS v1.0 for suboptimal health status assessment of Tianjin residents and factors affecting sub-health

A cross-sectional study

Jiameng Miao, MS[a], Ju Liu, MD[b], Yao Wang, MS[c], Yuelin Zhang, BS[a], Hongxia Yuan, MD[d,*]

Abstract

The study aimed to explore the reliability and validity of the Sub-Health Measurement Scale version 1.0 (SHMS v1.0) for the assessment of the suboptimal health status (SHS) of Tianjin residents.

This was a cross-sectional study that surveyed 2640 urban residents in Tianjin from June 2016 to January 2018. Demographic and clinical characteristics were collected. Each subject completed the SHMS v1.0 and Short Form-36 (SF-36) scale assessments.

The retest coefficient was 0.675. The overall Cronbach's α coefficient was 0.921. The correlation between SHMS v1.0 and SF-36 was 0.781 ($P < .01$). The SHS frequency increased with age, from 62.4% in participants ≤25 years of age to 72.8% in those ≥56 years of age. The multivariable analysis showed that female sex ($P < .001$), age >25 years old ($P = .009$), bachelor degree or above ($P < .001$), obesity ($P < .0$), regular smoking ($P = .043$), frequent drinking ($P = .045$), sleep time < 6 hours ($P = .006$), working time >10 hours ($P < .001$), physical exercise <5 times/mo ($P < .001$), and adverse events >9 ($P < .001$) were associated with SHS.

The prevalence of SHS is high among urban residents in Tianjin.

Abbreviations: BMI = body mass index, PCGDP = per capita gross domestic product, SF-36 = short form-36, SHS = suboptimal health status.

Keywords: China, health status, suboptimal health status, urban population

1. Introduction

The "biological-psychological-social" (biopsychosocial) medical model was first suggested in 1977 and implied that an individual's medical condition is not only dictated by his/her biological factors, but also by the psychological and social factors.[1] This model is often used in the management of chronic diseases and chronic pain, requiring the understanding of the disease mechanism and the psychosocial factors that can be modified to improve the patient's condition.[2] The suboptimal health status (SHS) is characterized by some disturbances in psychological behaviors or physiological characteristics or in some medical indexes but without typical pathological features.[3–5] It is considered as an intermediate state between health and overt disease, but without being one or the other.[5] Due to differences in definitions and tools used to screen for SHS, the prevalence of SHS varies widely from 20% to 80%.[4,6–8] SHS is associated with an important burden to individuals and society.[9,10]

Lifestyle factors and chronic diseases are considered as the most important factors for SHS,[11–14] including work/study-related stress, physical inactivity, lack of sleep, unhealthy diet, and internet/smartphone addiction.[4,6,7,15–18] Hence, many different scales are available to evaluate SHS, including the Sub-Health Measurement Scale version 1.0 (SHMS v1.0),[6,7] Short Form-36 (SF-36),[19] Multidimensional Sub-health Questionnaire of Adolescents,[20] and Suboptimal health status.[21,22]

Those questionnaires explore the SHS based on fatigue, cardiovascular, immune, digestive, and mental domains, but the questionnaires cover those domains in different proportions and in different manners, leading to inconsistent results. SHMS v1.0 is a validated tool for the determination of SHS.[6,7,17,23] The current SHS of the Chinese population is poorly known. In addition, SHMS v1.0 has not yet been validated against SF-36, which is a well-recognized tool for quality.[19] Furthermore, the SHS and lifestyle-related influencing factors of the Chinese

Editor: Ediriweera Desapriya.

This study was funded by the Tianjin Science Popularization Project [No.15KPXMOISF029].

The authors have no conflicts of interests to disclose.

Supplemental Digital Content is available for this article.

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

[a] Post-graduate College of TUTCM, Tianjin, [b] Treating Potential Disease Department, Traditional Chinese Medicine Hospital of Kunshan, Nanjing, Jiangsu, [c] Women's and Children's Health and Family Planning Service Center in Nankai District, [d] School of Management, Tianjin University of TCM, Tianjin, China.

[*] Correspondence: Hongxia Yuan, School of Management, Tianjin University of TCM, No. 10, Poyanghu Road, West Zone of Tuanbo New Town, Jinghai District, Tianjin 301617, China (e-mail: yhx1877@163.com).

How to cite this article: Miao J, Liu J, Wang Y, Zhang Y, Yuan H. Reliability and validity of SHMS v1.0 for suboptimal health status assessment of Tianjin residents and factors affecting sub-health: a cross-sectional study. Medicine 2021;100:17(e25401).

Received: 25 October 2020 / Received in final form: 12 March 2021 / Accepted: 15 March 2021

http://dx.doi.org/10.1097/MD.0000000000025401

population or urban residents in northern China have not been extensively studied. One study from Dalian (China) showed that the financial status, age, level of education, and body mass index (BMI) were associated with SHS among college students.[24]

Therefore, the purpose of this study was to explore the reliability and validity of the SHMS v1.0 for the assessment of the SHS of Tianjin residents, and the application of SHMS v1.0 to investigate the factors influencing SHS.

2. Methods

2.1. Study design and participants

This was a cross-sectional study that surveyed 2640 urban residents in Tianjin from June 2016 to January 2018. The study was approved by the ethics committee of Tianjin Hospital of ITCWM Nankai Hospital. Written informed consent was obtained prior to the study.

The participants were selected using a random stratified sampling method. First, the residents of the 6 districts in Tianjin were divided into 2 stratifications according to the 2016 per capita gross domestic product (PCGDP): high-income group (PCGDP >50,000 yuan) and low-income group (PCGDP <50,000 yuan). Each stratification randomly selected 2 districts. In the 4 districts, based on the streets community, each district randomly selected 2 neighborhood committees. Finally, 2 neighborhood committees were randomly selected from the 8 street communities. The residents in the area under the jurisdiction of the residents' committee were then selected as participants. The sample size calculation indicated that the survey sample size had to be at least 2400 across sex (male: female = 1:1) and age groups (16–25, 26–35, 36–45, 46–55, 56–65, and >66 years of age).

The inclusion criteria were:

1. residents of one of the 6 districts in Tianjin for at least 10 years; and
2. willing to participate.

The exclusion criteria were:

1. serious diagnosed organic diseases;
2. disease with a significant effect on the body state; or
3. could not cooperate with the final investigation.

2.2. Measurement scales

The SHMS v1.0 is composed of 9 dimensions and 39 items, covering the physical, mental, and social health aspects. The Cronbach's α and split-half reliability coefficients are 0.917 and 0.831, respectively.[24] The specific composition and structure of the scale are shown in the Supplementary Table S1, http://links.lww.com/MD2/A96. Using Likert 5-point scoring, the scores were 1 to 5 for very poor, poor, average, better, and very good, respectively. Among them, the positive scoring questions were questions 1 to 3, 13 to 19, and 26 to 39. The reverse scoring questions were questions 4 to 12, and 20 to 25, and their rescoring is the opposite of the original scoring (5–1 points). In addition to the 4 sub-health overall evaluation indicator topics (recorded as G1, G2, G3, and G4 in Supplementary Table S1, http://links.lww.com/MD2/A96), the sum of the scores is the original score for that dimension. The sum of the scores of all dimensions of each subscale (referred to as PS, MS, and SS) are the original scores of the subscales. The sum of the scores of the 3 subscales is the original score of the total scale (labeled TS). A higher score indicates better health. The score was converted into a percentile scale: dimensional conversion score = (dimensional original score - dimensional lowest theoretical score)/(dimensional highest theoretical score - dimensional minimum theoretical score) * 100.

The quality of life scale SF-36 is considered the standard for health status.[19] It includes 10 parts and a total of 36 items: physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional, mental health, a total of 8 dimensions. The Chinese version of the SF-36 has a Cronbach's α of 0.791, with Cronbach's α for all sections being >0.7, except for social function (0.631).[25]

2.3. Definition of SHS

The concept of health status includes 3 statuses health, disease, and SHS. SHS refers to medically undiagnosed or functional somatic syndromes, characterized by a decline in vitality, physiological function, and the capacity to adapt to varying conditions.[6,9,26,27] Based on the results of SHMS v1.0, the participants were divided into disease status, severe SHS, moderate SHS, mild SHS, and health.

2.4. Observation indicators and data collection

Sex, age group, ethnic distribution, marital status, education status, work status, household registration status, monthly financial status, average daily work/learning time, and living status were surveyed. Each subject completed the SHMS v1.0 and SF-36 scale assessments. Scale reliability (retest reliability, split-half reliability, and internal consistency reliability) was determined. Retest reliability was tested by sending a second questionnaire to 400 randomly selected participants 2 weeks after receiving the first questionnaire. Scale validity (content effect, structure validity, and standard validity) was examined. The responsiveness of the scale (ceiling and floor effects) was assessed. The cut-off values of the total conversion points of the SHMS v1.0 scale were examined based on the mean ± 1.5 standard deviations, the mean ± 2.0 standard deviations, and the mean ± 3.5 standard deviations for severe, moderate, and mild SHS, respectively.[28,29]

2.5. Statistical analysis

All data were analyzed using SPSS 22.0 (IBM, Armonk, NY, USA). Normal distribution was tested for all continuous variables using the Kolmogorov-Smirnov test. Data conforming to the normal distribution were expressed as means ± standard deviations, and the difference among groups was tested using ANOVA and the LSD post hoc test or using the independent sample *t*-test. For data that do not meet the normal distribution, medians (range) were used to present the results, and analyses were performed using non-parametric tests. Categorical variables were expressed as frequencies (percentages), and the Chi-Squared test was used. Correlation analysis was performed using the Spearman correlation analysis. Multivariable statistical analysis was performed using non-conditional logistic regression analysis. $P < .05$ was considered statistically significant.

3. Results

3.1. Characteristics of the participants

A total of 2640 questionnaires were distributed, and 2551 valid questionnaires were recovered. The effective recovery rate was

Table 1

General demographic distribution.

Variables	Stratifications	n (%)
Sex, n (%)	Male	1163 (45.6)
	Female	1388 (55.4)
Age, n (%)	<25 yr	433 (17.0)
	26–35 yr	421 (16.5)
	36–45 yr	429 (16.8)
	46–55 yr	431 (16.9)
	56–65 yr	435 (17.1)
	> 66 yr	402 (15.8)
Nationality, n (%)	Han	2213 (86.8)
	Others	338 (13.3)
Marital status, n (%)	Unmarried	643 (25.2)
	Married	1707 (66.9)
	Others	201 (7.9)
Education status, n (%)	High school or lower	857 (33.6)
	Junior college	878 (34.4)
	Undergraduate or higher	816 (32.0)
	Student	425 (16.7)
Work status, n (%)	In-service	1442 (56.5)
	Retired	174 (6.8)
	Unemployed	510 (20.0)
Household registration status, n (%)	Permanent	2232 (87.5)
	Temporary	161 (6.3)
	Collective	123 (4.8)
	Others	35 (1.4)
Monthly financial status, n (%)	<3000 yuan	797 (31.3)
	3000–6000 yuan	711 (27.9)
	6000–8000 yuan	607 (23.8)
	>8000 yuan	436 (17.1)
Average daily work/learning time, n (%)	<8 h	705 (27.6)
	8.1–10 h	1145 (44.9)
	> 10 h	701 (27.5)
Living status, n (%)	With family	2248 (88.1)
	With friends	108 (4.3)
	Alone	99 (3.9)
	Others	96 (3.8)

96.6%. There were 1163 males (45.6%), the mean age was 44.7 ±15.4 years, and there were 2213 Hans (86.8%). The marital status, education status, work status, household registration distribution, monthly family financial status, daily work/study time, and living status are shown in Table 1.

3.2. Reliability, validity, and responsiveness of SHMS v1.0

For retest reliability, among the 400 questionnaires that were sent, 358 were recovered (recovery rate of 89.50%), and 341 valid questionnaires could be retested (95.3% of the recovered questionnaires). The product-moment correlation coefficient between the total score of the first test and the retest was 0.675.

Table 3

SHMS v1.0 dimensions and scale scores of urban residents in Tianjin.

Scale/dimension	Original score	Conversion score
PS	54.5 ± 7.6	69.3 ± 13.5
P1	9.6 ± 2.2	55.3 ± 18.8
P2	20.4 ± 6.4	57.3 ± 24.4
P3	11.2 ± 4.5	66.9 ± 34.3
P4	8.1 ± 2.0	80.1 ± 33.3
MS	43.7 ± 7.2	64.3 ± 15.0
M1	15.4 ± 3.1	67.9 ± 19.1
M2	20.4 ± 6.0	59.1 ± 25.3
M3	7.8 ± 1.7	60.1 ± 19.2
SS	31.3 ± 8.2	62.1 ± 17.1
S1	15.8 ± 3.5	67.9 ± 19.3
S2	17.7 ± 4.5	61.1 ± 18.4
GS	127.1 ± 18.9	64.4 ± 13.5

GS = general item of sub-health, M1 = positive emotion, M2 = psychosocial symptom, M3 = cognitive function, MS = subscale of mental sub-health, P1 = physical symptom, P2 = organic function, P3 = physical mobility function, P4 = vitality, PS = subscale of physical sub-health, S1 = social adaptability, S2 = social resource and social support, SS = subscale of social sub-health.

For split-half reliability, the numbers of the 2 half-scale entries of SHMS v1.0 were 17 and 18, respectively. The analysis results showed that the total Spearman-Brown correlation coefficient was 0.842, and the Guttman split-half was 0.844.

For the internal consistency reliability, the overall Cronbach's α coefficient of SHMS v1.0 was 0.921. The Cronbach's α of the 3 subscales of physical sub-health, psychological sub-health, and social adaptation sub-health were 0.851, 0.870, and 0.892, respectively.

For structural validity, the correlation between the score of each item and its dimensional score was high, with correlation coefficients of 0.656 to 0.878, while the correlation coefficient with the scores of the other dimensions was low ($P < .01$). The correlation between the scores of each dimension and their sub-scale scores was high, with correlation coefficients of 0.586 to 0.868, while the correlation with the other sub-scale scores was low ($P < .01$).

Standard validity analysis of the combined results of the population samples showed that the correlation coefficient between the total score of SHMS v1.0 and the total score of SF-36 was 0.781 ($P < .01$). The reactivity analysis showed that the total score of the SHMS v1.0 scale and the 3 sub-scales was 100, with the lowest scores being 14.29, 0.00, 0.00, and 10.71.

Supplementary Table S2, http://links.lww.com/MD2/A96 shows the ceiling and floor effect of SHMS v1.0 and subscale.

3.3. SHMS v1.0 cut-off points

Table 2 presents the cut-off points for disease, severe SHS, moderate SHS, mild SHS, and health across 3 age subgroups (≤25, 26–55, and ≥56 years). Table 3 shows the SHMS v1.0 dimensions and scale scores of urban residents in Tianjin.

Table 2

Cutoff points of SHMS v1.0 total score of urban residents in Tianjin.

Groups	Disease	Severe sub-health	Moderate sub-health	Mild sub-health	Health
≤25 yr	[0, 54.25)	[54.25, 59.93)	[59.93, 71.29)	[71.29, 76.97)	[76.97, 100]
26–55 yr	[0, 48.84)	[48.84, 56.01)	[56.01, 70.35)	[70.35, 77.52)	[77.52, 100]
≥56 yr	[0, 42.82)	[42.82, 49.56)	[49.56, 63.05)	[63.05, 69.80)	[69.80, 100]

Table 4

Incidence of SHS among urban residents in Tianjin based on SHMS v1.0.

		≤25 years	26–55 years	≥56 years	Total
Disease, n (%)		46 (10.6%)	272 (21.2%)	124 (14.8%)	442 (17.3%)
Sub-health, n (%)	Total	357 (62.4%)	865 (66.8%)	609 (72.8%)	1831 (71.8%)
	Severe	36 (8.1%)	162 (12.6%)	226 (27.0%)	424 (16.6%)
	Moderate	212 (49.0%)	375 (29.3%)	262 (31.3%)	849 (33.3%)
	Mild	109 (25.2%)	328 (25.6%)	121 (14.4%)	558 (21.9%)
Health, n (%)		30 (6.9%)	144 (11.2%)	104 (12.4%)	278 (10.9%)
Total		433	1281	837	2551

3.4. SHS status among Tianjin residents

Table 4 presents the SHS status among urban residents in Tianjin, based on their SHMS v1.0 results. The SHS frequency increased with age, from 62.4% in participants ≤25 years of age to 72.8% in those ≥56 years of age.

3.5. Factors associated with SHS

Analyses of the SHMS v1.0 score differences were conducted based on the residents' lifestyles (Table 5). The difference in physical sub-health scores of Tianjin urban residents with different smoking conditions was significant ($P < .05$). Non-smokers scored higher than smokers. There were significant differences in physical sub-health, mental sub-health, and total sub-health scores of Tianjin urban residents with different alcohol consumption conditions ($P < .05$). The non-drinking group scored higher than the occasional-drinking and frequent-drinking groups, and the frequent-drinking group had the lowest score. There was a statistically significant difference in physical sub-health and total scores among Tianjin residents with different BMI ($P < .05$). The score in the normal BMI group was the highest, and the obesity group had the lowest score. The differences in the subscales and total scores of Tianjin urban residents with different three-meal regularity were statistically significant ($P < .05$). Those who eat 3 meals regularly had the highest score. Differences in subscales and total scores of urban

Table 5

SHMS v1.0 scores of urban residents according to lifestyle habits.

Lifestyle	Groups	PS	MS	SS	GS
Smoking status	Yes	60.4±20.2	59.9±16.5	61.1±16.4	60.1±15.1
	No	57.6±20.5	59.6±18.4	62.2±16.5	59.4±13.8
	P	0.050	0.401	0.169	0.324
Alcohol	Non-drinking	62.8±20.3	61.1±17.5	61.0±17.2	61.7±15.7
	Occasional	57.2±19.5	57.9±15.0	61.6±15.2	58.2±14.6
	Frequent	54.6±19.9	56.6±17.7	61.8±14.3	57.4±15.2
	P	0.001	0.005	0.589	<0.001
BMI	Thin	60.2±15.4	59.7±15.4	60.1±15.4	60.5±14.4
	Normal	61.3±15.6	61.2±14.6	61.6±14.2	61.9±15.3
	Obesity	57.3±14.3	59.2±15.3	58.6±12.4	59.3±16.4
	P	<0.001	0.561	0.223	0.012
Regularity of meals	Everyday	62.5±17.9	61.5±17.5	55.0±18.4	62.3±15.2
	Often	58.8±18.8	57.5±15.8	58.9±17.4	58.7±15.3
	Occasionally	55.2±18.0	55.4±15.2	60.2±16.7	56.3±14.4
	Never	53.1±19.0	53.8±14.7	63.0±15.7	53.8±14.0
	P	0.001	<0.001	<0.001	<0.001
Sleep time	<4 h	51.8±18.5	55.7±17.5	58.0±15.6	54.5±14.6
	4–6 h	54.7±17.6	58.1±16.9	53.2±13.9	55.3±15.5
	6–8 h	59.8±19.2	59.6±15.3	59.5±15.5	59.4±15.3
	>8 h	60.7±18.2	60.9±16.5	63.7±14.9	61.3±14.4
	P	0.005	0.021	<0.001	<0.001
Staying up late	Hardly	62.3±11.3	62.3±12.5	62.5±13.8	61.3±13.7
	2–5 nights/mo	60.1±13.9	61.6±15.3	61.5±15.4	60.1±15.3
	6–8 nights/mo	58.4±16.3	60.5±14.4	60.4±16.3	58.3±14.9
	9–12 nights/mo	57.1±14.9	57.4±15.2	61.3±14.2	57.0±15.2
	>12 nights/mo	55.2±15.3	54.6±13.5	60.5±15.3	54.1±16.3
	P	<0.001	<0.001	<0.001	<0.001
Physical exercise	Few	54.3±14.4	54.9±15.1	54.3±16.1	54.5±15.3
	1–4 times/mo	56.3±17.2	56.1±14.2	57.0±14.4	56.9±16.3
	5–8 times/mo	58.4±16.3	58.5±16.2	59.2±15.2	59.0±15.9
	9–12 times/mo	60.3±15.3	60.9±14.5	60.1±14.5	60.4±14.6
	12 times/mo	62.5±14.4	61.8±15.4	62.6±15.3	61.9±14.3
	P	<0.001	<0.001	<0.001	<0.001
Adverse event	Few	62.4±15.2	63.5±15.2	62.5±14.3	62.4±14.3
	3–5 times	61.2±16.5	60.5±14.2	62.1±15.1	61.2±15.3
	6–9 times	59.0±15.5	57.4±13.5	60.6±15.3	59.0±15.1
	10–12 times	58.1±15.3	54.7±14.2	58.4±15.5	56.4±13.8
	>12 times	57.3±16.3	53.6±14.4	55.2±13.5	55.6±14.9
	P	.047	<.001	<.001	<.001

BMI = body mass index, GS = general item of sub-health, MS = subscale of mental sub-health, PS = subscale of physical sub-health, SS = subscale of social sub-health.

Table 6

Logistic multivariate analysis.

		95% CI		
	Odds ratio	Lower limit	Upper limit	P
Sex	1.979	1.509	2.595	<.001
Age	1.277	1.063	1.534	.009
Education level	0.711	0.711	0.621	<.001
Working h	1.195	1.268	1.967	<.001
Smoking status	0.777	0.554	1.091	.043
Alcohol consumption	1.2580	0.557	1.091	.045
Sleep time	0.770	0.638	0.928	.006
Physical exercise	0.682	0.627	0.743	<.001
Experience	0.684	0.509	0.824	<.001
Regular meals	0.790	0.473	0.971	.034
Constant	19.804			<.001

residents with different sleep conditions were statistically significant ($P < .05$).

The group with the sleep time of 6 to 8 hours had the highest score, and those with < 6 hours had the lowest score. Differences in subscales and total scores of urban residents with different conditions of staying up late were significant ($P < .05$). The group that stayed up late less frequently had the highest score, while the group that stayed up late >12 times a month had the lowest score. The differences in the subscales and total scores of Tianjin urban residents with different times of physical exercise were significant ($P < .05$). The few physical exercise groups had the lowest scores, and those who participated in physical exercises >12 times a month had the highest scores. The differences in subscales and total scores of Tianjin urban residents with different adverse events were significant ($P < .05$), with few groups receiving the highest score.

3.6. Multivariable analysis

Regression analysis was performed on the factors that showed significant differences in the univariable analyses (Table 6). The results showed that female sex, age >25 years old, bachelor degree or above, obesity, regular smoking, frequent drinking, sleep time <6 h, working time >10 hours, physical exercise <5 times/mo, and adverse events >9 were associated with SHS of urban residents in Tianjin.

4. Discussion

The SHS and lifestyle-related influencing factors of the Chinese population or urban residents in northern China have not been extensively studied. Therefore, this study aimed to explore the reliability and validity of the SHMS v1.0 for the assessment of the SHS of Tianjin residents, and the application of SHMS v1.0 to investigate the factors influencing SHS. The results showed that the prevalence of SHS is high among urban residents in Tianjin, and that female sex, age >25 years old, bachelor degree or above, obesity, regular smoking, frequent drinking, sleep time <6 hours, working time >10 hours, physical exercise <5 times/mo, and adverse events >9 were associated with Tianjin town residents' SHS.

In the present study, the retest reliability was 0.675, the Spearman-Brown correlation coefficient was 0.842, the Guttman split-half was 0.844, the Cronbach's α coefficient was 0.921. The structural validity was good. The correlation between SHMS v1.0 and SF-36 was 0.781 ($P < .01$). The reactivity analysis showed good reactivity. Therefore, those results suggest that SHMS v1.0 has good validity and reliability for SHS in a Chinese population. This is supported by previous studies.[6,7,17,23,24]

The prevalence of SHS in an urban Tianjin sample was 71.8%, which falls within the rather wide range (20%–80%) observed in other populations.[4,6–8] SHS is a composite outcome of biological, psychological, and social factors. Therefore, different cities with different pollution, economic, and social conditions will have different SHS. In addition, the different tools used to assess SHS can affect the results. The result of the SHMS v1.0 questionnaire showed that the prevalence of SHS among students in Guangzhou, Foshan, Zhanjiang, Shaoguan and Southern China were 55.9% and 46.0%, respectively.[6,7] In addition, based on the questionnaire, the incidence of SHS was 42.7% over 18 months in students in Guangzhou.[30] The present study also suggests thresholds of SHS severity and showed that SHS severity increases with age, which is one of the major risk factors for SHS as supported by previous studies.[4,5,7,13] Future large-scale studies should examine this severity stratification in different populations.

This study identified influencing factors for SHS in this population. The results showed that female sex, age >25 years old, bachelor degree or above, obesity, regular smoking, frequent drinking, sleep time <6 hours, working time >10 hours, physical exercise <5 times/mo, and adverse events >9 were associated with SHS of urban residents in Tianjin. Other studies also identified potential risk factors for SHS in the Chinese population. Bi et al[6] examined the association between the HPLP-II lifestyle score and HSS. The HPLP-II quantifies good lifestyle habits based on health responsibility, physical activity, nutrition, spirituality, interpersonal relations, and stress. In their study, high SHMS v1.0 scores (i.e., good health status) were correlated with high HPLP-II scores (i.e., good lifestyle habits) in Chinese students.[6] More specifically, spirituality, health responsibility, physical activity, interpersonal relations, and stress management were associated with SHS. Similar results were reported by Lolokote et al.[24] Chen et al[7] concluded that consuming breakfast regularly was associated with better SHS. Yao et al[16] studied students and showed that anxiety and female sex were associated with SHS. Wu et al[31] suggested that a poor work-recreation balance was associated with SHS. Taken together, the literature and the present study indicate that poor lifestyle habits are associated with SHS. As observed in the present study, we found people who were with chronic diseases are associated with SHS, which was consistent with literature reports.[2,4]

Importantly, the SHS can be improved. Indeed, many factors involved in SHS like irregular eating habits, lack of exercise, insomnia, and stress are modifiable factors like diet, exercising, sleep, and stress. In addition, traditional Chinese medicine techniques can improve health status.[30] Such interventions should be examined more closely in future studies. Chen et al[32] revealed that simply improving lifestyle habits could improve health status.

This study has limitations. This was a cross-sectional study, and no cause-to-effect relationship could be inferred. Only urban residents were examined, and a similar study should be performed in rural residents. The participants were from a single city, and the results should be validated in multiple cities in China.

5. Conclusions

In conclusion, the present study showed that the prevalence of SHS is high among urban residents in Tianjin. Female sex, age >25 years old, bachelor degree or above, obesity, regular smoking, frequent drinking, sleep time <6 hours, working time >10 hours, physical exercise <5 times/mo, and adverse events >9 were associated with SHS in this population.

Author contributions

Conceptualization: Jiameng Miao, Hongxia Yuan.
Data curation: Jiameng Miao.
Formal analysis: Jiameng Miao, Ju Liu.
Funding acquisition: Jiameng Miao.
Methodology: Jiameng Miao.
Project administration: Yuelin Zhang.
Resources: Yao Wang.
Software: Ju Liu, Yao Wang, Yuelin Zhang.
Supervision: Yao Wang.
Visualization: Ju Liu.
Writing – original draft: Jiameng Miao.
Writing – review & editing: Jiameng Miao.

References

[1] Gatchel RJ, Peng YB, Peters ML, et al. The biopsychosocial approach to chronic pain: scientific advances and future directions. Psychol Bull 2007;133:581–624.
[2] Wijma AJ, van Wilgen CP, Meeus M, et al. Clinical biopsychosocial physiotherapy assessment of patients with chronic pain: The first step in pain neuroscience education. Physiother Theory Pract 2016;32:368–84.
[3] Yan YX, Liu YQ, Li M, et al. Development and evaluation of a questionnaire for measuring suboptimal health status in urban Chinese. J Epidemiol 2009;19:333–41.
[4] Wang W, Yan Y. Suboptimal health: a new health dimension for translational medicine. Clin Transl Med 2012;1:28.
[5] Li G, Xie F, Yan S, et al. Subhealth: definition, criteria for diagnosis and potential prevalence in the central region of China. BMC Public Health 2013;13:446.
[6] Bi J, Huang Y, Xiao Y, et al. Association of lifestyle factors and suboptimal health status: a cross-sectional study of Chinese students. BMJ Open 2014;4:e005156.
[7] Chen J, Cheng J, Liu Y, et al. Associations between breakfast eating habits and health-promoting lifestyle, suboptimal health status in Southern China: a population based, cross sectional study. J Transl Med 2014;12:348.
[8] Liu ZLM. The third state and psychosomatic medicine research. Med Philosophy 2001;22:36–8.
[9] Henningsen P, Zipfel S, Herzog W. Management of functional somatic syndromes. Lancet 2007;369:946–55.
[10] Wang W, Russell A, Yan Y. Global Health Epidemiology Reference GTraditional Chinese medicine and new concepts of predictive, preventive and personalized medicine in diagnosis and treatment of suboptimal health. EPMA J 2014;5:4.
[11] Coban A, Kavlak O, Ozbasaran F. The evaluation of school of health students' knowledge and behavior of healthy life-styles of related to importance to prevent cancer. Asian Pac J Cancer Prev 2010;11:773–6.
[12] Maksimovic MZ, Gudelj Rakic JM, Vlajinac HD, et al. Relationship between health behaviour and body mass index in the Serbian adult population: data from National Health Survey 2013. Int J Public Health 2016;61:57–68.
[13] Gooding HC, Shay CM, Ning H, et al. Optimal lifestyle components in young adulthood are associated with maintaining the ideal cardiovascular health profile into middle age. J Am Heart Assoc 2015;4:
[14] Takeshita T, Morimoto K. Effects of lifestyle on health status. Rinsho Byori 1995;43:1087–94.
[15] Ma C, Xu W, Zhou L, et al. Association between lifestyle factors and suboptimal health status among Chinese college freshmen: a cross-sectional study. BMC Public Health 2018;18:105.
[16] Yao Y, Wang L, Chen Y, et al. Correlation analysis of anxiety status and sub-health status among students of 13-26 years old. Int J Clin Exp Med 2015;8:9810–4.
[17] Xu J, Feng LY, Luo R, et al. Assessment of the reliability and validity of the Sub-health Measurement Scale Version1.0. Nan Fang Yi Ke Da Xue Xue Bao 2011;31:33–8.
[18] Yao B, Han W, Zeng L, et al. Freshman year mental health symptoms and level of adaptation as predictors of Internet addiction: a retrospective nested case-control study of male Chinese college students. Psychiatry Res 2013;210:541–7.
[19] Lins L, Carvalho FM. SF-36 total score as a single measure of health-related quality of life: scoping review. SAGE Open Med 2016;4:2050312116671725.
[20] Cao H, Tao FB, Huang L, et al. Situation of common psychosomatic symptom in adolescent and its influence on 6 months later suicide and self-injurious behavior. Zhonghua Yu Fang Yi Xue Za Zhi 2012;46:202–8.
[21] Wang Y, Ge S, Yan Y, et al. China suboptimal health cohort study: rationale, design and baseline characteristics. J Transl Med 2016;14:291.
[22] Yan YX, Dong J, Liu YQ, et al. Association of suboptimal health status with psychosocial stress, plasma cortisol and mRNA expression of glucocorticoid receptor alpha/beta in lymphocyte. Stress 2015;18:29–34.
[23] Xu J, Lu Y, Feng LY, et al. Preliminary study of Sub-Health Measurement Scale Version1.0 norms for Chinese civil servants. Nan Fang Yi Ke Da Xue Xue Bao 2011;31:1654–62.
[24] 2017;Lolokote S, Hidru TH, Li X. Do socio-cultural factors influence college students' self-rated health status and health-promoting lifestyles? A cross-sectional multicenter study in Dalian, China BMC Public Health. 17:478.
[25] Zhang Y, Qu B, Lun SS, et al. The 36-item short form health survey: reliability and validity in Chinese medical students. Int J Med Sci 2012;9:521–6.
[26] Schmid G, Dinkel A, Henningsen P, et al. Assessment of psychological aspects of somatoform disorders: a study on the German version of the Health Attitude Survey (HAS). Compr Psychiatry 2014;55:155–64.
[27] Schaefert R, Hausteiner-Wiehle C, Hauser W, et al. Non-specific, functional, and somatoform bodily complaints. Dtsch Arztebl Int 2012;109:803–13.
[28] Internet and World Wide Web - Internet of Things; New Internet of Things Findings Has Been Reported by Investigators at Newcastle University [Implemented IoT-Based Self-Learning Home Management System (SHMS) for Singapore]. Computers, Networks & Communications, 2018.
[29] Bogina M, Zlobin V, Svetov S, et al. Petrogenesis of siliceous high-Mg series: evidence from early paleoproterozoic mafic volcanic rocks of the vodlozero domain, fennoscandian shield. Geoscience Frontiers 2018;9:207–21.
[30] Wang T, Chen J, Sun X, et al. Effects of TCMC on transformation of good health status to suboptimal health status: a Nested Case-Control Study. Evid Based Complement Alternat Med 2015;2015:259727.
[31] Wu S, Xuan Z, Li F, et al. Work-recreation balance, health-promoting lifestyles and suboptimal health status in Southern China: a Cross-Sectional Study. Int J Environ Res Public Health 2016;13:
[32] Chen J, Xiang H, Jiang P, et al. The role of healthy lifestyle in the implementation of regressing suboptimal health status among college students in China: a Nested Case-Control Study. Int J Environ Res Public Health 2017;14: