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Original Article

Prevalence of Suboptimal Health Status and Its Influencing Factors among Chinese Software Programmers

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Abstract

Background: There is a lack of specific study of the suboptimal health status (SHS) in software programmers. The aims of the present study were to investigate the prevalence of SHS and analyze the influencing factors among Chinese software programmers.

Methods: A cross-sectional survey using a programmer SHS scale was conducted to evaluate the prevalence of SHS, as well chi-square test and multi-factor logistic regression were applied to analyze the relationship between suboptimal health and personal basic information, living and work habits in software programmers.

Results: The prevalence of SHS was 18.67% in software programmers. Single factor analysis found that there were differences in suboptimal health prevalence among different work cities (P = 0.031), hours of sleep per day (P = 0.046), overtime days per month (P = 0.010) and exercise frequency per week (P = 0.015). The factors for suboptimal health such as hours of sleep per day (OR = 0.307, 95% CI = 0.096~0.984) and exercise frequency per week (OR = 0.190, 95% CI = 0.054~0.671) significantly affected subjects of SHS via multi-factor logistic regression analysis, indicating that adequate sleep and exercise decreased the chance of SHS up to 30.70% and 19.00%, respectively.

Conclusion: Suboptimal health had become a serious public health challenge in Chinese software programmers. Whilst, the health status of the programmers could be effectively elevated by improving lifestyles.

Keywords: Software programmers; Suboptimal health status; Prevalence; Influencing factors

Introduction

Recently, the definition of health has evolved from "the absence of disease" or "the infirmity" to "a state of complete physical, mental and social well-being" (1). Meanwhile, thanks to the change of living environment, there is an intermediate state between health and disease, which is called suboptimal health status (SHS) (2). The clinical manifestations of suboptimal health include fatigue, weakness, emotional changes, poor social adaptive ability, etc. (3). According to these manifestations, SHS can be judged as physical, psychological and social communication suboptimal health (4, 5). As a recently introduced medical concept, SHS has attracted researchers' attention.

Previously, in Southern China, SHS occurred in 46.0% of a surveyed population (6). In the east of China, 14.2% of the 'left behind' students were in SHS (7). 55.0%~75.0% of Chinese adults suffered from SHS (8). Due to people's understanding of the work, many previous surveys on SHS mainly focused on specific populations, such as teachers, doctors, college students, etc. (9, 10). However, software programmers, as a relatively new professional population in China, there are only a few studies on their suboptimal health.

Recently, the occurrence of suboptimal health is on the increase, the related research on influencing factors of SHS is also increasing. College teachers are more prone to SHS (11). Their working characteristics require them to pay more attention to intellectual work, so that they do not have enough physical exercise. For college students, SHS was highly attributed to unhealthy lifestyles, such as poor physical activity, poor nutrition and so on (12). In addition, some researchers believed that SHS was associated with society, environment, psychology, living habits, daily diets, inheritance etc. (13, 14). However, the pathogenesis and influencing factors of SHS remains unclear, especially in programmers.

To address this gap in knowledge, we designed the specific suboptimal health questionnaire and analyzed the prevalence of SHS and influencing factors in Chinese software programmers. The results are expected to lay a foundation for the study about suboptimal health of software programmers, further better prevent diseases and promote the health status of the population.

Methods

Participants

The research subjects of this paper are full-time programmers in wechat group of programmer. Using convenience sampling method, the questionnaire star link of "programmer SHS scale" was sent to the wechat group of programmer, and all the participants voluntarily participated in the investigation and completed the questionnaire independently by scanning the code of the link. The inclusion criterion was full-time software programmers working at least one year, and the exclusion criterion was no organic disease.

Ethics approval

This link to the questionnaire was sent to wechat group of software programmers. The participants filled in the questionnaire voluntarily and anonymously. Thus, the researchers were unable to obtain personal identifiers or personal health information of participants.

Design of the questionnaire

On the basis of research, a questionnaire named "programmer SHS scale" was comprised with self-designed items and SHS questionnaire items. The self-designed items mainly focused on the programmers' personal basic information and living and work habits, providing data to support the research of programmers' SHS. This part included gender, age, education lever, etc., a total of 13 items. The SHS questionnaire items were used in the "Chinese sub-health evaluation scale (CSHES)" and made a little change (15). The SHS questionnaire items mainly covered questions in 3 dimensions (physical, psychological and social adaptation dimensions), 18 factors and 63 items, as shown in Table 1. The options of 63 items were graded as 5 grades (1-5 points). Except for the reverse scoring items (question 15, 26, 66, 69-76), all items were scored 1 point for the first options and 5 points for the fifth options (the reverse scoring item was 5 points for the first options and 1 point for the fifth options). The minimum and maximum scores were obtained by adding all the small items, respectively. The total score was obtained by adding the scores of all the items. And the scores of the three dimensions were the sum of the scores of each dimension. The higher the score of the respondents, the worse their health status were.

SHS assessment

Before the investigation, the researchers clarified the purpose of investigation and ensured that the respondents were free from organic or psychological diseases. According to the distribution of questionnaire scores, the criteria of SHS were determined. If the suboptimal health score of the population conformed to the normal distribution, the upper limit of unilateral 90% reference value range ($\overline{X} + 1.28S$) was used as the judgment standard of SHS. If the suboptimal health score of the population did not conform to the normal distribution, the percentile method was adopted to calculate the SHS score, and the unilateral *p*90 upper bound of the suboptimal health score was as a criterion of the SHS (16).

Issuance and recycling of questionnaires

The questionnaire star link of "programmer SHS scale" was sent to 180 programmers' wechat group, 150 of them filled in the questionnaire and 150 valid questionnaires were obtained. The sample size was calculated according to the following formula, where *P* was the expected prevalence, *q* = 1-*p*. The *P* value (0.792) was obtained from the study of Wang B et al (17).

$$n = 400 \times \frac{q}{p}$$

Statistical analysis

The SPSS 26.0 statistical software (Chicago, IL, USA) was used to analyze the data. The measurement data in accordance with the normal distribution was expressed as a mean ± standard deviation ($\overline{X} \pm S$), and the abnormal distribution was expressed by median and quartile [M (*P*25, *P*75)]. The statistical methods included: calculation of Cronbach's α, descriptive analysis, Chi square test and logistic regression analysis. Statistical results were considered as significant when the *P*-values were less than 0.05.

Results

Internal consistency analysis of scale

The Cronbach's α coefficient of the total scale (76 items) was 0.949, the Cronbach's α of the SHS (63 items) was 0.961, and the Cronbach's α of the three dimensions were 0.957 (physical dimension), 0.930 (psychological dimension) and 0.861 (social adaptation dimension). Since there were only one or two items in "allergy", "discomfort", "attention", "satisfaction" and "sexual life", the internal consistency of these five aspects was not analyzed. The Cronbach's α of the other 13 aspects were all higher than 0.70, indicating that the internal consistency and the reliability of the scale were high (Table 1).

General characteristics of subjects

In this study, a total of 150 software programmers were brought into investigation. The participants' characteristics are displayed in the Table 2.

Table 1: Distribution and reliability analysis in programmer SHS scale items

Dimension	*Factors*	*Itmes*	*Cronbach's α*
Basic information	/	13	/
Physical performance	/	40	0.957
	Fatigue	5	0.772
	Digestion	4	0.841
	Sleep	4	0.729
	Senility	3	0.745
	Weak	3	0.767
	Metabolic disorders	4	0.758
	Immune disorders	5	0.856
	Allergy	1	/
	Constipation	3	0.826
	Ache	6	0.867
	Discomfort	2	/

Psychological performance	/	11	0.930
	Depressed	6	0.856
	Anxious	4	0.886
	Attention	1	/
Social adaptation	/	12	0.816
	Pressure	4	0.713
	Satisfaction	2	/
	Social life	5	0.867
	Sexual life	1	/
SHS total	/	63	0.961
Total	/	76	0.949

Table 2: Characteristics of participating programmers in the survey (N = 150)

Participant Characteristics	***n***	***%***
Gender		
Male	128	85.3
Female	22	14.7
Age (year)		
15-24	35	23.3
25-34	109	72.7
≥35	6	4.0
Character		
Introverted	66	44.0
Extroverted	84	56.0
Education lever		
High school / vocational school	3	2.00
Junior college	19	12.7
Undergraduate	115	76.7
Master degree or above	13	8.7
Marital status		
Unmarried	100	66.7
Married	49	32.7
Widowed	1	0.7
Divorce	0	0.00
Work city		
First-tier cities	31	20.7
New first tier cities	87	58.0
Second-tier cities	13	8.7
Third-tier cities	19	12.7
Job category		
Test	24	16.0
Operation and maintenance	23	15.3
Development	103	68.7
Working time (year)		
<2	33	22.0
2-5	88	58.7
5-10	25	16.7
≥35	4	2.7
Working hours per day (hour)		
<6	2	1.3
6-8	22	14.7
8-10	94	62.7

≥10	32	21.3
Hours of sleep per day (hour)		
<6	10	6.7
6-8	124	82.7
8-10	15	10.0
≥10	1	0.7
Overtime days per month (weekends; day)		
<2	62	41.3
2-4	55	36.7
4-6	23	15.3
6-8	4	2.7
≥8	6	4.0
Short breaks frequency per day (excluding lunch break; time)		
<2	100	66.7
2-4	34	22.7
4-6	8	5.3
6-8	3	2.0
≥8	5	3.3
Exercise frequency per week (time)		
<1	90	60.0
1-2	43	28.7
2-4	10	6.7
4-6	3	2.0
Every day	4	2.7

"n" represents the number of people and "%" represents the constituent ratio.

Total score and average score of three dimensions

Since all items in the sample did not conform to normal distribution, they were expressed by M (P25, P75). The total score of suboptimal health items was 155.00 (138.00, 174.00), the minimum score was 73.00 and the maximum was 281.00 in the questionnaire. The total score of physical performance items, psychological performance and social adaptation were 90.00 (76.75, 103.00), 29.00 (23.00, 34.00) and 36.00 (32.00, 40.00), respectively. The scores of all factors included in the questionnaire were shown in Table 3.

Table 3: Total score and average score of SHS in three dimensions (N = 150)

Dimension	*Factors*	*Score [M (P25, P75)]*	*minimum value*	*maximum value*
Physical performance	Fatigue	15.00 (13.00, 17.00)	5.00	25.00
	Digestion	8.00 (6.00, 11.00)	4.00	20.00
	Sleep	10.00 (8.00, 13.00)	5.00	20.00
	Senility	6.00 (5.00, 8.00)	3.00	15.00
	Weak	6.00 (4.00, 7.00)	3.00	14.00
	Metabolic disorders	9.00 (7.00, 9.00)	4.00	20.00
	Immune disorders	11.00 (9.00, 13.00)	5.00	24.00
	Allergy	1.00 (1.00, 2.00)	1.00	5.00
	Constipation	4.00 (3.00, 6.00)	3.00	15.00
	Ache	14.00 (11.00, 18.00)	6.00	30.00

	Discomfort	4.00 (3.00, 6.00)	2.00	10.00
	Total	90.00 (76.75, 103.00)	41.00	198.00
Psychological performance	Depressed	15.00 (12.00, 18.00)	6.00	30.00
	Anxious	11.00 (4.00, 20.00)	8.00	13.00
	Attention	3.00 (2.00, 3.00)	1.00	5.00
	Total	29.00 (23.00, 34.00)	11.00	55.00
Social adaptation	Pressure	12.00 (10.00, 14.00)	4.00	20.00
	Satisfaction	6.00 (5.00, 7.00)	2.00	10.00
	Social life	15.00 (12.00, 17.00)	5.00	25.00
	Sexual life	3.00 (2.00, 5.00)	1.00	5.00
	Total	36.00 (32.00, 40.00)	16.00	54.00
Total score		155.00 (138.00, 174.00)	73.00	281.00

The signal factor analysis on SHS of software programmers

Taking the unilateral *p*90 point of all dimensions of a crowd as the criterion, the dividing line scores of physical, psychological and social suboptimal health were 126.90, 39.90 and 44.00, respectively. When the score of any of the three dimensions was higher than the dividing line score, it could be judged as SHS. If participants did not have SHS with respect to any of these three dimensions, they were considered as healthy. Table 4 presented the prevalence of SHS for different general characteristics of programmers. The difference of the SHS prevalence was statistically significant in different working cities of programmers SHS (P = 0.031). The prevalence of SHS with "hours of sleep per day (hour) < 6 hours" was significantly higher than that with long hours of sleep (P = 0.046). In addition, the programmers SHS had significant difference in different overtime days (P = 0.010) and different exercise frequency (P = 0.015). However, other characteristics of programmers had no obvious impact on their SHS (P> 0.05).

Table 4: Single factor analysis on SHS of software programmers

Participant Characteristics	*N*	*SHS [n (%)]*	χ^2/p
Gender			
Male	128	23 (18.0)	0.564 (Fisher)
Female	22	5 (22.7)	
Age (yr)			0.209/0. 922 (Freeman-Halton)
15-24	36	7 (19.4)	
25-34	108	20 (18.5)	
≥35	6	1 (16.7)	
Character			0.311/0.577
Introverted	66	11 (16.7)	
Extroverted	84	17 (20.2)	
Education level			3.414/0.321 (Freeman-Halton)
High school / vocational school	3	1 (33.3)	
Junior college	19	1 (5.3)	

Undergraduate	115	24 (20.9)	
Master degree or above	13	2 (15.4)	
Marital status			3.703/0.183 (Freeman-Halton)
Unmarried	100	17 (17.0)	
Married	49	10 (20.4)	
Widowed	1	1 (100.0)	
Divorce	0	0 (0.0)	
Work city			8.355/0.031 (Freeman-Halton)
First-tier cities	31	6 (19.4)	
New first tier cities	87	17 (19.5)	
Second-tier cities	13	5 (38.5)	
Third-tier cities	19	0 (0.0)	
Job category			0.573/0.772 (Freeman-Halton)
Test	24	4 (16.7)	
Operation and maintenance	23	3 (13.0)	
Development	103	21 (20.4)	
Working years (year)			3.097/0.345 (Freeman-Halton)
<2	33	9 (27.3)	
2-5	88	13 (14.8)	
5-10	25	5 (20.0)	
≥10	4	1 (25.0)	
Working hours per day (hour)			6.418/0.081 (Freeman-Halton)
<6	2	1 (50.0)	
6-8	22	2 (9.1)	
8-10	94	15 (16.0)	
≥10	32	10 (31.3)	
Hours of sleep per day (hour)			7.095/0.046 (Freeman-Halton)
<6	10	5 (50.0)	
6-8	124	22 (17.7)	
8-10	15	1 (6.7)	
≥10	1	0 (0.0)	
Overtime days per month (weekends; day)			
<2	62	7 (11.3)	12.115/0.010 (Freeman-Halton)
2-4	55	10 (18.2)	
4-6	23	5 (21.7)	
6-8	4	2 (50.0)	
≥8	6	4 (66.7)	
Short breaks frequency per day (excluding lunch break; time)			1.465/0.843 (Freeman-Halton)
<2	100	19 (19.0)	
2-4	34	8 (23.5)	
4-6	8	1 (12.5)	

6-8	3	0 (0.0)	
≥8	5	0 (0.0)	
Exercise frequency per week (time)			11.133/0.015 (Freeman-Halton)
<1	90	25 (27.8)	
1-2	43	3 (7.0)	
2-4	10	0 (0.0)	
4-6	3	0 (0.0)	
Every day	4	0 (0.0)	

"n" represents SHS cases, "%" represents the incidence of SHS.

Multi-factor logistic regression analysis on SHS software programmers

Taking "health or suboptimal health" as the dependent variable (health = 0, suboptimal health = 1), and the factors with statistically significant difference screened out by signal factor analysis as independent variables, multi-factor logistic regression analysis was conducted and the results for SHS are shown in Table 5. Stepwise method was used to screen the independent variables (α_{in} = 0.05, α_{out} = 0.10).

Table 5: Multi-factor logistic regression analysis for programmers SHS

Factors	*B*	*SE*	*Wald χ^2*	*OR (95% CI)*	*P*
Work city	-0.382	0.310	1.515	0.682 (0.371~1.254)	0.218
Hours of sleep per day (hour)	-1.181	0.594	3.951	0.307 (0.096~0.984)	0.047
Overtime days per month (weekends; day)	0.402	0.210	3.675	1.496 (0.991~2.257)	0.055
Exercise frequency per week (time)	-1.661	0.644	6.656	0.190 (0.054~0.671)	0.010

Discussion

This study aimed to assess SHS level and its influencing factors in software programmers' community revealed some significant associations. Strong correlations between lifestyle and SHS were demonstrated.

Many researchers have studied the SHS of different populations around the world. Wang Y et al (18) carried out a large cross-sectional survey based on "Suboptimal Health Status Questionnaire-25" in 4313 adults (from 18 to 65 years old) and results showed that the detection rate of SHS was 9.0%. In Renmin University of China, 51.2% of college freshmen experienced the SHS (16). Another study found the overall suboptimal health rate of teachers was 50.7% in Chang'an University (11). In this study, 150 software programmers were investigated for SHS, and the overall prevalence rate was 18.7%. Compared with the above researches, the SHS rate of programmers was lower than that of college freshmen in Renmin University and teachers in Chang'an University, but higher than that of the large-scale cross-sectional survey by Wang Y et al (18). The possible reason was that the average age of subjects was 26.93 ± 4.48 in this study, their physical fitness was better than that of college freshmen, whilst they were faced with less pressure than university teachers. However, the low prevalence reported by Wang Y et al. in a large cross-section study was mainly attributable to different participant selection criteria and higher threshold for scores.

As far as the influencing factors of SHS were concerned, this study conducted a single factor analysis via Chi square test on the different demographic characteristics, living and work habits of programmers. For demographic characteristics, there was a high prevalence of SHS among respondents, especially in those who they were in the second-tier cities, and the lowest prevalence of SHS in respondents who they were in the third-tier cities. Nevertheless, the prevalence rate in the first and new first tier cities was in the middle. For programmers, the results might be due to the better development of software industry, more companies, more job opportunities and higher wages in first-tier and new first tier cities. Although there were fewer software development companies in the third-tier cities, the local living costs were lower, hence the life pressure was relatively less. However, the two aspects of second-tier cities were in the middle, which resulted in the highest prevalence of SHS. In addition, there was no obvious difference in other participant characteristics such as age, gender, marital status, education, etc. This result was not consistent with the study of Wang B et al (17), and they found that the SHS of Chinese software programmers were different between different genders. The above-mentioned inconsistent could be involved in the differences between the survey time, the respondents and disunity of SHS standard.

As for programmers' daily living and work habits, sleep less than 6 hours a day, 6-8 days of overtime in per month and exercise frequency less than once a week were significant factors affecting the health conditions of software programmers in the current study. The results demonstrated that bad work and living habits tended to cause SHS, which was similar to the study of Ma et al (16) that good sleep quality and abundant physical exercise were negatively associated with SHS. Meanwhile, excessive overtime and workload not only make employees tired of work, but also seriously endanger employees' health, increase the SHS incidence, and even cause diseases (19).

Lifestyle is one of the most important factors affecting health and SHS is highly attributable to unhealthy lifestyles (20). Sleep deprivation may cause severe cognitive and emotional problems (21). Much existing evidence suggested that inadequate sleep duration is positively associated with SHS (21, 22). Short sleep duration can even cause diseases, such as cardiovascular disease, psychiatric disorders and so on (23). Similarly, according to multi-factor logistic regression analysis, we further confirmed that inadequate sleep duration was associated with a higher prevalence risk of programmers' SHS. In addition, exercise is associated with numerous health benefits, especially influence mental health (24). As the same to other studies (12, 25), we demonstrated that the major factor which could increase the SHS risk of programmers was lack of exercise. Possible mechanisms include increasing serotonin or other neurotransmitters and "endorphin effect" to alleviate negative emotions (16).

Limitations

For one thing, the sample size was small and the representativeness was not enough. For another, in term of the possible influencing factors, dietary factors were not involved in the questionnaire. In the future, it is necessary to increase the sample size and enhance the representativeness of samples, as well as design multiple factors in the questionnaire, so as to deeply analyze the influencing factors of software programmers' SHS.

Conclusion

The current cross-sectional survey suggested the prevalence of SHS was 18.7% in software programmers. Hours of sleep and exercise frequency were the key influencing factors of SHS. Our results could provide some basis for understanding the clinical features of SHS, diagnosing suboptimal health, as well establishing prevention and treatment methods.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

Authors declare that there were no conflicts of interest.

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