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The Physical Activity Status of Individuals in a Unique City and Related Factors: A National Survey of Cardiovascular Diseases in Chongqing, China

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Abstract

Background: Low physical activity is associated with health hazards. Chongqing is a city with unique geographical characteristics in China and the prevalence rate of cardiovascular diseases in Chongqing is higher than that across the whole country. We aimed to explore the physical activity of residents who live in this unique geographical location.

Methods: Data were collected through the "12th Five-Year Plan" of the National Science and Technology Support Program. The stratified multi-stage random sampling method was adopted. Personal questionnaires collected data on basic demographics (age, sex, ethnicity, occupation, education, marital status, etc.) and lifestyle habits (diet, physical activity, etc.). In the physical examination, height, body mass index, waist circumference, and body fat percentage were measured. Physical activity was assessed using the Global Physical Activity Questionnaire (GPAQ). Total physical activity was calculated using metabolic equivalents. Logistic regression analysis was used to evaluate the association between low physical activity and potential risk factors.

Results: Overall, 15,021 individuals were included. Physical activity at work contributed largely to physical activity. The prevalence of physical inactivity was 23.0%. Urban residents were more active than rural residents. Men were more inactive than women. The highest prevalence of low physical activity was found in individuals ≥ 75 years old. The Tujia Chinese population was more active than the Han Chinese population. Unmarried individuals and divorced individuals were 1.23 times and 1.56 times more inactive than married/remarried/cohabitating individuals, respectively.

Conclusions: The rate of physical activity in Chongqing is lower than the global rate. This study is the first to survey the physical activity status in Chongqing using the GPAQ. Future interventions for increasing physical activity should focus on inactive individuals.

Keywords: Physical activity; Risk factors; GPAQ; Status survey

Introduction

With the rapid development of the social economy, science, and technology, the work habits and lifestyle of populations have undergone great changes. Physical inactivity has become an important public health problem [1]. Low physical activity has been demonstrated to be an important risk factor for diseases, such as colon cancer and hypertension [2]. Insufficient PA is also associated with frequent occurrence of type 2 diabetes, and other cardiovascular diseases, breast cancer, bowel cancer, and death [3]. Recent evidence shows that physical inactivity causes 9.0% (5.3 million) of annual deaths worldwide and 6-10.0% of deaths caused by non-communicable diseases are attributed to physical inactivity [4]. In 2016, a report in the 63th American Society of Sports Medicine (ACSM) clearly mentions Out, the study of physical activity to improve cognitive function and academic ability is promising and developable [5], Chongqing, a unique city, is located in southwestern China. It is dominated by hills and mountains, with the topography demonstrating the appearance of "one mountain and one ridge" and "one mountain and two ridges." It includes a large sloping area, and it is referred to as the "mountain city." The prevalence rate of some cardiovascular diseases in Chongqing, such as hypertension, is higher than that of the whole country [6]. This study is the first to survey the physical activity status and risk factors for low physical activity in Chongqing using the Global Physical Activity Questionnaire (GPAQ-version 2.0), which has been demonstrated to have good validity and reliability for assessing physical activity in a national survey of

developing countries with average incomes [7,8]. Additionally, this investigation of physical activity is comprehensive and includes a large sample size. The main aim of the study was to explore the physical activity of residents who live in this unique geographical location. The specific goals of the study were as follows:

- To describe the prevalence of physical activity levels in different characteristics;
- To describe the percentage of people who engaged in various PA levels (low, moderate, high);
- To describe the composition of physical activity (%) according to different region, sex, and age groups, and the condition of sedentary behavior among participants who reported sedentary behavior;
- To describe the factors associated with low PA levels.

Methods

Experimental

This study was a cross-sectional study and it was part of a nationwide survey conducted by the Ministry of Health and the National Center for Cardiovascular Diseases using a stratified multi-stage random sampling method. A total of 500,000 individuals aged ≥ 15 years from 31 provinces/municipalities in China were surveyed to investigate the prevalence of major cardiovascular diseases, status, and distribution characteristics. As the first project city to be launched in China, Chongqing selected 15,280 residents among the city's total population of 3,500,000 according to the top-level design plan, among whom 15,021 individuals participated in physical activity surveys. This nationwide survey was launched in September 2012 and was completed in mid-2015. This study was approved by the Institutional Ethics Review Board of Chongqing Medical University and the participants were asked to sign informed consent forms.

Sampling: The stratified multi-stage random sampling method was adopted. First, four districts and four counties were chosen in Chongqing using probability proportional to size. Second, two streets/townships were respectively chosen in the selected district/counties using Simple Random Sampling (SRS). Third, three villages and/or communities were respectively extracted from each selected street/township using SRS. Finally, according to sex and age (15-24, 25-34, 35-44, 45-54, 55-64, 65-74, ≥ 75 years old), a total of 14 layers were selected to extract the corresponding number of individuals using the SRS method. Individuals aged ≥ 15 years who had lived in Chongqing for >6 months were eligible to participate in the survey.

Data collection: Questionnaires collected data on basic demographics (age, sex, ethnicity, occupation, education, marital status, etc.) and lifestyle habits (diet, physical activity, etc.). In the physical examination, height, Body Mass Index (BMI) was measured.

Definitions

BMI: BMI was calculated by dividing weight in kilograms by height in meters squared and defined as follows: underweight, BMI < 18.5; normal weight, 18.5 ≤ BMI ≤ 23.9; overweight, 24 ≤ BMI ≤ 27.9; obese, BMI ≥ 28.0.

Physical activity: A physical activity survey usually refers to 1 week of physical activity. It does not include special conditions such as long vacations or business trips. Physical activity was assessed in 3 domains: work (including household chores), commute-related, and recreational activities. Work and recreational activities were divided into vigorous-intensity and moderate-intensity. Physical activity levels

Table 1: Characteristics of Respondents.

Characteristics	N (%)
Residential area	
Urban	7335 (48.8)
Rural	7686 (51.2)
Sex	
Male	7462 (49.7)
Female	7559 (50.3)
Age Group	
15-24	2313 (15.4)
25-34	3210 (21.4)
35-44	2568 (17.1)
45-54	2062 (13.7)
55-64	1740 (11.6)
65-74	1605 (10.7)
≥ 75	1523 (10.1)
Ethnicity	
Han Chinese population	13409 (89.3)
Tujia Chinese population	1549 (10.3)
Others[a]	63 (0.4)
Level of education	
Illiterate	2089 (13.9)
Primary school	4293 (28.6)
Junior high school	5220 (34.8)
High school/Technical secondary school	2584 (17.2)
Bachelor's degree and above	835 (5.6)
Marital status	
Unmarried	2380 (15.8)
Married/remarried/cohabitation	11145 (74.2)
Separation	258 (1.7)
Divorced	151 (1.0)
Widowed	1087 (7.2)
Occupational class	
Management and technical workers	1329 (8.8)
Business	1953 (13.0)
No fixed occupation	3603 (24.0)
Agricultural laborers	8097 (54.0)
Body mass index	
Underweight	845 (5.6)
Normal weight	8822 (58.7)
Overweight	4213 (28.0)
Obese	1141 (7.6)
Hypertension	
Yes	3094 (20.6)
No	11927 (79.4)

[a]Others: Miao Chinese population, Zang Chinese population, etc.

were grouped using the GPAQ recommended by the WHO. Metabolic Equivalents (METs) are commonly used to evaluate the intensity of physical activity. For GPAQ data analysis, 4 METs were allocated to time spent in moderate activities (including commute-related activities) and 8 METs to the time spent in vigorous activities to verify overall physical activity level.

Total physical activity was calculated by adding all MET × minutes for moderate- or vigorous-intensity physical activity performed during work, commute, and recreation [7].

The GPAQ framework divided physical activity levels into the following levels:

- **High**: Vigorous-intensity activity for at least 3 days with a consumption of at least 1500 MET-min/week or a combination of walking and moderate- or vigorous-intensity activities for at least 7 days with a consumption of at least 3000 MET-min/week.
- **Moderate**: Three or more days of vigorous-intensity activity for at least 20 min per day, or five or more days of moderate-intensity activity (including walking) for at least 30 min per day, or five or more days of any combination of walking, moderate-, or vigorous-intensity activities achieving a minimum of at least 600 MET-min/week.
- **Low**: Not meeting the criteria for either high or moderate levels.

Statistical analysis

SPSS (IBM, Armonk, NY, USA) was used for statistical analysis of the original data. Normally distributed measurement data are expressed as mean ± standard deviation; non-normally distribution data are expressed as median (25th-75th percentile), and categorical variables as percentage. The non-parametric rank sum test (abbreviated as H) was used for measurement data that does not conform to normal distribution, and the chi-square test was used for qualitative variables. Logistic regression analysis was used to evaluate the association between low physical activity and potential risk factors. A p-value <0.05 and 95% confidence interval (CI) ≠ 1 were considered statistically significant.

Results

The number of samples for this survey was 15,280. However, the actual number of respondents reporting physical activity was 15,021. The average age was 45.2 ± 19.4 years. Among all participants, 7345 were from urban settings (48.8%) and 7686 were from rural settings (51.2%); 7462 (49.7%) were men and 7559 (50.3%) were women. The characteristics of the investigated population are reported in table 1.

After analyzing the prevalence of physical activity level in Chongqing, 23.0%, 29.3%, and 47.7% of individuals were classified into low, moderate, and high physical activity categories, respectively. The prevalence of low physical activity in the rural area (26.6%; 95% CI: 25.6-27.6) was higher than that in the urban area (19.3%; 95% CI: 18.4-20.2) (p<0.001). The prevalence of low physical activity among male participants (25.3%; 95% CI: 24.4-26.3) was higher than that among female participants (20.8%; 95% CI: 19.9-21.7) (p<0.001). Concerning age groups, individuals aged ≥ 75 years had the highest prevalence of low physical activity (35.9%; 95% CI: 33.5-38.3) and those aged 55-64 years had the lowest prevalence of low physical activity (12.5%; 95% CI: 11.0-14.1). The differences in physical activity levels among age groups were significant (p<0.001). Table 2 reports the prevalence of physical activity levels according to other characteristics.

Work (72.4%) and commute (21.0%) account for the majority of total physical activity. Male (74.7%) work-related physical activity was higher than female (69.7%) work-related activity (X^2 =76.793; p<0.001). Rural (77.7%) work-related physical activity was higher than urban (66.8%) work-related physical activity (X^2 =364.865; p<0.001). Commute-related physical activity in urban (24.7%) areas was higher than that in rural (17.5%) areas (X^2 =172.007; p<0.001), and higher among female participants (23.8%) than male participants (18.6%) (X^2 =89.345; p<0.001). Urban recreational physical activity (8.5%) was higher than rural recreational activity (4.8%) (X^2 =32.737; p<0.001) (Figure 1).

Work-related physical activity increased gradually with age from 15 to 54 years old; values for the 15-24, 25-34, 35-44, and 45-54 years old groups were 48.8%, 70.7%, 77.7%, and 78.6%, respectively. For those aged >54 years, there was a trend towards decreased work-related activity with age; values for the 55-64, 65-74, and ≥ 75 years old groups were 78.0%, 70.8%, and 58.5%, respectively. There are significant differences in work-related physical activities between different age groups (X^2 =4450.331; p<0.001). Physical activity while commuting decreased with age from 15 to 54 years old; values for the 15-24, 25-34, 35-44, and 45-54 years old groups were 29.0%, 22.2%, 17.5%, and 16.9%, respectively. There was a tendency towards increased commute-related activity with age among those aged >54 years; values for the 55-64, 65-74, and ≥ 75 years old groups were 17.5%, 24.0%, and 35.6%, respectively. There are significant differences in commuting-related physical activities between different age groups (X^2 =1817.270; p<0.001). The highest proportion of recreation physical activity was reported by the 15-24 years old group (22.2%) (Figure 1).

A total of 13,610 and 7475 participants reported sedentary behavior on working and non-working days, respectively. Significant differences between age groups were identified on working days (H=916.442; p<0.001) and non-working days (H=224.678; p<0.001). Sedentary behavior on working and non-working days were higher among those in urban areas than those in rural areas (p<0.001) (Figure 2).

Table 3 shows the odds ratios of associated factors for low physical activity among groups divided according to characteristics. Compared to those living in rural areas, participants living in urban areas showed a trend towards a reduced risk of low physical activity. Unmarried and divorced individuals had a higher risk of low physical activity compared with married/remarried/cohabiting individuals. Men were 1.33 times as inactive as women. Participants aged ≥ 75 years were more likely to report low physical activity than other age groups. Compared to those with bachelor's degree and above, participants who reported lower education levels had a reduced risk of low physical activity. The Tujia Chinese population was more active compared to the Han Chinese population. However, no correlation was found between BMI or occupational class and the prevalence of low physical activity.

Discussion

The current survey found that the proportion of participants reporting low physical activity among residents of Chongqing was 23.0%, which is lower than the 49.7% reported in surveys of Pondicherry, India and 44.8% reported in Iran [9,10], representing developing countries. Some developed countries such as the Czech Republic (27.9%) [11] and the United States (43%) [12] also have a higher proportion of low physical activity than Chongqing. The above studies all used the GPAQ questionnaire to collect data on physical activity. The proportion of activities attributed to work, commute, and recreation among Chongqing residents was 72.4%, 21.0%, and 6.6%, respectively; these results are similar to reports from studies in India (work, commute, and recreation values of 77.4%, 11%, and

Table 2: Prevalence of physical activity levels according to characteristics.

Characteristics	Low physical activity % [95% CI]	Moderate physical activity % [95% CI]	High physical activity % [95% CI]	p value[b]
Residential area				
Urban	19.3 [18.4,20.2]	28.7 [27.7,29.8]	51.9 [50.8,53.1]	<0.001
Rural	26.6 [25.6,27.6]	29.8 [28.8,30.9]	43.6 [42.5,44.7]	
Sex				
Male	25.3 [24.4,26.3]	28.4 [27.4,29.4]	46.2 [45.1,47.4]	<0.001
Female	20.8 [19.9,21.7]	30.1 [29.1,31.2]	49.1 [47.9,50.2]	
Age groups				
15-24	31.1 [29.2,33.0]	39.4 [37.4,41.4]	29.4 [27.6,31.3]	<0.001
25-34	27.7 [26.1,29.2]	32.8 [31.2,34.4]	39.5 [37.8,41.2]	
35-44	19.2 [17.6,20.7]	26.2 [24.5,27.9]	54.6 [52.7,56.6]	
45-54	15.6 [14.0,17.2]	22.0 [20.2,23.8]	62.4 [60.3,64.5]	
55-64	12.5 [11.0,14.1]	24.2 [22.2,26.2]	63.3 [61.0,65.5]	
65-74	17.1 [15.2,18.9]	25.4 [23.3,27.6]	57.5 [55.1,59.9]	
≥ 75	35.9 [33.5,38.3]	31.5 [29.1,33.8]	32.6 [30.3,35.0]	
Ethnicity				
Han Chinese population	24.6 [23.8,25.3]	30.4 [29.6,31.2]	45.0 [44.2,45.9]	<0.001
Tujia Chinese population	9.5 [8.0,11.0]	19.9 [17.9,21.9]	70.6 [68.4,72.9]	
Others[a]	34.9 [22.8,47.0]	25.4 [14.3,36.4]	39.7 [27.3,52.1]	
Level of education				
Illiterate	25.9 [24.1,27.8]	24.2 [22.3,26.0]	49.9 [47.7,52.0]	<0.001
Primary school	19.4 [18.2,20.6]	23.8 [22.5,25.1]	56.8 [55.3,58.3]	
Junior high school	22.3 [21.1,23.4]	28.8 [27.6,30.1]	48.9 [47.6,50.3]	
High school/Technical secondary school	25.9 [24.2,27.5]	39.6 [37.7,41.4]	34.6 [32.8,36.4]	
Bachelor's degree and above	30.8 [27.6,33.9]	41.4 [38.1,44.8]	27.8 [24.7,30.8]	
Marital status				
Unmarried	31.8 [29.9,33.6]	39.5 [37.5,41.4]	28.8 [27.0,30.6]	<0.001
Married/remarried/cohabitation	20.8 [20.0,21.5]	26.9 [26.1,27.7]	52.3 [51.4,53.3]	
Separation	21.3 [16.3,26.3]	29.1 [23.5,34.6]	49.6 [43.5,55.8]	
Divorced	29.1 [21.8,36.5]	25.2 [18.2,32.2]	45.7 [37.7,53.7]	
Widowed	27 [24.3,29.6]	32.3 [29.5,35.1]	40.8 [37,8,43.7]	
Body mass index				
Underweight	29.1 [26.0,32.2]	35.3 [32.0,38.5]	35.6 [32.4,38.9]	<0.001
Normal weight	23.2 [22.4,24.1]	29.7 [28.8,30.7]	47.0 [46.0,48.1]	
Overweight	22 [20.8,23.3]	27.9 [26.5,29.2]	50.1 [48.6,51.6]	
Obese	20.9 [18.6,23.3]	26.7 [24.2,29.3]	52.3 [49.4,55.2]	
Occupational class				
Management and technical workers	24.2 [21.8,26.5]	40.0 [37.3,42.6]	35.9 [33.3,38.5]	<0.001
Business	23.4 [21.5,25.3]	34.5 [32.4,36.6]	42.1 [39.9,44.3]	
Agricultural laborers	21.3 [20.4,22.2]	22.3 [21.4,23.2]	56.5 [55.4,57.5]	
No fixed occupation	26.5 [25.1,27.9]	38.3 [36.7,39.9]	35.2 [33.6,36.8]	
Hypertension				
Yes	22.7 [21.3,23.8]	27.5[26.2,28.9]	49.8[43.3,55.4]	0.01
No	23.1 [22.3,24.2]	30.0[29.2,31.1]	46.9[45.8,47.4]	

[a]Others: Miao Chinese population, Zang Chinese population, etc.

p value[b]: b represents whether there are differences in physical activity levels with different characteristics.

CI: confidence interval.

Table 3: Odds ratios of factors associated with low physical activity among different groups.

Characteristics		p	OR	95% CI of OR	
				Lower	Upper
Residential area	Rural	-	1		
	Urban	0	0.767	0.703	0.836
Sex	Female	-	1		
	Male	0	1.333	1.229	1.446
Age groups	≥ 75	-	1		
	15-24	0.137	0.829	0.647	1.061
	25-34	0.038	0.815	0.672	0.989
	35-44	0	0.49	0.406	0.591
	45-54	0	0.369	0.305	0.447
	55-64	0	0.268	0.22	0.325
	65-74	0	0.379	0.318	0.452
Ethnicity	Han Chinese population	-	1		
	Tujia Chinese population	0	0.362	0.3	0.436
	Others	0.055	1.675	0.988	2.839
Level of education	Bachelor's degree and above	-	1		
	Illiteracy	0.55	1.075	0.847	1.365
	Primary school	0.295	0.893	0.722	1.104
	Junior high school	0.019	0.799	0.663	0.963
	High school/technical secondary school	0.011	0.788	0.656	0.947
Marital status	Married/ remarried/ cohabitation	-	1		
	Unmarried	0.016	1.23	1.039	1.455
	Separation	0.876	0.976	0.717	1.328
	Divorced	0.017	1.557	1.081	2.243
	Widowed	0.901	1.011	0.851	1.201
Body mass index	Normal weight	-	1		
	Underweight	0.055	1.174	0.996	1.384
	Overweight	0.095	1.083	0.986	1.19
	Obese	0.259	1.096	0.935	1.284
Occupational class	Agricultural laborers	-	1		
	Management and technical workers	0.671	0.965	0.82	1.136
	Business	0.313	0.937	0.826	1.063
	No fixed occupation	0.672	1.024	0.917	1.144
Hypertension	Yes	-	1		
	No	0.776	0.983	0.876	1.104

OR- Odds Ratio; CI- Confidence Interval

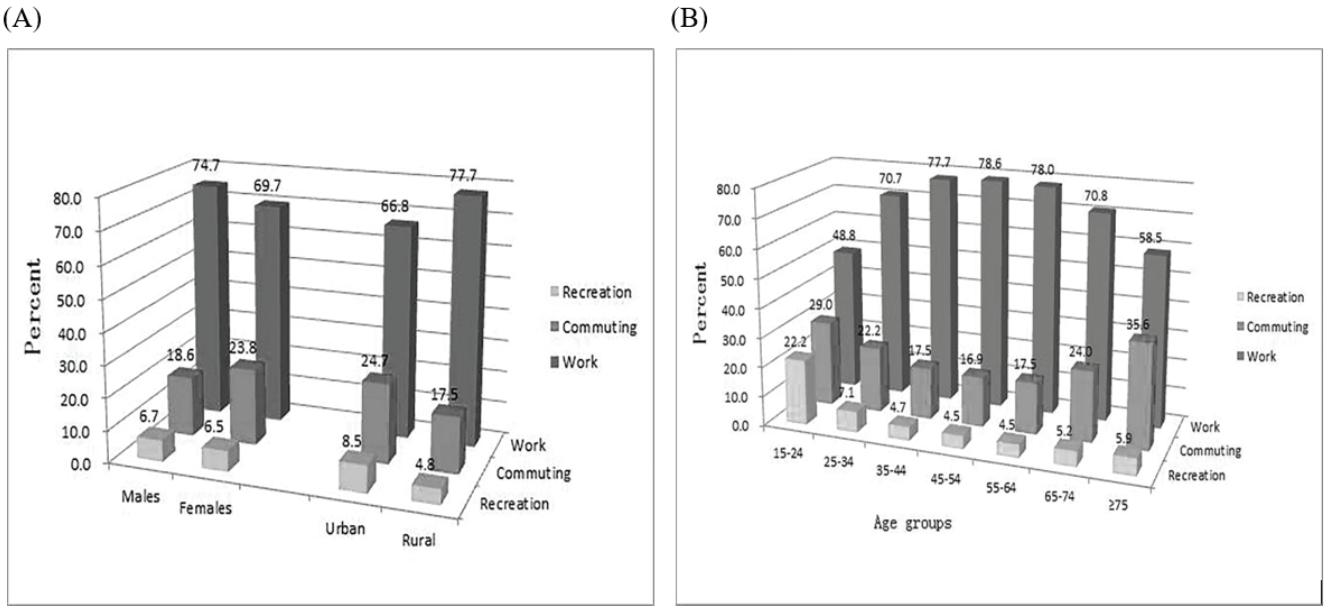

Figure 1: (A&B) Composition of physical activity (%) according to region, sex, and age groups.

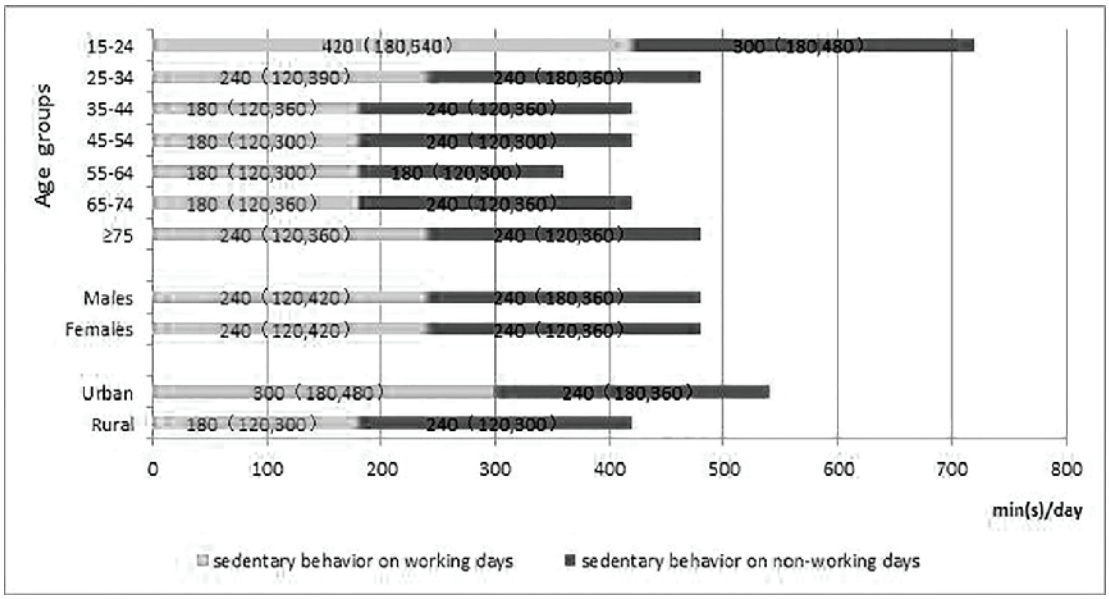

Figure 2: Median (25th, 75th percentile) of sedentary behavior among participants who reported sedentary behavior.

11.6%, respectively) and Iran (work, commute, and recreation values of 71%, 20%, and 9%, respectively), with the majority of activity being reported as occupational [9,13]. However, the results differ from those of developed countries in which leisure-related and commute-related physical activities are more common [14]. The main associated factors with low physical activity were male sex, rural area, age ≥ 75 years, Han Chinese population, college degree or above and unmarried individuals and divorced individuals. Public health policies should target the groups at highest risk of low physical activity.

The results of different physical activity questionnaires were different. Most previous research used the GPAQ, which has demonstrated good validity and reliability for assessing physical activity. The prevalence of low physical activity globally was 21.4% in 2011 [15]. In previous studies, the influence of sex/education level/residential area on physical activity varies among countries. Most previous research indicates that urban residents are more likely than rural residents to have low physical activity [16], which is opposite to our result. In terms of age, the results in most countries are similar: the older the age, the easier to have low physical activity [10,17]. In France, women with higher education pay more attention to physical activity than those with lower education [18], Consistent with a Czech survey on physical activity of persons aged 20-64 [11], in the

current study, participants with higher education tended to have lower physical activity. The results of the Prevalence of Physical Activity among Chinese Adults Study, conducted in 2005, showed that in China, women are more prone to have low physical activity than men [19], this is similar to previously reported results [10,20,21], but contrary to our research results, one possible explanation for this is that women are engaged in more housework activities. Particularly in the past 10 years, leisure, cultural, and recreational activities of middle-aged and older women have become more abundant with the addition of square dancing, leading to increased physical activity among women [22].

In this study, we assessed the level of physical inactivity in the residents in Chongqing, China. The unique geography of Chongqing influences the physical activity of residents. Through our analysis, We found that, compared to the global, residents in Chongqing have a higher rate of physical inactivity; concentrated on males, divorced/widowed individuals, and those aged greater than 75 years. The type of physical activity in Chongqing is mainly associated with work and commuting. Future lifestyle interventions aimed at increasing physical activity should especially focus on leisure-related physical activities for populations at higher risk, including men, older individuals, and unmarried and divorced individuals.

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Conflict of interest

The author states that there is no conflict of interest.

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