The Relationship Between Macro-Social Environmental Factors and Subjective Health Perception: The Mediating Role of Exercise Intention

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Abstract

This study explored the relationship between macro-social environmental factors and subjective health perception among urban residents in China, as well as the mediating role of exercise intention between the two. This study is based on 6,245 valid data from the 2017 China General Social Survey (CGSS) and the China Statistical Yearbook (CSY) cross-sectional dataset for exploration. This study employed the questionnaire from CGSS 2017 to collect data on exercise intentions and subjective health perceptions and used CSY 2017 to gather relevant data on macro-social environmental variables. Based on SPSS 25.0, Stata 12.0, and AMOS 12.0 software, this study primarily conducted statistical analyses using Spearman correlation analysis, multiple linear regression analysis, binary logistic regression analysis, and mediation effect testing. The results indicate that GDP per capita, urbanization rate, and air excellence rate are associated with the transformation of exercise intention and subjective health perception. In addition, exercise intention plays a mediating role between macro-social environmental factors and subjective health perception, particularly in the relationships between urbanization rate, green coverage in built-up areas, GDP per capita, and subjective health perception. The results enrich the "environment-behavior-health" model and have positive implications for the formulation of relevant policies on macro-social environment.

Keywords: Exercise Intention, Subjective Health Perception, Social Environment, Behavioral Change, Stage Model.

Introduction

Health is a combination of physical, mental and social conditions that are essential for human survival, development and well-being (Pressman, Kraft, & Bowlin, 2020; Stucki & Bickenbach, 2019). With the high degree of socio-economic development, human beings are facing potential health threats while enjoying a convenient life (Woodward et al., 2000). Subjective health perception is an individual's subjective and comprehensive evaluation of their own health status, encompassing an overall cognition of physical condition, psychological state, and quality of life (Suchman, Streib, & Phillips, 1958). The relationship between subjective health perception and physical and mental health is mutually influential and interactive, and to a certain extent, it is highly correlated with objectively measured health status (Wu & Xiong, 2021). In other words, to maintain and improve an individual's level of physical and mental health, it is necessary to pay attention to and enhance their subjective health perception. This can be achieved through positive psychological interventions and adjustments to lifestyle, thereby strengthening individuals' awareness and behaviors related to health. Therefore, subjective health perception has become an important alternative indicator to objective measurements in large-sample surveys and has been widely used by researchers (Jylhä, 2009).

With the development of research, numerous studies (He & Jia, 2022; Liu et al., 2017; Meng, Lu, & Zhang, 2008) have confirmed a significant correlation between macro-social environmental factors and subjective health perception. However, previous studies have mainly focused on exploring a single factor within the macro-social environment, lacking a comprehensive and integrated analysis of all factors. Moreover, exercise intention, a core component of many sport psychology models, is an important prerequisite for individuals to decide whether to participate in physical exercise (Gomes et al., 2018), and it may play a mediating role between the two. Although previous studies (Brownson, Boehmer, & Luke, 2005; Li et al., 2017; Zhang et al., 2020) have explored the potential correlation between certain macro-social environmental factors and residents' physical exercise, they mostly classify exercise in a binary manner, simply categorizing it as "yes" or "no," overlooking the transformation of exercise intention. Understanding the macro-social environmental factors that influence residents' exercise intention transformation is positively significant for promoting their "unity of knowledge and action" and improving their health status. However, based on current research, the relationship between macro-social environmental factors, exercise intention, and subjective health perception remains unclear and urgently needs to be confirmed.

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Given the above issues, this study aims to explore the relationship between macro-social environmental factors, exercise intention, and subjective health perception in the Chinese context, which will yield profound research value and significance. Firstly, theoretically, this study expands the "environment- behavior- health" model, further enriching and improving existing health promotion theories, and promoting the localization of relevant theories in China. Secondly, practically, it can provide scientific evidence for the government to formulate relevant policies and measures to better promote residents' health and well-being.

Literature Review

Macro-social environmental factors are closely linked to individuals' subjective health perceptions. For instance, the development of urbanization leads to a shift in people's lifestyles and social patterns from diverse and dynamic to singular and static, which may result in the emergence of anxiety and feelings of loneliness (He & Jia, 2022). Additionally, urban green spaces provide areas for leisure and exercise, enhancing residents' sense of pleasure and comfort, thereby improving their subjective health perceptions (Liu et al., 2017). Furthermore, the higher the level of socio-economic development, the more resources and conditions people have to focus on and maintain their health, strengthening their assessment of their own health status. Lastly, good air quality is crucial for people's respiratory and cardiovascular health. Living in cities with high rates of good air quality allows people to breathe fresh air, which helps reduce the incidence of respiratory and cardiovascular diseases, thus enhancing subjective health perceptions (Meng et al., 2008). In summary, this study proposes the following research hypothesis:

H1: There is a significant association between macro-social environmental factors and residents' subjective health perceptions.

The function of exercise has been widely recognized by society, with individuals achieving health benefits and contributing to socioeconomic development through exercise (Ruegsegger & Booth, 2018). In recent years, the health literacy level of Chinese residents has risen steadily, and they are gradually acquiring the necessary exercise knowledge and skills (Li et al., 2023; Tian et al., 2023). Although the health benefits of regular exercise have gradually gained popularity, the majority of Chinese residents have still not taken practical action, and the problem of insufficient physical activity remains prominent (Zhang et al., 2023). The reason for this is that this "lack of integration of knowledge and action" may stem from a low exercise intention, so that even if there is a positive attitude and cognition towards exercise, it cannot be translated into practical action without a positive intention to exercise (Song et al., 2012; Zou, Jiang, & Xu, 2022). Exercise intention is the response tendency to participate in exercise that arises after logical thinking in long-term sedentary individuals, which is the starting component and key element of health behavior, and an important prerequisite for people to decide whether or not to participate in physical exercise (Gomes et al., 2018). Numerous studies (Barg et al., 2012; Fuchs et al., 2017) have demonstrated that exercise intention is the best predictor of the amount of exercise and a central component of many psychological models of exercise. Therefore, how to improve the exercise intention is the focus of the promotion of the "knowledge and practice" of the residents' exercise.

The stages of behavior change model identifies an individual's behavioral change as a dynamic, progressive, and nonlinear process of stage change, rather than the all-or-nothing state of traditional behavioral change, providing the possibility of explaining the black box between behavioral intention and actual action, and providing more targeted interventions for individuals at different stages of the process (de Freitas et al., 2020; Kleis et al., 2021). Among the many models of the stages of behavior change, the Health Action Process Approach (HAPA) has received increasing attention from researchers. HAPA classifies the stages of individual behavior change into three stages: no intention, intention, and action, and has a high degree of relevance across different health promotion domains (Shen, Mao, & Zhang, 2010). For the division of exercise stage, Si (2005) used whether an individual has behavioral intention and the intensity of behavioral intention as the criteria for dividing the stage of change they are in, and subsequently Fan et al. (2019) used this criterion to explore the influencing factors of adolescents' exercise intention in China. Therefore, this study will continue to continue this stage delineation criterion to delineate the exercise intention of our adult exercise by the strength of behavioral intention.

Exercise intention may play a mediating role in the relationship between the relationship between macro-social environmental factors and subjective health perception. Although previous studies (Gao, 2022) have explored the influencing factors of physical exercise among Chinese residents, they have mostly categorized exercise in a two-dimensional way, that is, physical exercise is simply categorized as "yes" and "no", ignoring the transformation of exercise intention. First, the accelerating process of urbanization has led to an influx of large rural populations

into towns and cities, where the reinforced concrete urban environment and social structure "confine" people and may limit their physical exercise (Brownson et al., 2005). However, the convenience of supporting environmental facilities such as urban parks and green spaces in turn promotes participation in physical exercise by residents (Liu et al., 2017). Second, the level of socio-economic development helps residents to participate in physical activities, improve social health and enhance the quality of life in society (Li et al., 2017). Third, there is a link between population density and physical exercise. Some studies (Braza, Shoemaker, & Seeley, 2004; Frank et al., 2007) have suggested that higher population densities allow for closer proximity to amenities needed for residents to work, study, and live, and can increase rates of walking and bicycling. But there are also studies (Xu et al., 2010; Zhang et al., 2020) showing that population density can reduce physical activity time and increase screen time and sedentary time, leading to an increased likelihood of developing obesity. Finally, air quality is one of the most important influences on physical exercise. A meta-analysis by Ying et al. (2020) noted that air pollution reduces Chinese residents' outdoor exercise time, increases the choice of confined-space modes of transportation such as private cars and rail transit. In summary, this study proposes the following research hypothesis:

H2: There is a significant association between macro-social environmental factors and residents' exercise intention.

H3: Exercise intention mediates the relationship between macro- social environmental factors and subjective health perception.

Methods

Data Sources

The data for this study come from two major cross-sectional datasets, the 2017 Chinese General Social Survey (CGSS) and the Chinese Statistics Yearbook (CSY).

CGSS is the earliest national, comprehensive, and continuous academic survey project in China, which summarizes the trend of social change through systematic and comprehensive collection of data at multiple levels of society, community, family, and individual, and provides data for international comparative research. It has now become the most important data source for studying Chinese society, and is widely used in scientific research, teaching, and government decisions (China Academic Survey Information Database, 2017). The CGSS database has been extensively used in research areas such as health perception (Chen et al., 2021) and physical exercise (Wang et al., 2022), providing valuable references for this study.

CSY is an informative annual publication compiled and printed by the National Bureau of Statistics to comprehensively reflect the economic and social development of China, and it is the most comprehensive and authoritative comprehensive statistical yearbook in China, and an important source of information for social science research (National Bureau of Statistics, 2017). The CSY database provides numerous indicators reflecting China's macro social environment, which offers data support for this study to explore the relationship between macro social environmental factors and subjective health perception. Additionally, Su and Liu (2022) explored the relationship between macro social environmental factors and the prevalence of depression among Chinese youth using this database, providing valuable insights for the current study.

In this study, a total of 9,764 valid data were obtained after excluding the samples of "don't know" and "refused to answer" in the CGSS and subjective health perception variables; 6,245 valid data were obtained after excluding the rural data. For this study, we referenced previous study (Su & Liu, 2022) and matched the two datasets based on regional variables. In addition, this study uses linear interpolation for missing value processing.

Variables

Exercise Intention

CGSS 2017 investigated how often participants had participated in physical exercise during their free time in the past year. In this study, based on the conceptual definitions of previous studies (Fan et al., 2019; Si, 2005), "never" was defined as the "no intention" stage in which the intention to exercise never arose and was assigned a value of 1; "several times a year or less" and "several times a month" were defined as the "intention" stage in which the intention to exercise was present but seldom exercised, and were assigned a value of 2; "several times a week" and "every day" were defined as the "action" stage of intention to exercise and regular exercise, and assigned a value of 3.

Subjective health perception

The CGSS 2017 asked participants to judge the extent of their recent subjective health perception on a 5-point Likert scale, where "very unhealthy" to "very healthy" was assigned a value of 1-5.

Macro-social environmental variables

Based on the review of previous studies (Braza et al., 2004; Brownson et al., 2005; Frank et al., 2007; He & Jia, 2022; Li et al., 2017; Liu et al., 2017; Meng et al., 2008; Xu et al.,

2010; Ying et al., 2020; Zhang et al., 2020) and the CSY 2017 dataset, this study selected urbanization rate, green coverage rate of built-up areas, GDP per capita, population density, and air excellence rate as the macro-social environmental factors of cities for this study.

Control Variables

Based on previous studies (Chen et al., 2021; Wang et al., 2022), this study selects control variables at both the individual and household levels. Individual factors included age, gender, education, socio-economic status (SES), and body mass index (BMI); family factors included father's and mother's education. (1) For the age variable, CGSS 2017 asked for the date of birth of the participants. This study subtracted the year of birth of the participants from 2017 to get their age. (2) For the gender variable, "male" is assigned the value of 1 and "female" is assigned the value of 2. (3) In terms of the education level, "no education, private school, literacy class, primary school" is assigned a value of 1, that is, "primary school and below"; "junior school" is assigned a value of 2; "vocational school, general high school, junior college, technical school" is assigned a value of 3, that is, "senior school"; "university college, bachelor's degree, postgraduate and above" is assigned a value of 4, "college and above". (4) For SES, the CGSS 2017 determines a participant's current SES by asking about the participant's current social class. The subjective judgment of class was divided into 10 levels, with the highest "10" representing the top level and the lowest "1" representing the bottom level. (5) For BMI, CGSS 2017 investigated the height and weight of the participants and calculated the BMI of the participants based on the BMI formula. (6) For the father's and mother's education, the variables are treated in the same way as in article (3).

Statistical Methods

This study used SPSS 25.0, Stata 12.0, and AMOS 21.0 software for data processing and statistical analysis. Descriptive statistics were performed using mean (*M*) and standard deviation (*SD*) for continuous variables, frequency and standard deviation for categorical variables. Firstly, Spearman correlation analysis was used to explore the relationship between macro-social environmental factors, exercise intention, and subjective health perception. Secondly, subjective health perception was taken as the independent variable, and multiple linear regression analysis was conducted to explore the relationship between macro-social environmental factors and subjective health perception after controlling for relevant variables. Thirdly, the adjacent stages of exercise intention were used as independent variables, and binary logistic regression analysis was conducted to explore the relationship between macro-social environmental factors and exercise intention after controlling for relevant variables. Finally, mediation effect tests were conducted to explore the mediating role of exercise intention in the relationship between macro-social environmental factors and subjective health perception. The statistical test levels for the above statistical methods were set at α=0.05.

Table 1

The Results of The Correlation Analysis Between Macro-Social Environmental Factors, Exercise Intention, and Subjective Health Perception

Variables	Urbanization rate	Green coverage rate of built-up areas	GDP per capita	Population density	Air excellence rate	Exercise intention	Subjective health perception
Urbanization rate	1.000						
Green coverage rate of built-up areas	0.229**	1.000					
GDP per capita	0.908**	0.360**	1.000				
Population density	0.866**	0.325**	0.891**	1.000			
Air excellence rate	-0.035**	-0.146**	-0.200**	-0.149**	1.000		
Exercise intention	0.166**	0.058**	0.175**	0.148**	-0.019	1.000	
Subjective health perception	-0.001	0.000	0.008	0.008	-0.020	0.142**	1.000

Note: **P<0.01.

Results

Basic Information About The Participants

The age of the 6245 participants ranged from 18 to 103 years, with a mean age of (48.80 ± 17.28) years, including 47.1% males and 52.9% females. The order of the number of 6,245 participants in terms of educational attainment was: college and above (30.4%), junior high school (25.1), senior school (22.3%), and primary school and below (22.2%). The mean SES of the participants was in the low to moderate class (4.36±1.64) and the mean BMI was (22.83±3.67) kg/m^2. In addition, according to the survey, 31.5% of the 6,245 participants were in the stage of no intention to exercise, 24.9% were in the stage of intention to exercise, and 43.6% of the residents were in the stage of action to exercise regularly. The mean subjective health perception of 6245 participants was above moderate (3.66 ± 1.01).

Correlation Among Macro-Social Environmental Factors, Exercise Intention, and Subjective Health Perception

The correlation analysis results (Table 1) of macro-social environmental factors, exercise intention, and subjective health perception indicate that urbanization rate (r=0.166), green coverage rate in built-up areas (r=0.058), GDP per capita (r=0.175), and population density (r=0.148) have significant positive correlations with exercise intention (P<0.01). However, the correlation between air quality index and exercise willingness is not significant (P>0.05). Additionally, green coverage rate in built-up areas (r=0.038) and exercise intention (r=0.142) have significant positive correlations with subjective health perception (P<0.01), while urbanization rate, GDP per capita, population density, and air quality index do not show significant correlations with subjective health perception (P>0.05).

Relationship Between Macro-Social Environmental Factors and Subjective Health Perception

After controlling for relevant variables, GDP per capita was found to have a significant positive correlation with subjective health perception (β=0.046, 95% CI=0.024~0.069, P<0.01), while urbanization rate (β=-0.010, 95% CI=-0.016 ~ -0.004, P<0.01) and air excellence rate (β=-0.327, 95% CI=-0.507 ~ -0.148, P<0.01) exhibited negative correlations with subjective health perception. In addition, the relationship between green coverage of built-up areas and population density with subjective health perception was not significant (P>0.05). The results of the multiple linear regression analysis of the relationship between macro-social environmental factors and subjective health perception of urban residents are shown in Table 2.

Table 2

Results of Multiple Linear Regression Analysis of the Relationship Between Macro-Social Environmental Factors and Subjective Health Perception of Urban Residents

Variables	β	*SE*	*t*	95%*CI*
Urbanization rate	-0.010	0.003	-3.42**	(-0.016, -0.004)
Green coverage rate of built-up area	0.002	0.004	0.53	(-0.005, 0.010)
GDP per capita	0.046	0.011	4.10**	(0.024, 0.069)
Population density	-5.56e-06	0.000	-0.32	(-0.000, 0.000)
Air excellence rate	-0.327	0.091	-3.58**	(-0.507, -0.148)
Control variables	Control	Control	Control	Control

Note: **P<0.01.

Relationship Between Macro-Social Factors and Exercise Intention

Compared to those who have no intention to exercise, individuals with the intention to exercise tend to have a higher GDP per capita (OR=1.127, 95% CI=1.049~1.211, P<0.01) and a higher air excellence rate (OR=4.301, 95% CI=2.411~7.671, P<0.01). In addition, those who are in the regular exercise stage tend to have a higher GDP per capita (OR=1.096, 95% CI=1.028~1.167, P<0.01), but lower urbanization rate (OR=0.980, 95% CI=0.964~0.996, P<0.05) and air excellence rate (OR=0.425, 95% CI=0.253~0.715, P<0.01) compared to those with the intention to exercise. The results of the binary logistic regression analysis of the relationship between macro-social environmental factors and exercise intention of urban residents are shown in Table 3.

Table 3

Results of the Binary Logistic Regression Analysis of The Relationship Between Macro-Social Environmental Factors and Exercise Intention of Urban Residents

Variables	No intention→Intention		Intention→Action	
	OR	***95%CI***	***OR***	***95%CI***
Urbanization rate	0.988	(0.970, 1.006)	0.980*	(0.964, 0.996)
Green coverage rate of built-up area	1.001	(0.977, 1.025)	1.007	(0.985, 1.029)
GDP per capita	1.127**	(1.049, 1.211)	1.096**	(1.028, 1.167)
Population density	1.000	(1.000, 1.000)	1.000	(1.000, 1.000)
Air excellence rate	4.301**	(2.411, 7.671)	0.425**	(0.253, 0.715)
Control variables	Control	Control	Control	Control

Note: *P<0.05; **P<0.01.

The Mediation Effect of Exercise Intention Between Macro-Social Environmental Factors and Subjective Health Perception

The mediation analysis results (Figure 1) indicate that the mediating effect of exercise intention is significant between urbanization rate, green coverage rate of built-up areas, GDP per capita, and subjective health perception (P<0.01). However, the mediating effect is not significant between population density, air excellence rate, and subjective health perception (P>0.05).

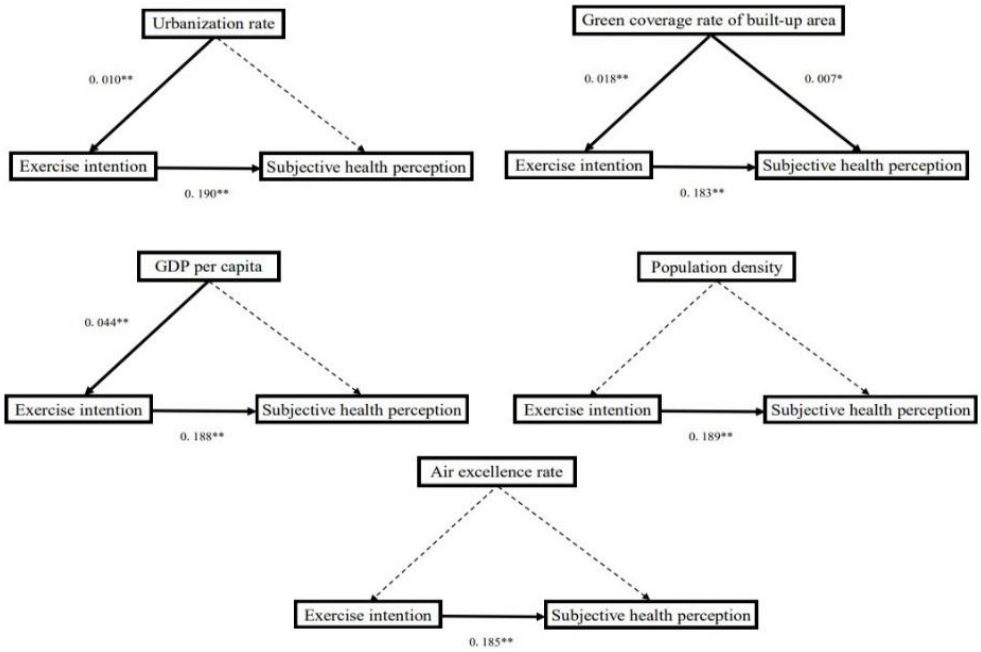

Figure 1: The Mediating Role of Exercise Intention Between Macro-Social Environmental Factors and Subjective Health Perception.
Note: Solid lines indicate statistically significant regression coefficients; dashed lines indicate non-significant regression coefficients; *P<0.05; **P<0.01.

Discussion

The Association Between Macro-Social Environmental Factors and Subjective Health Perception

The results of this study found a significant correlation between macro-social environmental factors and subjective health perception, supporting Hypothesis 1. Specifically, there is a significant positive correlation between GDP per capita and subjective health perception, while urbanization rate and air excellence rate are significantly negatively correlated with subjective health perception.

Firstly, an increase in GDP per capita means that people's economic conditions have improved, providing more resources for improving their quality of life and health status (Li, 2019). Additionally, with economic development, the social security system will continue to improve, enabling people to enjoy better medical services, further enhancing subjective health perception.

Secondly, as urbanization accelerates, the density of urban population increases, leading to issues such as traffic congestion and increased life pressure, which may have a negative impact on physical and mental health, resulting in a decrease in subjective health perception.

Finally, the quality of air directly affects respiratory health and living environment. When the air excellence rate decreases, it may lead to the occurrence and exacerbation of respiratory and cardiovascular diseases, thereby reducing subjective health perception (Meng et al., 2008). However, the results of this study are inconsistent with previous research (An & Xiang, 2015; Roberts, Voss, & Knight, 2014), and further exploration is needed in subsequent studies.

The Association Between Macro-Social Environmental Factors and Exercise Intention

The results of this study found that there is a correlation between macro-social environmental factors and exercise intention, supporting research hypothesis 2. Specifically, compared to those with no intention to exercise, a higher GDP per capita and a higher air excellence rate are associated with intention to exercise. On the other hand, compared to those with intention to exercise, a higher GDP per capita, a lower urbanization rate, and a lower air excellence rate are associated with regular exercise.

Firstly, as the GDP per capita increases, indicating a higher overall economic income for the residents of the region, they possess more sufficient financial resources to invest in physical exercise (Li, 2019). Socio-economic development promotes consumption upgrading, resulting in an increase in the proportion of consumption invested by residents in leisure and entertainment, education and culture.

Secondly, as urbanization progresses, exercise space is restricted, so the likelihood that residents will actually exercise decreases. Urbanization accelerates the transformation of residents from manual labor to sedentary mental labor, thus exacerbating the shrinkage of exercise time (Ye & Guo, 2016). Therefore, numerous studies (He & Jian, 2022; Monda et al., 2007) have suggested that the likelihood of residents participating in physical exercise decreases with an increase in the rate of urbanization, a result similar to the results of this study.

Finally, higher air quality is conducive to realizing the transformation of exercise intention from the no intention to the intention stage, but not to realizing the transformation of exercise intention from the intention to the action stage. A meta-analysis by Ying et al. (2020) found that air quality is an important macro-social environmental factor for physical exercise participation among Chinese residents, and that lower air quality will limit the amount of time residents spend participating in physical exercise and increase sedentary time. This study, however, found that higher air quality was a facilitator of the transformation from the no intention to the intention stage and a barrier to the transformation from the intention to the action stage. The results were unexpected and are not yet consistent with previous studies and need to be further explored in subsequent studies.

The Mediating Role of Exercise Intention

The findings of this study reveal that exercise intention plays a mediating role between macro-social environmental factors and subjective health perception, particularly in the relationships between urbanization rate, green coverage in built-up areas, GDP per capita, and subjective health perception, supporting research hypothesis 3.

Significant associations exist between urbanization rate, green coverage in built-up areas, GDP per capita, and exercise intention. While the urbanization rate and GDP per capita have been discussed in detail in the previous sections, the focus here will be on green coverage in built-up areas. Liu et al. (2017) suggests that areas with higher green coverage offer pleasant environments conducive to outdoor physical exercise, enhancing individuals' pleasant experiences and sense of comfort. Therefore, there is a significant positive correlation between green coverage in built-up areas and exercise intention.

Furthermore, numerous studies (Barg et al., 2012; Fuchs et al., 2017; Ruegsegger & Booth, 2018) have confirmed a significant positive relationship between exercise intention and subjective health perception. As a result, exercise intention serves as a bridge connecting macro-social environmental factors and subjective health perception, playing a mediating role in their relationship. This suggests that by enhancing exercise intention, individuals can better adapt to urban environments and improve their personal health levels.

Conclusion

This study explored the relationship between macro-social environmental factors and subjective health perception among urban residents in China, as well as the mediating role of exercise intention between the two. The results of this study revealed a significant positive correlation between GDPs per capita and subjective health perception, while urbanization rate and air excellence rate are significantly negatively correlated with subjective health perception. In addition, compared to those with no intention to exercise, a higher GDP per capita and a higher air excellence rate are associated with intention to exercise.

On the other hand, compared to those with intention to exercise, a higher GDP per capita, a lower urbanization rate, and a lower air excellence rate are associated with regular exercise. Finally, exercise intention plays a mediating role between macro-social environmental factors and subjective health perception, particularly in the relationships between urbanization rate, green coverage in built-up areas, GDP per capita, and subjective health perception.

This study enriches the "environment-behavior-health" model and contributes to the formulation of macro-social and environmental policies. First, this study contributes to enriching and refining existing health promotion theories. By considering China's unique socio-cultural, economic, and policy backgrounds, this research can reveal how these macro-social environmental factors affect individuals' exercise intentions and subjective health perception, thereby promoting the localization and development of relevant theories. Secondly, the findings of this study can provide scientific evidence for the government to formulate relevant policies and measures. For instance, the government can adjust public health policies based on the research results, stimulate residents' exercise intentions by improving the social environment, and better promote residents' health and well-being.

However, this study still has some limitations. First, by using only one question item to assess exercise intention and subjective health perception, the accuracy of the assessment may still be insufficient, which may cause bias in the study results. Furthermore, there may be issues with the compatibility of the two databases, which could potentially interfere with the accuracy of the results. Therefore, further exploration is needed in subsequent research.

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