An Empirical Study on Physical Sub-Health Risk Perception: Physical Examination Data of Tertiary Grade-A Hospitals in Anhui Province, China

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Abstract

Background: Physical sub-health is directly related to people's work effectiveness and quality of life. Sub-health prevention has become an urgent medical problem. Current research on sub-health mainly focuses on the diagnosis, influencing factors and treatment. Based on the proposed physical sub-health risk perception scale, we explore the differences in the demographic factors and the mechanism of risk perception level on physical sub-health to provide data support for the management of public physical sub-health.

Methods: Clinical and risk perception data were collected from 770 physical examinees, which were analyzed using SPSS 23.0, R, and Python software. Pearson correlation coefficient was used to investigate the correlation and multiple stepwise regression analysis was used to explore the influence of demographic variables on physical sub-health and risk perception. Also, this study used a two-way interaction moderated multiple regression approach to examine the moderating effects of demographic variables on physical sub-health and risk perception.

Results: Attribute of living place, sub-health duration, marital status, average annual household income, risk perception level were negatively associated with physical sub-health ($r = -0.07 \sim -0.17$, $P < 0.05$). The risk perception level was positively correlated with education, attribute of living place,average annual household income, sub-health duration, number of employees in the unit and sub-health proportion in the unit ($r = 0.09 \sim 0.26$, P□0.05), but negatively correlated with age ($r = -0.11$, P□0.05). The number of children had a moderating effect on physical sub-health and risk perception (Interaction coefficient $\alpha = -0.3$, P□ 0.05).

Conclusions: The factors directly affecting the physical sub-health included age, education, attribute of living place,sub-health duration and sub-health proportion in the unit, while the risk perception level, marital status and average annual household income were found to be indirect influencing factors. The number of children had a moderating effect on physical sub-health and risk perception. Therefore, we suggest attaching importance to public physical exercise and health checkups, correctly guiding public risk perception, and spreading the national policy of bearing and rearing better children etc. to promote the development of public physical health in China.

Background

In 2006, the Clinical Guidelines of Chinese Medicine on Sub-health issued by the China Association of Chinese Medicine [1] pointed out that sub-health refers to a state in which the human body is in a state between unhealthy and healthy; the person shows symptoms of decreased vitality, function, and adaptability within a certain period, but it does not meet the clinical or sub-clinical diagnostic criteria of modern medicine's defined diseases. This condition is also known as a "grey state" or "third state". Sub-health includes symptoms such as physical fatigue, psychological anxiety and depression, the decline of social adaptability, which seriously affects people's quality of life. Generally speaking, the process of

body life is the mutual transformation of health, sub-health, and disease. If intervention is not in time, sub-health will lead to the occurrence of diseases [2]. A study pointed that only 5% of the global population were in a complete health state, and 20% were in a disease state, and the remaining 75% were in sub-health status [3]. Individual physical sub-health is a global public health problem that needs to be solved urgently.

Physical sub-health not only affects the quality of life and happiness index of individuals, but also increases the risk of decline in social creative dynamics. The increasingly competitive environment, the dual pressure of life and work as well as other factors have led to an soaring number of people in a sub-healthy state. Physical sub-health risk perception is the individual's awareness and perception of the objective risks associated with sub-health, and it is a way for people to integrate all available information to assess the possible sub-health risks of the body, so that they can change their behavior [4] and provide a basis for decision making in risk management to minimize the risks and losses caused by unsafe factors.

Domestic and international scholars have carried out a series of studies on sub-health, but those researches mainly focuses on the diagnosis [2], influencing factors [5] and treatment options [6] of sub-health, while there is a relative lack of research on the prevention of sub-health. This study explores the influencing factors of physical sub-health from a new perspective of risk perception, analyzes the mechanism of action between risk perception and physical sub-health, and discusses the moderating effects of demographic variables and related control variables on physical sub-health and risk perception to provide a theoretical basis for reducing public sub-health risk and providing a judgment basis for health warning. Therefore, research on sub-health is related to people’s quality of life and benefits both the country and the people.

Methods

Ethics and consent statement

The survey was administered by researchers assisted by undergraduate students majoring in health management, master of health management students, professional lecturers and associate professors. This research team was trained before distributing the questionnaires. We confirmed that all methods were performed in accordance with the relevant guidelines and regulations. Verbal Informed consent was obtained from all subjects to the questionnaire, and for those under 18 years of age, verbal informed consent was obtained from their parents and/or legal guardians. This approval procedure was approved by the Ethics Committee of Anhui Medical University.

Sample and data collection

Anhui Province is an important part of the Yangtze River Delta, which embraces the Yangtze River channel internally, and is promoted by the economy of coastal areas externally. It is located in the strategic center of national economic development and the docking zone of several domestic economic

plates. Since the 18th National Congress of the Communist Party of China, Anhui's economy has been developing rapidly and its comprehensive strength has been steadily improved. With the booming economy, people's pressure is also increasing, and the public's health status has attracted much attention. This study selected physical examinees from the physical examination center of Anhui province's tertiary grade-A hospitals from June to September 2019 as the research subjects, and explored the relationship between public risk perception level and physical sub-health status. The study protocol received the appropriate human subjects review and approval. According to the sample size of 5 ~ 10 times of the number of items, 785 questionnaires were collected in this study. After eliminating invalid questionnaires, 770 valid questionnaires were obtained, and the response rate was 98%. The average age of the subjects was 34 (sd= 11), with 312 males and 458 females. The characteristics of other demographic variables and control variables are shown in Table 1.

Table 1 Characteristics of demographic variables and control variables of subjects

Variable		Number	Percentage(%)
Gender	Male	312	40.5
	Female	458	59.5
Age/years	<31	384	49.9
	31-45	256	33.2
	46-60	96	12.5
	≥61	34	4.4
Education	Primary or below	44	5.7
	Junior high school	103	13.4
	Senior high school	111	14.4
	Junior college	146	19.0
	Undergraduate	304	39.5
	Master's degree and above	62	8.1
Years of Working	<5	306	39.7
	5~10	186	24.2
	11~20	161	20.9
	21~30	74	9.6
	>30	43	5.6
Attribute of living place	Rural	117	15.2
	Cities and towns	132	17.1
	Third-tier city	110	14.3
	Second-tier city	411	53.4
Marital status	Unmarried	287	37.3
	Married	457	59.4
	Others	26	3.4
Number of children	0	315	40.9
	1	244	31.7
	2	158	20.5
	≥3	53	6.9

Average annual household income	<30,000 yuan	88	11.4
	30,000~60,000 yuan	152	19.7
	60,000~100,000 yuan	227	29.5
	100,000~200,000 yuan	205	26.6
	>200,000 yuan	98	12.7
Self-health evaluation	Serious than sub-health	67	8.7
	Sub-health	499	64.8
	Unclear	61	7.9
	Health	143	18.6
Sub-health duration	<3 months	126	16.4
	3~6 months	88	11.4
	6 months~1 year	161	20.9
	<2 years	162	21.0
	≥3 years	233	30.3
Number of employees in the unit	Freelancer	171	22.2
	<50	152	19.7
	50~150	141	18.3
	150~500	139	18.1
	≥500	167	21.7
Sub-health proportion in the unit	10%	97	12.6
	30%	174	22.6
	50%	246	31.9
	70%	182	23.6
	≥90%	71	9.2

The relationship between physical sub-health and risk perception

Risk perception reflects people's cognition and intuitive judgment of risk [7], which belongs to the field of psychology [8]. The term "risk perception" was first introduced by Professor Bauer at Harvard University in 1960 and applied to consumer behavior research [9]. Risk perception is one of the core elements of health behavior theories [10], which suggest that when exposed to risk, risk perception motivates people to stop

unhealthy behaviors and adopt healthy behaviors to avoid it. For example, the Health Belief Model [11-13] takes susceptibility to disease and severity as pretest factors of whether an individual adopts a healthy behavior, where the cognition of susceptibility to disease and severity is the risk perception; the Protective Motivation Theory [14-15] explains why health behaviors occur from the perspective of motivation, in which risk perception plays a central role. The level of risk perception affects the behavioral lifestyle of the public [16], while lifestyle is one of the most important factors influencing health status. Positive risk perception attitudes of the public play a key role in driving individual adaptive behavior [17] and are a precondition for the public to make healthier lifestyle choices, participate in health screenings, and adhere to health care [18]. People with higher risk perception level are more likely to resist unhealthy behaviors and adopt healthy lifestyle habits, which helps to increase their level of self-protection against risks and reduce health threats due to various risks. [19-23]. In this study, two variables, physical sub-health risk perception level and clinical manifestations of physical sub-health, were used to collect data from physical examinees through cross-sectional survey. Python-3.8.6 software was used to analyze the data of physical sub-health status and risk perception level. We found that a few physical examinees were in poor risk perception level, most of them were in good risk perception level, and as the risk perception level increased, the rate of physical sub-health status tended to increase and then decrease, and peaked at the good risk perception level (except when the physical sub-health score was 2, which peaked at the general risk perception level). The details are shown in Figure 1.

Note. 5□4□3□2□1□0□-1□-2□-3□-4□-5 represent the physical health scores of the physical examinees. The closer the score is to 5, the lower the risk of sub-health is, the better the health status is; the closer the score is to - 5, the greater the sub-health risk is, the worse the health status is; poor, general, good, excellent represent the risk perception level respectively. “Poor” indicates the score of risk perception scale is between 18 ~ 35; “general” indicates the score of risk perception scale is between 36 ~ 53; “good” indicates the score of risk perception scale is between 54 ~ 71; “excellent” indicates the score of risk perception scale is between 72 ~ 90.

To sum up, it is believed that improving the public's physical sub-health risks perception level may also prompt the public to take measures to protect their own health, thus avoiding or delaying the occurrence of public sub-health symptoms, and it even helps to transform the existing sub-health symptoms into healthy ones. Therefore, hypothesis 1 and hypothesis 2 are proposed.

Hypothesis 1: Risk perception level is significantly positively correlated with physical sub-health.

Hypothesis 2: Physical sub-health has a negative effect on individual risk perception.

Risk perception level is affected by demographic variables. Many studies have pointed out that demographic variables have significant relationship with risk perception and risk behavior reduction. Relevant studies show that risk behavior will decrease accordingly with the increase of age [24], the level of risk perception of women is higher than that of men [25], education level is negatively correlated with risk perception level [26], and higher income will reduce the occurrence of risk behavior [27].

Therefore, on the basis of the existing literature, we put forward the following hypothesis 3 and hypothesis 4.

Hypothesis 3: Demographic variables and related control variables have a significant impact on the level of risk perception.

Hypothesis 4: Demographic variables and related control variables have a significant impact on physical sub-health.

The specific conceptual model is shown in Figure 2.

The rest of the article is organized as follows: The next section introduces the methods of data collection and analysis of physical sub-health and risk perception level as well as the relevant tools used, followed by a section that presents the results of the study and discussion of the results. Finally, conclusions are provided in the last section of the article.

Physical Sub-health Risk Perception Scale

Based on the theory of Protective Action Decision Model, we designed a physical sub-health risk perception questionnaire. On this basis, the public sub-health risk perception survey was carried out to explore the physical sub-health risk perception scale, and the reliability and validity of the physical sub-health risk perception scale were tested. The Cronbach α coefficient of the scale was 0.889, which also passed the validity test. It provides the basis for sub-health research and fills in the blank of this research field in China.

The scale has 18 items, which are divided into 5 dimensions, including the health knowledge (I'm more knowledgeable about sub-health/unhealthy than the people around me; I regularly browse and read health newsletters/exam related websites/sub-health related brochures. There are two items.), trust selection (Doctors at local community hospitals; doctors in provincial and municipal hospitals; provincial or national public health administrators; experts/scholars at medical research institutions. There are four items.), information channel (I obtain sub-health related information through Internet search (Baidu, Soso, etc.); I obtain sub-health related information through related Hospital Websites; I need to search for more information about sub-health/unhealthy; I will compare this information with other relevant information. There are four items.), risk perception (Total presence of sub-health/unhealthy indicators in an individual's body; sub-healthy/unhealthy physical symptoms that I fear are a threat to my quality of life; sub-health/unhealthy symptoms in my body and I feel anxious and scared; do you think the occurrence of sub-health/unhealthy is related to the individual's behavioral habits? ; do you think the occurrence of sub-health/unhealthy is related to the degree of integrity of an individual's family structure? There are five items.), social groups (Family members; social networks (QQ, WeChat, Weibo, etc.); friends, relatives, neighbors and colleagues. There are three items.). Using Likert's 5-grade scoring standard, each item has five options, namely “totally disagree, basically disagree, neither agree nor disagree, basically agree, fully

agree”, which scored 1~5 points respectively, and the score of this scale ranged from 18 to 90. The higher the score, the better the individual's competence of physical sub-health risk perception.

Self-compiled questionnaire on demographic variables

The questionnaire included parts for gathering demographic data about the subjects (gender, age, education, years of working, attribute of living place, marital status, number of children, average annual household income) and control variables data (self-health evaluation, sub-health duration, number of employees in the unit, sub-health proportion in the unit). The data is formatted as follows: male = 1, female = 2. Age is measured in years. Education is a six[1]point variable with primary or below= 1, junior high school= 2, senior high school= 3, junior college= 4, undergraduate= 5, master's degree and above= 6. Years of working has five categories, less than 5 years= 1, 5 to 10 years= 2, 11 to 20 years= 3, 21 to 30 years= 4, more than 30 years= 5. Attribute of living place has four categories, rural= 1, cities and towns= 2, third-tier city= 3, second-tier city= 4. Marital status has three categories,unmarried=1,Married=2, Others (eg.,remarried, divorced, widower/Widow) = 3. Number of children has four categories, zero child= 1, one child= 2, two children= 3, three or more children= 4. Average annual household income has five categories, less than 30,000 yuan= 1, 30,000 to 60,000 yuan= 2, 60,000 to 100,000 yuan= 3, 100,000 to 200,000 yuan= 4, more than 200,000 yuan= 5. Self-health evaluation has four categories, serious than sub-health= -2, sub-health= -1, unclear= 0, health= 1. Sub-health duration has five categories, less than 3 months= 1, 3 to 6 months= 2, 6 months to 1 year= 3, less than 2 years= 4, more than 3 years= 5. Number of employees in the unit has five categories, freelance= 1, less than 50= 2, 50 to 150 = 3, 150 to 500 = 4, more than 500= 5. Sub-health proportion in the unit has five categories, 10%= 1, 30%= 2, 50%= 3, 70%= 4, more than 90%= 5.

Self-compiled questionnaire for clinical manifestations of physical sub-health

We compiled a questionnaire to collect individual sub-health clinical data. Specifically, participants were asked if they had the following clinical symptoms that lasted for three months or longer. Clinical symptoms mainly include: short-term knee pain symptoms; gastrointestinal and liver abnormalities (e.g., nausea in the morning, palpitations, hunger, and similar symptoms); cardiac abnormalities (e.g., shortness of breath, arrhythmia, snoring, sexual dysfunction, and similar symptoms); stool abnormalities (e.g., alternating diarrhea and constipation and long-term chronic diarrhea); painlessness abnormalities (e.g., painless neck mass, painless hematuria, and similar symptoms); and other abnormalities (e.g., dizziness, dry throat, itching, pain, edema of both eyes). For each item, clinical manifestation options are divided into three categories “No, Yes and No idea”, which scored 1,-1,0 points respectively, the score of this questionnaire ranged from -5 to 5. The closer the score to 5 the individual gets, the healthier the body he has.

Statistical methods

EpiData 3.1 software was used to establish the database and double input data. Then data cleaning was carried out. SPSS 23.0 was used for descriptive statistics, and R software and python software were used

for statistical analysis of the measured data. Pearson correlation coefficient was used to analyze the correlation among physical sub-health, risk perception, demographic variables and related control variables. Factor analysis was used to test the multicollinearity, and multiple linear stepwise regression analysis was used to explore the effects of demographic variables and control variables on physical sub-health and risk perception. Two-way interactions in moderated multiple regression were used to test the moderating effect of demographic variables and control variables on physical sub-health and risk perception. Differences are considered to be statistically significant when $P<0.05$.

Results

According to Comrey's guidelines, the sample size of 100 is too small, while 200 is acceptable, 500 is good, and 1000 is excellent [28-29]. Sun et al. [30] suggest that the sample size is more than 10 times than the number of observed variables, which could ensure the validity of the research results. The sample size of this study was 770, which met the standard.

Results of correlation analysis

Based on the clinical manifestations and risk perception sample data of physical sub-health, we get the correlation diagram as shown in Figure 3. which shows the correlation among physical sub-health, risk perception, demographic variables and control variables.

Note. The larger the shadow circle and the deeper the color is, the greater the correlation coefficient (absolute value) is. The numerical value of the lower left part represents the correlation coefficient between the variables; the upper right shaded circle indicates significant correlation at 0.05 level (2-tailed), and the blank parts indicates no significant correlation at 0.05 level (2-tailed). R1 stands for physical sub-health; R2 stands for risk perception level; R3 stands for gender; R4 stands for age/years; R5 stands for education; R6 stands for years of working; R7 stands for attribute of living place; R8 stands for marital status; R9 stands for number of children; R10 stands for average annual household income; R11 stands for self-health evaluation; R12 stands for sub-health duration; R13 stands for number of employees in the unit; R14 stands for sub-health proportion in the unit.

From Figure 3, it can be seen that physical sub-health was negatively correlated with the attribute of living place, marital status, average annual household income, sub-health duration and physical sub-health risk perception level ($P < 0.05$). The risk perception level was positively correlated with the education, attribute of living place, average annual household income, sub-health duration , number of employees in the unit and sub-health proportion in the unit ($P < 0.05$), and negatively correlated with age ($P < 0.05$). Generally, there will be a multicollinearity problem when the correlation coefficient is more than 0.9, and there may be a problem when the correlation coefficient is over 0.8 [31-32] , so 0.6 is the baseline for an acceptable correlation coefficient [33]. In this study, only the correlation coefficient between age and working years or age and the number of children exceeds 0.6, and both correlation coefficients were 0.66. We conducted a multicollinearity test on all data. In general, the larger the variance inflation factor (VIF), the greater the problem of multicollinearity. More specifically, multicollinearity is not a problem when the tolerance value

is greater than 0.10 or the variance inflation factors (VIFs) are less than 10. In our study, the lowest tolerance value is 0.354, and the highest VIF is 2.829. Accordingly, multicollinearity does not appear to be a significant problem in our dataset.

Results of regression analysis

The regression model for physical sub-health and risk perception level on demographic characteristic variables and control variables is provided in Table 2

Table 2 Regression model

	Step 1		Step 2	
	β/Coef	SE	β/Coef	SE
Physical sub-health				
Gender	0.091	0.247		
Age/years	0.045*	0.017	0.028*	0.014
Education	0.245*	0.116	0.244*	0.106
Years of Working	-0.174	0.142		
Attribute of living place	-0.425*	0.117	-0.433*	0.107
Marital status	-0.340	0.241	-0.446*	0.226
Number of children	-0.071	0.186		
Average annual household income	-0.081	0.116		
Self-health evaluation	0.069	0.155		
Sub-health duration	-0.324*	0.097	-0.354*	0.090
Number of employees in the unit	0.096	0.091		
Sub-health proportion in the unit	0.235*	0.114	0.237*	0.111
Adjust R^2	0.052		0.054	
F	4.48		8.338	
Risk perception level				
Gender	0.773	0.885		
Age/years	-0.113	0.062	-0.079*	0.038
Education	-0.061	0.416		
Years of Working	0.563	0.509		
Attribute of living place	1.586*	0.418	1.649*	0.405
Marital status	-0.427	0.864		
Number of children	-0.026	0.667		
Average annual household income	1.371*	0.416	1.369*	0.390
Self-health evaluation	-0.365	0.555		
Sub-health duration	0.143	0.349		
Number of employees in the unit	0.784*	0.326	0.814*	0.316

Sub-health proportion in the unit	0.683	0.408	0.851*	0.371
Adjust R^2	0.091		0.096	
F	7.442		17.331	

Note. * indicates P<0.05.

It can be seen from Table 2 that age, education and the sub-health proportion in the unit have a significant positive influence on the physical sub-health (P < 0.05), while the attribute of living place, marital status and sub-health duration have a significant negative influence on the physical sub-health of the examinees (P<0.05). Attribute of living place, average annual household income, number of employees in the unit and sub-health proportion in the unit had a significant positive influence on the level of risk perception (P<0.05), while age had a significant negative influence on the level of risk perception (P<0.05).

The results in Figure 3 show that there is a significant negative correlation between physical sub-health and risk perception level. Therefore, hypothesis 1 is denied and hypothesis 4 is partially supported.

Figure 3 and Table 2 support hypothesis 3 and hypothesis 4. Some demographic variables and related control variables have significant effects on physical sub-health and risk perception level.

Results of the moderating effect analysis

On this basis, we used two-way interactions in a moderated multiple regression to explore the moderating effect of demographic variables and control variables on physical sub-health and risk perception level (Table 3). The results showed that among the above variables, only the number of children of physical examinees had significant moderating effect on physical sub-health and risk perception level (P < 0.05). The specific moderating efficiency is shown in Fig. 4.

Table 3. The moderating effect of demographic variables and control variables

Dependent variable	Independent variable	Moderator Variable	Interaction coefficient	Adjust R^2
Risk perception level	Physical sub-health	Gender	0.312	0.0018
		Age/years	-0.006	0.0003
		Education	0.041	0.0002
		Years of Working	0.167	0.0026
		Attribute of living place	-0.156	0.0025
		Marital status	-0.101	0.0003
		Number of children	-0.300*	0.0052*
		Average annual household income	-0.034	0.0001
		Sub-health duration	-0.018	0.0001
		Number of employees in the unit	0.024	0.0001
		Sub-health proportion in the unit	-0.048	0.0002

Note. * indicates P<0.05.

The risk perception level of physical examinees with more children and higher health level was significantly lower than those with less children. Risk perception levels were higher in families with less children than in families with more children. The poorer the level of physical health, the higher the level of risk perception (Figure 4).

Discussion

The results of the study show that age, education, attributes of living place, sub-health duration, sub-health proportion in the unit, marital status, average annual household income, and risk perception level of the study participants have an effect on physical sub-health. Among the physical examinees, physical sub-health status was positively correlated with education and sub-health proportion in the unit, and negatively correlated with attributes of living, sub-health duration, marital status, average annual household income, and risk perception level. One of the possible reasons for this is that most of the physical examinees in this study were under 45 years of age (83%) and fewer were elderly. With the improvement of living standards, contemporary young people are more concerned about their health, so it is understandable that age has a positive effect on physical health in this study. Later, the scope of the study subjects can be further expanded to increase the data of the elderly group. The second possible reasons is that the study subjects with higher education level mainly focus on their own and family's

quality of life, are more willing to spend money and time to buy health care products or exercise, so they have relatively better physical health status. The third possible reasons is that the higher the sub-health proportion in the unit of the study subjects, the more risks the study subjects perceive, and they will take various measures to improve their health status actively. The fourth possible reason is that people living in second-tier developed cities have a more stressful and faster life, and serious environmental pollution, which lead to poorer physical health. The fifth possible reason is that divorce has become more common in recent years, people with unhappy marital status (e.g., divorce, widowhood) and discordant family life have indirectly induced the emergence of physical sub-health conditions due to psychological imbalance, negative emotions, and increased stress [34-36], which is to some extent consistent with the studies of Sarason [37] and Lopez [38]. The sixth possible reason is that most people with higher average annual household income are more socially active, smoking, alcohol abuse, and overeating are all health risk factors [39-40]. The seventh possible reason is that when the body is in a sub-healthy state for a long time without intervention or treatment, the sub-healthy condition will gradually worsen and even evolve into a disease. The result is consistent with Bo-Yang P's research to some extent [2]. Of course, other possible reasons cannot be ruled out.

In this study, the factors that influenced the physical sub-health risk perception level among the study participants were age, education, attribute of living place, average annual household income, sub-health duration, number of employees in the unit, and sub-health proportion in the unit. The risk perception level was positively correlated with education, attributes of living place, average annual household income, sub-health duration, number of people in the unit, and sub-health percentage in the unit, and negatively correlated with age. The first possible reason is that the older the study participants are, the greater life experience and exposure, the better their ability to handle risk and the lower the physical sub-health risk perception level they have. The second possible reason is that the higher the level of education, the more prosperous and developed the place of living, the higher the average annual household income, and the higher the quality of life, the more concerned about their health condition[41], and the higher the level of physical sub-health risk perception. The third possible reason is that the more employees in the unit, the higher the sub-health proportion in the unit, and the longer the sub-health duration will bring psychological panic and anxiety to the study participants, and they will worry more about their health status, and the level of physical sub-health risk perception will gradually increase.

From Figure 3, it can be seen that the physical sub-health status and the risk perception level of the study subjects were significantly and negatively correlated. One of the possible reasons is that when the risk perception level of the study participants increased above the normal level, they became more worried about their health, which further caused psychological anxiety and tension [42], and it is not difficult to understand the increasing severity of sub-health symptoms. This is also consistent with Michael et al. [43] who suggest that poor psychological status can explain bad physical symptoms to some extent. Physical sub-health is often an outward manifestation of psychological sub-health. More psychological pressure can lead to the growth of negative emotions [44]. Studies have found that anxiety and depression can reduce the subjective sense of health of the public [45], increase the degree of physical and mental discomfort of the public [46], and make their physical health in a low-quality state [47]. A

second possible reason is that as physical sub-health deepens, the public's internal anxiety and worry can raise the risk perception level. The result is consistent with earlier research results [48].

The results show that the number of children of physical examinees had significant moderating effect on physical sub-health and risk perception level. The risk perception level of physical examinees with more children and higher health level was significantly lower than those with less children. Risk perception levels were higher in families with less children than in families with more children. The poorer the level of physical health, the higher the level of risk perception. One of the possible reasons is that the more children and the healthier the examinees, the more time and energy they spend on their children and the less attention they pay to their own physical health, so it is understandable that the risk perception level of examinees with more children and better health is significantly lower than that of those with fewer children. The second possible reason is that, generally speaking, families with less children have a lower level of economic pressure than families with more children, so they have more energy and financial resources to spend on their own health management. And they are more sensitive to information about their own health status, and once they perceive a change in their health status, they will quickly take countermeasures, so it is not difficult to understand that families with less children have a higher level of risk perception than those with more children. The third possible reason is that when the physical health status of the examinees is at a poor level, their psychological burden will increase, and it will also trigger their internal panic and anxiety, so the risk perception level of the examinees is correspondingly higher. The number of children is related to China's population policy, and the family planning policy, which has been implemented for the longest time since the founding of the country and has attracted the most attention from the public, has made a remarkable contribution to reducing China's fertility rate, controlling the total population, and avoiding the negative problems caused by overpopulation, but we also need to face up to the series of problems it brought, such as the accelerated process of population aging and the serious imbalance of the sex ratio at birth [49]. With the continuous development of economy and society, the progress of medical and health services, the improvement of people's living standards, the aging population is also increasing [50]. In response to the increasing aging of the population, China implemented a comprehensive two-child policy to adjust the demographic structure and slow down the aging trend, but the implementation of the policy did not trigger a birth boom among pregnant women of the right age in China. Cha L et al. [51] found that after the implementation of the "comprehensive two-child" policy in China, the second-child fertility rate among women of childbearing age did not increase, but was at a low level, mainly because women of childbearing age in China perceive risks such as high financial pressure, high cost of raising children, unattended children, and impact on work and career development [52-53] and other risks. How to coordinate population aging and the "comprehensive two-child" policy requires the support and cooperation of relevant government departments.

Limitations of the study

There are limitations of the present study that should be considered. First, the majority of the subjects in this study were young and middle-aged people aged 45 and younger, with a relative lack of data on older age groups and insufficient data coverage.. Second, we relied on questionnaire data rather than

conducting face-to-face investigations. Notwithstanding, these findings fill an important gap in the pertinent literature.

Conclusion

The poorer the level of physical health, the higher the level of risk perception. The more severe clinical manifestations of individual sub-health (e.g., short-term knee pain, gastrointestinal and liver abnormalities, cardiac abnormalities, stool abnormalities, and painlessness abnormalities, etc.), the more attention will be paid to sub-health, and the level of risk perception of physical sub-health will naturally increase. It revealed that the risk perception level counteracts the physical sub-health. Therefore, we screened the public on the physical sub-health risk perception scale, and for those groups with low level of physical sub-health risk perception, we targeted and pushed physical sub-health prevention knowledge through technology software or programs such as WeChat applet and big health APPs to improve the public's physical sub-health perception level. For groups with a high level of risk perception of physical sub-health, information about physical health checkups and common clinical symptoms of sub-health and health care knowledge can be targeted and pushed through WeChat applet, big health APPs and other technology software or programs to enhance public awareness of physical health care, thereby promoting public physical health and thus achieving the overall improvement of public health.

The results reveals that age, education, attributes of living place, marital status, sub-health duration, and sub-health proportion in the unit were direct factors influencing the physical sub-health status of the physical examinees, and risk perception level and average annual household income were indirect factors. The number of children had a significant moderating effect on physical sub-health status and risk perception level. Therefore, we put forward the following suggestions. First, improve the cultural level and literacy of the public. Second, reduce environmental pollution, water pollution, etc. to improve the public housing and living environment. Third, perfect the relevant marriage laws, implement the implementation of the divorce cooling-off period, and strengthen psychological guidance and intervention for those who are ready to divorce, so as to reduce the divorce rate. Fourth, strengthen community health knowledge education and propaganda, improve community sports infrastructure equipment, encourage the public to attend regular medical checkups, attach importance to public physical exercise and health checkups. Fifth, reasonably allocate social resources, reduce the gap between the rich and the poor, and avoid unreasonable wage increases. Sixth, pay attention to public mental health and correctly guide public risk perception. And seventh, spread the national policy of bearing and rearing better children to promote the development of public physical health in China.

Declarations

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Authors' contributions

XJ was involved in the study design, data-entry, and original writing. LZ participated in the data entry of the study, and the writing of the original article, and funded this study. JS was involved in the language editing, data collection, and financial support. YG was involved in the language editing. ZT reviewed the manuscript. And CH financially supported the study.

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Availability of data and materials

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

Ethics approval and consent to participate

Ethical approval for the study was received from the ethics committee of Anhui Medical University and meets the ethical requirements. We confirm that the ethics committee of Anhui Medical University approved the procedure for verbal consent. They considered that written consent was not necessary because there were no risks and disputes of interest associated with this study, and verbal consent was easily understood by the subjects and verbal consent is better for informational purposes. And this study was only to get information about the subjects' physical sub-health status and would not cause any loss to the subjects, except for a few minutes of questionnaire completion time. The details of documenting consent were: First, the purpose, usage, general content, and the time it might take were explained to the subjects before this study. Second, exclude subjects who did not obtain verbal consent prior to the start of the questionnaire or who refused to conduct this study while the questionnaire was in progress. Third, subjects who gave verbal consent to participate in this study were included and questionnaires were administered. Ensure that subjects are voluntarily agreeing to participate in the study. Fourth, For subjects under the age of 18, verbal informed consent was obtained from their parents and/or legal guardians. This approval procedure was approved by the Ethics Committee of Anhui Medical University.

Consent for publication

Not applicable.

Competing interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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Figures

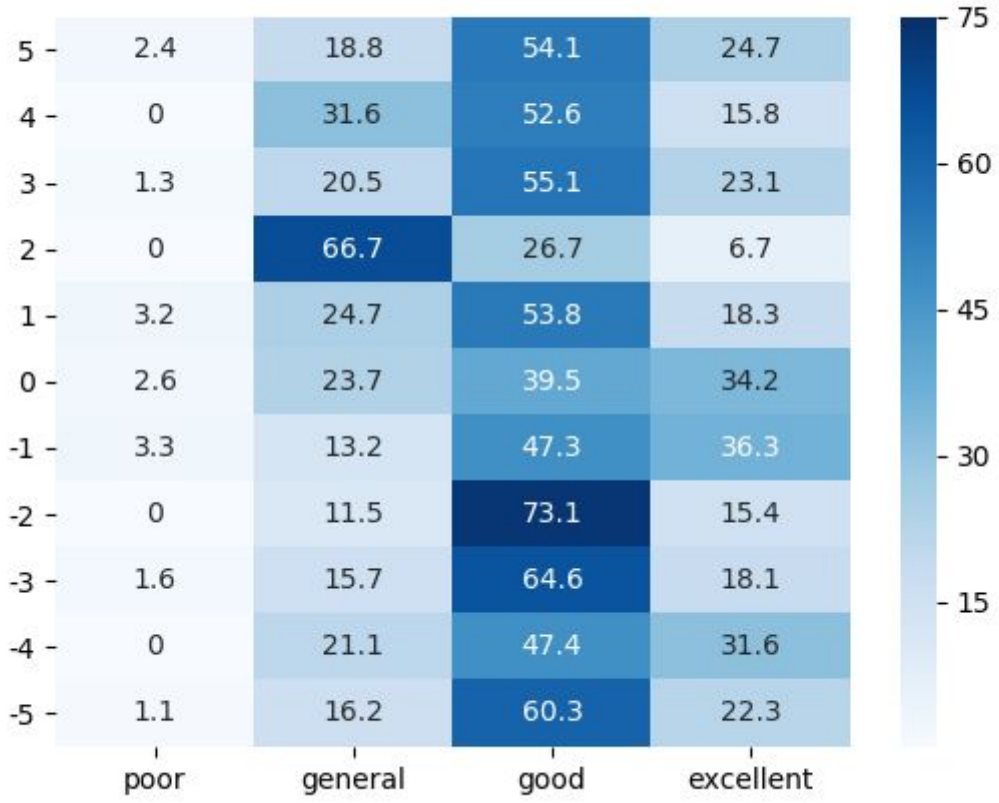

Figure 1

Heat map of the distribution of physical sub-health rate in different risk perception levels(%)

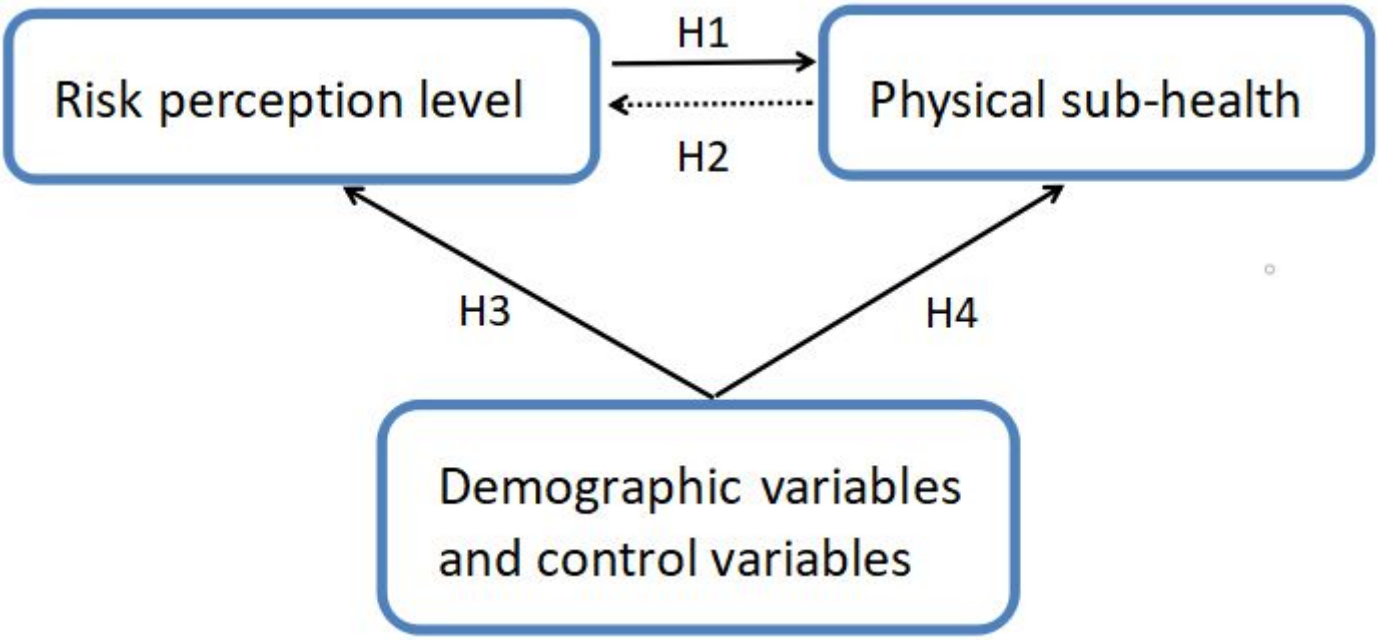

Figure 2

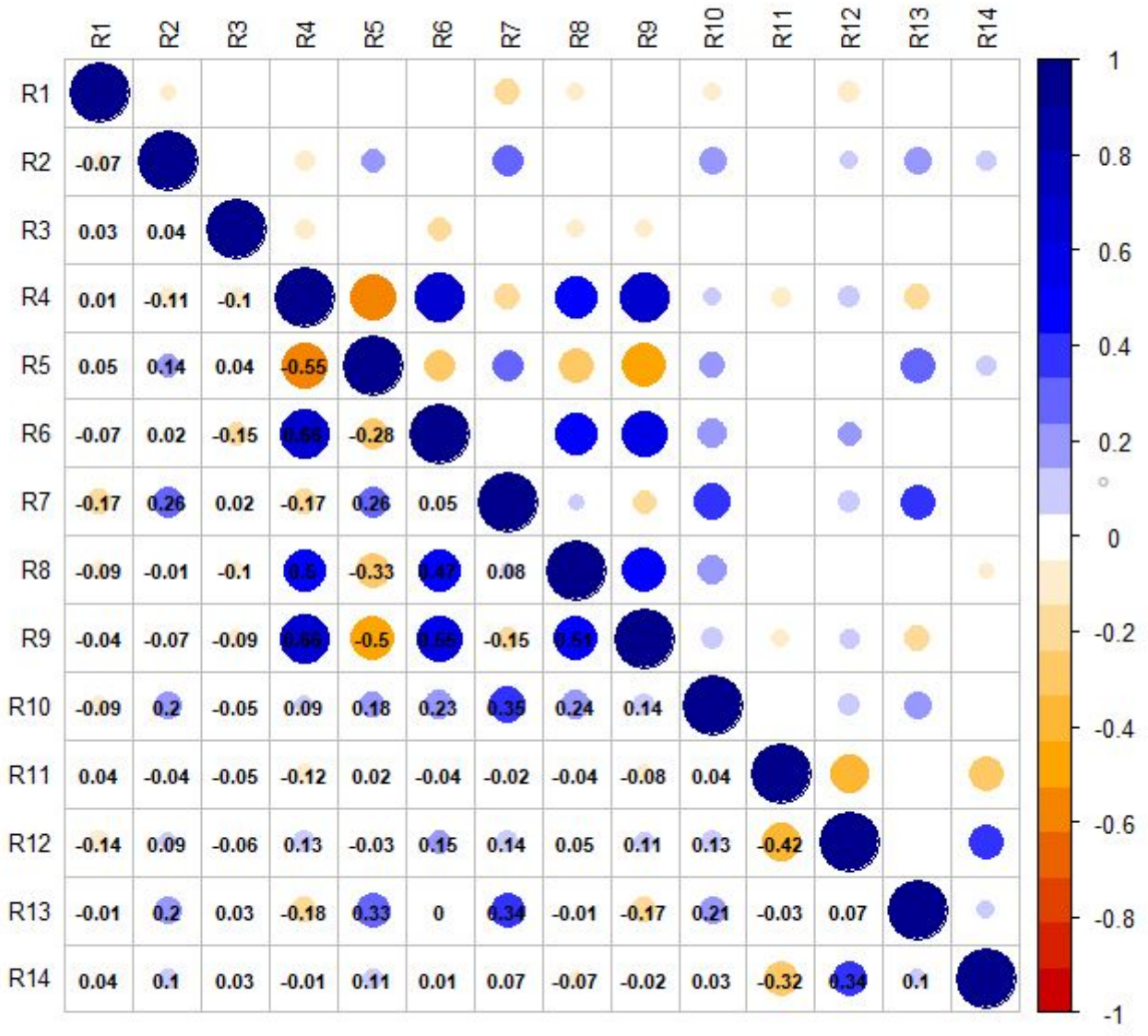

Figure 3

Correlation diagram.

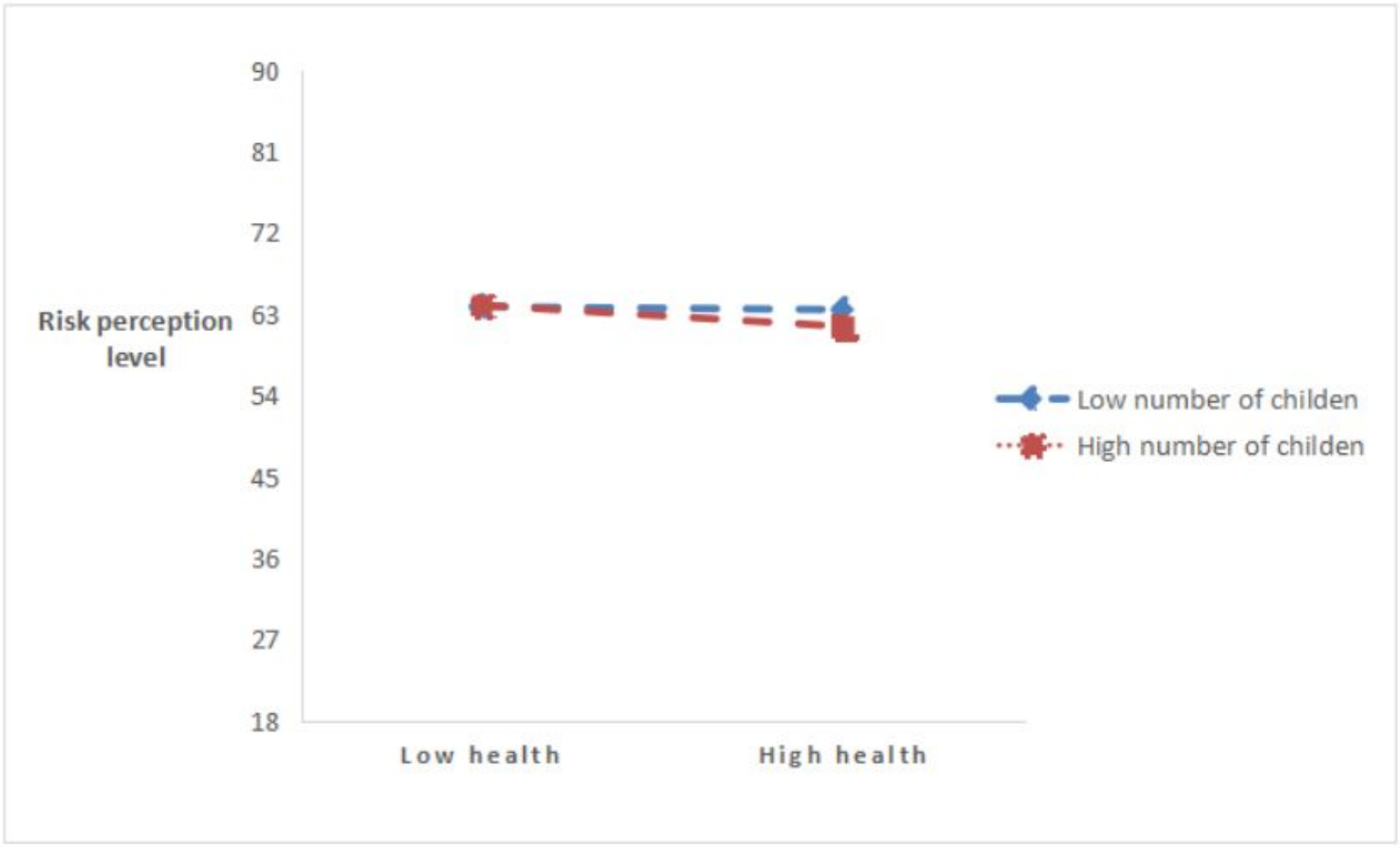

Figure 4

Number of children moderation interaction diagram for physical sub-health and risk perception level