

RESEARCH ARTICLE

Influence of health promoting lifestyle on health management intentions and behaviors among Chinese residents under the integrated healthcare system

Chi Zhou¹, Weijun Zheng², Fang Tan¹, Sihong Lai¹, Qi Yuan^{3*}

1 School of Public Health, Hangzhou Normal University, Hangzhou, Zhejiang, China, **2** School of Basic Medical Science, Zhejiang Chinese Medical University, Hangzhou, Zhejiang, China, **3** Research Division, Institute of Mental Health, Singapore, Singapore

* Qi_YUAN@imh.com.sg



OPEN ACCESS

Citation: Zhou C, Zheng W, Tan F, Lai S, Yuan Q (2022) Influence of health promoting lifestyle on health management intentions and behaviors among Chinese residents under the integrated healthcare system. PLoS ONE 17(1): e0263004. <https://doi.org/10.1371/journal.pone.0263004>

Editor: Enamul Kabir, University of Southern Queensland, AUSTRALIA

Received: May 17, 2021

Accepted: January 10, 2022

Published: January 25, 2022

Copyright: © 2022 Zhou et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Data Availability Statement: All relevant data are within the paper and its [Supporting Information](#) files.

Funding: This study was supported by the Zhejiang Philosophy and Social Science Research Project (Ref No.: 22NDJC135YB) and the Zhejiang Province Science and Technology Plan Project Soft Science Research Plan (Ref No.: 2020C35008).

Competing interests: The authors have declared that no competing interests exist.

Abstract

Background

Health promoting lifestyle is an important influencing factor of individual health status. This study aims to assess the health promoting lifestyle of community residents in China, and explore its association with their health management intention and behaviors during the integrated healthcare system reform.

Methods

A total of 666 residents were recruited from six county level hospitals and 12 community health centers from July to August 2019 in Zhejiang Province, China. Health promoting lifestyle was measured by the Chinese version Health Promoting Lifestyle Profile-II scale (HPLP-II).

Results

The average total score of HPLP-II among our sample was 130.02±23.19. Among the six domains, interpersonal relationship had the highest average score (2.68±0.50), and physical activity scored the lowest (2.21±0.59). Total score of HPLP-II scale was negatively associated with being male ($\beta = -0.13$, $p < 0.01$; Ref: female), positively associated with being students ($\beta = 0.15$, $p < 0.01$; Ref: self-employed), and positively associated with a monthly per capita income of more than 8000 RMB ($\beta = 0.15$, $p < 0.01$; Ref: less than 3000 RMB). The domain scores of HPLP-II were significantly correlated with residents' health management intention and their behavior on following doctors' advice or not.

Conclusions

The health promoting lifestyles of community residents in China are at moderate levels. Improving residents' healthy lifestyle levels might be helpful for changing their health management intentions or behaviors.

Introduction

Over the past few decades China has gone through major society and economic developments. The average life expectancy increased from 71.40 to 77.3, and the average household income increased from 12514.2 RMB to 30732.8 RMB from 2000 to 2019 [1, 2]. Together with the great achievements are the huge lifestyle changes among Chinese population and a much higher prevalence of non-communicable diseases and their associated heavy financial burdens [3]. For example, the increasing numbers of people traveling by vehicles have led to significant reductions of physical activity levels among the residents, and as a result increased the rate of overweight, obesity and type 2 diabetes in the urban areas [4–6]. Similarly, diets higher in salt, sugar and fat have given rise to the greater prevalence of metabolic and cardiovascular diseases [7, 8]. For instance, the prevalence of hypertension, diabetes, and metabolic diseases were 181.4‰, 53.1‰ and 62.5‰ respectively among Chinese residents aged 18 and above in 2018; compared to 26.2‰, 5.6‰, 7.5‰ in 2003 [1, 2]. Among the middle aged and elderly people in the capital city of Zhejiang Province, 38.75%, 29.01%, and 16.05% of residents were found to have hypertension, fasting hyperglycemia (>6.1 mmol/L), and elevated total cholesterol (≥ 6.22 mmol/L) in 2018; compared to 27.04%, 22.65%, and 7.96% in 2010 [9]. Healthy lifestyle plays an important role on individual's health. Studies suggested that healthy diet, physical activity, healthy body weight, alcohol and tobacco control were associated with lower prevalence of obesity, diabetes, cardiovascular diseases, and cancers [10–12]. This in turn could constraint the costs on health care, especially among aging societies [13, 14].

The Health-promoting lifestyle profile-II (HPLP-II) is an international instrument widely used to measure individuals' healthy lifestyles, and it has six domains including health responsibility, physical activity, nutrition, spiritual growth, interpersonal relations, and stress management [15]. This scale has been translated into different languages and was tested under various cultural backgrounds, and the results all showed consistently good reliability and validity. For example, Cronbach coefficient of the Iranian version, the Kurdish version, and the Japanese version were all above 0.8 [16–18]. This scale has also been tested among different populations, including college students, elderly people, middle-aged women, chronic disease residents and etc. [13]. In China, it was firstly translated into Chinese and tested among Taiwanese people [19], and later on it was also used among individuals in mainland [20]. However, previous studies, yet limited, were all focusing on special populations, such as elderly residents with chronic disease or college students in the local healthcare system [21, 22]. In the meantime, the previous studies were done under the past "medical oriented" healthcare system environment. Ever since 2017, the Chinese government began to build an integrated healthcare system to promote the healthy lifestyle among local residents. Some strategies, such as physical and nutrition prescription, early detection screen for chronic disease and related health education, set up self-service health rooms, health theme parks, and etc., had been implemented [23, 24]. As such, it would be meaningful to measure the current HPLP level among general residents in China under the integrated healthcare system, and this might be helpful for the future public health planning for all citizens.

HPLP level might be affected by a lot of factors, such as gender, age, income, education, employment status, lifestyles of family members [25–27]. However, these factors might vary due to culture differences. For example, in Japan a study among college students found that being female, at relatively senior levels, and living with family were positively associated with HPLP-II scores [18]. In comparison, another study among Iranian elderlies found that being male, age below 75 years old, and with higher education level were significantly associated with higher scores of HPLP-II [25].

Previous studies on HPLP tended to focus more on its relationship with individuals' self-perceived health status, while less attention was given to how it is related with individuals' health management intention and behaviors. For example, one study among adult cancer survivors in USA found that those with better perceived health status showed much higher level HPLP scores [28]. Another study found that all the HPLP domain scores were positively associated with self-rated health status, and negatively with self-reported health complaints in urban Chinese women [29]. However, it is important to explore how HPLP might affect individuals' health intention and behaviors as this might help to understand how it affects individuals' health in general.

The current study aims to 1) evaluate the HPLP levels among general citizens in China under the integrated healthcare system; 2) explore the significant correlates of HPLP-II total and domain scores; 3) investigate the relationships between health promoting lifestyle with health management intention and behaviors.

Methods

Study design & setting

A cross-sectional study was carried out from July to August 2019. Data were collected using self-administered questionnaires. Three cities (Hangzhou, Deqing, and Yuhuan) were selected to represent the well-, middle-, and less-developed economy levels in Zhejiang Province, and each city has two established integrated health service groups. One hospital and two of its associated community health centers were chosen from each health service groups from each city. In total, six county hospitals and 12 community health centers were selected as the investigation sites, the name of the participating health organizations were listed in the [S1 File](#).

Participants

Residents waiting in the outpatient hall of each hospital/community health centers were approached. Participants had to meet the following eligibility criteria: 1) aged 18 to 80 years; 2) lived in the local area for more than half a year; 3) had used local health services; 4) without any cognitive disability. Recommendations on sample size for studies using scales suggested a minimum of 10 subjects per item are needed [30]. Since HPLP-II scale has 52 items, the minimum sample size should be 520. In our study, 743 residents completed the survey in the end. After removing those with missing items in the survey, the final sample was 666.

Study measures

Health promoting lifestyle profile-II (HPLP-II) has 52 items, and it was revised from an initial version with 48 items which was developed back in 1987 [13]. It has been translated from English to Chinese with cultural validations. It has a good internal consistency (Cronbach's alpha 0.91) [31]. The Chinese version HPLP-II comprises of the same 52 items, covering six domains: health responsibility (9 items, e.g. ask for information from health professionals about how to take good care of myself, read or watch TV program about improving health, attend educational programs on personal health care, report any unusual signs or symptoms to a physician or other health professional etc.), physical activity (8 items, e.g. follow a planned exercise program, exercise vigorously for 20 or more minutes at least three times a week, do stretching exercise at least 3 times per week, reach my target heart rate when exercising etc.), nutrition (9 items, e.g. choose a diet low in fat, saturated fat, and cholesterol, limit use of sugars and food containing sugar, eat breakfast, read labels to identify nutrients etc.), spiritual growth (9 items, e.g. feel I am growing and changing in positive ways, believe that my life has purpose,

look forward to the future, am aware of what is important to me in life, etc.), interpersonal relations (9 items, e.g. discuss my problems and concerns with people close to me, praise other people easily for their achievements, spend time with close friends, settle conflicts with others through discussion and compromise etc.), stress management (8 items, e.g. get enough sleep, take some time for relaxation each day, concentrate on pleasant thoughts at bedtime, use specific methods to control my stress etc.). In the current study, the participants were required to rate on a 4-point Likert scale from 1 (not at all) to 4 (always). All item scores were summed up, with the total score of HPLP-II ranged between 52 and 208. Each domain can be used independently, domain scores of physical activity and stress management ranged between 8 and 32, and the other four domains ranged from 9 to 36. Higher scores indicated healthier lifestyles [32]. According to the previous study, a total HPLP-II score between 52 and 104 is considered as poor, between 105 and 156 as moderate, and between 157 and 208 as good [21]. In this study, the Cronbach's α of the overall scale is 0.95. The Cronbach's α of each domain is: health responsibility (0.81), physical activity (0.83), nutrition (0.72), spiritual growth (0.84), interpersonal relations (0.84), stress management (0.80).

Health management intentions and behaviors were measured by six self-developed questions, with three on intentions and three on behaviors, the questions list could be found in the [S2 File](#).

Statistical analysis

Data were entered through EpiData 3.1 (The Epidata Association, Odense, Denmark) and analyzed using SPSS 23.0 (SPSS Inc., Chicago, IL, USA). Descriptive analyses were performed for socio-demographic variables. Categorical data were listed as frequency and percentage, while age as the only continuous socio-demographic variable was shown as mean and standard deviation (SD). HPLP-II scale scores were shown as mean and standard deviation. Separate multiple linear regressions were conducted to explore the significant correlates of all six domains of HPLP-II, with each being the dependent variable and regressed on gender, age, occupation, education level, monthly per capita income. Binary logistic regressions were conducted to explore the significant correlates of each health management intentions and behaviors separately, with six domainial scores of HPLP-II being the independent variables after controlling for socio-demographic variables. The significant level of all the regressions were set as $P < 0.05$.

Ethics considerations

This study was approved by the Hangzhou Normal University Ethics Board (University of Zhejiang, China). Written informed consent form was obtained from each participant prior to the enrolment. A copy of the signed consent form was given to each participant.

Results

Sample characteristics

[Table 1](#) shows the socio-demographic characteristics of the study sample. The mean age of the subjects was 38.7 years old (SD = 15.6), 59.2% of them were female, and 41.7% were self-employed. A majority of the subjects (78.3%) had an education level of Junior college and below. More than half of the subjects (61.7%) have a monthly per capita income of 5000 RMB or less.

The mean scores of HPLP-II

The average and total scores of each HPLP-II domain and the overall scale are listed in [Table 2](#). The average total score of HPLP-II was 130.02 ± 23.19 . For domain scores,

Table 1. Sample characteristics [n(%)] (N = 666).

Variate	n/ \bar{x}	%/SD
Gender		
Male	272	40.8
Female	394	59.2
Age		
<30	225	33.8
30–39	159	23.8
40–49	124	18.6
50–59	79	11.9
≥60	79	11.9
Occupation		
Self-employed	278	41.7
White collar	171	25.7
Blue collar	122	18.3
Student	56	8.4
Unemployed	39	5.9
Education level		
primary school and below	89	13.4
Middle school	164	24.6
High school	139	20.9
Junior college	129	19.4
undergraduate college and above	145	21.7
Monthly Per Capita Income		
less than 3000 RMB	156	23.4
3001–5000 RMB	255	38.3
5001–8000 RMB	149	22.4
more than 8000 RMB	106	15.9

<https://doi.org/10.1371/journal.pone.0263004.t001>

interpersonal relationship (2.68±0.50) had the highest average score, while physical activity (2.21±0.59) had the lowest average score.

The influence of socio-demographic characteristics on HPLP-II scale scores

The association between socio-demographic characteristics and health promoting lifestyles were analyzed by liner regression, and shown in Table 3. Score of HPLP-II was negatively associated with being male ($\beta = -0.13$, $p < 0.01$; Ref: female), positively associated with being students ($\beta = 0.15$, $p < 0.01$; Ref: self-employed) and with a monthly per capita income of 8000 RMB or above ($\beta = 0.15$, $p < 0.01$; Ref: less than 3000 RMB).

For domain scores, health responsibility was positively associated with age ($\beta = 0.12$, $p < 0.05$), and negatively associated with being male ($\beta = -0.15$, $p < 0.001$; Ref: female). Physical activity was positively associated with being students ($\beta = 0.15$, $p < 0.01$; Ref: self-employed). Nutrition was negatively associated with being male ($\beta = -0.22$, $p < 0.001$; Ref: female), and positively associated with age ($\beta = 0.11$, $p < 0.05$), being students ($\beta = 0.09$, $p < 0.05$; Ref: self-employed), with a monthly per capita income of 8000 RMB or above ($\beta = 0.12$, $p < 0.05$; Ref: less than 3000 RMB). Spiritual growth was negatively associated with male ($\beta = -0.09$, $p < 0.05$; Ref: female), unemployed ($\beta = -0.11$, $p < 0.01$; Ref: self-employed), and positively associated with student ($\beta = 0.13$, $p < 0.01$; Ref: self-employed), with a monthly per capita income of 8000

Table 2. HPLP-II domain and total scores.

Variate	Items	Scores	Average score of each domain ($\bar{x} \pm SD$)	Average score of each item ($\bar{x} \pm SD$)
Health responsibility	9	9~36	22.21±4.60	2.47±0.51
Physical activity	8	8~32	17.68±4.73	2.21±0.59
Nutrition	9	9~36	23.24±4.26	2.58±0.47
Spiritual growth	9	9~36	22.89±4.84	2.54±0.54
Interpersonal relations	9	9~36	24.16±4.53	2.68±0.50
Stress management	8	8~32	19.84±4.07	2.48±0.51
Total scores	52	52~208	130.02±23.19	2.50±0.45

<https://doi.org/10.1371/journal.pone.0263004.t002>

RMB or above ($\beta = 0.17$, $p < 0.001$; Ref: less than 3000 RMB). Interpersonal relations were negatively associated with being male ($\beta = -0.09$, $p < 0.05$; Ref: female), positively associated with being student ($\beta = 0.14$, $p < 0.01$; Ref: self-employed) and with a monthly per capita income of 8000 RMB or above ($\beta = 0.19$, $p < 0.001$; Ref: less than 3000 RMB). Stress management score were positively associated with age ($\beta = 0.14$, $p < 0.05$), being students ($\beta = 0.19$, $p < 0.001$; Ref: self-employed), and with a monthly per capita income of 8000 RMB or above ($\beta = 0.12$, $p < 0.05$; Ref: less than 3000 RMB).

Table 3. Liner regression of demographic characteristics on each domain scores of HPLP-II scale (Standardized β value).

Variables	Health responsibility	Physical activity	Nutrition	Spiritual growth	Interpersonal relations	Stress management	Total scores
Gender							
Female	1	1	1	1	1	1	1
Male	-0.15***	-0.06	-0.22***	-0.09*	-0.09*	-0.06	-0.13**
Age	0.12*	0.06	0.11*	0.02	0.10	0.14*	0.10
Occupation							
Self-employed	1	1	1	1	1	1	1
White collar	0.07	0.06	0.05	-0.01	0.03	0.03	0.04
Blue collar	-0.02	0.02	0.01	0.01	-0.04	0.01	-0.01
Student	0.06	0.15**	0.09*	0.13**	0.14**	0.19***	0.15**
Unemployed	-0.05	-0.06	-0.01	-0.11**	-0.05	-0.03	-0.06
Education level							
primary school and below	1	1	1	1	1	1	1
Middle school	0.01	0.06	0.01	-0.02	-0.03	0.03	0.01
High school	-0.01	0.04	-0.08	-0.01	-0.02	-0.03	-0.02
Junior college	0.10	0.10	-0.07	0.01	0.02	0.02	0.04
undergraduate college and above	0.09	0.10	-0.02	0.01	0.06	0.06	0.06
Monthly Per Capita Income							
less than 3000 RMB	1	1	1	1	1	1	1
3001–5000 RMB	0.01	0.03	-0.01	0.01	0.07	0.03	0.03
5001–8000 RMB	0.04	0.02	0.03	0.05	0.07	0.04	0.05
more than 8000 RMB	0.10	0.07	0.12*	0.17***	0.19***	0.12*	0.15**

* $P < 0.05$

** $P < 0.01$

*** $P < 0.001$.

<https://doi.org/10.1371/journal.pone.0263004.t003>

The influence of HPLP-II scale scores on health management intentions and behaviors

The association between health promoting lifestyles and health management intentions/behaviors were analyzed by binary logistic regression, and shown in Table 4. Perceived good health status was positively associated with spiritual growth (OR = 1.13, 95%CI:1.05~1.21). Intention of regular medical examinations was positively associated with health responsibility (OR = 1.14, 95%CI:1.07~1.22), physical activity (OR = 1.07, 95%CI:1.01~1.13), interpersonal relations (OR = 1.09, 95%CI:1.01~1.17), and negatively associated with stress management (OR = 0.86, 95%CI:0.80~0.93). Increasing demand of community health managers was positively associated with health responsibility (OR = 1.08, 95%CI:1.01~1.17), and negatively associated with interpersonal relations (OR = 0.91, 95%CI:0.84~0.99). Following doctors' advice was positively associated with health responsibility (OR = 1.08, 95%CI:1.01~1.14), nutrition (OR = 1.07, 95%CI:1.01~1.14), and interpersonal relations (OR = 1.08, 95%CI:1.00~1.16). Having a family doctor and choosing community health institutions as the initial medical treatment have no association with any domains of HPLP-II.

Discussion

This is the first large scale survey to assess the healthy lifestyle levels of community residents in China under the new integrated healthcare system. The total score of HPLP-II among community residents in Zhejiang Province is 130.02±23.19, which is at a moderate level. Compare with other countries, the HPLP total score was very close to that of USA and Japan in 2011 [33]. Among the six subscales of HPLP-II, the highest subscale score is interpersonal relations, and the lowest subscale score is physical activity. This is similar with the results from other countries [26, 34–36].

Findings from the current study suggested that factors influencing the HPLP-II scores included gender, age, occupation, and family income. These factors are consistent with findings from other studies [25, 26, 34]. But for each domain, their influencing factors might vary depending on where the studies were conducted. Among our sample, male residents were found to report significant lower scores of health responsibility, nutrition, spiritual growth, and interpersonal relations. This is very similar to findings from the Japanese study [33]. One

Table 4. Binary logistic regression of HPLP-II scale scores on health management intentions and behaviors [OR(95%CI)].

Variables	Perceived good health status N = 654	Intention of regular medical examinations N = 665	Increasing demand of community health managers N = 653	Follow doctors' advice N = 661	Have a family doctor N = 618	Choose community health service institutions as the initial medical treatment N = 656
Health responsibility	0.97(0.91,1.03)	1.14(1.07,1.22)***	1.08(1.01,1.17)*	1.08(1.01,1.14)*	1.05(0.98,1.14)	1.06(0.99,1.13)
Physical activity	1.02(0.97,1.08)	1.07(1.01,1.13)*	1.03(0.97,1.10)	0.95(0.89,1.00)	1.05(0.98,1.12)	1.03(0.97,1.09)
Nutrition	1.02(0.96,1.09)	1.03(0.97,1.10)	1.02(0.94,1.09)	1.07(1.01,1.14)*	1.03(0.96,1.11)	0.99(0.93,1.05)
Spiritual growth	1.13(1.05,1.21)***	0.95(0.88,1.01)	1.04(0.96,1.12)	0.96(0.90,1.03)	0.99(0.91,1.08)	0.99(0.92,1.06)
Interpersonal relations	0.93(0.87,1.00)	1.09(1.01,1.17)*	0.91(0.84,0.99)*	1.08(1.00,1.16)*	0.94(0.86,1.03)	0.97(0.90,1.04)
Stress management	1.03(0.95,1.11)	0.86(0.80,0.93)***	1.00(0.91,1.09)	1.03(0.95,1.11)	1.01(0.92,1.12)	0.95(0.88,1.03)

*P<0.05

**P<0.01

***P<0.001.

Adjusted for gender, age, education level, occupation, monthly per capita income.

<https://doi.org/10.1371/journal.pone.0263004.t004>

possible explanation is that both countries shared similar Asian family culture of ‘male leads outside while female leads inside’, and such belief is still quite common in China nowadays. As a result, females usually need to pay more attention on family members’ health and nutrition [37]. Spiritual growth is about individual’s positivity towards future. Compared to male residents, females tend to be more optimistic [38]. One possibility is that men usually face greater pressures such as from work or higher expectation from the society [39, 40]. Good interpersonal relations indicated good social support from friends. Compare to men, women are more willing to seeking emotional support from friends as this is one of their coping mechanisms to relieve their stress [41]. As such, female residents generally scored higher on interpersonal relations.

Residents at older age group were found to report significantly higher level of health responsibility, nutrition, and stress management compared to those in the younger age groups. This could be partially due to the fact that as individuals getting older, they are more likely to face health problems and thus having higher awareness on health. This result is the same as that found in Japan and North of USA, except on health responsibility [33]. Higher health responsibility among elder residents might be due to the fact that there are very limited numbers of family doctors in China [42, 43], and the service priority was given to elder citizens ever since 2016 as requested by the government. According to the requirements of national family doctor contract services, family doctors should carry out regular health education and follow-up services for the elderlies at their own home, which might cause the increase of their health awareness [44].

Compare to those who were self-employed, being students had significantly higher scores on almost all domains of HPLP-II. For students in China, as health related courses are usually part of the syllabus; in the meantime, they are also more likely to participate in daily sports activities and have close friendship with classmates, as such they are more likely to have healthier lifestyles than the working adults [18]. Compare to self-employed occupation, unemployed people were found negatively associated with spiritual growth. This is similar with other results among unemployed people [45, 46]. Lastly, residents with higher monthly family incoming levels had significantly higher HPLP scores on nutrition, spiritual growth, interpersonal relations and stress management. This is understandable as in most of the cases people with higher incomes tend to pay more attention to their own health and also have the ability to invest more on their health [47, 48].

The logistic regression suggested that most domains of HPLP-II are positively associated with better health management intentions, including perceived good health status, intention of regular medical examination, and increasing demand of community health managers. This is similar to findings from previous studies [29, 35, 49]. However, there are two exceptions: between stress management and intention of regular medical examination, and between interpersonal relations and demand of community health managers. Stress management is related to individuals’ mental health. It reflects individual’s capability of recognizing the stressors, and take measures to control the damage to their health [29]. As mental health and physical health are inter-related, it’s possible that individuals with good mental health status tend to have an overall high rating on their perceived health status and result in lower intention of regular physical examination [50]. Higher scores on interpersonal relations indicates better social supports received from family members or friends. In the meantime, studies also found that maintain good social support might reduce health-care demands and misconceived health beliefs among patients [51].

Regarding health management behaviors, our results suggested that HPLP are only significantly correlated with following doctor’s advice, but not associated with having a family doctor and choosing community health service institutions as the initial medical treatment. A

previous qualitative study among Chinese residents found that lower awareness on health responsibility is a barrier to the utilization of family doctor and choose community health center as initial medical treatment [52–54]. However, our study provides a different view as these two seems to be less relevant since having family doctor and utilization of community health service really more depends on individual's confidence towards them. According to a previous study, the performance of local community health service is still not as good as expected [55]. Also, unlike in western countries where there is a strict hierarchical medical system [56], residents in China can choose the health service providers freely which makes it more difficult for family doctors and community health service centers to compete [57].

Limitations

There are some limitations of this study. Firstly, this study was only done in Zhejiang Province, thus cannot represent the overall situation in China. Secondly, data were collected through self-administered questionnaire, which might cause recall bias. Thirdly, the current sample was relatively young, which might affect the representativeness of the findings.

Conclusions

The healthy lifestyle of community residents in Zhejiang Province of China are at moderate levels, and there is still space for further improvements. Most domains of HPLP-II are positively associated with better health management intentions and increasing demand of community health managers, but not with health management behavior on following doctor's advice. Special attention should be given to residents who are male, at younger and middle age group, being self-employed, and with low-income levels, to improve their healthy lifestyle levels.

Supporting information

S1 File. Participating hospitals/institutions as the investigation sites.

(DOCX)

S2 File. Self-developed question on health management intentions and behaviors.

(DOCX)

S1 Data.

(SAV)

Acknowledgments

We thank the help of doctors and nurses from the six counties hospitals and 12 community health centers of Hangzhou, Deqing, Yuhuan cities, and all the research staffs during the surveys.

Author Contributions

Conceptualization: Chi Zhou.

Data curation: Chi Zhou.

Formal analysis: Chi Zhou, Weijun Zheng.

Funding acquisition: Chi Zhou.

Investigation: Chi Zhou, Fang Tan, Sihong Lai.

Methodology: Chi Zhou, Weijun Zheng.

Project administration: Chi Zhou.

Resources: Chi Zhou.

Software: Chi Zhou, Weijun Zheng.

Supervision: Qi Yuan.

Validation: Qi Yuan.

Visualization: Chi Zhou, Qi Yuan.

Writing – original draft: Chi Zhou.

Writing – review & editing: Chi Zhou, Qi Yuan.

References

1. National Health Commission. China Health Statistics Yearbook. Beijing: Peking Union Medical College;2010.
2. National Health Commission. China Health Statistics Yearbook. Beijing: Peking Union Medical College;2020.
3. Griffiths SM. Leading a healthy lifestyle: The challenges for China. *Asia-Pacific J Public Heal.* 2010; 22 (SUPPL. 3):110–116. <https://doi.org/10.1177/1010539510373000> PMID: 20566542.
4. Thomas GN, Wang MP, Ho SY, Mak KH, Cheng KK, Lam TH. Adverse lifestyle leads to an annual excess of 2 million deaths in China. *PLoS One.* 2014; 9(2): e89650. <https://doi.org/10.1371/journal.pone.0089650> PMID: 24586936.
5. Fan S, Chen J, Huang J, Li Y, Zhao L, Liu X, et al. Physical activity level and incident type 2 diabetes among Chinese adults. *Medicine & Science in Sports & Exercise.* 2015; 47:751–756. <https://doi.org/10.1249/MSS.0000000000000471> PMID: 25116084.
6. Day K, Alfonso M, Chen Y, Guo Z, Lee KK. Overweight, Obesity, And inactivity and urban design in rapidly growing Chinese cities. *Health & Place.*2013; 21:29–38. <https://doi.org/10.1016/j.healthplace.2012.12.009> PMID: 23416231.
7. Ogawa R, Oishi AS, Chan RKH, Wang LR. Gender, Care and Migration in East Asia. HK:Series in Asian Labor and Welfare Policies; 2018.
8. Sharma N, Okere IC, Barrows BR, Lei B, Duda MK, Yuan CL, et al. High-sugar diets increase cardiac dysfunction and mortality in hypertension compared to low-carbohydrate or high-starch diets. *J. Hypertens.*2008; 26(7):1402–1410. <https://doi.org/10.1097/HJH.0b013e3283007dda> PMID: 18551017.
9. Yang SY, Ding XY, Yang ZQ, Wang Q, Sun Ying, Ma HY. Trends in prevalence, incidence and negative conversion of hypertension, fasting hyperglycemia and elevated total cholesterol in middle-aged and elderly populations from Hangzhou in even-numbered years between 2010 and 2018. *Chinese General Practice.*2020; 23(18):2235–2241. <https://doi.org/https%3A//doi.org/10.12114/j.issn.1007-9572.2020.00.065> [Article in Chinese].
10. Walid EA, Gabriele BB. Country and gender-specific achievement of healthy nutrition and physical activity guidelines: Latent class analysis of 6266 university students in Egypt, Libya, and Palestine. *Nutrients.*2017; 9:1–12. <https://doi.org/https%3A//doi.org/10.3390/nu9070738> PMID: 28696407.
11. Jung AY, Miljkovic I, Rubin S, Kritchevsky SB, Klepin HD, Newman AB, et al. Adherence to cancer prevention guidelines among older white and black adults in the health ABC study. *Nutrients.*2019; 11:1–14. <https://doi.org/10.3390/nu11051008> PMID: 31058834.
12. Moorehead RA. Rodent models assessing mammary tumor prevention by Soy or Soy isoflavones. *Genes.*2019; 10:566. <https://doi.org/10.3390/genes10080566> PMID: 31357528.
13. Meihan L, Chung-Ngok W. Validation of the psychometric properties of the health-promoting lifestyle profile in a sample of Taiwanese women. *Qual Life Res.* 2011; 20(4):523–528. <https://doi.org/10.1007/s11136-010-9790-6> PMID: 21088913.
14. Dalmases M, Benítez I, Sapiña-Beltran E, et al. Impact of sleep health on self-perceived health status. *Sci Rep.* 2019; 9(1):1–7. <https://doi.org/10.1038/s41598-018-37186-2> PMID: 30626917.
15. Walker SN, Sechrist KR, Pender NJ. The health-promoting lifestyle profile: Development and psychometric characteristics. *Nurs Res.* 1987; 36(2):76–81. <https://doi.org/https%3A//doi.org/10.1097/00006199-198703000-00002> PMID: 3644262.

16. Mohamadian H, Ghannaei M, Kortdzanganeh J, Meihan L. Reliability and construct validity of the Iranian version of health-promoting lifestyle profile in a female adolescent population. *Int J Prev Med*. 2013; 4(1):42–49. PMID: [23412661](https://pubmed.ncbi.nlm.nih.gov/23412661/).
17. Kamali ASMA, Sadeghi R, Tol A, Yaseri M. Reliability and Validity of Kurdish Language Version of Health Promoting Lifestyle Profile II among Kurdish Healthcare Providers Kurdish Version of HPLP-II. *Arch Iran Med*. 2016; 19(12):824–831. <https://doi.org/0161912/AIM.003> PMID: [27998156](https://pubmed.ncbi.nlm.nih.gov/27998156/).
18. Wei CN, Harada K, Ueda K, Fukumoto K, Minamoto K, Ueda A. Assessment of health-promoting lifestyle profile in Japanese university students. *Environ Health Prev Med*. 2012; 17(3):222–227. <https://doi.org/10.1007/s12199-011-0244-8> PMID: [21987366](https://pubmed.ncbi.nlm.nih.gov/21987366/).
19. Huang Chiou. Assessment of the health-promoting lifestyle profile on reliability and validity. *Kaohsiung J Med Sci*. 1996; 12(9):529–537. PMID: [8819356](https://pubmed.ncbi.nlm.nih.gov/8819356/).
20. Cao W, Guo Y, Ping W, Zheng J. Development and psychometric tests of a Chinese version of the HPLP-II Scales. *Chin J Dis Control Prev*. 2016; 20(3):286–289. <https://doi.org/https%3A//doi.org/10.1016/j.archger.2012.07.003> PMID: [22854282](https://pubmed.ncbi.nlm.nih.gov/22854282/)
21. Chen J, Xiang H, Jiang P, Yu J, Jiang Y, Li F, 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(3):1–17. <https://doi.org/10.3390/ijerph14030240> PMID: [28264509](https://pubmed.ncbi.nlm.nih.gov/28264509/).
22. Cao WJ, Chen CS, Hua Y, Li YM, Xu YY, Hua QZ. Factor analysis of a health-promoting lifestyle profile (HPLP): Application to older adults in Mainland China. *Arch Gerontol Geriatr*. 2012; 55(3):632–638. <https://doi.org/10.1016/j.archger.2012.07.003> PMID: [22854282](https://pubmed.ncbi.nlm.nih.gov/22854282/).
23. Lin W.L., 2017. Research on Health Care Alliance Practice in Tianchang County of Anhui Province from the Perspective of Stakeholders. Beijing: Peking Union Medical College. [Article in Chinese].
24. Zhou C. Analysis on performance of primary medical service in Zhejiang's county-level medical alliances from the perspective of supply and demand balance. *Chinese Hosp Manag J*. 2020; 36(7):534–538. <https://doi.org/https%3A//doi.org/10.3760/cma.j.cn111325-20200331-00966> [Article in Chinese].
25. Rakhshani T, Shojaiezadeh D, Lankarani KB, Rakhshani F, Kaveh MH, Zare N. The association of health-promoting lifestyle with quality of life among the Iranian elderly. *Iran Red Crescent Med J*. 2014; 16(9):e18404. <https://doi.org/10.5812/ircmj.18404> PMID: [25593729](https://pubmed.ncbi.nlm.nih.gov/25593729/).
26. Shaheen AM, Nassar OS, Amre HM, Hamdan-Mansour AM. Factors Affecting Health-Promoting Behaviors of University Students in Jordan. *Health (Irvine Calif)*. 2015; 07(01):1–8. <https://doi.org/https%3A//doi.org/10.4236/health.2015.71001>
27. Zhang SC, Tao FB, Ueda A, Wei CN, Fang J. The influence of health-promoting lifestyles on the quality of life of retired workers in a medium-sized city of Northeastern China. *Environ Health Prev Med*. 2013; 18(6):458–465. <https://doi.org/10.1007/s12199-013-0342-x> PMID: [23700274](https://pubmed.ncbi.nlm.nih.gov/23700274/).
28. Smith AB, Bashore L. The effect of clinic-based health promotion education on perceived health status and health promotion behaviors of adolescent and young adult cancer survivors. *J Pediatr Oncol Nurs*. 2006; 23(6):326–334. <https://doi.org/10.1177/1043454206293266> PMID: [17035623](https://pubmed.ncbi.nlm.nih.gov/17035623/).
29. Cheng J, Wang T, Li F, Xiao Y, Bi J, Chen J. Self-Rated Health Status and Subjective Health Complaints Associated with Health-Promoting Lifestyles among Urban Chinese Women: A Cross-Sectional Study. *PLoS One*. 2015; 10(2):e0117940. <https://doi.org/10.1371/journal.pone.0117940> PMID: [25671578](https://pubmed.ncbi.nlm.nih.gov/25671578/).
30. Everitt BS. Multivariate analysis: The need for data, and other problems. *Br J Psychiatry* 1975; 126:237. <https://doi.org/10.1192/bjp.126.3.237> PMID: [1125504](https://pubmed.ncbi.nlm.nih.gov/1125504/)
31. Lee RLT, Loke AJTY. Health-promoting behaviors and psychosocial well-being of university students in Hong Kong. *Public Health Nurs*. 2005; 22(3):209–220. <https://doi.org/10.1111/j.0737-1209.2005.220304.x> PMID: [15982194](https://pubmed.ncbi.nlm.nih.gov/15982194/).
32. Sonmezer H, Cetinkaya F, Nacar M. Healthy life-style promoting behaviour in Turkish women aged 18–64. *Asian Pacific J Cancer Prev*. 2012; 13(4):1241–1245. <https://doi.org/10.7314/apjcp.2012.13.4.1241> PMID: [22799312](https://pubmed.ncbi.nlm.nih.gov/22799312/).
33. Kemppainen J, Bomar PJ, Kikuchi K, Kanematsu Y, Ambo H, Noguchi K. Health promotion behaviors of residents with hypertension in Iwate, Japan and North Carolina, USA. *Japan J. Nurs. Sci*. 2011; 8:20–32. <https://doi.org/10.1111/j.1742-7924.2010.00156.x> PMID: [21615695](https://pubmed.ncbi.nlm.nih.gov/21615695/).
34. Zhang SC, Wei CN, Harada K, Ueda K, Fukumoto K, Matsuo H, et al. Relationship between lifestyle and lifestyle-related factors in a rural-urban population of Japan. *Environ Health Prev Med*. 2013; 18(4):267–274. <https://doi.org/10.1007/s12199-012-0315-5> PMID: [23160850](https://pubmed.ncbi.nlm.nih.gov/23160850/).
35. Kang Y., Ha Y., Eun Y. Health Status and Health-Promoting Lifestyle Profile II of North Korean Immigrants. *Journal of Korean Academy of Community Health*. 2012; 23(3):231–243. <https://doi.org/https%3A//doi.org/10.12799/jkachn.2012.23.3.231>

36. Tanjani PT, Azadbakht M, Garmaroudi G, Sahaf R, Fekrizadeh Z. Validity and reliability of health promoting lifestyle profile II in the Iranian elderly. *Int. J. Prev. Med.* 2016; 7:74. <https://doi.org/10.4103/2008-7802.182731> PMID: 27280010.
37. Kim S, Fenech MF, Kim PJ. Nutritionally recommended food for semi-to strict vegetarian diets based on large-scale nutrient composition data. *Sci. Rep.* 2018; 8:1–11. <https://doi.org/10.1038/s41598-017-17765-5> PMID: 29311619.
38. Arrosa ML, Gandelman N. Happiness decomposition: female optimism María. *Journal of Happiness Studies.* 2016; 17:731–756. <https://doi.org/https%3A//doi.org/10.1007/s10902-015-9618-8>
39. Lin WL. Research on Health Care Alliance Practice in Tianchang County of Anhui Province from the Perspective of Stakeholders. Beijing: Peking Union Medical College;2017. [Article in Chinese].
40. Theodossiou I. The effects of low-pay and unemployment on psychological well-being: A logistic regression approach. *J Health Econ.* 1998; 17(1):85–104. [https://doi.org/10.1016/s0167-6296\(97\)00018-0](https://doi.org/10.1016/s0167-6296(97)00018-0) PMID: 10176317.
41. D'Exelle B, Riedl A. Gender differences and social ties effects in resource sharing. *Research Memorandum.* 2016; 23:1–38. <https://doi.org/https%3A//doi.org/10.26481/umagsb.2016023>
42. Meng XM, Pan XY, Dong Q. A comparative study on the training of general practitioners at home and abroad. *Hebei Medicine.* 2013; 35:2359–2360. <https://doi.org/https%3A//doi.org/10.3969/j.issn.1002-7386.2013.15.071> [Article in Chinese].
43. Huang D, Yin W, Yu Q, Guo H, Sun K, Hu J, et al. Comparative Analysis on Current Status of China's General Practitioners Human Resources and 2020 Policy Goal. *Heal. Resource Alloc.* 2017; 36:51–55. <https://doi.org/https%3A//doi.org/10.7664/CHE20171013> [Article in Chinese].
44. Wang C, Yan S, Jiang H, Nie JQ, Miller M, He Y, et al. Residents' Willingness to Maintain Contracts with Family Doctors: a Cross-sectional Study in China. *J Gen Intern Med.* 2020; 36:622–631. <https://doi.org/10.1007/s11606-020-06306-y> PMID: 33140279.
45. Harris E, Harris MF. Reducing the impact of unemployment on health: Revisiting the agenda for primary health care. *Medical Journal of Australia.* 2009; 191:119–122. <https://doi.org/10.5694/j.1326-5377.2009.tb02709.x> PMID: 19619102.
46. Peláez-Fernández MA, Rey L, Extremera N. Pathways from emotional intelligence to well-being and health outcomes among unemployed: Mediation by health-promoting behaviours. *J Health Psychol.* 2020. <https://doi.org/https%3A//doi.org/10.1177/1359105320974431> PMID: 33233967.
47. Ulla Díez SM, Pérez-Fortis A. Socio-demographic predictors of health behaviors in Mexican college students. *Health Promot Int.* 2010; 25(1):85–93. <https://doi.org/10.1093/heapro/dap047> PMID: 19875462.
48. Park JS, Lee HR. A Comparative Study on a Health Promoting Lifestyle and Perceived Health Status between High and Low Income Elderly. *J. Korean Community Nurs.* 2003; 14(1):157–166.
49. Ozen B, Zincir H, Kaya Erten Z, Ozkan F, Elmali F. Knowledge and Attitudes of Women about Breast Cancer, Self Breast Examination and Healthy Life Style Behaviours. *J Breast Heal.* 2013; 9(4):200–204. <https://doi.org/https%3A//doi.org/10.5152/tjbh.2013.33>
50. Zheng YY. The research on health status and health service utilization of residents in differernt rural areas. Shangdong: Shangdong University;2008. [Article in Chinese].
51. Asbury EA, Webb CM, Collins P. Group support to improve psychosocial well-being and primary-care demands among women with cardiac syndrome X. *Climacteric.* 2011; 14(1):100–104. <https://doi.org/10.3109/13697137.2010.499181> PMID: 20642328.
52. Wang J. Research on the situation of Gate-Keeper development and its influencing factors. Wuhan: Huazhong University;2008. [Article in Chinese].
53. He Z, Ma P, Wang L, Han Z, Liu J, Gao F, et al. Influence of family doctor's contractual service mode with medical-nursing-assistant responsibility system on residents' perceptions of contractual acquisition. *Chinese Community Doctors.* 2019; 35,178–180. <https://doi.org/https%3A//doi.org/10.3969/j.issn.1007-614x.2019.09.125> [Article in Chinese].
54. Xie Y. A positive analysis of the mechanism of community doctor as gatekeeper—a case study from Nanjing. Beijing: Peking Union Medical College;2010. [Article in Chinese].
55. Pan X, Dib HH, Wang X, Zhang H. Service utilization in community health centers in China: A comparison analysis with local hospitals. *BMC Health Serv Res.* 2006; 6:1–8. <https://doi.org/10.1186/1472-6963-6-1> PMID: 16403235.
56. Ham C. Incentives, priorities, and clinical integration in the NHS. *Lancet.* 2008; 371(9607):98–100. [https://doi.org/10.1016/S0140-6736\(08\)60084-7](https://doi.org/10.1016/S0140-6736(08)60084-7) PMID: 18191671.
57. Zhou Z, Zhao Y, Shen C, Lai S, Nawaz R, Gao J. Evaluating the effect of hierarchical medical system on health seeking behavior: A difference-in-differences analysis in China. *Soc Sci Med.* 2021; 268:113372. <https://doi.org/10.1016/j.socscimed.2020.113372> PMID: 32979776.