

Exploring the multi-dimensional influencing factors associated with sub-health status for residents: a cross-sectional study from China

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Abstract

Background: The high incidence of sub-health and its impact on life and work have attracted wide attention. Sub-health status has been studied in China; however, there remains a lack of studies on multi-dimensional factors affecting sub-health status. This study aims to explore the sub-health status of residents, and its influencing factors in Zhuhai city of Guangdong Province of China.

Methods: Data were originated from the baseline survey of Zhuhai WHO Healthy Cities Index System in 2015, which was a cross-sectional study for the influencing factors associated with sub-health status. Finally, 3,313 participants aged 16-65 years were recruited. The study used the Sub-health Measurement Scale (SHMS V1.0), and the multivariate logistic regression model was to examine their possible associations with sub-health status. Data were analyzed using the SPSS version 22.0.

Results: Sub-health and non-sub-health groups accounted for 56.8% and 43.2% of the study population, respectively. There existed significant differences in terms of all items of SHMS V1.0 between the two groups. In the multivariate model, the place of residence was statistically significantly associated with sub-health, followed by having many close neighbors, relatives or friends, and happy feelings.

Conclusion: There are significant differences in many items of SHMS V1.0 between sub-health and non-sub-health groups. The leading determinants of sub-health included place of residence; having close neighbors, relatives or friends; having happy feelings; and negative emotions. To develop an effective sub-health intervention program, these factors should be taken into consideration. To develop an effective sub-health intervention program, the influencing factors should be taken into consideration.

Background

In recent years, the concept of human health has gradually been broadened on account of the changes in the disease spectrum and medical model. Apart from such health indicators as morbidity, mortality and life expectancy, attention has been paid to physical, psychological, and social health status [1, 2]. In other words, the concern has been transitioned from disease to health. In 1946, the World Health Organization (WHO) first defined health as a “state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity.” Since the 1980s, many scholars have proposed that more individuals were in the intermediate state between health and illness, which is called the third state by WHO. In China, it is often called the sub-health state [3]. Sub-health is related to physical, psychological, and social imbalances, leading to lower physical health and energy, lower cognitive and emotional performance, as well as less social interaction and support [4]. According to a global survey carried out by the WHO, only 5% of the global citizens are truly healthy, whereas 75% of them are in the sub-health state. Moreover, it is estimated that six million people in America and 37 million people in Australia are in the sub-health state every year; In addition, 35% of 1,000 white-collar workers participating in a survey in Japan had sub-health conditions [5]. More studies in other countries have focused on exploring the chronic fatigue syndrome (CFS) - the main sign of sub-health. The diagnostic criteria of CFS has been established, and

dynamic follow-up studies have been conducted in many regions [6–9]. However, studies on determinants of sub-health tend to pay more attention to causes of CFS, and most of them only examined a single factor. For instance, a study by He et al. pointed out a close physiological association between cerebral vascular control and skeletal muscle pH management, and neurological disorders may play a role in the development of CFS [10]. Wang et al. showed that the biosynthetic pathway of monoamine neurotransmitters may be related to the clinical features of CFS, and those genetic factors played an important role in the occurrence of CFS [11]. In recent years, there have been some improvements in the conduct of studies on determinants of sub-health in China; nevertheless, they have been mainly focused on mental health. This indicates a lack of studies on multi-dimensional sub-health. Based on the changes in the concept of human health, we conducted this study with the aim to explore sub-health status and its determinants of Zhuhai residents in Guangdong Province, thereby providing suggestions for an effective sub-health intervention program and the making of health policy by health administration departments.

Methods

Study Design and Data Source

The data were originated from the baseline survey of Zhuhai WHO Healthy Cities Index System in 2015. Zhuhai city is located in the south-central Guangdong Province with a population of approximately 1.89 million. In 2018, its gross domestic product per capita reached 2,914.74 billion Yuan, ranking ninth in the province [12]. Considering its geographic and jurisdictional diversity, a stratified cluster sampling method was adopted. All six districts in Zhuhai were involved in the study. Furthermore, we selected eight sampled towns from all the 15 towns using the probability proportional to size (PPS) method. After that, we randomly selected 109 communities in eight sampled towns. Finally, this study recruited 3,487 participants aged 16-65 years in Zhuhai city. All of them were asked to sign an informed consent document after being introduced about the purpose of the study. We sent out and then collected 3,487 questionnaires, of which only 3,323 were valid for analysis (the valid rate was 95.3%). The study protocol was approved by the Research Ethics Committee of Zhuhai Health and Family Planning Commission.

The Sub-health Measurement Scale (SHMS V1.0) (Table 1) that we used in this study was developed by the Southern Medical University using the Delphi method, item analysis and selection method [13]. This tool was proved by previous studies to be reliable and valid [14, 15]. It reflected the health of participants for the last four weeks. The questionnaire includes three sub-scales, namely physical sub-health (PS), mental sub-health (MS), and social sub-health (SS). These sub-scales cover nine dimensions, including physical symptom (P1), organic function (P2), physical mobility function (P3), vitality (P4), positive emotion (M1), psychosocial symptom (M2), cognitive function (M3), social adaptability (S1), as well as social resource and social support (S2). It consists of 39 items, all of which use a 5-point Likert scale, ranging from 1 (very poor) to 5 (very good). The positive items include questions 1-3, 13-19 and 26-39 whose scores remain the same as the score of the selected option (1-5 points). Meanwhile, the score of any negative item is equal to 6 minus the score of the selected option. Except for the four general sub-

health items (15, 28, 38, and 39), the total score of certain dimensions is the score of the corresponding sub-scale.

The higher the score, the better the health status. The maximum scores of PS, MS and SS, and overall sub-health are 70, 60, 45, and 175, whereas the minimum scores are 14, 12, 9, and 35, respectively. For the sake of making comparisons, we converted the raw scores into percentage scores. The thresholds in the three sub-scales of PS, MS and SS are 68, 67 and 67, respectively. When the scores of any of the three sub-scales are lower than the thresholds, the participants could be judged as sub-health, other judged as healthy state [16]. Therefore, the participants were assigned to non-sub-health group vs sub-health group.

Statistical Analysis

The study participants could select only one option for each questionnaire item. Any item with multiple options was considered invalid and therefore listed as a missing value. Data were entered twice independently by two data entry operators using EpiData version 3.1 and checked for inconsistencies in order to enhance accuracy. We used descriptive statistics to summarize characteristics of the study participants and presented the scores of SHMS V1.0 as mean \pm standard deviation (SD). Variables demonstrating statistical significance ($p < 0.05$) in the univariate analysis were then included into the multivariate logistic regression model to examine their possible associations with sub-health status. The outcome variable was treated as a nominal measure: non-sub-health vs sub-health. All analyses were performed using SPSS version 22.0 for Windows (IBM Corporation, Armonk, NY).

Results

Characteristics of Study Participants

Of the 3,313 study participants, males accounted for 49.0%, while females formed 51.0%. Those aged 45 years or above accounted for 36.7%, and 39.8% lived in urban areas. Only 14.5% reported having an undergraduate or higher degree, and 75.2% were married. In addition, the majority (68.6%) of the study participants had a monthly income of less than 5,000 Yuan. More than two-thirds (74.0%) of the participants exercised fewer than five times per week. 70.0% of them followed vegetarian and carnivorous diets (15.2% only vegetarian diets and 10.2% only carnivorous diets, respectively). Only 40.3% of the participants listened to mental health lectures.

In our study, 56.8% of the study participants experienced sub-health status, while the non-sub-health group made up 43.2%. Two groups showed differences in factors other than gender, marital status, monthly income, eating habits and listening to mental health lectures. Sub-health status was more likely to be found among participants who were between 25 and 34 years old, had lower education level, lived in urban areas, were engaged in other occupations, and exercised fewer than three times per week (Table 2).

Comparison of mean SHMS V1.0 scores between sub-health group and non- sub-health group

The sub-health group had a mean total score of 65.72 ± 13.14 lower than that of the non-sub-health group (74.21 ± 7.98). Besides, in both groups, the mean score in the PS was lower than that of either MS or SS, and the mean scores of P2 and P3 were higher. In the sub-health group, M3 of the MS had the lowest mean score (56.32 ± 13.55), followed by S2 of the SS (56.82 ± 12.55), and P1 of the PS (59.06 ± 15.20). These results were also seen in the non-sub-health group. The sub-health group and the non-sub-health group were different from each other in terms of all items (Table 3).

Influencing factors of sub-health

Univariate analysis showed that the frequency of physical exercise per week, the place of residence, and all the 35 items of the SHMS V1.0 (except for the general sub-health item) were significantly associated with sub-health status. Meanwhile, the multivariate logistic regression model identified the place of residence as the leading determinant of sub-health (OR=1.60, 95% CI: 1.45-1.76), followed by having many close neighbors, relatives or friends (OR=1.31, 95% CI: 1.15-1.49) and having happy feelings (OR=1.29, 95% CI: 1.15-1.44). The frequency of physical exercise per week, appetite, gastrointestinal upset, difficulty in walking 3-5 stairs, negative emotions, memory, and interpersonal relationship also had a significant impact on sub-health (Table 4).

Discussion

Our results showed that sub-health residents in Zhuhai accounted for 56.8%. This figure was slightly lower than that in a study conducted by Sun et al. on sub-health residents in Guangdong Province [17]. This may result from the differences in their samples and questionnaires [18-20]. Our study found that the proportion of participants with sub-health status varied across different age groups. Previous studies indicated that middle-aged people were more likely to experience sub-health status since they were at a critical stage of their career (e.g. personal promotion) and personal life. They had to face up with a lot of problems relating to their interpersonal relationships, children's education, economic pressure, and responsibility for taking care of elderly family members. All these might increase their exposure to physical and mental problems [21, 22]. In our study, the 25-34-year-olds constituted the highest proportion of all participants having sub-health conditions (27.4%). This means that the sub-health population tends to be younger, and therefore, more attention should be paid to them. In addition, better-educated participants were less likely to be vulnerable to sub-health. A possible explanation is that they had better healthcare-related knowledge, more effective psychological adjustment methods, and healthier lifestyles [23].

Sub-health status assessed by the SHMS V1.0

The PS score of the sub-health group was the lowest of all the three sub-scales. This indicated that physical sub-health was the key factor leading to sub-health status. The symptoms of physical sub-health include lack of energy, insomnia, bitter taste, headache, as well as pain in body parts, like waist and legs. This causes an individual more susceptible to diseases. In view of this situation, boosting the immunity system is the best way to defend against harmful infections and diseases, and promote good

health [24, 25]. To have a better immune system, a person needs to pursue a healthy lifestyle that balances different aspects of life, including work, rest and physical activity, have a balanced diet, and consume recommended dietary supplements.

Determinants of sub-health

The multivariate regression model showed that the pace of residence had the greatest impact (OR=1.60) on sub-health status. Urban residents were more likely to be in a sub-health status. Since the economic reform in 1978, Chinese economy has been growing at a rapid pace, leading to greater urbanization. Environmental pollution derived from urban development, pressure relating to resource allocation, and social competition have posed a lot of health threats to urban residents [26].

Social support is the external support, whether material or spiritual, that an individual receives when facing a stressful event. In our study, individuals having no close neighbors, relatives and friends in the SS were at a higher risk of sub-health status (Many vs. None, OR=1.31). As an intermediary factor between stress and physical health, social support plays an important role in protecting an individual's physical and mental health. Most scholars believed that unlike negative social relations, positive social support is beneficial to physical and mental health [27, 28]. Therefore, lack of social support is considered to be an important contributor to long-term fatigue existence of sub-health and dysfunction. Lower social support puts a person at a higher risk of having sub-health conditions. Our results also showed that the score of social resource and support in the sub-health group was lower than that in the non-sub-health group.

Emotion plays a crucial part in the occurrence and development of sub-health status. Happy feelings (Always vs. None, OR=1.29) and negative emotions or depression (None vs. Always, OR=1.28) in the MS were deemed as two other important factors leading to sub-health status. With the acceleration of modern social life, negative emotions usually include depression and stress. They may further develop into anxiety disorders and non-communicable diseases, seriously threatening human health unless timely interventions are implemented [29]. Psychological adjustment is an irreplaceable approach to solving sub-health problems through improving self-cultivation, establishing a positive outlook on life, and taking courage to face reality [30].

Other contributors to sub-health status included the frequency of physical exercise per week (Daily vs. None), appetite (Very good vs. Very poor), gastrointestinal upset (None vs. Always), walking 3-5 stairs (None vs. Very difficult), memory (Very good vs. Very poor), and interpersonal relationship (Very satisfied vs. Very unsatisfied).

Limitations of the study

Our study encountered two potential limitations. Firstly, as a cross-sectional study, it can result in the information bias of measuring the study outcome. Secondly, we only surveyed the participants in Zhuhai city on account of time and resource restrictions; hence, these findings may not be generalizable to other

regions in Guangdong province. Further studies, therefore, need to be conducted with more statistical methods while taking our limitations into consideration.

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Conclusion

The high incidence of sub-health and its impact on life and work have attracted wide attention. In our study, the sub-health group outnumbered the non-sub-health group (56.8% vs 43.2%). There existed significant differences in terms of all items of SHMS V1.0 between the two groups. The leading determinants of sub-health included place of residence; having close neighbors, relatives or friends; having happy feelings; and negative emotions. To develop an effective sub-health intervention program, these factors should be taken into consideration.

Declarations

Acknowledgements

We would like to thank all the participants in this study.

Authors'contributions

JJR, and GYL contributed to the conception and design of the study. YHL was responsible for communicating with participants in the survey. LJZ, JR and NZ contributed to the data collection. XLY, and JL contributed to literature search and data quality control. XLY, and LJZ did the statistical analysis and drafted the original manuscript. JJR revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets generated and analyzed during the current study are not publicly available due to privacy restrictions. Respondents were informed during the consent process that the data they provide would be available only to the Zhuhai Health and Family Planning Commission and Zunyi Medical University.

Ethics approval and consent to participate

This study was reviewed and approved by the Research Ethics Committee of Zhuhai Health and Family Planning Commission. Respondents' consent to participate was given by agreeing to fill out the online questionnaire. The Research Ethics Committee of Zhuhai Health and Family Planning Commission approved the use of implied consent to participate upon returning of the completed survey.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Abbreviations

CI: Confidence Interval; OR: Odds Ratio; WHO: World Health Organization; CFS: Chronic Fatigue Syndrome; SHMS V1.0: Sub-health Measurement Scale V1.0; PS: Physical Sub-health; MS: Mental Sub-health; SS: Social Sub-health; SD: Standard Deviation.

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Tables

Table 1 The structure of SHMS V1.0

Aspects	Dimensions	Item distributions
Sub-scale of Physical Sub-health (PS)	Physical symptom (P1)	1 ,2, 3
	Organic function (P2)	4, 5, 6, 7, 8, 9
	Physical mobility function (P3)	10, 11, 12
	Vitality (P4)	13, 14
Sub-scale of Mental Sub-health (MS)	Positive emotion (M1)	16, 17, 18, 19
	Psychosocial symptom (M2)	20, 21, 22, 23, 24, 25
	Cognitive function (M3)	26, 27
Sub-scale of Social Sub-health (SS)	Social adaptability (S1)	29, 30, 31, 32
	Social resource and Social support (S2)	33, 34, 35, 36, 37
General item of Sub-health (GS)	Physical, Mental, Social and Overall Sub-health (G1, G2, G3, G4)	15, 28, 38, 39

Table 2 Association between sub-health status and characteristics of study participants

Variables	Total N=3313 (%)		Sub-health group N=1881 (%)		Non sub-health group N=1432 (%)		P Value
Gender							
Male	1623	49.0	901	47.9	722	50.4	0.15
Female	1690	51.0	980	52.1	710	49.6	
Age							
15-	467	14.1	248	13.2	219	15.3	0.02
25-	851	25.7	515	27.4	336	23.5	
35-	779	23.5	445	23.7	334	23.3	
45-	699	21.1	371	19.7	328	22.9	
55-65	517	15.6	302	16.1	215	15.0	
Place of residence							
Urban areas	1318	39.8	905	48.1	413	28.8	<0.001
Town	1062	32.1	535	28.4	527	36.8	
Rural areas	933	28.2	441	23.4	492	34.4	
Education level							
Junior college and less	424	12.8	262	13.9	162	11.3	<0.001
Junior middle school	832	25.1	414	22.0	418	29.2	
Senior middle school	1578	47.6	894	47.5	684	47.8	
Undergraduate and above	479	14.5	311	16.5	168	11.7	
Marriage status							
Unmarried	727	21.9	407	21.6	320	22.3	0.28
Married	2491	75.2	1411	75.0	1080	75.4	
Divorced	59	1.8	40	2.1	19	1.3	
Others	36	1.1	23	1.2	13	0.9	
Occupation							
Students	187	5.6	89	4.7	98	6.8	0.04
Staffs	421	12.7	252	13.4	169	11.8	
Workers	488	14.7	261	13.9	227	15.9	
Farmers	403	12.2	235	12.5	168	11.7	
Individual occupation	458	13.8	258	13.7	200	14.0	
Others	1356	40.9	786	41.8	570	39.8	
Per capita monthly income							
<2500	1065	32.1	612	32.5	453	31.6	0.44
2500-	1210	36.5	692	36.8	518	36.2	
5000-	646	19.5	347	18.4	299	20.9	
7500-	211	6.4	127	6.8	84	5.9	
10000-	181	5.5	103	5.5	78	5.4	

The frequency of physical exercise per week

0	571	17.2	354	18.8	217	15.2	<0.001
<3	1263	38.1	773	41.1	490	34.2	
3-5	621	18.7	343	18.2	278	19.4	
Daily	858	25.9	411	21.9	447	31.2	
Food habits							
Vegetarian	154	4.6	95	5.1	59	4.1	0.053
Vegetarian-based	503	15.2	285	15.2	218	15.2	
Vegetarian and carnivore	2318	70.0	1289	68.5	1029	71.9	
Carnivore-based	338	10.2	212	11.3	126	8.8	
Attending lectures on mental health							
Yes	1334	40.3	766	40.7	568	39.7	0.54
No	1979	59.7	1115	59.3	864	60.3	

Table 3 Comparisons of mean SHMS V1.0 scores between sub-health group and non sub-health group

Aspects	Dimensions	Sub-health group	Non sub-health group	<i>P</i> -Value
		Mean (SD)	Mean (SD)	
PS		59.65 (9.87)	66.97 (10.95)	<0.001
	P1	59.06 (15.20)	69.10 (16.24)	<0.001
	P2	71.84 (14.42)	80.39 (12.95)	<0.001
	P3	81.06 (15.71)	88.58 (13.41)	<0.001
	P4	68.65 (18.97)	75.79 (20.50)	<0.001
MS		64.64 (9.90)	74.00 (9.37)	<0.001
	M1	62.04 (13.14)	72.13 (13.49)	<0.001
	M2	69.05 (13.08)	78.60 (11.44)	<0.001
	M3	56.32 (13.55)	63.80 (15.10)	<0.001
SS		70.64 (10.63)	79.11 (9.83)	<0.001
	S1	63.16 (10.95)	71.25 (12.04)	<0.001
	S2	56.82 (12.55)	63.55 (14.18)	<0.001
Overall Sub-health		65.72 (8.28)	74.21 (7.98)	<0.001

Table 4 Results of multivariate logistic regression between sub-health and determinants

Variables	β	S.E.	Wald	Sig.	OR (95%CI)
The frequency of physical exercise per week (Daily vs. None)	0.18	0.04	20.65	<0.001	1.19 (1.11-1.29)
Place of residence (Rural vs. Urban areas)	0.47	0.05	88.51	<0.001	1.60 (1.45-1.76)
Appetite (Very good vs. Very poor)	0.23	0.07	12.77	<0.001	1.26 (1.11-1.43)
Gastrointestinal upset (None vs. Always)	0.19	0.05	15.52	<0.001	1.21 (1.10-1.34)
Walking 3-5 stairs (None vs. Very difficult)	0.23	0.06	17.41	<0.001	1.26 (1.13-1.40)
Having happy feelings (Always vs. None)	0.25	0.06	18.65	<0.001	1.29 (1.15-1.44)
Negative emotions (None vs. Always)	0.25	0.07	13.14	<0.001	1.28 (1.12-1.47)
Memory (Very good vs. Very poor)	0.16	0.06	7.61	<0.001	1.17 (1.05-1.30)
Interpersonal relationship (Very satisfied vs. Very unsatisfied)	0.20	0.06	10.26	<0.001	1.22 (1.08-1.38)
Having close neighbors, relatives or friends (Many vs. None)	0.27	0.07	16.49	<0.001	1.31 (1.15-1.49)
Constant	-5.03	0.75	45.40	<0.001	

95% CI = 95% confidence interval