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The prevalence and influence factors of physical activity and sedentary behavior in Chinese rural population: The Henan Rural Cohort Study

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Title:

The prevalence and influence factors of physical activity and sedentary behavior in Chinese rural population: The Henan Rural Cohort Study

Authors:

Runqi Tu^{a†}, Yuqian Li^{b†}, Lijun Shen^{c,d}, Huijuan Yuan^{c,d}, Zhenxing Mao^a, Xiaotian Liu^a, Haiqing Zhang^a, Liying Zhang^a, Ruiying Li^a, Yikang Wang^a, Yuming Wang^{c,d*}, Chongjian Wang^{a*}

Authors affiliations:

^a Department of Epidemiology and Biostatistics, College of Public Health, Zhengzhou University, Zhengzhou, Henan, *PR* China.

^b Department of Clinical Pharmacology, School of Pharmaceutical Science, Zhengzhou University, Zhengzhou, Henan, *PR* China.

^c Department of Endocrinology and Metabolism, Henan Provincial People's Hospital, Zhengzhou, Henan, *PR* China.

^d Department of Endocrinology and Metabolism, Zhengzhou University People's Hospital, Zhengzhou, Henan, *PR* China.

† Runqi Tu and Yuqian Li contributed equally to this work.

*** Correspondence author**

Dr. Chongjian Wang & Yuming Wang

Department of Epidemiology and Biostatistics

College of Public Health, Zhengzhou University

100 Kexue Avenue, Zhengzhou, 450001, Henan, *PR* China

Phone: +86 371 67781452;

Fax: +86 371 67781868

E-mail: tjwcj2005@126.com & henanyuming@sina.com

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3 **What is already known on this topic?**
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5 Previous studies had explored the prevalence of physical activity and sedentary behaviour
6 among inhabitants of urban China , but there is little evidence in rural areas of China that have
7 undergone rapid socio-economic development. Therefore, updating the prevalence and risk factors
8 of physical activity and sedentary behaviour, and then evaluating the levels of physical activity
9 and sedentary behaviour in rural areas of China could provide important evidence to generate
10 strategy and promote physical activity in the population.
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17 **What does this study add?**
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20 The results of the current data showed that the prevalence of physical inactivity was 32.02%
21 and sitting>7.5 hours per day was 26.60% was relatively higher, which suggest a higher
22 prevalence of physical inactivity and sedentary behaviour among Chinese rural adults. More
23 attention should be given to the aged, divorced/widowed/unmarried and drinking individuals who
24 are at high risk of physical inactivity. These population should take measures to promote the
25 physical activity and decrease the sitting time.
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Strengths and limitations of this study

- The study was focused on rural population.
- The higher prevalence of physical inactivity was 32.02% and the sitting >7.5 hours per day was 26.60%
- The aged, divorced/widowed/unmarried and drinking individuals who are at high risk of physical activity.
- The results were based on a cross-sectional study, so the causal relationships between factors and physical activity could not be confirmed.

Abstract

Objectives: There is little evidence in rural areas of China about the prevalence of physical activity. The study aimed to estimate prevalence and influencing factors of physical activity and sedentary behaviour in rural areas of China

Methods: 38515 participants aged 18 to 79 years were enrolled from the Henan Rural Cohort Study for the cross-sectional study. The prevalence of physical activity and sedentary behaviour were estimated. Multiple logistic regression analysis was used to calculate odds ratios (*ORs*) and 95% confidence interval (*CI*) of potential influencing factors with physical inactivity.

Results: The age-standardized prevalence of low physical activity and sitting >7.5 hours per day were 32.74% and 26.88% in the general Chinese rural adults, respectively. Gender differences were: 34.91%, 29.76% for men and 31.75%, 25.16% for women respectively. The prevalence of participants with both low physical activity and sitting >7.5 hours per day was 13.95%. 70-79 age group, divorced/widowed/unmarried, ever drinking were negatively associated with low physical activity and sitting >7.5 hours per day.

Conclusion: Physical inactivity and sedentary behaviour were high in rural China. There is an increased need in promoting healthy lifestyle to rural population.

Key words: physical activity; sedentary behaviour; prevalence; rural population

Introduction

Over the past few decades, epidemiologic studies have suggested that physical inactivity or sedentary behaviour were risk factors for non-communicable (NCDs), such as breast cancer^[1], prostate cancer^[2], cardiovascular diseases (CVD)^[3], stroke^[4], type 2 diabetes^[5], and metabolic syndrome^[6]. Physical inactivity is the physical activity levels unable to meet recommended levels^[7]. Sedentary behaviour is on the other hand any walking behaviour characterized by an energy expenditure ≤ 1.5 metabolic equivalents (Mets), while in a sitting or reclining posture^[8].

A research about prevalence of sitting in 20 countries showed that the sitting median was 300 minutes/day and the mean was 346.2 minutes/day, and also proved that there was a linear positive relationship between light physical activity and sitting time. Conversely, there was a linear inverse relationship between vigorous physical activity and sitting time^[9,10]. Besides physical inactivity and sedentary behavior, vigorous physical activity was also an index of physical activity levels. A global physical activity research showed that there were large differences between regions: 38.0% in Africa, 24.6% in Americas, 43.2% in eastern Mediterranean, 25.4% in Europe, 43.2% in southeast Asia, and 35.3% in the western Pacific^[11]. With the development of science and technology, agricultural mechanization in rural areas led to reductions in physical activity levels.

Overall, compared to less active, individuals who are more active are more likely to have healthy body mass index and less risk of CVD and other chronic non-communicable diseases. However, the prevalence of physical activity and sedentary behaviour were unclear in rural areas of China. So the objective of current study were: (1) to explore the prevalence of physical activity and sedentary behaviour, (2) to investigate potential influencing factors of physical activity and sedentary behaviour.

Participants and method

Settings and participants

This cross-sectional study was carried from 2015 to 2017 in 5 rural regions (Suiping, Yuzhou, Xinxiang, Tongxu, and Yima countries) of Henan province. The participants were permanent residents aged 18-79 years. Some target participants with deficient information about their physical activity and sitting time were excluded. Ultimately, 38515 participants with completed questionnaires, anthropometric measurements and blood tests were included in our analysis.

Data collection

The information was collected by face to face interview. The data about general demographic characteristics, lifestyles, and history of diseases were included in a standard questionnaire. Educational level was classified into primary school or below and junior middle school or above, marital status into married/cohabitation and unmarried/divorced/widowed categories. The smoking status were categorized into never, ever and current smoker (a person who smoked more than one cigarette per day in the past 6 months was considered a current smoker). The drinking status were divided into never, ever and current drinker of alcoholic beverages (spirits, beer, wine, and other alcohol beverages) at least 12 times in the past year and drinking now. According to Chinese dietary guidelines^[12], More vegetable and fruit intake was considered as daily consumption of vegetable and fruit more than 500 g. A person's diet was defined as high fat diet, if they ate more than 75 g meat daily. The waist circumference (WC), by a non-elastic tape to the nearest 0.1 cm, was measured at 1 cm above the navel in a horizontal plane. Height, using a wall-mounted ruler tape with an insertion buckle at one end to the nearest 0.1 cm, was measured twice without shoes. Body weight, using mechanical scale on a level surface to the nearest 0.1 kg, was measured once with the subjects in light clothing and barefoot^[13]. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters.

Definitions

International Physical Activity Questionnaire (IPAQ) was used to assess the levels of Physical activity^[14]. All the weekly time of vigorous activity, moderate activity and walking was calculated with the number of Mets in each category and average daily estimated. Mets reflected the energy expenditure specific for vigorous activity, moderate activity and walking. In this study, the Mets of vigorous activity was 8; the Mets of moderate activity was 4; the Mets of walking was 3,3. The value of Mets was estimated by the sum of the three physical activities in one week. The physical activity categorized into three levels were light (physically inactive), moderate and vigorous. These categories were based on standard scoring criteria of IPAQ. The vigorous activity should meet either of the following two criteria: (1) vigorous activity was at least 3 days/week and the week of accumulating Mets was at least 1500 MET-minutes/week; or (2) any combination of vigorous activity, moderate activity or walking at least 5 days/week and the accumulating Mets was at least 3000 MET-minutes/week. The moderate activity should meet either of the following

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4 four criteria: (1) moderate activity was at least 30 min in 5 days a week;(2) vigorous activity was
5 at least 20 min in 3 days a week; (3) walking at least 30 min a day for 5 or more days a week; (4)
6 the accumulating Mets, of any combination of moderate activity, vigorous activity or walking, was
7 at least 600 MET-minutes/week in 5 or more days a week. the light activity category were for
8 individuals who neither met vigorous nor moderate criteria.
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13 **Statistical analysis**

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15 Continuous variables were presented as mean \pm standard deviation (SD). Differences between
16 groups were tested using t-test. Categorical variables presented as numbers and percentages were
17 compared using chi-square test. Based on Chinese population data from 2010 census, direct
18 standardization was used to calculate the age-standardized prevalence of Mets. The multinomial
19 logistic regression models were used to calculate ORs and 95% CI between the potential factors
20 and Mets. All statistical tests were two-tailed, and P value<0.05 was considered statistically
21 significant. The data were analyzed using SAS9.1 software package (SAS Institute, USA) and R
22 version 3.5.1.
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30 **Result**

31 **Demographic characteristics.**

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33 Table1 showed the demographic characteristics of the 38515 participants aged from 18 to 79
34 years old. The mean (standard deviation, SD) age was 55.65(12.14) years. Overall, a total of
35 11510, 14672 and 12333 subjects were engaged in vigorous, moderate and light physical activity,
36 respectively. Being man, current smoking and current drinking were more common among
37 vigorous activity participants, while younger age, being women, Married/cohabiting, never
38 smoking and drinking, more adequate vegetable and fruit intake and high fat diet were more
39 prevalent among moderate physical activity participants. Among the 38515 participants, 29270
40 were sitting \leq 7.5 hours per day. Except for high fat diet, all other characteristics were more
41 prevalent in the subjects with sitting \leq 7.5 hours per day than sitting $>$ 7.5 hours per day($p<0.001$).
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52 **The sex-specific distributions of physical activity and sitting time according to age.**

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54 Figure 1 describes the sex-specific distribution of the Mets of physical activity and sitting time
55 according to age. The median of Mets for physical activity and sitting time were 7092 MET-
56 minutes/week and 5 h., respectively. The median of Mets for physical activity and sitting time
57 were 6558 MET-minutes/week, 7119 MET-minutes/week and 5 h, 5 h for men and women,
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4 respectively. The mean \pm standard deviation (SD) of Mets for physical activity and sitting time
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6 were 7626.02 \pm 4229.32 MET-minutes/week and 5.70 \pm 3.23 h., respectively. The mean \pm SD of
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8 Mets for physical activity and sitting time were 7506.15 \pm 4524.75 MET-minutes/week, 7704.20 \pm
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10 4023.12 MET-minutes/week and 5.97 \pm 3.39 h, 5.53 \pm 3.12 h for men and women ($P < 0.001$),
11
12 respectively. Notably, the sitting time of the men was higher than women. The 50-59 age group
13
14 had the highest Mets. The 70-79 age group had the highest sitting time.

15 **Prevalence of light physical activity and sitting >7.5 hours per day.**

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17 Supplementary table 1 displays the prevalence of light physical activity and sitting >7.5 hours
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19 per day among various characteristics. The prevalence of light physical activity and sitting >7.5
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21 hours per day were 32.02% and 26.60%, and the corresponding age-standardized rates were
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23 32.90% and 26.88%, respectively. Subgroups study showed that the prevalence of low physical
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25 activity and sitting >7.5 hours per day were higher in those who were younger or older, being men,
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27 Widowed/single/divorced/separated with lower per capita monthly income, ever drinking,
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29 inadequate vegetable and fruit intake.

30 **Changes of light physical activity and sitting >7.5 hours per day in different subgroup.**

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32 Figure 2 presents that the age-standardized prevalence of light physical activity and sitting >7.5
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34 hours per day changed with age in both sexes. The prevalence of light physical activity and
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36 sitting >7.5 hours per day decreased with age firstly and then increased. Men had higher
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38 probability of having high physical activity and sitting >7.5 hours per day than women in all the
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40 age groups.

41 **The percentage according to the cut-off points of physical activity and sitting time in 42 different sexes.**

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44 Figure 3 shows the age-standardized percentage according to the cut-off points of physical
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46 activity and sitting time in different sexes. A total of 17346 subjects (7434 men and 9912 women)
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48 had light physical activity or sitting >7.5 hours per day, and the corresponding age-standardized
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50 prevalence was 45.84% (48.99% in men and 43.98% in women). The age-standardized prevalence
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52 of participants with both light physical activity and single sitting >7.5 hours per day was 13.95%
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54 (15.68% in men and 12.93% in women).

55 **Analysis of influencing factors.**

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57 Table 2 describes the odds ratios (ORs) of potential influencing factors association with light
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4 physical activity and sitting time >7.5 hours per day. Being women, 70-79 age group, level of
5 education \geq Junior middle school, divorced/widowed/unmarried, ever smoking and drinking,
6 inadequate vegetable and fruit intake were significantly negatively associated with light physical
7 activity, while being women, level of education \geq Junior middle school, inadequate vegetable and
8 fruit intake and current smoking were significantly positively association with sitting >7.5 hours
9 per day.
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Discussion

New insights of physical activity and sedentary behaviour were provided by the results from this large survey among rural population in Henan of China. Overall, the median levels of sitting time were higher in rural adults of China than the previous study of a 20 country comparison of sitting^[9], and the percent levels of physical inactivity were higher in Chinese rural adults than the previous study of global physical activity levels^[11]. There was an association of decreased physical activity with age firstly and then increased in the prevalence of light physical activity and sitting>7.5 hours per day. The percent individuals that had both light physical activity and sitting>7.5 hours per day were 15.68%, 12.93% and 13.95% in men, women and total, respectively. Further analysis of multiple logistic regression presented that gender, age, the level of education, marital status, smoking, drinking and vegetables intake were influencing factors for light physical activity and sitting>7.5 hours.

Previous studies had shown that the levels of physical inactivity and sedentary was high in urban China^[15,16]. Compared with those in urban area, the levels of physical inactivity and sedentary was relatively low in rural area of China. This gap between the urban and rural might be explained by the more use of intelligent technology for urban construction, with the social progress, scientific and economic development. The mean of Mets increased with age firstly and then at the age group of 50-59 decreased. While the sitting time was highest in 70-79 age group. It is likely that the decline in physical ability with age limits the physical activity and increase the sedentary nature of the elderly^[17]. Furthermore, the aged might fear injuries, which was another reason to lead them into physical inactivity^[18]. About physical activity, the subgroup analysis showed that under the various characteristics, the prevalence of vigorous physical activity was about 30%, moderate physical activity was about 40% and the light physical activity was about 30%. While about sitting time, under all the various characteristics, the sitting time≤7.5 hours per day was about 70%. These results were similar to a Chilean study^[18].

The results of co-existence of physical activity and sedentary behavior showed that light physical activity and sitting time>7.5 hours per day was 15.68%, 12.93% and 13.95% in men, women and total, respectively. It was similar with a study from Japan^[19]. For these participants who were light physical activity and sitting time>7.5 hours per day, should take a measure to

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4 promote the physical activity.

5 Evidence showed that there were negative relationships between junior middle school or above,
6 divorced/widowed/unmarried, per capita monthly income ≥ 500 RMB and high fat diet with
7 moderate physical activity. Being elderly (70-79 years old), having a junior middle school or
8 above, divorced/widowed/unmarried, ever smoking, and ever drinking were positively association
9 with light physical activity. For sitting > 7.5 hours per day, the negative factors were 70-79 years
10 old, being men, divorced/widowed/unmarried, current smoking, ever drinking, and more vegetable
11 intake.
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19 The current study focused on the epidemiologic characteristics of physical activity and
20 sedentary behaviour based on a relatively large sample size of rural population in Henan of China.
21 Although a series of measures, such as standardized tools and training implementation, had been
22 done to guarantee the authenticity, there were several limitations. First of all, these results were
23 based on a cross-sectional study, so the causal relationships between factors and physical activity
24 or sedentary behaviour could not be confirmed. Second, the responses were from self-reported
25 data, which could distort real facts. Third, according to the actual rural circumstances, the
26 residents who studied or worked in cities were not included in this study, so the prevalence of
27 Mets might be over or under estimated in rural population. Although these limitations existed in
28 the study, the relatively large epidemiological study also could reflect the prevalence of physical
29 activity and sedentary behaviour in rural areas of China.
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40 **Conclusion**

41 This study suggests relatively higher prevalence of physical inactivity among Chinese rural
42 adults has emerged with economic and social transition. More attention should be given to the
43 aged, and drinking individuals who are at high risk of physical inactivity.
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52 critical reading of the manuscript.
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57 **Ethics approval and consent to participate**

58 Ethics approval was obtained from the “Zhengzhou University Life Science Ethics Committee”,
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4 and written informed consent was obtained for all participants. Ethic approval code: [2015] MEC
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6 (S128).

7 The purpose and the importance of the study were explained to the participants. Information
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9 confidentiality was maintained throughout the study by excluding personal identifiers from the
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11 data collection form.
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13 14 **Consent for publication**

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16 All authors consent for publication
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18 19 **Conflict of interest**

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21 The authors declared no conflict of interest associated with this manuscript.
22

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39
40 study design, data collection and analysis, decision to publish, or preparation of the manuscript.
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42 43 **Data sharing statement**

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45 All relevant data are within the paper and its Supporting Information files. Contact to Dr.
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47 Chongjian Wang (tjwcj2005@126.com) for additional information regarding data access.

48 49 **Author Contributions**

50
51 C.J.W. and Y.M.W. conceived and designed the study. R.Q.T., Y.L.Q., L.J.S., H.J.Y., Z.X.M.,
52
53 X.T.L., H.Q.Z., L.Y.Z., R.Y.L, and Y.K.W. coordinated data collection. Y.L.Q., L.J.S., H.J.Y.,
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55 Z.X.M., X.T.L., H.Q.Z., L.Y.Z., R.Y.L, and Y.K.W. conducted the analyses. R.Q.T. wrote the
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57 manuscript. All co-authors critically revised the manuscript. All authors have approved the final
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59 manuscript.
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Table1. Demographic characteristics of the participants

Variable	Overall (N=38515)	Physical activity			<i>P</i>	Sitting time per day		<i>P</i>
		Vigorous (N=11510)	Moderate (N=14672)	Light (N=12333)		≤7.5 hours (N=29270)	>7.5 hours (N=10245)	
Age(years), mean±SD	55.65±12.14	55.48±10.81	54.62±12.05	57.02±13.25	<0.001	55.46±11.93	56.17±12.68	<0.001
Sex, n (%)					<0.001			<0.001
Women	23331(60.52)	5963(51.81)	10402(70.90)	6945(56.31)		17588(62.21)	5722(55.85)	
Men	15205(39.48)	5547(48.19)	4270(29.10)	5388(43.69)		10682(37.79)	4523(44.15)	
Marital status, n (%)					<0.001			<0.001
Married/cohabiting	34571(89.76)	10567(91.81)	13231(90.18)	10773(87.35)		25502(90.20)	9069(88.50)	
Widowed/single/ divorced/separated	3944(10.24)	943(8.19)	1441(9.82)	1560(12.65)		2768(9.80)	1176(11.50)	
Education, n (%)					0.234			0.001
≤Primary school	17277(44.86)	5149(44.74)	6521(44.45)	5607(45.46)		12533(44.33)	4744(46.31)	
≥Junior school	21238(55.14)	6361(55.26)	8151(55.55)	6726(54.54)		15737(55.67)	5501(53.69)	
Per capita monthly income, n (%)					<0.001			<0.001
≤500RMB	13746(35.69)	4169(36.22)	4841(32.99)	4736(38.40)		9812(34.71)	3934(38.40)	
500RMB~	12657(32.86)	3724(32.35)	4959(33.80)	3974(32.22)		9720(34.38)	2937(28.67)	
≥1000RMB	12112(31.45)	3617(31.42)	4872(33.21)	3623(29.38)		8738(30.91)	3374(32.93)	
Smoking, n (%)					<0.001			<0.001
Never	28023(72.76)	7652(66.48)	11768(80.21)	8603(69.76)		20929(74.03)	7094(69.24)	
Ever	3149(8.18)	1036(9.00)	855(5.83)	1258(10.20)		2212(7.82)	937(9.15)	
Current	7343(19.07)	2822(24.52)	2049(13.97)	2472(20.04)		5129(18.14)	2214(21.61)	
Drinking, n (%)					<0.001			<0.001
Never	29751(77.25)	8221(71.42)	12201(83.16)	9329(75.64)		22009(77.85)	7742(75.57)	
Ever	1807(4.69)	557(4.84)	509(3.47)	741(6.01)		1149(4.06)	658(6.42)	
Current	6957(18.06)	2732(23.74)	1962(13.37)	2263(18.35)		5112(18.08)	1845(18.01)	
Adequate vegetable and fruit intake, n (%)	22300(57.90)	5054(43.91)	6956(47.41)	4205(34.10)	<0.001	11061(39.13)	5154(50.31)	<0.001
High fat diet, n (%)	31150(80.88)	2254(19.58)	3084(21.02)	2027(16.44)	<0.001	5393(19.08)	1972(19.25)	0.705
Height(cm), mean ± SD	159.69±8.20	160.65±8.24	158.62±7.84	160.07±8.43	<0.001	159.59±8.17	159.98±8.28	<0.001
Weight(kg), mean ± SD	63.48±11.14	63.92±10.86	62.44±10.76	64.30±11.72	<0.001	63.60±11.09	63.15±11.27	<0.001
BMI(kg/m ²), mean ± SD	24.84±3.57	24.72±3.46	24.77±3.50	25.03±3.73	<0.001	24.92±3.56	24.61±3.59	<0.001
WC(cm), mean ± SD	84.07±10.41	83.65±10.03	83.44±10.19	85.22±10.90	<0.001	84.42±10.35	83.10±10.50	<0.001

Table 2. Association of potential risk factors for physical activity and sitting time.

Factors	OR(95% CI)		
	Moderate	Light	Sitting > 7.5 hours per day
Age(year)			
18-	1.00	1.00	1.00
30-	0.76(0.63,0.91)	0.63(0.52,0.76)	0.99(0.85,1.15)
40-	0.53(0.44,0.62)	0.46(0.39,0.55)	0.89(0.78,1.02)
50-	0.51(0.43,0.60)	0.38(0.32,0.45)	0.83(0.72,0.94)
60-	0.52(0.44,0.62)	0.50(0.42,0.60)	0.81(0.71,0.93)
70-79	0.76(0.63,0.91)	1.21(1.01,1.47)	1.19(1.03,1.21)
Gender			
Female	1.00	1.00	1.00
Male	0.47(0.43,0.51)	0.81(0.75,0.88)	1.27(1.18,1.37)
Culture			
≤Primary school	1.00	1.00	1.00
≥Junior middle school	1.16(1.09,1.22)	1.24(1.16,1.31)	0.90(0.85,0.95)
Marital status			
Married/cohabiting	1.00	1.00	1.00
Divorced/widowed/ unmarried	1.18(1.08,1.29)	1.26(1.15,1.38)	1.12(1.03,1.21)
Per capita monthly income			
<500 RMB	1.00	1.00	1.00
500RMB-	1.14(1.07,1.21)	1.01(0.95,1.07)	0.79(0.75,0.84)
≥1000 RMB	1.13(1.09,1.20)	0.99(0.92,1.05)	1.00(0.95,1.06)
Smoking			
Never	1.00	1.00	1.00
Ever	1.05(0.93,1.18)	1.18(1.05,1.32)	1.00(0.90,1.11)
Current	0.93(0.85,1.02)	0.96(0.88,1.05)	1.11(1.02,1.21)
Drinking			
Never	1.00	1.00	1.00
Ever	1.05(0.92,1.21)	1.25(1.10,1.42)	1.34(1.20,1.50)
Current	0.77(0.71,0.84)	0.84(0.78,0.91)	0.88(0.82,0.94)
High fat diet	1.22(1.15,1.30)	0.94(0.88,1.01)	0.93(0.88,0.99)
More vegetables intake	0.47(0.43,0.51)	0.69(0.65,0.73)	1.60(1.53,1.68)

Figure Legends

Figure 1. The violin chart of metabolic equivalence per week and sitting time per day according to gender and age. (a) is for metabolic equivalence per week; (b) is sitting time per day.

Figure 2. Changes in the age-standardized prevalence of physical activity and sitting time with aging in different gender. (a) is for light physical activity; (b) is for moderate physical activity; (c) is for vigorous physical activity. (d) is sitting time ≤ 7.5 hours per day; (e) is sitting time > 7.5 hours per day.

Figure 3. The age-standardized percentage according to the cut-off points of physical activity and sitting time in different gender. (a) is for total; (b) is for men; (c) is for women.

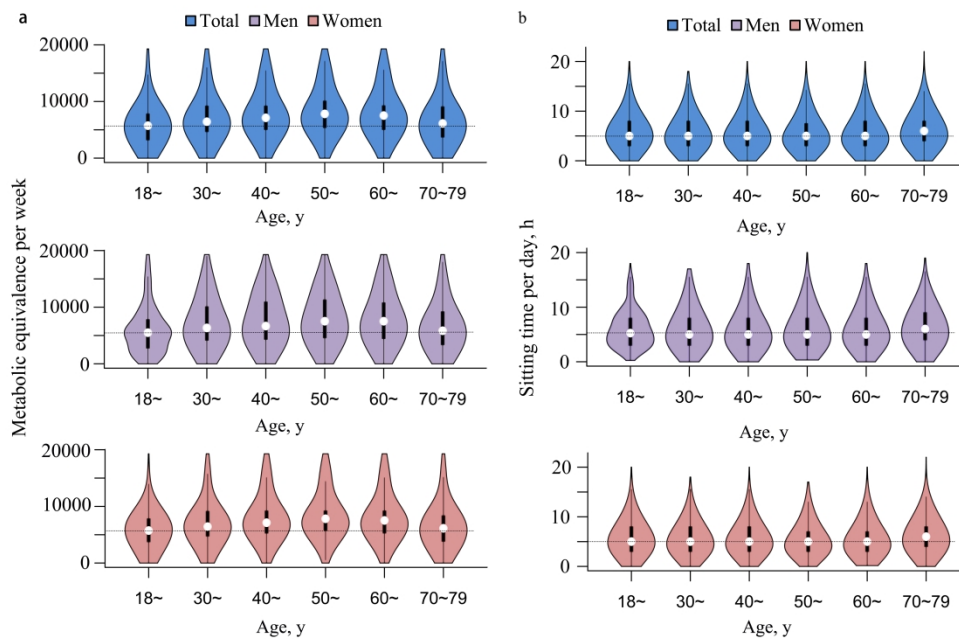


Figure 1. The violin chart of metabolic equivalence per week and sitting time per day according to gender and age. (a) is for metabolic equivalence per week; (b) is sitting time per day.

247x161mm (600 x 600 DPI)

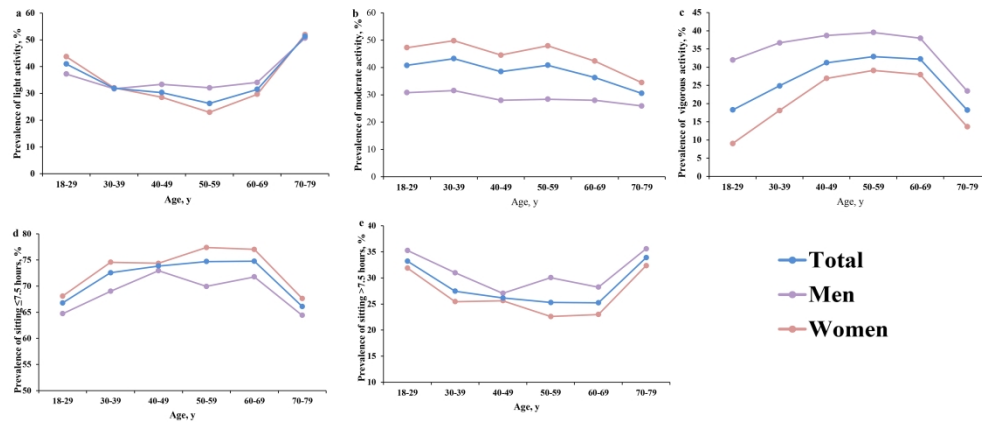


Figure 2. Changes in the age-standardized prevalence of physical activity and sitting time with aging in different gender. (a) is for light physical activity; (b) is for moderate physical activity; (c) is for vigorous physical activity. (d) is sitting time ≤ 7.5 hours per day; (e) is sitting time > 7.5 hours per day.

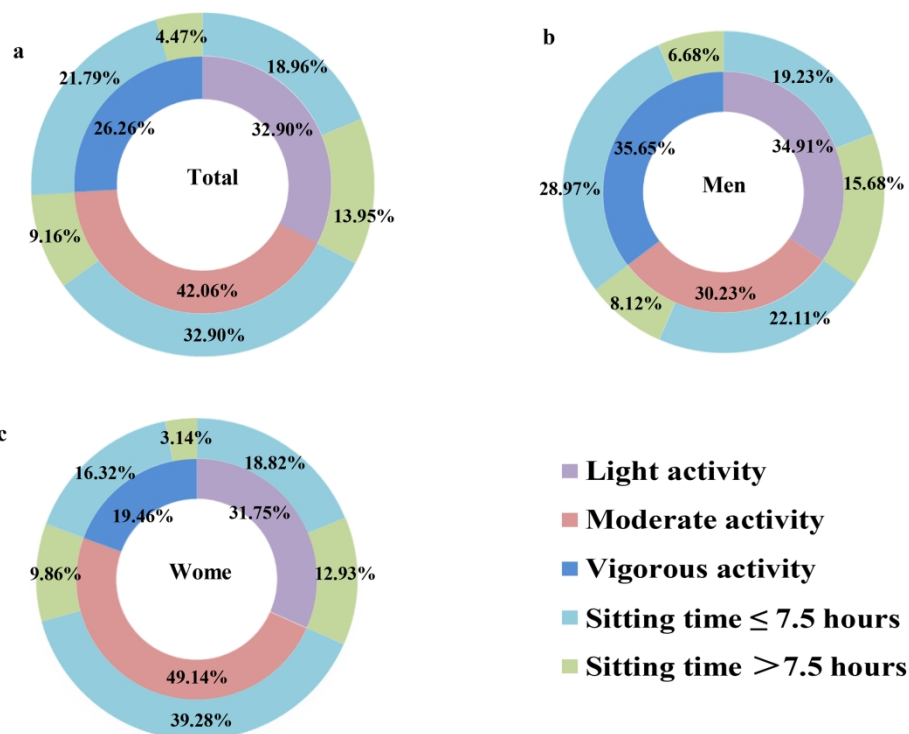


Figure 3. The age-standardized percentage according to the cut-off points of physical activity and sitting time in different gender. (a) is for total; (b) is for men; (c) is for women.

253x194mm (300 x 300 DPI)

Supplementary Table 1. Prevalence of physical activity and sitting time about various characteristics

Variable	Physical activity			<i>P</i>	Sitting time per day		<i>P</i>
	Vigorous (N=11510)	Moderate (N=14672)	Light (N=12333)		≤7.5 hours (N=29270)	>7.5 hours (N=10245)	
Age, n (%)				<0.001			<0.001
18~	220(17.49)	558(44.36)	480(38.16)		910(72.34)	348(27.66)	
30~	685(25.19)	1172(43.10)	862(31.70)		1975(72.64)	744(27.36)	
40~	2275(31.71)	2807(39.13)	2092(29.16)		5327(74.25)	1847(25.75)	
50~	3539(33.36)	4320(40.73)	2748(25.91)		7965(75.09)	2642(24.91)	
60~	3861(31.99)	4358(36.11)	3849(31.89)		8996(74.54)	3072(25.46)	
70~79	930(19.83)	1457(31.07)	2302(49.09)		3097(66.05)	1592(33.95)	
Sex, n (%)				<0.001			<0.001
Women	5963(25.58)	10402(44.62)	6945(29.79)		17588(75.45)	5722(24.55)	
Men	5547(36.48)	4270(28.08)	5388(35.44)		10682(70.25)	4523(29.75)	
Marital status, n (%)				<0.001			<0.001
Married/cohabiting	10567(30.57)	13231(38.27)	10773(31.16)		25502(73.77)	9069(26.23)	
Widowed/single/ divorced/separated	943(23.91)	1441(36.54)	1560(39.55)		2768(70.18)	1176(29.82)	
Education, n (%)				0.234			0.001
≤Primary school	5149(29.81)	6521(37.74)	5607(32.45)		12533(72.54)	4744(27.46)	
≥Junior school	6361(29.95)	8151(38.38)	6726(31.67)		15737(74.10)	5501(25.90)	
Per capita monthly income, n (%)				<0.001			<0.001
≤500RMB	4169(30.33)	4841(35.22)	4736(34.45)		9812(71.38)	3934(28.62)	
500RMB~	3724(29.42)	4959(39.18)	3974(31.40)		9720(76.80)	2937(23.20)	
≥1000RMB	3617(29.86)	4872(40.23)	3623(29.91)		8738(72.14)	3374(27.86)	
Smoking, n (%)				<0.001			<0.001
Never	7652(27.31)	11768(41.99)	8603(30.70)		20292(74.69)	7094(25.31)	
Ever	1036(32.90)	855(27.15)	1258(39.95)		2212(70.24)	937(29.76)	
Current	2822(38.43)	2049(27.90)	2472(33.67)		5129(69.85)	2214(30.15)	
Drinking, n (%)				<0.001			<0.001
Never	8221(27.63)	12201(41.01)	9329(31.36)		22009(73.98)	7742(26.02)	
Ever	557(30.82)	509(28.17)	741(41.01)		1149(63.59)	658(36.41)	
Current	2732(39.27)	1962(28.20)	2263(32.53)		5112(73.48)	1845(26.52)	
Adequate vegetable and fruit intake, n (%)	5054(31.17)	6956(42.90)	4205(25.93)	<0.001	11061(68.21)	5154(31.79)	<0.001
High fat diet, n (%)	2254(30.60)	3084(41.87)	2027(27.52)	<0.001	5393(73.22)	1972(26.78)	0.705

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	P4
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	P4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	P5
Objectives	3	State specific objectives, including any prespecified hypotheses	P5
Methods			
Study design	4	Present key elements of study design early in the paper	P5, P6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	P5, P6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	P5, P6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	P6, P7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	P6, P7
Bias	9	Describe any efforts to address potential sources of bias	P7
Study size	10	Explain how the study size was arrived at	P6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	P7
		(b) Describe any methods used to examine subgroups and interactions	P7, P8
		(c) Explain how missing data were addressed	P6
		(d) If applicable, describe analytical methods taking account of sampling strategy	P7
		(e) Describe any sensitivity analyses	
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	P6
		(b) Give reasons for non-participation at each stage	P6
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	P6
		(b) Indicate number of participants with missing data for each variable of interest	P6
Outcome data	15*	Report numbers of outcome events or summary measures	P6
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	P7, P8
		(b) Report category boundaries when continuous variables were categorized	P8
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	P9
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	P8
Discussion			
Key results	18	Summarise key results with reference to study objectives	P10, P11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	P10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	P11
Generalisability	21	Discuss the generalisability (external validity) of the study results	P11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	P12

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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The prevalence and influence factors of physical activity and sedentary behavior in Chinese rural population: The Henan Rural Cohort Study

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Complete List of Authors:	Tu, Runqi ; Zhengzhou University, Department of Epidemiology and Biostatistics, College of Public Health Li, Yuqian; Zhengzhou University, Department of Clinical Pharmacology, School of Pharmaceutical Science Shen, Lijun; Henan Provincial People's Hospital, Department of Endocrinology and Metabolism Yuan, HuiJuan; Henan Provincial People's Hospital, Department of Endocrinology and Metabolism Mao, Zhenxing ; Zhengzhou University, Department of Epidemiology and Biostatistics, College of Public Health Liu, Xiaotian; Zhengzhou University, Department of Epidemiology and Biostatistics, College of Public Health Zhang, Haiqing; Zhengzhou University, Department of Epidemiology and Biostatistics, College of Public Health zhang, Liying; Zhengzhou University, Department of Epidemiology and Biostatistics, College of Public Health Li, Ruiying; Zhengzhou University, Department of Epidemiology and Biostatistics, College of Public Health Wang, Yikang; Zhengzhou University, Department of Epidemiology and Biostatistics, College of Public Health Wang, Yuming; Henan Provincial People's Hospital, Department of Endocrinology and Metabolism Wang, Chongjian; Zhengzhou University, Department of Epidemiology and Biostatistics, College of Public Health
Primary Subject Heading:	Public health
Secondary Subject Heading:	Public health, Epidemiology, Sports and exercise medicine
Keywords:	physical activity, sedentary behaviour, prevalence, rural population

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Manuscripts

Title:

The prevalence and influence factors of physical activity and sedentary behavior in Chinese rural population: The Henan Rural Cohort Study

Authors:

Runqi Tu^{a†}, Yuqian Li^{b†}, Lijun Shen^{c,d}, Huijuan Yuan^{c,d}, Zhenxing Mao^a, Xiaotian Liu^a, Haiqing Zhang^a, Liying Zhang^a, Ruiying Li^a, Yikang Wang^a, Yuming Wang^{c,d*}, Chongjian Wang^{a*}

Authors affiliations:

^a Department of Epidemiology and Biostatistics, College of Public Health, Zhengzhou University, Zhengzhou, Henan, *PR* China.

^b Department of Clinical Pharmacology, School of Pharmaceutical Science, Zhengzhou University, Zhengzhou, Henan, *PR* China.

^c Department of Endocrinology and Metabolism, Henan Provincial People's Hospital, Zhengzhou, Henan, *PR* China.

^d Department of Endocrinology and Metabolism, Zhengzhou University People's Hospital, Zhengzhou, Henan, *PR* China.

† Runqi Tu and Yuqian Li contributed equally to this work.

*** Correspondence author**

Dr. Chongjian Wang & Yuming Wang

Department of Epidemiology and Biostatistics

College of Public Health, Zhengzhou University

100 Kexue Avenue, Zhengzhou, 450001, Henan, *PR* China

Phone: +86 371 67781452;

Fax: +86 371 67781868

E-mail: tjwcj2005@126.com & henanyuming@sina.com

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Abstract

Objectives: The study aimed to estimate prevalence and influencing factors of physical activity and sedentary behaviour in rural areas of China.

Design: Cross-sectional study.

Setting: A multistage, stratified cluster sampling method was used to obtain samples in the general population of Henan province in China.

Participants: 38515 participants aged 18 to 79 years were enrolled from the Henan Rural Cohort Study for the cross-sectional study.

Main outcome measures: International Physical Activity Questionnaire (IPAQ) was used to assess the levels of Physical activity and sedentary behavior. Multiple logistic regression analysis was used to calculate odds ratios (ORs) and 95% confidence interval (CI) of potential influencing factors with physical inactivity.

Results: The age-standardized prevalence of low physical activity and sitting >7.5 hours per day were 32.74% and 26.88% in the general Chinese rural adults, respectively. Gender differences were: 34.91%, 29.76% for men and 31.75%, 25.16% for women respectively. The prevalence of participants with both low physical activity and sitting >7.5 hours per day was 13.95%. Education \geq Junior middle school, divorced/widowed/unmarried, 1000RMB > per capita monthly income \geq 500RMB, sitting >7.5 hours per day were negatively associated with low physical activity and being male, heavy smoking, fishery products, vegetables and fruits, moderate and light physical activity were negatively associated with sitting >7.5 hours per day.

Conclusion: Physical inactivity and sedentary behaviour were high in rural China. There is an increased need in promoting healthy lifestyle to rural population.

Clinical Trial Registration

The Henan Rural Cohort study has been registered at Chinese Clinical Trial Register (Registration number: ChiCTR-OOC-15006699). <http://www.chictr.org.cn/showproj.aspx?proj=11375>

Key words: physical activity; sedentary behaviour; prevalence; rural population

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Strengths and limitations of this study

- The study was focused on rural population.
- The study was based on a large sample.
- Enough potential confounding variables were included in this study.
- The study were based on a cross-sectional study.
- The questionnaire was a standard version.

Introduction

Over the past few decades, epidemiologic studies have suggested that physical inactivity or sedentary behaviour (SB) were risk factors for non-communicable diseases (NCDs), such as breast cancer^[1], prostate cancer^[2], cardiovascular diseases (CVD)^[3], stroke^[4], type 2 diabetes mellitus (T2DM)^[5], and metabolic syndrome^[6]. Moreover, a study ranging from eastern Mediterranean to western Pacific region showed that more than 5.3 million death would be avoided each year, if the inactive people become active^[7]. In addition to the burden of disease, physical inactivity and SB also result in the substantial economic burden to patients and society, especially in rural areas with limited resources^[8].

The prevalence of physical inactivity was about 31.1% all over the world, and varied by regions. For instance, the prevalence of physical inactivity was 43.3% in USA, while it was just 17.0% in southeast Asia^[9]. Even in a country, the prevalence of physical inactivity also varies from region to region. In China, the prevalence of physically inactive was 63.1% in Shenzhen^[10], and another study in Shanghai showed that only 18.4% of participants met physical activity (PA)^[11]. Although previous studies had explored the prevalence of physical activity and sedentary behaviour among inhabitants of urban China, there is little evidence in rural areas of China that have undergone rapid socio-economic development^[12]. Therefore, updating the prevalence and risk factors of physical activity and sedentary behaviour, and then evaluating the levels of physical activity and sedentary behaviour in rural areas of China are necessary to provide important evidence to generate strategy and promote physical activity in the population.

So the objectives of the current study were: (1) to explore the prevalence of physical activity and sedentary behaviour, (2) to investigate potential influencing factors of physical activity and sedentary behaviour.

Methods

Settings and participants

This cross-sectional study was carried from 2015 to 2017 in 5 rural regions (Suiping, Yuzhou, Xinxiang, Tongxu, and Yima countries) of Henan province. The participants were permanent

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3 residents aged 18-79 years. 744 participants with deficient information about their physical
4 activity and sitting time were excluded. Ultimately, 38515 participants with completed
5 questionnaires, anthropometric measurements and blood tests were included in our analysis.
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10 **Data collection**

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13 The detail of the sampling process were previously reported^[13]. Briefly, A multistage, stratified
14 cluster sampling method was used. First stage, five rural counties were selected in Henan province
15 of central, south, north, east, and west. Second stage, one to three rural communities (referred to
16 as 'townships') in each county were selected. Last stage, all permanent residents who were 18-79
17 years and signed informed consent were selected as the study sample. The information was
18 collected by face-to-face interview. The data about general demographic characteristics, and
19 lifestyles were included in a standard questionnaire. Educational level was classified into primary
20 school or below and junior middle school or above, marital status into married/cohabitation and
21 unmarried/divorced/widowed categories. In accordance with the smoking index of the World
22 Health Organization (WHO)^[14], the smoking status were divided into never smoking, light
23 smoking, moderate smoking, and heavy smoking. According to daily alcohol intake of WHO^[14],
24 drinking was categorized into never drinking, light drinking, moderate drinking, and heavy
25 drinking. According to Chinese dietary guidelines^[15], dietary habits were evaluated from the four
26 aspects of meat and poultry, fishery products, vegetables and fruits, and soy products. The waist
27 circumference (WC), by a non-elastic tape to the nearest 0.1 cm, was measured at 1 cm above the
28 navel in a horizontal plane. Height, using a wall-mounted ruler tape with an insertion buckle at
29 one end to the nearest 0.1 cm, was measured twice without shoes. Body weight, using mechanical
30 scale on a level surface to the nearest 0.1 kg, was measured once with the subjects in light clothing
31 and barefoot^[16]. Body mass index (BMI) was calculated as weight in kilograms divided by the
32 square of height in meters.
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52 **Ethical considerations**

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55 The purpose and the importance of the study were explained to the participants. Confidentiality
56 of the information was maintained throughout the study by excluding personal identifiers from the
57 data collection form.
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Patient and public involvement

Neither patients nor the public were involved in developing this project.

Definitions

International Physical Activity Questionnaire (IPAQ) was used to assess the levels of PA^[17]. All the weekly time of vigorous activity, moderate activity and walking was calculated with the number of Mets in each category and average daily estimated. Mets reflected the energy expenditure specific for vigorous activity, moderate activity and walking. In this study, the Mets of vigorous activity was 8; the Mets of moderate activity was 4; the Mets of walking was 3,3. The value of Mets was estimated by the sum of the three physical activities in one week. The PA categorized into three levels were light (physically inactive), moderate and vigorous^[9,18]. These categories were based on standard scoring criteria of IPAQ. The vigorous activity should meet either of the following two criteria: (1) vigorous activity was at least 3 days/week and the week of accumulating Mets was at least 1500 MET-minutes/week; or (2) any combination of vigorous activity, moderate activity or walking at least 5 days/week and the accumulating Mets was at least 3000 MET-minutes/week. The moderate activity should meet either of the following four criteria: (1) moderate activity was at least 30 min in 5 days a week; (2) vigorous activity was at least 20 min in 3 days a week; (3) walking at least 30 min a day for 5 or more days a week; (4) the accumulating Mets, of any combination of moderate activity, vigorous activity or walking, was at least 600 MET-minutes/week in 5 or more days a week. the light activity category were for individuals who neither met vigorous nor moderate criteria. And about the SB, the cut-point was set 7.5 hours^[19,20].

Statistical analysis

Continuous variables were presented as mean \pm standard deviation (SD). Differences between two groups were tested using t-test and more than two group were tested using ANOVA. Categorical variables presented as numbers and percentages were compared using chi-square test. Based on Chinese population data from 2010 census, direct standardization was used to calculate the age-standardized prevalence of Mets. The multinomial logistic regression models were used to

calculate ORs and 95% CI between the potential factors and Mets. All statistical tests were two-tailed, and P value < 0.05 was considered statistically significant. The data were analyzed using SAS9.1 software package (SAS Institute, USA) and R version 3.5.1.

Result

Demographic characteristics.

Table 1 showed the demographic characteristics of the 38515 participants aged from 18 to 79 years old. The mean (standard deviation, SD) age was 55.65(12.14) years. Overall, a total of 11510, 14672 and 12333 subjects were engaged in vigorous, moderate and light physical activity, respectively. Being man, married/cohabiting, the smoking of light, moderate and heavy level and the drinking of light and moderate were more common among vigorous activity participants, while older age, widowed/single/divorced/separated, \leq Primary school, per capita monthly income ≤ 500 RMB, heavy drinking were more prevalent among moderate physical activity participants. Among the 38515 participants, 29270 were sitting ≤ 7.5 hours per day. Being women, married/cohabiting, \geq Junior school, 500RMB $<$ per capita monthly income < 1000 RMB, never smoking and never drinking were more prevalent in the subjects with sitting ≤ 7.5 hours per day than sitting > 7.5 hours per day ($p < 0.001$). Meanwhile, the supplementary table 1 showed the 95%CI of each value.

The sex-specific distributions of physical activity and sitting time according to age.

Figure 1 describes the sex-specific distribution of the Mets of physical activity and sitting time according to age. The median of Mets for physical activity and sitting time were 7092 MET-minutes/week and 5 h., respectively. The median of Mets for physical activity and sitting time were 6558 MET-minutes/week, 7119 MET-minutes/week and 5 h, 5 h for men and women, respectively. The mean \pm standard deviation (SD) of Mets for physical activity and sitting time were 7626.02 \pm 4229.32 MET-minutes/week and 5.70 \pm 3.23 h., respectively. The mean \pm SD of Mets for physical activity and sitting time were 7506.15 \pm 4524.75 MET-minutes/week, 7704.20 \pm 4023.12 MET-minutes/week and 5.97 \pm 3.39 h, 5.53 \pm 3.12 h for men and women ($P < 0.001$), respectively. Notably, the sitting time of the men was higher than women. The 50-59 age group

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4 had the highest Mets. The 70-79 age group had the highest sitting time.
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6 7 **Prevalence of light physical activity and sitting>7.5 hours per day.**

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9 Supplementary table 2 displays the prevalence of light physical activity and sitting>7.5 hours
10 per day among various characteristics. The prevalence of light physical activity and sitting>7.5
11 hours per day were 32.02% and 26.60%, and the corresponding age-standardized rates were
12 32.90% and 26.88%, respectively. Subgroups study showed that the prevalence of low physical
13 activity and sitting>7.5 hours per day were higher in those who were younger or older, being men,
14 Widowed/single/divorced/separated with lower per capita monthly income, heavy smoking and
15 drinking.
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23 24 **Changes of light physical activity and sitting>7.5 hours per day in different subgroup.**

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26 Figure 2 presents that the age-standardized prevalence of light physical activity and sitting>7.5
27 hours per day changed with age in both sexes. The prevalence of light physical activity and
28 sitting>7.5 hours per day decreased with age firstly and then increased. Men had higher
29 probability of having high physical activity and sitting>7.5 hours per day than women in all the
30 age groups.
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37 38 **The percentage according to the cut-off points of physical activity and sitting time in** 39 **different sexes.**

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41 Figure 3 shows the age-standardized percentage according to the cut-off points of physical
42 activity and sitting time in different sexes. A total of 17346 subjects (7434 men and 9912 women)
43 had light physical activity or sitting>7.5 hours per day, and the corresponding age-standardized
44 prevalence was 45.84% (48.99% in men and 43.98% in women). The age-standardized prevalence
45 of participants with both light physical activity and single sitting>7.5 hours per day was 13.95%
46 (15.68% in men and 12.93% in women).
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54 55 **Analysis of influencing factors.**

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57 Table2 describes the odds ratios (*ORs*) of potential influencing factors association with light
58 physical activity and sitting time >7.5 hours per day. Being women, 18-29 age group, level of
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4 education \geq Junior middle school, divorced/widowed/unmarried, 1000RMB > per capita monthly
5 income \geq 500 RMB, never smoking and drinking, and sitting time per day were significantly
6 negatively associated with light physical activity, while being men, level of education \leq Primary
7 school, per capita monthly income < 500 RMB, heavy somking and drinking, fishery products,
8 vegetables and fruits were significantly negatively association with sitting >7.5 hours per day.
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Discussion

New insights of physical activity and sedentary behaviour were provided by the results from this large survey among rural population in Henan of China. Overall, the median levels of sitting time were higher in rural adults of China than the previous study of a 20 country comparison of sitting^[21], and the percent levels of physical inactivity were higher in Chinese rural adults than the previous study of global physical activity levels^[9]. There was an association of decreased physical activity with age firstly and then increased in the prevalence of light physical activity and sitting>7.5 hours per day. The percent individuals that had both light physical activity and sitting>7.5 hours per day were 15.68%, 12.93% and 13.95% in men, women and total, respectively. Further analysis of multiple logistic regression presented that gender, age, the level of education, marital status, smoking, drinking and vegetables intake were influencing factors for light physical activity and sitting>7.5 hours.

Previous studies had shown that the levels of physical inactivity and sedentary was high in urban China^[10,11]. Compared with those in urban area, the levels of physical inactivity and sedentary was relatively low in rural area of China. This gap between the urban and rural might be explained by the more use of intelligent technology for urban construction, with the social progress, scientific and economic development. The mean of Mets increased with age firstly and then at the age group of 50-59 decreased. While the sitting time was highest in 70-79 age group. It is likely that the decline in physical ability with age limits the physical activity and increase the sedentary nature of the elderly^[22]. Furthermore, the aged might fear injuries, which was another reason to lead them into physical inactivity^[23]. About physical activity, the subgroup analysis showed that under the various characteristics, the prevalence of vigorous physical activity was about 30%, moderate physical activity was about 40% and the light physical activity was about 30%. While about sitting time, under all the various characteristics, the sitting time \leq 7.5 hours per day was about 70%. These results were similar to a Chilean study^[23].

The results of co-existence of physical activity and sedentary behavior showed that light physical activity and sitting time>7.5 hours per day was 15.68%, 12.93% and 13.95% in men,

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4 women and total, respectively. It was similar with a study from Japan^[24]. For these participants
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6 who were light physical activity and sitting time >7.5 hours per day, should take a measure to
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8 promote the physical activity.
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10 Evidence showed that there were negative relationships between junior middle school or above,
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12 divorced/widowed/unmarried, per capita monthly income ≥ 500 RMB and meat and poultry
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14 consumption with moderate physical activity. Having a junior middle school or above,
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16 divorced/widowed/unmarried, 1000RMB > per capita monthly income ≥ 500 RMB, and sitting
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18 time per day >7.5 hours were negative association with light physical activity. For sitting >7.5
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20 hours per day, the negative factors were being men, divorced/widowed/unmarried, heavy
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22 smoking, Fishery products and vegetable and fruits intake.
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25 The current study focused on the epidemiologic characteristics of physical activity and
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27 sedentary behaviour based on a relatively large sample size of rural population in Henan of China.
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29 Although a series of measures, such as standardized tools and training implementation, had been
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31 done to guarantee the authenticity, there were several limitations. First of all, these results were
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33 based on a cross-sectional study, so the causal relationships between factors and physical activity
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35 or sedentary behaviour could not be confirmed. Second, the responses were from self-reported
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37 data, which could distort real facts. Third, according to the actual rural circumstances, the
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39 residents who studied or worked in cities were not included in this study, so the prevalence of
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41 Mets might be over or under estimated in rural population. Although these limitations existed in
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43 the study, the relatively large epidemiological study also could reflect the prevalence of physical
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45 activity and sedentary behaviour in rural areas of China.
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47 **Conclusion**

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49 This study suggests relatively higher prevalence of physical inactivity among Chinese rural
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51 adults has emerged with economic and social transition. More attention should be given to the
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53 aged, and drinking individuals who are at high risk of physical inactivity.
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6 critical reading of the manuscript.
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8 **Ethics approval and consent to participate**

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11 Ethics approval was obtained from the “Zhengzhou University Life Science Ethics Committee”,
12
13 and written informed consent was obtained for all participants. Ethic approval code: [2015] MEC
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15 (S128).
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18 The purpose and the importance of the study were explained to the participants. Information
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20 confidentiality was maintained throughout the study by excluding personal identifiers from the
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22 data collection form.
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24 **Consent for publication**

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27 All authors consent for publication
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29 **Conflict of interest**

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32 The authors declared no conflict of interest associated with this manuscript.
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52 study design, data collection and analysis, decision to publish, or preparation of the manuscript.
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54 **Data sharing statement**

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57 All relevant data are within the paper and its Supporting Information files. Contact to Dr.
58
59 Chongjian Wang (tjwcj2005@126.com) for additional information regarding data access.
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Author Contributions

C.J.W. and Y.M.W. conceived and designed the study. R.Q.T., Y.L.Q., L.J.S., H.J.Y., Z.X.M., X.T.L., H.Q.Z., L.Y.Z., R.Y.L., and Y.K.W. coordinated data collection. Y.L.Q., L.J.S., H.J.Y., Z.X.M., X.T.L., H.Q.Z., L.Y.Z., R.Y.L., and Y.K.W. conducted the analyses. R.Q.T. wrote the manuscript. All co-authors critically revised the manuscript. All authors have approved the final manuscript.

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Table 1. Demographic characteristics of the participants

Variable	Overall (N=38515)	Physical activity			<i>P</i>	Sitting time per day		<i>P</i>
		Vigorous (N=11510)	Moderate (N=14672)	Light (N=12333)		≤7.5 hours (N=28270)	>7.5 hours (N=10245)	
Age(years), mean±SD	55.65±12.14	55.48±10.81	54.62±12.05	57.02±13.25	<0.001	55.46±11.93	56.17±12.68	<0.001
Sex, n (%)					<0.001			<0.001
Women	23331(60.52)	5963(51.81)	10402(70.90)	6945(56.31)		17588(62.21)	5722(55.85)	
Men	15205(39.48)	5547(48.19)	4270(29.10)	5388(43.69)		10682(37.79)	4523(44.15)	
Marital status, n (%)					<0.001			<0.001
Married/cohabiting	34571(89.76)	10567(91.81)	13231(90.18)	10773(87.35)		25502(90.20)	9069(88.50)	
Widowed/single/divorced/separated	3944(10.24)	943(8.19)	1441(9.82)	1560(12.65)		2768(9.80)	1176(11.50)	
Education, n (%)					0.234			0.001
≤Primary school	17277(44.86)	5149(44.74)	6521(44.45)	5607(45.46)		12533(44.33)	4744(46.31)	
≥Junior school	21238(55.14)	6361(55.26)	8151(55.55)	6726(54.54)		15737(55.67)	5501(53.69)	

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4							
5	Per capita monthly income, n (%)					<0.001	<0.001
6							
7	≤500RMB	13746(35.69)	4169(36.22)	4841(32.99)	4736(38.40)	9812(34.71)	3934(38.40)
8							
9	500RMB~	12657(32.86)	3724(32.35)	4959(33.80)	3974(32.22)	9720(34.38)	2937(28.67)
10							
11	≥1000RMB	12112(31.45)	3617(31.42)	4872(33.21)	3623(29.38)	8738(30.91)	3374(32.93)
12							
13							
14	Smoking, n (%)					<0.001	<0.001
15							
16	Never	28023(72.76)	7652(66.48)	11768(80.21)	8603(69.76)	20929(74.03)	7094(69.24)
17							
18	Light	2152(5.59)	786(6.83)	625(4.26)	741(6.01)	1599(5.66)	553(5.40)
19							
20	Moderate	1750(4.54)	632(5.49)	505(3.44)	613(4.97)	1252(4.43)	498(4.86)
21							
22	Heavy	6590(17.11)	2440(21.20)	1774(12.09)	2376(19.27)	4490(15.88)	2100(20.50)
23							
24							
25							
26	Drinking, n (%)					<0.001	<0.001
27							
28	Never	29833(77.46)	8257(71.74)	12223(83.31)	9353(75.84)	22068(78.06)	7765(75.79)
29							
30	Light	5360(13.92)	2065(17.94)	1525(10.39)	1770(14.35)	3840(13.58)	1520(14.84)
31							
32	Moderate	1820(4.73)	668(5.80)	534(3.64)	618(5.01)	1351(4.78)	469(4.58)
33							
34	Heavy	1502(3.90)	520(4.52)	390(2.66)	592(4.80)	1011(3.58)	491(4.79)
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Dietary habits (Kg/Month), (mean \pm SD)

Meat and poultry	1.32 \pm 1.32	1.21 \pm 1.28	1.40 \pm 1.35	1.33 \pm 1.33	<0.001	1.31 \pm 1.33	1.34 \pm 1.31	0.410
Fishery products	0.11 \pm 0.16	0.10 \pm 0.15	0.12 \pm 0.16	0.11 \pm 0.16	<0.001	0.11 \pm 0.16	0.13 \pm 0.17	<0.001
Vegetables and fruits	13.8 \pm 7.47	12.49 \pm 7.43	14.68 \pm 7.37	14.07 \pm 7.44	<0.001	13.27 \pm 7.23	15.24 \pm 7.91	<0.001
Soy products	0.48 \pm 0.64	0.41 \pm 0.60	0.49 \pm 0.65	0.53 \pm 0.67	<0.001	0.49 \pm 0.65	0.46 \pm 0.63	<0.001
Height(cm), mean \pm SD	159.69 \pm 8.20	160.65 \pm 8.24	158.62 \pm 7.84	160.07 \pm 8.43	<0.001	159.59 \pm 8.17	159.98 \pm 8.28	<0.001
Weight(kg), mean \pm SD	63.48 \pm 11.14	63.92 \pm 10.86	62.44 \pm 10.76	64.30 \pm 11.72	<0.001	63.60 \pm 11.09	63.15 \pm 11.27	<0.001
BMI(kg/m ²), mean \pm SD	24.84 \pm 3.57	24.72 \pm 3.46	24.77 \pm 3.50	25.03 \pm 3.73	<0.001	24.92 \pm 3.56	24.61 \pm 3.59	<0.001
WC(cm), mean \pm SD	84.07 \pm 10.41	83.65 \pm 10.03	83.44 \pm 10.19	85.22 \pm 10.90	<0.001	84.42 \pm 10.35	83.10 \pm 10.50	<0.001

Table 2. Association of potential risk factors for physical activity and sitting time.

Factors	OR(95% CI)					
	Physical activity				Sitting time per day	
	Moderate ^a	Moderate ^b	Light ^a	Light ^b	>7.5 hours ^a	>7.5 hours ^b
Age(year)						
18-	1.00	1.00	1.00	1.00	1.00	1.00
30-	0.67(0.56,0.81)	0.70(0.58,0.85)	0.58(0.48,0.70)	0.63(0.51,0.76)	0.99(0.85,1.14)	1.04(0.89,1.22)
40-	0.49(0.41,0.57)	0.52(0.44,0.62)	0.42(0.36,0.50)	0.47(0.39,0.56)	0.91(0.79,1.04)	0.98(0.85,1.13)
50-	0.48(0.41,0.57)	0.52(0.44,0.61)	0.36(0.30,0.42)	0.39(0.33,0.47)	0.87(0.76,0.99)	0.94(0.82,1.09)
60-	0.45(0.38,0.52)	0.51(0.43,0.61)	0.46(0.39,0.54)	0.51(0.43,0.62)	0.89(0.78,1.02)	0.89(0.77,1.02)
70-79	0.62(0.52,0.74)	0.72(0.60,0.87)	1.13(0.95,1.35)	1.17(0.97,1.42)	1.34(1.17,1.54)	1.08(0.93,1.26)
Gender						
Women	1.00	1.00	1.00	1.00	1.00	1.00
Men	0.44(0.42,0.46)	0.46(0.43,0.50)	0.83(0.79,0.88)	0.76(0.70,0.83)	1.30(1.24,1.36)	1.25(1.16,1.35)

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Education						
≤Primary school	1.00	1.00	1.00	1.00	1.00	1.00
≥Junior middle school	1.01(0.96,1.06)	1.07(1.01,1.14)	0.97(0.92,1.02)	1.27(1.20,1.35)	0.92(0.88,0.97)	0.85(0.81,0.90)
Marital status						
Married/cohabiting	1.00	1.00	1.00	1.00	1.00	1.00
Divorced/widowed/unmarried	1.22(1.12,1.33)	1.15(1.05,1.26)	1.62(1.49,1.77)	1.19(1.09,1.31)	1.20(1.11,1.28)	1.08(1.00,1.17)
Per capita monthly income						
<500 RMB	1.00	1.00	1.00	1.00	1.00	1.00
500RMB-	1.15(1.08,1.22)	1.16(1.09,1.23)	0.94(0.88,1.00)	1.08(1.01,1.15)	0.75(0.71,0.80)	0.79(0.75,0.84)
≥1000 RMB	1.16(1.09,1.23)	1.13(1.06,1.21)	0.88(0.83,0.94)	1.00(0.93,1.07)	0.96(0.91,1.02)	1.01(0.95,1.07)
Smoking						
Never	1.00	1.00	1.00	1.00	1.00	1.00
Light	0.52(0.46,0.58)	0.57(0.51,0.64)	0.84(0.75,0.93)	0.79(0.70,0.89)	1.04(0.93,1.16)	0.88(0.78,0.99)
Moderate	0.52(0.46,0.59)	0.61(0.54,0.69)	0.86(0.77,0.97)	0.85(0.75,0.97)	1.21(1.07,1.36)	1.02(0.90,1.16)

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5	Heavy	0.47(0.44,0.51)	0.57(0.52,0.61)	0.87(0.81,0.92)	0.83(0.77,0.90)	1.41(1.33,1.51)	1.20(1.10,1.31)
6							
7	Drinking,						
8							
9	Never	1.00	1.00	1.00	1.00	1.00	1.00
10							
11	Light	0.50(0.46,0.54)	0.64(0.59,0.69)	0.76(0.71,0.81)	0.80(0.74,0.87)	1.19(1.10,1.28)	0.98(0.90,1.06)
12							
13	Moderate	0.54(0.48,0.61)	0.71(0.63,0.81)	0.82(0.73,0.91)	0.93(0.82,1.05)	1.08(0.96,1.22)	0.82(0.72,0.92)
14							
15	Heavy	0.51(0.44,0.58)	0.70(0.61,0.81)	1.01(0.89,1.13)	1.10(0.96,1.27)	1.31(1.16,1.48)	1.06(0.93,1.21)
16							
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18							
19	Dietary habits						
20							
21	Meat and poultry	1.04(1.02,1.06)	1.08(1.06,1.10)	0.93(0.91,0.95)	1.01(0.99,1.04)	1.01(0.99,1.03)	0.95(0.93,0.97)
22							
23	Fishery products	1.16(0.99,1.34)	0.97(0.82,1.16)	0.61(0.52,0.72)	0.76(0.63,0.93)	2.16(1.86,2.52)	2.21(1.87,2.60)
24							
25	Vegetables and fruits	1.01(1.01,1.01)	1.01(1.00,1.01)	0.97(0.97,0.97)	0.96(0.96,0.97)	1.04(1.03,1.04)	1.05(1.04,1.05)
26							
27	Soy products	0.91(0.88,0.94)	0.88(0.85,0.92)	0.74(0.71,0.77)	0.81(0.78,0.85)	0.91(0.87,0.95)	0.91(0.88,0.95)
28							
29							
30	Sitting time per day						
31							
32	≤7.5 hours	1.00	1.00	1.00	1.00	-	-
33							
34	>7.5 hours	1.34(1.25,1.42)	1.35(1.27,1.44)	3.68(3.47,3.91)	4.09(3.84,4.36)	-	-
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Physical activity						
Vigorous	-	-	-	-	1.00	1.00
Moderate	-	-	-	-	1.34(1.25,1.42)	1.37(1.28,1.46)
Light	-	-	-	-	3.68(3.47,3.91)	4.08(3.83,4.34)

^awas a crude model; ^bwas a full model.

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Figure Legends

Figure 1. The violin chart of metabolic equivalence per week and sitting time per day according to gender and age. (a) is for metabolic equivalence per week; (b) is sitting time per day.

Figure 2. Changes in the age-standardized prevalence of physical activity and sitting time with aging in different gender. (a) is for light physical activity; (b) is for moderate physical activity; (c) is for vigorous physical activity. (d) is sitting time ≤ 7.5 hours per day; (e) is sitting time > 7.5 hours per day.

Figure 3. The age-standardized percentage according to the cut-off points of physical activity and sitting time in different gender. (a) is for total; (b) is for men; (c) is for women.

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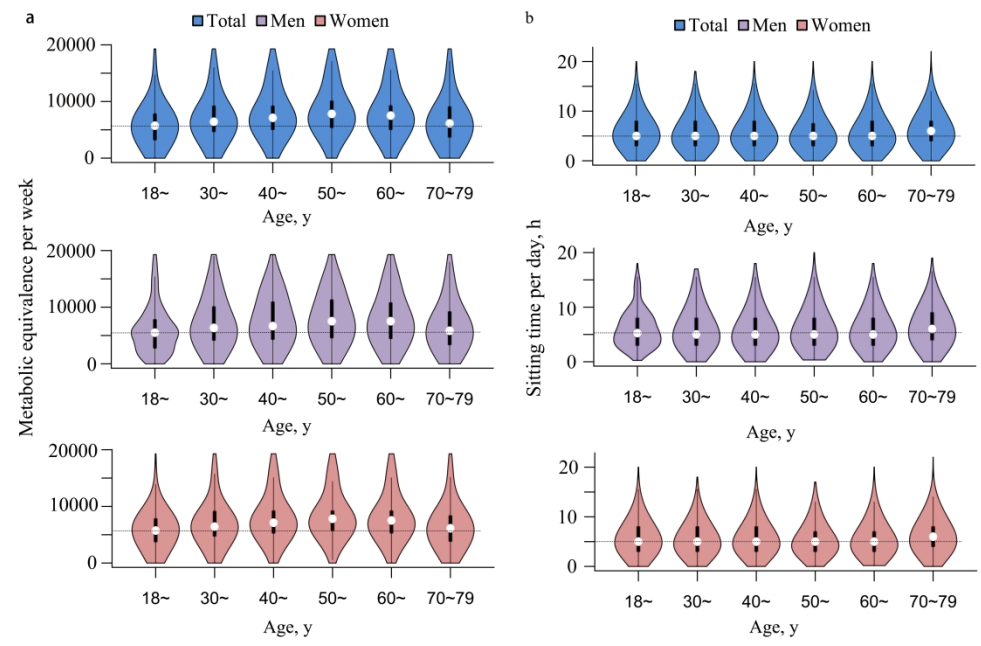


Figure 1. The violin chart of metabolic equivalence per week and sitting time per day according to gender and age. (a) is for metabolic equivalence per week; (b) is sitting time per day.

247x161mm (600 x 600 DPI)

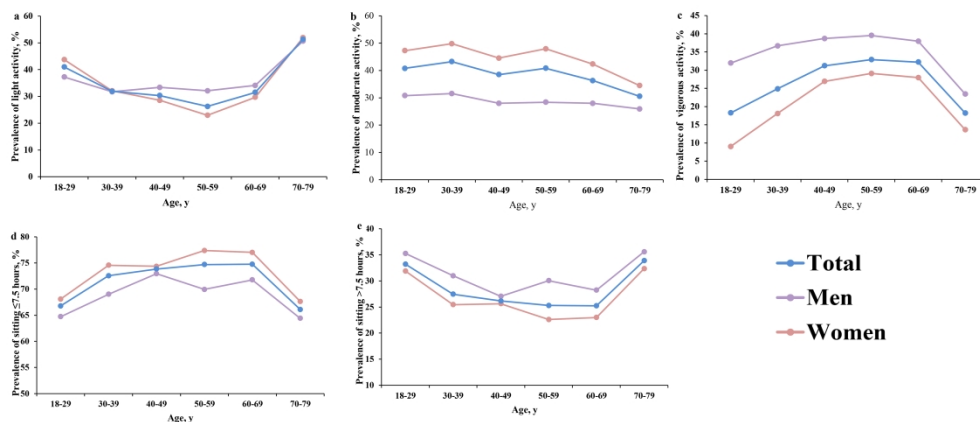


Figure 2. Changes in the age-standardized prevalence of physical activity and sitting time with aging in different gender. (a) is for light physical activity; (b) is for moderate physical activity; (c) is for vigorous physical activity. (d) is sitting time ≤ 7.5 hours per day; (e) is sitting time > 7.5 hours per day.

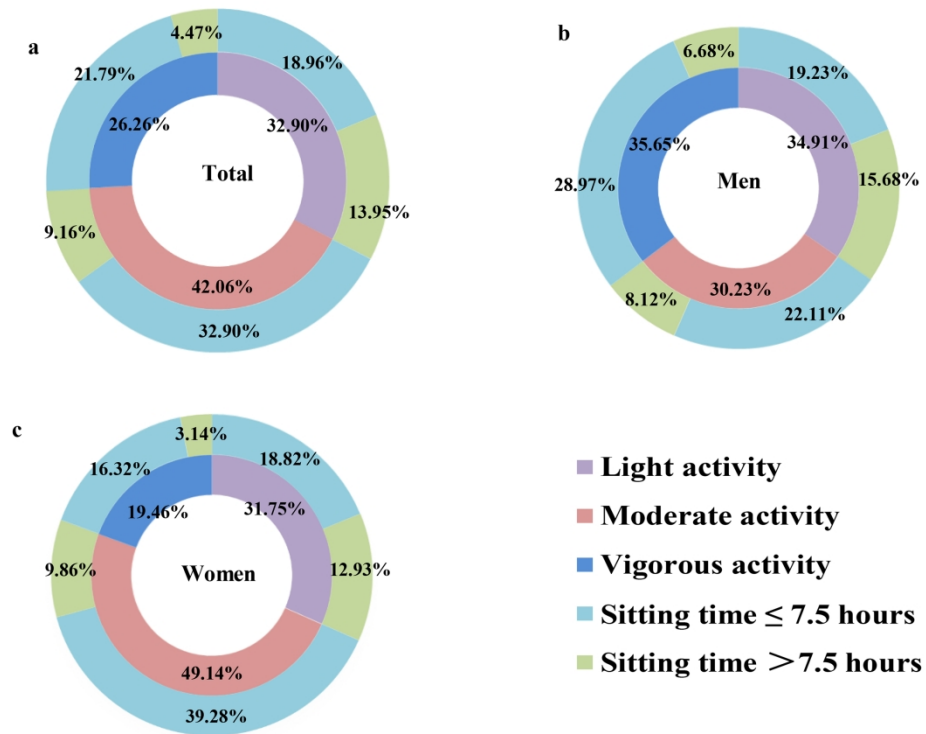


Figure 3. The age-standardized percentage according to the cut-off points of physical activity and sitting time in different gender. (a) is for total; (b) is for men; (c) is for women.

253x194mm (300 x 300 DPI)

Supplementary Table 1. 95% CI of demographic characteristics of the participants

Variable	Overall (N=38515)	Physical activity			Sitting time per day	
		Vigorous (N=11510)	Moderate (N=14672)	Light (N=12333)	≤7.5 hours (N=28270)	>7.5 hours (N=10245)
Age(years)	(55.529,55.771)	(56.786,57.254)	(54.425,54.815)	(55.283,55.677)	(55.321,55.599)	(55.924,56.416)
Sex						
Women	(0.601,0.611)	(0.509,0.527)	(0.702,0.716)	(0.554,0.572)	(0.616,0.628)	(0.549,0.568)
Men	(0.390,0.400)	(0.473,0.491)	(0.284,0.298)	(0.428,0.446)	(0.372,0.384)	(0.432,0.451)
Marital status						
Married/cohabiting	(0.895,0.901)	(0.913,0.923)	(0.897,0.907)	(0.868,0.879)	(0.899,0.906)	(0.879,0.891)
Widowed/single/ divorced/separated	(0.099,0.105)	(0.077,0.087)	(0.093,0.103)	(0.121,0.132)	(0.094,0.101)	(0.109,0.121)
Education						
≤Primary school	(0.444,0.454)	(0.438,0.456)	(0.436,0.453)	(0.446,0.463)	(0.438,0.449)	(0.453,0.473)
≥Junior school	(0.546,0.556)	(0.544,0.562)	(0.547,0.564)	(0.537,0.554)	(0.551,0.562)	(0.527,0.547)
Per capita monthly income						
≤500RMB	(0.352,0.362)	(0.353,0.371)	(0.322,0.338)	(0.375,0.393)	(0.342,0.353)	(0.375,0.393)
500RMB~	(0.324,0.333)	(0.315,0.332)	(0.330,0.346)	(0.314,0.331)	(0.338,0.349)	(0.278,0.296)
≥1000RMB	(0.310,0.319)	(0.306,0.323)	(0.324,0.340)	(0.286,0.302)	(0.304,0.315)	(0.320,0.339)
Smoking						
Never	(0.723,0.732)	(0.739,0.755)	(0.796,0.808)	(0.612,0.629)	(0.735,0.745)	(0.683,0.701)
Light	(0.054,0.058)	(0.060,0.069)	(0.039,0.046)	(0.059,0.068)	(0.054,0.059)	(0.050,0.059)
Moderate	(0.043,0.048)	(0.049,0.058)	(0.032,0.037)	(0.047,0.055)	(0.042,0.047)	(0.045,0.053)
Heavy	(0.167,0.175)	(0.199,0.214)	(0.116,0.126)	(0.191,0.205)	(0.155,0.163)	(0.197,0.213)
Drinking						
Never	(0.770,0.779)	(0.805,0.820)	(0.827,0.840)	(0.661,0.677)	(0.776,0.785)	(0.750,0.766)
Light	(0.136,0.143)	(0.147,0.161)	(0.099,0.109)	(0.161,0.174)	(0.132,0.140)	(0.142,0.155)
Moderate	(0.045,0.049)	(0.050,0.058)	(0.033,0.040)	(0.050,0.058)	(0.045,0.050)	(0.042,0.050)
Heavy	(0.037,0.041)	(0.047,0.056)	(0.024,0.029)	(0.191,0.205)	(0.039,0.046)	(0.044,0.052)
Dietary habits						
(Kg/Month)						
Meat and poultry	(1.307,1.333)	(1.309,1.357)	(1.378,1.421)	(1.190,1.235)	(1.298,1.329)	(1.312,1.363)
Fishery products	(0.110,0.113)	(0.111,0.117)	(0.115,0.120)	(0.099,0.105)	(0.104,0.108)	(0.124,0.130)
Vegetables and fruits	(13.723,13.872)	(13.933,14.205)	(14.559,14.798)	(12.363,12.625)	(13.189,13.358)	(15.089,15.395)
Soy products	(0.472,0.485)	(0.522,0.546)	(0.481,0.502)	(0.401,0.422)	(0.478,0.493)	(0.448,0.472)
Height(cm)	(159.608,159.772)	(159.921,160.219)	(158.493,158.747)	(160.499,160.801)	(159.495,159.685)	(159.819,160.141)
Weight(kg)	(63.369,63.591)	(64.092,64.508)	(62.276,62.624)	(63.721,64.119)	(63.471,63.729)	(62.931,63.369)
BMI(kg/m ²)	(24.804,24.876)	(24.964,25.096)	(24.713,24.827)	(24.657,24.783)	(24.878,24.962)	(24.54,24.68)
WC(cm)	(83.966,84.174)	(85.027,85.413)	(83.285,83.615)	(83.467,83.833)	(84.299,84.541)	(82.896,83.304)

Supplementary Table 2. Prevalence of physical activity and sitting time about various characteristics

Variable	Physical activity			<i>P</i>	Sitting time per day		<i>P</i>
	Vigorous (N=11510)	Moderate (N=14672)	Light (N=12333)		≤7.5 hours (N=29270)	>7.5 hours (N=10245)	
Age, n (%)				<0.001			<0.001
18~	220(17.49)	558(44.36)	480(38.16)		910(72.34)	348(27.66)	
30~	685(25.19)	1172(43.10)	862(31.70)		1975(72.64)	744(27.36)	
40~	2275(31.71)	2807(39.13)	2092(29.16)		5327(74.25)	1847(25.75)	
50~	3539(33.36)	4320(40.73)	2748(25.91)		7965(75.09)	2642(24.91)	
60~	3861(31.99)	4358(36.11)	3849(31.89)		8996(74.54)	3072(25.46)	
70~79	930(19.83)	1457(31.07)	2302(49.09)		3097(66.05)	1592(33.95)	
Sex, n (%)				<0.001			<0.001
Women	5963(25.58)	10402(44.62)	6945(29.79)		17588(75.45)	5722(24.55)	
Men	5547(36.48)	4270(28.08)	5388(35.44)		10682(70.25)	4523(29.75)	
Marital status, n (%)				<0.001			<0.001
Married/cohabiting	10567(30.57)	13231(38.27)	10773(31.16)		25502(73.77)	9069(26.23)	
Widowed/single/ divorced/separated	943(23.91)	1441(36.54)	1560(39.55)		2768(70.18)	1176(29.82)	
Education, n (%)				0.234			0.001
≤Primary school	5149(29.81)	6521(37.74)	5607(32.45)		12533(72.54)	4744(27.46)	
≥Junior school	6361(29.95)	8151(38.38)	6726(31.67)		15737(74.10)	5501(25.90)	
Per capita monthly income, n (%)				<0.001			<0.001
≤500RMB	4169(30.33)	4841(35.22)	4736(34.45)		9812(71.38)	3934(28.62)	
500RMB~	3724(29.42)	4959(39.18)	3974(31.40)		9720(76.80)	2937(23.20)	
≥1000RMB	3617(29.86)	4872(40.23)	3623(29.91)		8738(72.14)	3374(27.86)	
Smoking, n (%)				<0.001			<0.001
Never	7652(27.31)	11768(41.99)	8603(30.70)		20929(74.69)	7094(25.31)	
Light	786(36.52)	625(29.04)	741(34.43)		1599(74.30)	553(25.70)	
Moderate	632(36.11)	505(28.86)	613(35.03)		1252(71.54)	498(28.46)	
Heavy	2440(37.03)	1774(26.92)	2376(36.05)		4490(68.13)	2100(31.87)	
Drinking, n (%)				<0.001			<0.001
Never	8257(27.68)	12223(40.97)	9353(31.35)		22068(73.97)	7765(26.03)	
Light	2065(38.53)	1525(28.45)	1770(33.02)		3840(71.64)	1520(28.36)	
Moderate	668(36.70)	534(29.34)	618(33.96)		1351(74.23)	469(25.77)	
Heavy	520(34.62)	390(25.97)	592(39.41)		1011(67.31)	491(32.69)	

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Title:

The prevalence and influence factors of physical activity and sedentary behavior in Chinese rural population: The Henan Rural Cohort Study

Authors:

Runqi Tu^{a†}, Yuqian Li^{b†}, Lijun Shen^{c,d}, Huijuan Yuan^{c,d}, Zhenxing Mao^a, Xiaotian Liu^a, Haiqing Zhang^a, Liying Zhang^a, Ruiying Li^a, Yikang Wang^a, Yuming Wang^{c,d*}, Chongjian Wang^{a*}

Authors affiliations:

^a Department of Epidemiology and Biostatistics, College of Public Health, Zhengzhou University, Zhengzhou, Henan, *PR* China.

^b Department of Clinical Pharmacology, School of Pharmaceutical Science, Zhengzhou University, Zhengzhou, Henan, *PR* China.

^c Department of Endocrinology and Metabolism, Henan Provincial People's Hospital, Zhengzhou, Henan, *PR* China.

^d Department of Endocrinology and Metabolism, Zhengzhou University People's Hospital, Zhengzhou, Henan, *PR* China.

† Runqi Tu and Yuqian Li contributed equally to this work.

*** Correspondence author**

Dr. Chongjian Wang & Yuming Wang

Department of Epidemiology and Biostatistics

College of Public Health, Zhengzhou University

100 Kexue Avenue, Zhengzhou, 450001, Henan, *PR* China

Phone: +86 371 67781452;

Fax: +86 371 67781868

E-mail: tjwcj2005@126.com & henanyuming@sina.com

Abstract

Objectives: The study aimed to estimate prevalence and influencing factors of physical activity (PA) and sedentary behavior (SB) in rural areas of China.

Design: Cross-sectional study.

Setting: A multistage, stratified cluster sampling method was used to obtain samples in the general population of Henan province in China.

Participants: 38515 participants aged 18 to 79 years were enrolled from the Henan Rural Cohort Study for the cross-sectional study.

Main outcome measures: International Physical Activity Questionnaire (IPAQ) was used to assess the levels of PA and SB. Multiple logistic regression analysis was used to calculate odds ratios (ORs) and 95% confidence interval (CI) of potential influencing factors with physical inactivity.

Results: The age-standardized prevalence of light PA and sitting >7.5 hours per day were 32.74% and 26.88% in the general Chinese rural adults, respectively. Gender differences were: 34.91%, 29.76% for men and 31.75%, 25.16% for women respectively. The prevalence of participants with both light PA and sitting >7.5 hours per day was 13.95%. Education \geq Junior middle school, divorced/widowed/unmarried, 1000RMB > per capita monthly income \geq 500RMB, sitting >7.5 hours per day were negatively associated with low PA and being male, heavy smoking, fishery products, vegetables and fruits, moderate and light PA were negatively associated with sitting >7.5 hours per day.

Conclusion: Physical inactivity and SB were high in rural China. There is an increased need in promoting healthy lifestyle to rural population.

Clinical Trial Registration

The Henan Rural Cohort study has been registered at Chinese Clinical Trial Register (Registration number: ChiCTR-OOC-15006699). <http://www.chictr.org.cn/showproj.aspx?proj=11375>

Key words: physical activity; sedentary behavior; prevalence; rural population

Strengths and limitations of this study

- The study was focused on rural population.
- The study was based on a large sample.
- Enough potential confounding variables were included in this study.
- The study were based on a cross-sectional study.
- The questionnaire was a standard version.

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Introduction

Over the past few decades, epidemiologic studies have suggested that physical inactivity or sedentary behavior (SB) were risk factors for non-communicable diseases (NCDs), such as breast cancer [1], prostate cancer [2], cardiovascular diseases (CVD) [3], stroke [4], type 2 diabetes mellitus (T2DM) [5], and metabolic syndrome [6]. Moreover, a study ranging from eastern Mediterranean to western Pacific region showed that more than 5.3 million death would be avoided each year, if the inactive people become active [7]. In addition to the burden of disease, physical inactivity and SB also result in the substantial economic burden to patients and society, especially in rural areas with limited resources [8].

The prevalence of physically inactivity was about 31.1% all over the world, and varied by regions. For instance, the prevalence of physically inactivity was 43.3% in USA, while it was just 17.0% in southeast Asia [9]. Even in a country, the prevalence of physically inactivity also varies from region to region. In China, the prevalence of physically inactive was 63.1% in Shenzhen [10], and another study in Shanghai showed that only 18.4% of participants met physically activity (PA) [11]. Although previous studies had explored the prevalence of PA and SB among inhabitants of urban China, there is little evidence in rural areas of China that have undergone rapid socio-economic development [12]. Therefore, updating the prevalence and risk factors of PA and SB, and then evaluating the levels of PA and SB in rural areas of China are necessary to provide important evidence to generate strategy and promote PA in the population.

The objectives of the current study were: (1) to explore the prevalence of PA and SB, (2) to investigate potential influencing factors of PA and SB.

Methods

Settings and participants

This cross-sectional study was carried from 2015 to 2017 in five rural regions (Suiping, Yuzhou, Xinxiang, Tongxu, and Yima countries) of Henan province. The participants were permanent residents aged 18-79 years. 744 participants with deficient information about their PA and sitting time were excluded. Ultimately, 38515 participants with completed questionnaires, anthropometric measurements and blood tests were included in our analysis.

Data collection

The detail of the sampling process were previously reported [13]. Briefly, a multistage, stratified

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4 cluster sampling method was used. First stage, five rural counties were selected in Henan province
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6 of central, south, north, east, and west. Second stage, one to three rural communities (referred to
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8 as 'townships') in each county were selected. Last stage, all permanent residents who were 18-79
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10 years and signed informed consent were selected as the study sample. The information was
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12 collected by face-to-face interview. The data about general demographic characteristics, and
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14 lifestyles were included in a standard questionnaire. Educational level was classified into primary
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16 school or below and junior middle school or above, marital status into married/cohabitation and
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18 unmarried/divorced/widowed categories. In accordance with the smoking index of the World
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20 Health Organization (WHO) [14], the smoking status were divided into never smoking, light
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22 smoking, moderate smoking, and heavy smoking. According to daily alcohol intake of WHO [14],
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24 drinking was categorized into never drinking, light drinking, moderate drinking, and heavy
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26 drinking. According to Chinese dietary guidelines [15], dietary habits were evaluated from the four
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28 aspects of meat and poultry, fishery products, vegetables and fruits, and soy products. The waist
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30 circumference (WC), by a non-elastic tape to the nearest 0.1 cm, was measured at 1 cm above the
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32 navel in a horizontal plane. Height, using a wall-mounted ruler tape with an insertion buckle at
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34 one end to the nearest 0.1 cm, was measured twice without shoes. Body weight, using mechanical
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36 scale on a level surface to the nearest 0.1 kg, was measured once with the subjects in light clothing
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38 and barefoot [16]. Body mass index (BMI) was calculated as weight in kilograms divided by the
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40 square of height in meters.

41 **Ethical considerations**

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43 The purpose and the importance of the study were explained to the participants. Confidentiality
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45 of the information was maintained throughout the study by excluding personal identifiers from the
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47 data collection form.

48 **Patient and public involvement**

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50 Neither patients nor the public were involved in developing this project.

52 **Definitions**

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54 International Physical Activity Questionnaire (IPAQ) was used to assess the levels of PA and SB
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56 [17]. All the weekly time of vigorous activity, moderate activity and walking was calculated with the
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58 number of Mets in each category and average daily estimated. Mets reflected the energy expenditure
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60 specific for vigorous activity, moderate activity and walking. In this study, the Mets of vigorous

activity was 8; the Mets of moderate activity was 4; the Mets of walking was 3.3. The value of Mets was estimated by the sum of the three physical activities in one week. The PA categorized into three levels were light (physically inactive), moderate and vigorous [9, 18]. These categories were based on standard scoring criteria of IPAQ. The vigorous activity should meet either of the following two criteria: (1) vigorous activity was at least 3 days/week and the week of accumulating Mets was at least 1500 MET-minutes/week; (2) any combination of vigorous activity, moderate activity or walking at least 5 days/week and the accumulating Mets was at least 3000 MET-minutes/week. The moderate activity should meet either of the following four criteria: (1) moderate activity was at least 30 min in 5 days a week; (2) vigorous activity was at least 20 min in 3 days a week; (3) walking at least 30 min a day for 5 or more days a week; (4) the accumulating Mets, of any combination of moderate activity, vigorous activity or walking, was at least 600 MET-minutes/week in 5 or more days a week. The light activity category were for individuals who neither met vigorous nor moderate criteria. In addition, about the SB, the cut-point was set 7.5 hours [19, 20]. At same time, according the WHO, the PA was classified into insufficiently active, active, and highly active. Insufficiently active was doing some moderate- or vigorous-intensity physical activity but less than 150 minutes of moderate-intensity physical activity a week or 75 minutes of vigorous-intensity physical activity or the equivalent combination. Active is doing the equivalent of 150 minutes to 300 minutes of moderate-intensity physical activity a week. Highly active is doing the equivalent of more than 300 minutes of moderate-intensity physical activity a week [21, 22].

Statistical analysis

Continuous variables were presented as mean \pm standard deviation (SD). Differences between two groups were tested using t-test and more than two group were tested using ANOVA. Categorical variables presented as numbers and percentages were compared using chi-square test. Based on Chinese population data from 2010 census, direct standardization was used to calculate the age-standardized prevalence of Mets. The multinomial logistic regression models were used to calculate ORs and 95% CI between the potential factors and Mets. All statistical tests were two-tailed, and P value <0.05 was considered statistically significant. The data were analyzed using SAS9.1 software package (SAS Institute, USA) and R version 3.5.1.

Result

Demographic characteristics.

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4 Table1 showed the demographic characteristics of the 38515 participants aged from 18 to 79
5 years old. The mean (standard deviation, SD) age was 55.65(12.14) years. Overall, a total of 11510,
6 14672 and 12333 subjects were engaged in vigorous, moderate and light PA, respectively. Being
7 man, married/cohabiting, the smoking of light, moderate and heavy level and the drinking of light
8 and moderate were more common among vigorous activity participants, while older age,
9 widowed/single/divorced/separated, \leq Primary school, per capita monthly income \leq 500RMB, heavy
10 drinking were more prevalent among moderate PA participants. Among the 38515 participants,
11 29270 were sitting \leq 7.5 hours per day. Being women, married/cohabiting, \geq Junior school, 500RMB
12 $<$ per capita monthly income $<$ 1000RMB, never smoking and never drinking were more prevalent
13 in the subjects with sitting \leq 7.5 hours per day than sitting $>$ 7.5 hours per day ($p<0.001$).
14 Supplementary table 1 showed the demographic characteristics according to WHO.

25 **The sex-specific distributions of PA and sitting time according to age.**

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27 Figure 1 describes the sex-specific distribution of the Mets of PA and sitting time according to
28 age. The median of Mets for PA and sitting time were 7092 MET-minutes/week and 5 h.,
29 respectively. The median of Mets for PA and sitting time were 6558 MET-minutes/week, 7119
30 MET-minutes/week and 5 h, 5 h for men and women, respectively. The mean \pm standard deviation
31 (SD) of Mets for PA and sitting time were 7626.02 \pm 4229.32 MET-minutes/week and 5.70 \pm 3.23
32 h., respectively. The mean \pm SD of Mets for PA and sitting time were 7506.15 \pm 4524.75 MET-
33 minutes/week, 7704.20 \pm 4023.12 MET-minutes/week and 5.97 \pm 3.39 h, 5.53 \pm 3.12 h for men
34 and women ($P<0.001$), respectively. Notably, the sitting time of the men was higher women. The
35 50-59 age group had the highest Mets. The 70-79 age group had the highest sitting time.

44 **Prevalence of light PA and sitting $>$ 7.5 hours per day.**

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46 Supplementary table 2 displays the prevalence of light PA and sitting $>$ 7.5 hours per day among
47 various characteristics. The prevalence of light PA and sitting $>$ 7.5 hours per day were 32.02%
48 and 26.60%, and the corresponding age-standardized rates were 32.90% and 26.88%, respectively.
49 Subgroups study showed that the prevalence of low PA and sitting $>$ 7.5 hours per day were higher
50 in those who were younger or older, being men, Widowed/single/divorced/separated with lower
51 per capita monthly income, heavy smoking and drinking.

58 **Changes of light PA and sitting $>$ 7.5 hours per day in different subgroup.**

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60 Figure 2 presents that the age-standardized prevalence of light PA and sitting $>$ 7.5 hours per

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4 day changed with age in both sexes. The prevalence of light PA and sitting >7.5 hours per day
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6 decreased with age firstly and then increased. Men had higher probability of having high PA and
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8 sitting >7.5 hours per day than women in all the age groups. Supplementary figure 1 showed the
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10 age-standardized prevalence according to WHO.

11 **The percentage according to the cut-off points of PA and sitting time in different sexes.**

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13 Figure 3 shows the age-standardized percentage according to the cut-off points of PA and
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15 sitting time in different sexes. 17346 subjects (7434 men and 9912 women) had light PA or
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17 sitting >7.5 hours per day, and the corresponding age-standardized prevalence was 45.84%
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19 (48.99% in men and 43.98% in women). The age-standardized prevalence of participants with
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21 both light PA and single sitting >7.5 hours per day was 13.95% (15.68% in men and 12.93% in
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23 women). Supplementary figure 2 showed the age-standardized percentage according to the cut-off
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25 points of WHO and sitting time.

26 **Analysis of influencing Determinants.**

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28 Table2 describes the odds ratios (*ORs*) of potential influencing determinants association with
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30 light PA and sitting time >7.5 hours per day. Being women, 18-29 age group, level of education
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32 \geq Junior middle school, divorced/widowed/unmarried, 1000RMB >per capita monthly income \geq 500
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34 RMB, never smoking and drinking, and sitting time per day were significantly negatively associated
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36 with light PA; while being men, level of education \leq Primary school, per capita monthly income
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38 <500 RMB, heavy smoking and drinking, fishery products, vegetables and fruits were significantly
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40 negatively association with sitting >7.5 hours per day. Supplementary table 3 showed the potential
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42 influencing determinants according to WHO.
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Discussion

New insights of PA and SB were provided by the results from this large survey among rural population in Henan of China. Overall, the median levels of sitting time were higher in rural adults of China than the previous study of a 20-country comparison of sitting [23], and the percent levels of physical inactivity were higher in Chinese rural adults than the previous study of global PA levels [9]. There was an association of decreased PA with age firstly and then increased in the prevalence of light PA and sitting >7.5 hours per day. The percent individuals that had both light PA and sitting >7.5 hours per day were 15.68%, 12.93% and 13.95% in men, women and total, respectively. Further analysis of multiple logistic regression presented that gender, age, the level of education, marital status, smoking, drinking and vegetables intake were influencing factors for light PA and sitting >7.5 hours.

Previous studies had shown that the levels of physical inactivity and sedentary was high in urban China [10, 11]. Compared to urban area, the rural area stay a relatively low level. The different might be explained by the developmental level. The mean of Mets increased with age firstly and then at the age group of 50-59 decreased. While the sitting time was highest in 70-79 age group. It is likely that the decline in physical ability with age limits the PA and increase the sedentary nature of the elderly [24]. Furthermore, the aged might fear injuries, which was an-other reason to lead them into physical inactivity [25]. About PA, the subgroup analysis showed that under the various characteristics, the prevalence of vigorous PA was about 30%, moderate PA was about 40% and the light PA was about 30%. While about sitting time, under all the various characteristics, the sitting time ≤ 7.5 hours per day was about 70%. These results were similar to a Chilean study [23].

The results of co-existence of PA and sedentary behavior showed that light PA and sitting time >7.5 hours per day was 15.68%, 12.93% and 13.95 in men, women and total, respectively. It was similar with a study from Japan [26]. For these participants who were light PA and sitting time >7.5 hours per day, should take a measure to promote the PA.

Evidence showed that there were negative relationships between junior middle school or above, divorced/widowed/unmarried, per capita monthly income ≥ 500 RMB and meat and poultry consumption and moderate PA. Having a junior middle school or above, divorced/widowed/unmarried, 1000RMB > per capita monthly income ≥ 500 RMB, and sitting

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4 time per day >7.5 hours were negative association with light PA. For sitting >7.5 hours per day,
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6 the negative factors were being men, divorced/widowed/unmarried, heavy smoking, Fishery
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8 products and vegetable and fruits intake.

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10 The current study focused on the epidemiologic characteristics of PA and SB based on a
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12 relatively large sample size of rural population in Henan of China. Although a series of measures,
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14 such as standardized tools and training implementation, had been done to guarantee the
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16 authenticity, there were several limitations. First, these results were based on a cross-sectional
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18 study, so the causal relationships between factors and PA or SB could not be confirmed. Second,
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20 the responses were from self-reported data, which could distort real facts. Third, according to the
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22 actual rural circumstances, the residents who studied or worked in cities were not included in this
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24 study, so the prevalence of Mets might be over or under estimated in rural population. Fourth, the
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26 subjects of the present study had asymmetrical age structure, which might lead to potential bias of
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28 IPAQ. Fifth, according to the actual rural circumstances, the residents who studied or worked in
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30 city were not included in this study, so the prevalence of PA and SB might be overestimated in
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32 rural population. Although these limitations existed in the study, the relatively large
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34 epidemiological study also could reflect the prevalence of PA and SB in rural areas of China.

35 **Conclusion**

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37 This study suggests relatively higher prevalence of physical inactivity and SB among Chinese
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39 rural adults has emerged with economic and social transition. More attention should be given to
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41 the aged and drinking individuals who are at high risk of physical inactivity.

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46
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48
49 critical reading of the manuscript.

50 **Ethics approval and consent to participate**

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53 Ethics approval was obtained from the “Zhengzhou University Life Science Ethics Committee”,
54
55 and written informed consent was obtained for all participants. Ethic approval code: [2015] MEC
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57 (S128).
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4 The purpose and the importance of the study were explained to the participants. Information
5 confidentiality was maintained throughout the study by excluding personal identifiers from the
6 data collection form.
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8 9 **Consent for publication**

10 All authors consent for publication

11 12 **Conflict of interest**

13 The authors declared no conflict of interest associated with this manuscript.
14

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36 37 **Data sharing statement**

38 All relevant data are within the paper and its Supporting Information files. Contact to Dr.
39 Chongjian Wang (tjwcj2005@126.com) for additional information regarding data access.
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42 43 **Author Contributions**

44 C.J.W. and Y.M.W. conceived and designed the study. R.Q.T., Y.L.Q., L.J.S., H.J.Y., Z.X.M.,
45 X.T.L.,H.Q.Z., L.Y.Z., R.Y.L, and Y.K.W. coordinated data collection. Y.L.Q., L.J.S., H.J.Y.,
46 Z.X.M., X.T.L.,H.Q.Z., L.Y.Z., R.Y.L, and Y.K.W. conducted the analyses. R.Q.T. wrote the
47 manuscript. All co-authors critically revised the manuscript. All authors have approved the final
48 manuscript. All co-authors critically revised the manuscript. All authors have approved the final
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Table 1. Demographic characteristics of the participants

Variable	Overall (N=38515)	Physical activity			P	Sitting time per day		P
		Vigorous (N=11510)	Moderate (N=14672)	Light (N=12333)		≤7.5 hours (N=28270)	>7.5 hours (N=10245)	
Age(years), mean±SD	55.65±12.14	55.48±10.81	54.62±12.05	57.02±13.25	<0.001	55.46±11.93	56.17±12.68	<0.001
Sex, %(95%CI)					<0.001			<0.001
Women	60.52(60.03,61.01)	51.81(50.89,52.72)	70.90(70.16,71.63)	56.31(55.44,57.19)		62.21(61.65,62.78)	55.85(54.89,56.81)	
Men	39.48(38.99,39.97)	48.19(47.28,49.11)	29.10(28.37,29.84)	43.69(42.81,44.56)		37.79(37.22,38.35)	44.15(43.19,45.11)	
Marital status, %(95%CI)					<0.001			<0.001
Married/cohabiting	89.76(89.46,90.06)	91.81(91.31,92.31)	90.18(89.7,90.66)	87.35(86.76,87.94)		90.21(89.86,90.56)	88.52(87.9,89.14)	
Widowed/single/divorce d/separated	10.24(9.94,10.54)	8.19(7.69,8.69)	9.82(9.34,10.30)	12.65(12.06,13.24)		9.79(9.44,10.14)	11.48(10.86,12.10)	
Education, %(95%CI)					0.234			0.001
≤Primary school	44.86(44.36,45.35)	44.74(43.83,45.64)	44.45(43.64,45.25)	45.46(44.58,46.34)		44.33(43.75,44.91)	46.31(45.34,47.27)	
≥Junior school	55.14(54.65,55.64)	55.26(54.36,56.17)	55.55(54.75,56.36)	54.54(53.66,55.42)		55.67(55.09,56.25)	53.69(52.73,54.66)	
Per capita monthly income, %(95%CI)					<0.001			<0.001
≤500RMB	35.69(35.21,36.17)	36.22(35.34,37.10)	32.99(32.23,33.76)	38.40(37.54,39.26)		34.71(34.15,35.26)	38.40(37.46,39.34)	
500RMB~	32.86(32.39,33.33)	32.35(31.50,33.21)	33.80(33.03,34.56)	32.22(31.40,33.05)		34.38(33.83,34.94)	28.67(27.79,29.54)	
≥1000RMB	31.45(30.98,31.91)	31.42(30.58,32.27)	33.21(32.44,33.97)	29.38(28.57,30.18)		30.91(30.37,31.45)	32.93(32.02,33.84)	
Smoking, %(95%CI)					<0.001			<0.001
Never	72.76(72.31,73.20)	66.48(65.62,67.34)	80.21(79.56,80.85)	69.76(68.95,70.57)		74.03(73.52,74.54)	69.24(68.35,70.14)	
Light	5.59(5.36,5.82)	6.83(6.37,7.29)	4.26(3.93,4.59)	6.01(5.59,6.43)		5.66(5.39,5.93)	5.40(4.96,5.84)	
Moderate	4.54(4.34,4.75)	5.49(5.07,5.91)	3.44(3.15,3.74)	4.97(4.59,5.35)		4.43(4.19,4.67)	4.86(4.44,5.28)	
Heavy	17.11(16.73,17.49)	21.20(20.45,21.95)	12.09(11.56,12.62)	19.27(18.57,19.96)		15.88(15.46,16.31)	20.50(19.72,21.28)	

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3									
4									
5	Drinking, %(95%CI)				<0.001			<0.001	
6	Never	77.46(77.04,77.88)	71.74(70.92,72.56)	83.31(82.70,83.91)	75.84(75.08,76.59)		78.06(77.58,78.54)	75.79(74.96,76.62)	
7	Light	13.92(13.57,14.26)	17.94(17.24,18.64)	10.39(9.90,10.89)	14.35(13.73,14.97)		13.58(13.18,13.98)	14.84(14.15,15.52)	
8	Moderate	4.73(4.51,4.94)	5.80(5.38,6.23)	3.64(3.34,3.94)	5.01(4.63,5.40)		4.78(4.53,5.03)	4.58(4.17,4.98)	
9	Heavy	3.90(3.71,4.09)	4.52(4.14,4.90)	2.66(2.40,2.92)	4.80(4.42,5.18)		3.58(3.36,3.79)	4.79(4.38,5.21)	
10									
11	Dietary habits								
12	(Kg/Month), (mean ± SD)								
13									
14	Meat and poultry	1.32±1.32	1.21±1.28	1.40±1.35	1.33±1.33	<0.001	1.31±1.33	1.34±1.31	0.410
15	Fishery products	0.11±0.16	0.10±0.15	0.12±0.16	0.11±0.16	<0.001	0.11±0.16	0.13±0.17	<0.001
16	Vegetables and fruits	13.8±7.47	12.49±7.43	14.68±7.37	14.07±7.44	<0.001	13.27±7.23	15.24±7.91	<0.001
17	Soy products	0.48±0.64	0.41±0.60	0.49±0.65	0.53±0.67	<0.001	0.49±0.65	0.46±0.63	<0.001
18									
19	Height(cm), mean ± SD	159.69±8.20	160.65±8.24	158.62±7.84	160.07±8.43	<0.001	159.59±8.17	159.98±8.28	<0.001
20	Weight(kg), mean ± SD	63.48±11.14	63.92±10.86	62.44±10.76	64.30±11.72	<0.001	63.60±11.09	63.15±11.27	<0.001
21	BMI(kg/m ²), mean ± SD	24.84±3.57	24.72±3.46	24.77±3.50	25.03±3.73	<0.001	24.92±3.56	24.61±3.59	<0.001
22									
23	WC(cm), mean ± SD	84.07±10.41	83.65±10.03	83.44±10.19	85.22±10.90	<0.001	84.42±10.35	83.10±10.50	<0.001
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Table 2. Association of potential risk factors for physical activity and sitting time.

Factors	OR(95% CI)					
	Physical activity				Sitting time per day	
	Moderate ^a	Moderate ^b	Light ^a	Light ^b	>7.5 hours ^a	>7.5 hours ^b
Age(year)						
18-	1.00	1.00	1.00	1.00	1.00	1.00
30-	0.67(0.56,0.81)	0.70(0.58,0.85)	0.58(0.48,0.70)	0.63(0.51,0.76)	0.99(0.85,1.14)	1.04(0.89,1.22)
40-	0.49(0.41,0.57)	0.52(0.44,0.62)	0.42(0.36,0.50)	0.47(0.39,0.56)	0.91(0.79,1.04)	0.98(0.85,1.13)
50-	0.48(0.41,0.57)	0.52(0.44,0.61)	0.36(0.30,0.42)	0.39(0.33,0.47)	0.87(0.76,0.99)	0.94(0.82,1.09)
60-	0.45(0.38,0.52)	0.51(0.43,0.61)	0.46(0.39,0.54)	0.51(0.43,0.62)	0.89(0.78,1.02)	0.89(0.77,1.02)
70-79	0.62(0.52,0.74)	0.72(0.60,0.87)	1.13(0.95,1.35)	1.17(0.97,1.42)	1.34(1.17,1.54)	1.08(0.93,1.26)
Gender						
Women	1.00	1.00	1.00	1.00	1.00	1.00
Men	0.44(0.42,0.46)	0.46(0.43,0.50)	0.83(0.79,0.88)	0.76(0.70,0.83)	1.30(1.24,1.36)	1.25(1.16,1.35)
Education						
≤Primary school	1.00	1.00	1.00	1.00	1.00	1.00
≥Junior middle school	1.01(0.96,1.06)	1.07(1.01,1.14)	0.97(0.92,1.02)	1.27(1.20,1.35)	0.92(0.88,0.97)	0.85(0.81,0.90)
Marital status						
Married/cohabiting	1.00	1.00	1.00	1.00	1.00	1.00
Divorced/widowed/unmarried	1.22(1.12,1.33)	1.15(1.05,1.26)	1.62(1.49,1.77)	1.19(1.09,1.31)	1.20(1.11,1.28)	1.08(1.00,1.17)
Per capita monthly income						
<500 RMB	1.00	1.00	1.00	1.00	1.00	1.00
500RMB-	1.15(1.08,1.22)	1.16(1.09,1.23)	0.94(0.88,1.00)	1.08(1.01,1.15)	0.75(0.71,0.80)	0.79(0.75,0.84)
≥1000 RMB	1.16(1.09,1.23)	1.13(1.06,1.21)	0.88(0.83,0.94)	1.00(0.93,1.07)	0.96(0.91,1.02)	1.01(0.95,1.07)
Smoking						
Never	1.00	1.00	1.00	1.00	1.00	1.00

Light	0.52(0.46,0.58)	0.57(0.51,0.64)	0.84(0.75,0.93)	0.79(0.70,0.89)	1.04(0.93,1.16)	0.88(0.78,0.99)
Moderate	0.52(0.46,0.59)	0.61(0.54,0.69)	0.86(0.77,0.97)	0.85(0.75,0.97)	1.21(1.07,1.36)	1.02(0.90,1.16)
Heavy	0.47(0.44,0.51)	0.57(0.52,0.61)	0.87(0.81,0.92)	0.83(0.77,0.90)	1.41(1.33,1.51)	1.20(1.10,1.31)
Drinking,						
Never	1.00	1.00	1.00	1.00	1.00	1.00
Light	0.50(0.46,0.54)	0.64(0.59,0.69)	0.76(0.71,0.81)	0.80(0.74,0.87)	1.19(1.10,1.28)	0.98(0.90,1.06)
Moderate	0.54(0.48,0.61)	0.71(0.63,0.81)	0.82(0.73,0.91)	0.93(0.82,1.05)	1.08(0.96,1.22)	0.82(0.72,0.92)
Heavy	0.51(0.44,0.58)	0.70(0.61,0.81)	1.01(0.89,1.13)	1.10(0.96,1.27)	1.31(1.16,1.48)	1.06(0.93,1.21)
Dietary habits						
Meat and poultry	1.04(1.02,1.06)	1.08(1.06,1.10)	0.93(0.91,0.95)	1.01(0.99,1.04)	1.01(0.99,1.03)	0.95(0.93,0.97)
Fishery products	1.16(0.99,1.34)	0.97(0.82,1.16)	0.61(0.52,0.72)	0.76(0.63,0.93)	2.16(1.86,2.52)	2.21(1.87,2.60)
Vegetables and fruits	1.01(1.01,1.01)	1.01(1.00,1.01)	0.97(0.97,0.97)	0.96(0.96,0.97)	1.04(1.03,1.04)	1.05(1.04,1.05)
Soy products	0.91(0.88,0.94)	0.88(0.85,0.92)	0.74(0.71,0.77)	0.81(0.78,0.85)	0.91(0.87,0.95)	0.91(0.88,0.95)
Sitting time per day						
≤7.5 hours	1.00	1.00	1.00	1.00	-	-
>7.5 hours	1.34(1.25,1.42)	1.35(1.27,1.44)	3.68(3.47,3.91)	4.09(3.84,4.36)	-	-
Physical activity						
Vigorous	-	-	-	-	1.00	1.00
Moderate	-	-	-	-	1.34(1.25,1.42)	1.37(1.28,1.46)
Light	-	-	-	-	3.68(3.47,3.91)	4.08(3.83,4.34)

^awas a crude model;

^bwas a full model : adjusted for age, gender, education, marital status, per capita monthly income, smoking, drinking, and dietary habits.

Figure Legends

Figure 1. The violin chart of metabolic equivalence per week and sitting time per day according to gender and age. (a) is for metabolic equivalence per week; (b) is sitting time per day.

Figure 2. Changes in the age-standardized prevalence of physical activity and sitting time with aging in different gender. (a) is for light physical activity; (b) is for moderate physical activity; (c) is for vigorous physical activity. (d) is sitting time ≤ 7.5 hours per day; (e) is sitting time > 7.5 hours per day.

Figure 3. The age-standardized percentage according to the cut-off points of physical activity and sitting time in different gender. (a) is for total; (b) is for men; (c) is for women.

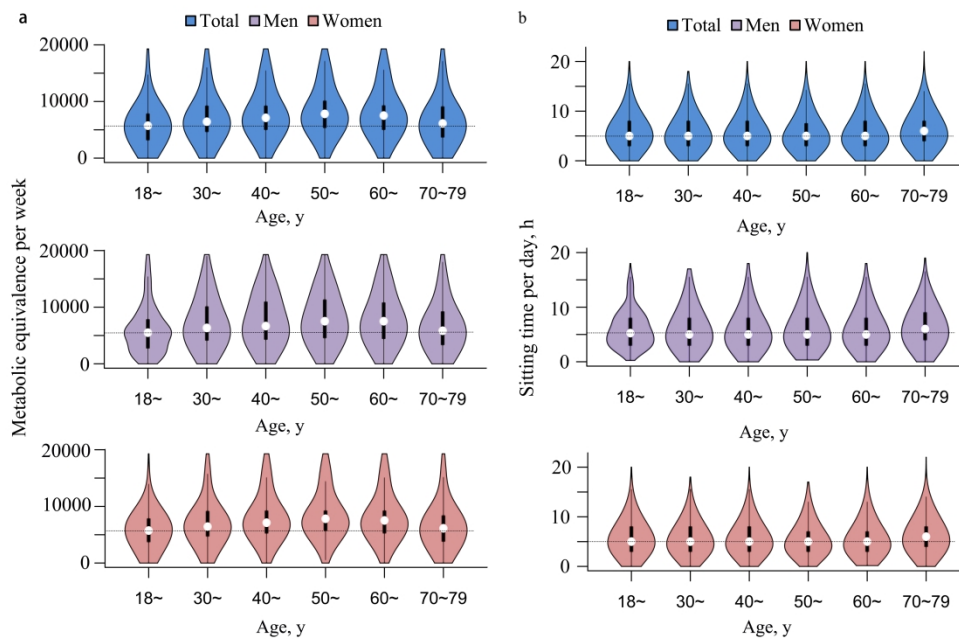


Figure 1. The violin chart of metabolic equivalence per week and sitting time per day according to gender and age. (a) is for metabolic equivalence per week; (b) is sitting time per day.

247x161mm (600 x 600 DPI)

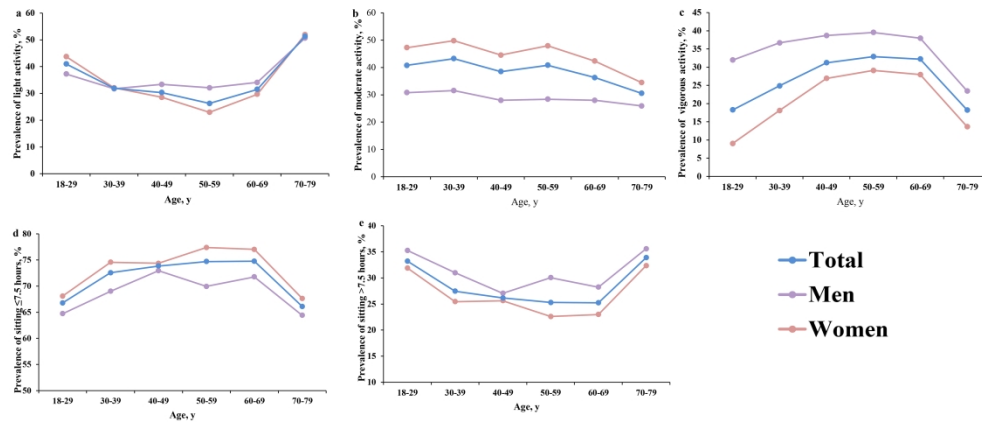


Figure 2. Changes in the age-standardized prevalence of physical activity and sitting time with aging in different gender. (a) is for light physical activity; (b) is for moderate physical activity; (c) is for vigorous physical activity. (d) is sitting time ≤ 7.5 hours per day; (e) is sitting time > 7.5 hours per day.

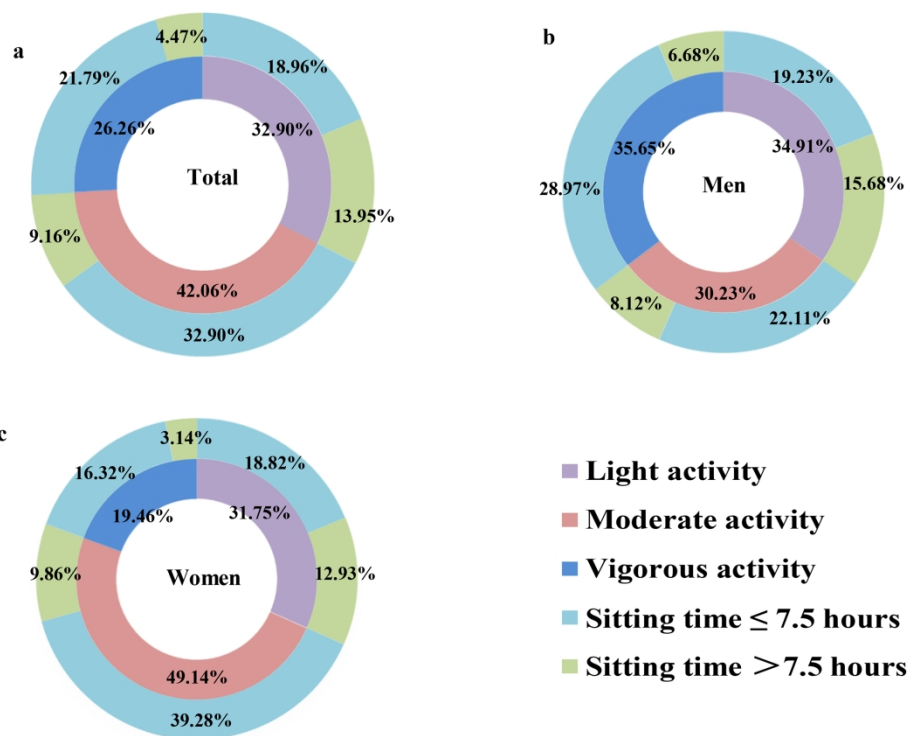


Figure 3. The age-standardized percentage according to the cut-off points of physical activity and sitting time in different gender. (a) is for total; (b) is for men; (c) is for women.

253x194mm (300 x 300 DPI)

Supplementary Table1. Demographic characteristics of the participants from WHO

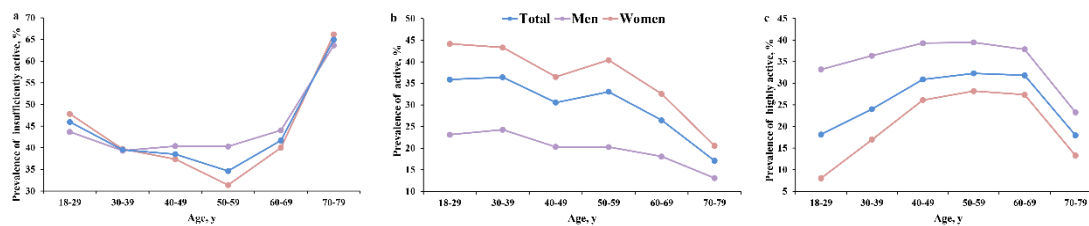
Variable	Physical activity(from WHO)			P
	Highly active (N=11341)	Active (N=11190)	Insufficiently active (N=15984)	
Age(years), mean \pm SD	55.51 \pm 10.8	53.57 \pm 11.91	57.2 \pm 12.95	<0.001
Sex, %(95%CI)				<0.001
Women	51.01(50.09,51.93)	74.49(73.68,75.29)	57.49(56.73,58.26)	
Men	48.99(48.07,49.91)	25.51(24.71,26.32)	42.51(41.74,43.27)	
Marital status, %(95%CI)				<0.001
Married/cohabiting	91.82(91.31,92.32)	91.55(91.03,92.06)	87.05(86.53,87.57)	
Widowed/single/divorced/separated	8.18(7.68,8.69)	8.45(7.94,8.97)	12.95(12.43,13.47)	
Education, %(95%CI)				0.234
\leq Primary school	44.69(43.77,45.60)	42.67(41.76,43.59)	46.51(45.74,47.28)	
\geq Junior school	55.31(54.40,56.23)	57.33(56.41,58.24)	53.49(52.72,54.26)	
Per capita monthly income, %(95%CI)				<0.001
\leq 500RMB	36.24(35.36,37.12)	31.74(30.88,32.61)	38.06(37.31,38.82)	
500RMB~	32.39(31.53,33.25)	33.81(32.93,34.68)	32.54(31.81,33.27)	
\geq 1000RMB	31.37(30.52,32.23)	34.45(33.57,35.33)	29.40(28.69,30.10)	
Smoking, %(95%CI)				<0.001
Never	65.89(65.02,66.77)	82.70(82.00,83.40)	70.67(69.96,71.38)	
Light	6.90(6.43,7.36)	3.88(3.52,4.24)	5.86(5.49,6.22)	
Moderate	5.59(5.17,6.01)	3.07(2.75,3.39)	4.83(4.50,5.16)	
Heavy	21.62(20.86,22.38)	10.35(9.78,10.91)	18.64(18.04,19.25)	
Drinking, %(95%CI)				<0.001
Never	71.33(70.50,72.17)	84.84(84.18,85.51)	76.63(75.98,77.29)	
Light	18.13(17.42,18.84)	9.30(8.76,9.84)	14.16(13.62,14.70)	
Moderate	5.93(5.50,6.37)	3.35(3.02,3.68)	4.83(4.50,5.16)	
Heavy	4.60(4.22,4.99)	2.50(2.21,2.79)	4.38(4.06,4.70)	
Dietary habits (Kg/Month), (mean \pm SD)				
Meat and poultry	1.34 \pm 1.33	1.42 \pm 1.34	1.23 \pm 1.3	<0.001
Fishery products	0.11 \pm 0.16	0.12 \pm 0.16	0.1 \pm 0.16	<0.001
Vegetables and fruits	14.06 \pm 7.44	14.7 \pm 7.33	12.98 \pm 7.5	<0.001
Soy products	0.53 \pm 0.67	0.5 \pm 0.64	0.43 \pm 0.62	<0.001
Height(cm), mean \pm SD	160.73 \pm 8.26	158.43 \pm 7.71	159.83 \pm 8.37	<0.001
Weight(kg), mean \pm SD	63.97 \pm 10.89	62.43 \pm 10.71	63.87 \pm 11.54	<0.001
BMI(kg/m ²), mean \pm SD	24.71 \pm 3.46	24.82 \pm 3.5	24.94 \pm 3.68	<0.001
WC(cm), mean \pm SD	83.65 \pm 10.04	83.46 \pm 10.18	84.8 \pm 10.76	<0.001

Supplementary Table 2. Prevalence of physical activity and sitting time about various characteristics

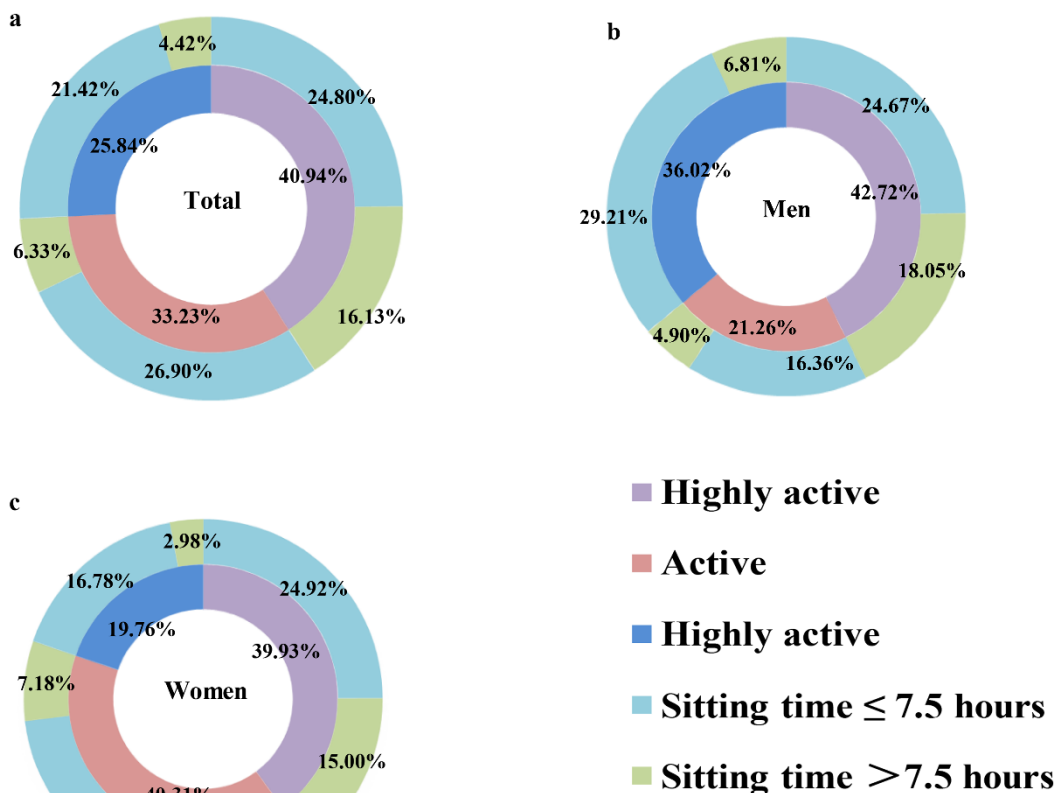
Variable	Physical activity			<i>P</i>	Sitting time per day		<i>P</i>
	Vigorous (N=11510)	Moderate (N=14672)	Light (N=12333)		≤7.5 hours (N=29270)	>7.5 hours (N=10245)	
Age, n (%)				<0.001			<0.001
18~	220(17.49)	558(44.36)	480(38.16)		910(72.34)	348(27.66)	
30~	685(25.19)	1172(43.10)	862(31.70)		1975(72.64)	744(27.36)	
40~	2275(31.71)	2807(39.13)	2092(29.16)		5327(74.25)	1847(25.75)	
50~	3539(33.36)	4320(40.73)	2748(25.91)		7965(75.09)	2642(24.91)	
60~	3861(31.99)	4358(36.11)	3849(31.89)		8996(74.54)	3072(25.46)	
70~79	930(19.83)	1457(31.07)	2302(49.09)		3097(66.05)	1592(33.95)	
Sex, n (%)				<0.001			<0.001
Women	5963(25.58)	10402(44.62)	6945(29.79)		17588(75.45)	5722(24.55)	
Men	5547(36.48)	4270(28.08)	5388(35.44)		10682(70.25)	4523(29.75)	
Marital status, n (%)				<0.001			<0.001
Married/cohabiting	10567(30.57)	13231(38.27)	10773(31.16)		25502(73.77)	9069(26.23)	
Widowed/single/ divorced/separated	943(23.91)	1441(36.54)	1560(39.55)		2768(70.18)	1176(29.82)	
Education, n (%)				0.234			0.001
≤Primary school	5149(29.81)	6521(37.74)	5607(32.45)		12533(72.54)	4744(27.46)	
≥Junior school	6361(29.95)	8151(38.38)	6726(31.67)		15737(74.10)	5501(25.90)	
Per capita monthly income, n (%)				<0.001			<0.001
≤500RMB	4169(30.33)	4841(35.22)	4736(34.45)		9812(71.38)	3934(28.62)	
500RMB~	3724(29.42)	4959(39.18)	3974(31.40)		9720(76.80)	2937(23.20)	
≥1000RMB	3617(29.86)	4872(40.23)	3623(29.91)		8738(72.14)	3374(27.86)	
Smoking, n (%)				<0.001			<0.001
Never	7652(27.31)	11768(41.99)	8603(30.70)		20929(74.69)	7094(25.31)	
Light	786(36.52)	625(29.04)	741(34.43)		1599(74.30)	553(25.70)	
Moderate	632(36.11)	505(28.86)	613(35.03)		1252(71.54)	498(28.46)	
Heavy	2440(37.03)	1774(26.92)	2376(36.05)		4490(68.13)	2100(31.87)	
Drinking, n (%)				<0.001			<0.001
Never	8257(27.68)	12223(40.97)	9353(31.35)		22068(73.97)	7765(26.03)	
Light	2065(38.53)	1525(28.45)	1770(33.02)		3840(71.64)	1520(28.36)	
Moderate	668(36.70)	534(29.34)	618(33.96)		1351(74.23)	469(25.77)	
Heavy	520(34.62)	390(25.97)	592(39.41)		1011(67.31)	491(32.69)	

Supplementary Table 3. Association of potential risk factors for physical activity and sitting time from WHO.

Factors	Physical activity from WHO			
	Active ^a	Active ^b	Insufficiently active ^a	Insufficiently active ^b
Age(year)				
18-	1.00	1.00	1.00	1.00
30-	0.67(0.55,0.80)	0.57(0.47,0.70)	0.64(0.53,0.76)	0.70(0.58,0.85)
40-	0.44(0.37,0.52)	0.48(0.40,0.59)	0.48(0.40,0.56)	0.54(0.46,0.65)
50-	0.45(0.38,0.54)	0.50(0.42,0.59)	0.41(0.35,0.49)	0.47(0.40,0.56)
60-	0.37(0.31,0.44)	0.48(0.40,0.57)	0.53(0.45,0.62)	0.63(0.53,0.75)
70-79	0.41(0.34,0.49)	0.69(0.57,0.83)	1.26(1.06,1.50)	1.43(1.19,1.72)
Gender				
Women	1.00	1.00	1.00	1.00
Men	0.36(0.34,0.38)	0.37(0.34,0.40)	0.77(0.74,0.81)	0.74(0.69,0.79)
Education				
≤Primary school	1.00	1.00	1.00	1.00
≥Junior middle school	1.09(1.03,1.14)	1.19(1.12,1.26)	0.93(0.89,0.98)	1.21(1.14,1.28)
Marital status				
Married/cohabiting	1.00	1.00	1.00	1.00
Divorced/widowed/unmarried	1.04(0.94,1.14)	1.14(1.03,1.26)	1.67(1.54,1.82)	1.51(1.39,1.65)
Per capita monthly income				
<500 RMB	1.00	1.00	1.00	1.00
500RMB-	1.19(1.12,1.27)	1.12(1.05,1.20)	0.96(0.90,1.01)	1.05(0.99,1.11)
≥1000 RMB	1.25(1.18,1.34)	1.14(1.06,1.22)	0.89(0.84,0.95)	0.98(0.92,1.04)
Smoking				
Never	1.00	1.00	1.00	1.00
Light	0.45(0.40,0.51)	0.89(0.80,1.00)	0.79(0.72,0.88)	1.02(0.91,1.15)
Moderate	0.44(0.38,0.50)	0.98(0.84,1.14)	0.81(0.72,0.90)	1.00(0.88,1.13)
Heavy	0.38(0.35,0.41)	0.89(0.80,1.00)	0.80(0.76,0.86)	0.92(0.84,1.00)
Drinking,				
Never	1.00	1.00	1.00	1.00
Light	0.43(0.40,0.47)	0.78(0.71,0.85)	0.73(0.68,0.78)	0.87(0.80,0.94)
Moderate	0.48(0.42,0.54)	0.90(0.78,1.03)	0.76(0.68,0.84)	0.96(0.85,1.08)
Heavy	0.46(0.39,0.53)	0.88(0.75,1.04)	0.89(0.79,1.00)	1.04(0.91,1.18)
Dietary habits				
Meat and poultry	1.05(1.03,1.07)	1.09(1.07,1.12)	0.94(0.92,0.96)	1.02(1.00,1.04)
Fishery products	1.25(1.06,1.46)	1.09(0.91,1.32)	0.65(0.56,0.76)	0.87(0.73,1.04)
Vegetables and fruits	1.01(1.01,1.01)	1.01(1.00,1.01)	0.98(0.98,0.98)	0.97(0.97,0.97)
Soy products	0.91(0.88,0.96)	0.87(0.84,0.91)	0.77(0.74,0.80)	0.83(0.80,0.86)
Sitting time per day				
≤7.5 hours	1.00	1.00	1.00	1.00
>7.5 hours	1.14(1.07,1.22)	1.18(1.10,1.27)	3.22(3.03,3.41)	3.53(3.32,3.75)



Supplementary Figure 1. Changes in the age-standardized prevalence of physical activity according to WHO with aging in different gender. (a) is for insufficiently active; (b) is for active; (c) is for highly active.



Supplementary Figure 2. The age-standardized percentage according to the cut-off points of physical activity from WHO and sitting time in different gender. (a) is for total; (b) is for men; (c) is for women.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	P1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	P2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	P4
Objectives	3	State specific objectives, including any prespecified hypotheses	P4
Methods			
Study design	4	Present key elements of study design early in the paper	P4, P5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	P4, P5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	P4, P5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	P5, P6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	P5, P6
Bias	9	Describe any efforts to address potential sources of bias	P6
Study size	10	Explain how the study size was arrived at	P4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	P6
		(b) Describe any methods used to examine subgroups and interactions	P6
		(c) Explain how missing data were addressed	P4
		(d) If applicable, describe analytical methods taking account of sampling strategy	P4
		(e) Describe any sensitivity analyses	
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	P4
		(b) Give reasons for non-participation at each stage	P4
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	P5
		(b) Indicate number of participants with missing data for each variable of interest	P5
Outcome data	15*	Report numbers of outcome events or summary measures	P4
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	P7, P8
		(b) Report category boundaries when continuous variables were categorized	P8
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	P8
Discussion			
Key results	18	Summarise key results with reference to study objectives	P9, P10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	P10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	P10
Generalisability	21	Discuss the generalisability (external validity) of the study results	P10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	P11

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.