Aging Clinical and Experimental Research (2020) 32:1985–1991
https://doi.org/10.1007/s40520-019-01410-4

ORIGINAL ARTICLE

Gender difference in the association of frailty and health care utilization among Chinese older adults: results from a population-based study

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Received: 2 September 2019 / Accepted: 2 November 2019 / Published online: 19 November 2019

Abstract

Background Frailty is a public health concern in the ageing population. Little is known about the role of gender in the relationship between frailty and health care utilization in older adults.

Aims The study aims to examine gender differences in the association between different frailty status and health care utilization among Chinese older people.

Methods A total of 7070 older adults (60+) from Shandong Province, China, were enrolled in this study. Frailty was assessed by frailty index constructed using 45 health deficits. Multivariate logistic regression models were employed separately for men and women to examine the impact of frailty on self-care, outpatient, and inpatient utilization.

Results Overall, the prevalence of frailty was 7.9% in older adults, with 7.1% and 8.3% in men and women, respectively. 49.4% respondents reported they had self-care in the previous 2 weeks, and women were more likely to have self-care than men. Being pre-frail and frail was significantly associated with utilization of all types of health care among older men and women, and the relationship was stronger in the frail groups than that in the pre-frail groups except for self-care. Respective odds ratios for outpatient utilization were higher in men than that in women.

Conclusions Frailty is a frequent condition in Chinese older adults. The association between frailty and health care utilization (except outpatient) tended to be stronger in women than men. The gender differences should be considered when designing the preventing or delaying the installation of frailty and geriatric care plans.

Keywords Older adults · Frailty · Health care utilization · Gender · China

Background

Population ageing is accelerating rapidly worldwide, according to a World Health Organization report, the proportion of the world's population over 60 years of age will nearly double, from 12% in 2015 to an estimated 22% by 2050 [1]. China's population has been rapidly ageing where 240.90 million (17.3%) people were aged 60 and above in 2017 [2] and this number is expected to rise to over 402 million by 2040 [3]. However, increasing longevity is being accompanied by an increased risk of suffering geriatric syndromes, rather than an extended period of good health, and foremost among the geriatric syndromes is the clinical condition of frailty [4]. It has been shown that frailty was a highly and increasingly prevalent condition in the ageing population, with estimated 4–59% of the population aged over 65 years identified as frail, depending on the definition of frailty used [5]. A recent nationally representative prospective study indicated that 7.0% of Chinese adults aged 60 years or older were frail measured by physical frailty phenotype (PFP) scale [6].

Many evidence showed that frail older adults were more at risk for adverse health outcomes, such as mortality [7, 8],

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s40520-019-01410-4) contains supplementary material, which is available to authorized users.

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and tend to be frequent users of health care system [9–11]. Health systems are striving to contain accurate information on care utilization by the cluster of aged people might help to prioritize interventions. Few studies have examined the relationship between frailty and health care utilization, finding in particular an increased primary and hospital care utilization and health care costs among frail older adults [10, 12–14]. However, the literature on the gender-specific patterns of association between frailty and health care utilization among the older adults is rather sparse. It is well known that women have higher FI scores than men at all ages [15], and older women had the greater utilization of health care services such as visiting medical practitioner and taking medications, nevertheless, for equal need, certain inequality was observed in hospital admission in that it proved less frequent among women [16]. In practice, it is recommended that frailty is identified and managed with integrated care planning considering gender difference [17, 18]. Accordingly, whether the impact frailty on different type of health care may differ between genders deserves to be explored. To our knowledge, currently there are no such in-depth and comprehensive analyses on Chinese samples.

Therefore, we attempt to fill the gap and estimate the prevalence of frailty and health care utilization, and to explore comprehensively the gender-specific impact of frailty on health care utilization, including self-care, outpatient care and inpatient care.

Methods

Data and Sample

The data were derived from the Survey of the Shandong Elderly Family Health Service, which was conducted by Shandong University in 2017. The detailed sampling and quality assurance measures have been described in a previously published paper [19]. In brief, a three-stage, stratified, random sampling scheme was used to ensure that samples are representative of the whole population of Shandong Province. In the first stage, six counties/districts were selected in Shandong Province. In the second stage, 18 villages and 18 communities were selected in sampled counties/districts. In the last stage, 7088 older individuals were identified. Of these, 18 did not complete the survey. In this study, all analyses are based on the final sample of 7070 older people.

Health care utilization

Health care utilization was measured by three binary variables, namely self-care utilization, outpatient utilization, and inpatient utilization. A record of self-care utilization was obtained by the question: "Have you ever been self-care (such as taking medication stored at home or purchased at a pharmacy) in the past 2 weeks before survey?" A record of outpatient visit was obtained by the question: "Have you ever visited a doctor in the past 2 weeks before survey?" A record of inpatient visit was obtained by the question: "Have you been hospitalized in the last year before survey?"

Frailty measurement

The frailty index (FI) of cumulative deficits was used to classify frailty in our study. The FI was first proposed by Rockwood and Mitnitski as a way to incorporate the multifaceted nature of frailty into an operational definition and has been validated in multiple studies worldwide [20, 21]. According to the standard procedure suggested by Searle and Rockwood [22], we used 45 health deficits to construct a FI (see Additional file 1). The overall FI included a range of variables: symptoms, activities of daily living (basic and instrumental), co-morbidities, psychological function and mental health. No variable had missing data. Then, the FI was calculated by summing all deficits and dividing by the total number of deficits ($n = 45$), with the FI ranging from 0 to 1. In this study, the FI was categorized into robust (FI scores<0.1), pre-frail (FI scores≥ 0.1 to <0.25) and frail (FI scores≥ 0.25) based on index scores. A FI of 0.25 has been proposed as the demarcation between 'fitness' and 'frailty' in older people [23].

Covariates

Data on the following demographic and socioeconomic variables were collected, including age, sex (male, female), marital status (married, not married/divorced/widowed or other), living arrangement, residence (rural, urban), education (no education, primary, junior, or above), personal yearly income and type of health insurance (Urban Employee Basic Medical Insurance, Urban and Rural Residents Basic Medical Insurance, others, or none).

Statistical analysis

We performed all analyses using SPSS 24.0 (IBM Crop, Armonk, NY, USA). The analyses first examined descriptive characteristics of the study population and tested gender differences using Chi-square tests. Comparisons of the utilization of three types of health care between frailty groups were conducted separately for men and women, and gender differences in self-care, outpatient utilization and inpatient utilization according to frailty status were also assessed through Chi-square tests. To further explore the association of frailty and health care utilization, multivariate logistic regressions were performed after controlling for the confounding

variables. The analysis was conducted separately for each gender, and odds ratios with 95% confidence intervals were estimated. A difference was considered statistically significant when $P < 0.05$.

Results

Participants' characteristics

According to Table 1, a total of 7070 people aged over 60 years were included in the study: 4224 (59.7%) were female, 5715 (80.8%) were married, and 5514 (78.0%) lived in rural areas. Women tended to be living alone and less educated, and reported lower income than men. The overall prevalence of frailty was 7.9% in older adults. Respective prevalence of being pre-frail and frail was higher in women than in men (39.3% vs 31.2%, 8.3% vs 7.1%, $P < 0.001$). In the previous 2 weeks before survey, 3490 (49.4%) respondents had self-care, and 1452 (20.5%) used outpatient care; in the previous 12 months, 1276 (18.0%) used inpatient care. Women were more inclined to using self-care (53.1% vs 43.7%, $P < 0.001$) and outpatient care (21.9% vs 18.6%, $P = 0.001$) than men.

Association between frailty and health care utilization

Compared with robust older people, individuals categorized as frail were more likely to use outpatient and inpatient care, whereas those who were pre-frail tended to use self-care (Table 2). Women in all frailty groups were more inclined to use self-care than men (43.8% vs 36.6%, 63.7% vs 55.8%, 62.2% vs 52.7%), while only women in robust group reported using outpatient care in significantly higher percentages than men (16% vs 12.5%, $P < 0.01$). Regarding inpatient utilization, gender difference was only found in pre-frail group, and men were more likely to use inpatient care than their counterparts (27.6% vs 23.1%, $P < 0.05$) (Fig. 1).

When the confounding variables were held constant, frailty was significantly associated with use of all types of health care in older adults (Table 3). In Model 1, the influence of being frail on self-care utilization was generally larger than that of being pre-frail in both men (2.180 vs 1.959) and women (2.206 vs 2.086). Additionally, respective odds ratios for self-care were higher in women than in men (2.206 vs 2.180 and 2.086 vs 1.959). Conversely, in Model 2, the association between being pre-frail and frail and outpatient utilization tended to be stronger in men than women (2.655 vs 1.879, 3.573 vs 3.226). In Model 3, being frail had a particularly stronger effect on women than men for inpatient utilization (3.687 vs 2.972).

Table 1 Characteristics of the study sample according to gender

Variables	Total *n* (%)	Men *n* (%)	Women *n* (%)	*P*
Observation	7070 (100)	2846 (40.3)	4224 (59.7)	
Age				< 0.001
60–64	1577 (22.3)	568 (20.0)	1009 (23.9)	
65–69	2129 (30.1)	818 (28.7)	1311 (31.0)	
70–74	1780 (25.2)	748 (26.3)	1032 (24.4)	
≥ 75	1584 (22.4)	712 (25.0)	872 (20.6)	
Marital status				< 0.001
Married	5715 (80.8)	2485 (87.3)	3230 (76.5)	
Single	1355 (19.2)	361 (12.7)	994 (23.5)	
Living arrangement				< 0.001
1	974 (13.8)	275 (9.7)	699 (16.5)	
2	4665 (66.0)	2055 (72.2)	2610 (61.8)	
≥3	1431 (20.2)	516 (18.1)	915 (21.7)	
Residence				< 0.001
Rural	5514 (78.0)	2366 (83.1)	3148 (74.5)	
Urban	1556 (22.0)	480 (16.9)	1076 (25.5)	
Education				< 0.001
No education	2270 (32.1)	491 (17.3)	1779 (42.1)	
Primary	2924 (41.4)	1294 (45.5)	1630 (38.6)	
Junior or above	1876 (26.5)	1061 (37.3)	815 (19.3)	
Income				< 0.001
Q1	1788 (25.3)	572 (20.1)	1216 (28.8)	
Q2	1771 (25.0)	718 (25.2)	1053 (24.9)	
Q3	1747 (24.7)	767 (27.0)	980 (23.2)	
Q4	1764 (25.0)	789 (27.7)	975 (23.1)	
Type of health insurance				0.006
UEBMI	1272 (18.0)	563 (19.8)	709 (16.8)	
URRBMI	5598 (79.2)	2214 (77.8)	3384 (80.1)	
Others	82 (1.2)	29 (1.0)	53 (1.3)	
None	118 (1.7)	40 (1.4)	78 (1.8)	
Frailty status				< 0.001
Robust	3966 (56.1)	1754 (61.6)	2212 (52.4)	
Pre-frail	2549 (36.1)	889 (31.2)	1660 (39.3)	
Frail	555 (7.9)	203 (7.1)	352 (8.3)	
Self-care				< 0.001
Yes	3490 (49.4)	1245 (43.7)	2245 (53.1)	
No	3580 (50.6)	1601 (56.3)	1979 (46.9)	
Outpatient				0.001
Yes	1452 (20.5)	528 (18.6)	924 (21.9)	
No	5618 (79.5)	2318 (81.4)	3300 (78.1)	
Inpatient				0.982
Yes	1276 (18.0)	514 (18.1)	762 (18.0)	
No	5794 (82.0)	2332 (81.9)	3462 (82.0)	

Single not married/divorced/widowed or others, *Income* personal yearly income, *Q1–Q4* quartile 1–4, quartile 1 is the poorest and quartile 4 is the richest, *UEBMI* Urban Employee Basic Medical Insurance, *URRBMI* Urban and Rural Residents Basic Medical Insurance

Table 2 Comparisons of utilization of three types of health care according to frailty status

	Robust	Pre-frail	Frail	*P*
Men				
Self-care				< 0.001
Yes	642 (36.6)	496 (55.8)	107 (52.7)	
No	1112 (63.4)	393 (44.2)	96 (47.3)	
Outpatient care				< 0.001
Yes	220 (12.5)	241 (27.1)	67 (33.0)	
No	1534 (87.5)	648 (72.9)	136 (67.0)	
Inpatient care				< 0.001
Yes	214 (12.2)	245 (27.6)	55 (27.1)	
No	1540 (87.8)	644 (72.4)	148 (72.9)	
Women				
Self-care				< 0.001
Yes	969 (43.8)	1057 (63.7)	219 (62.2)	
No	1243 (56.2)	603 (36.3)	133 (37.8)	
Outpatient				< 0.001
Yes	355 (16.0)	436 (26.3)	133 (37.8)	
No	1857 (84.0)	1224 (73.7)	219 (62.2)	
Inpatient				< 0.001
Yes	266 (12.0)	384 (23.1)	112 (31.8)	
No	1946 (88.0)	1276 (76.9)	240 (68.2)	

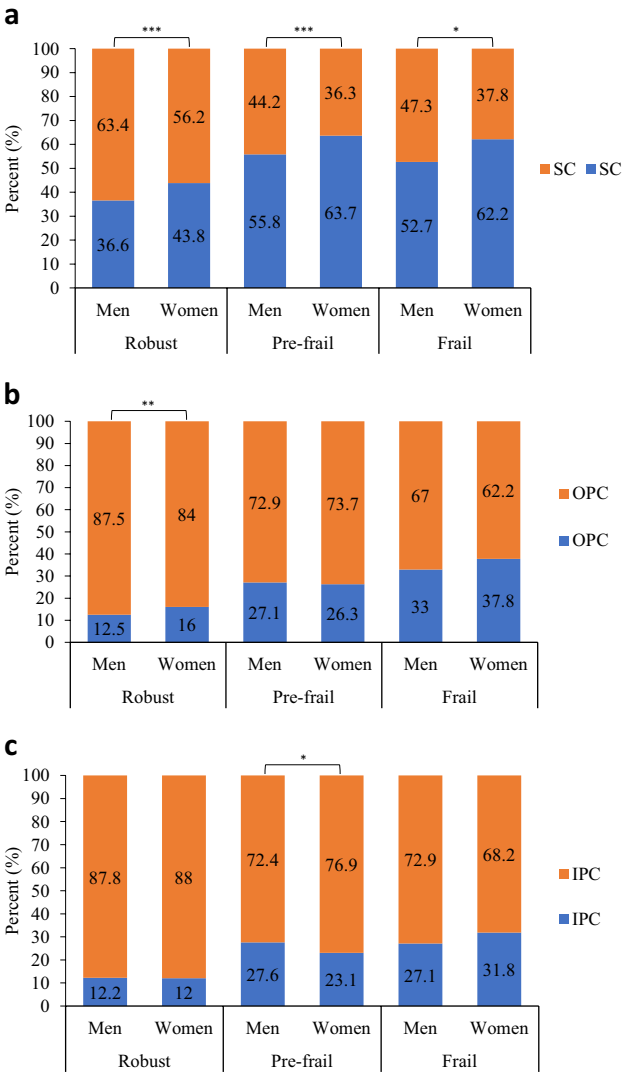

Fig. 1 Gender difference in health care utilization according to frailty status (*SC* self-care, *OPC* outpatient care, *IPC* inpatient care, $*P < 0.05$, $**P < 0.01$, $**P < 0.001$.)

Discussion

This study investigated the prevalence of frailty and explored, for the first time, gender difference in the association between frailty and health care utilization among Chinese older adults. We observed women were more likely to use self-care than men, and the influence of frailty on self-care and inpatient utilization tended to be stronger in women. However, the relationship between frailty and outpatient utilization was grater in men.

The overall prevalence of frailty was 7.9% in our study, slightly lower than previous studies using the FI to classify frailty [24–26], but similar to another large cross-sectional study that found the prevalence of frailty to be 7.0% using the PFP scale [6]. In general, the wide variation in frailty prevalence estimates is unsurprising owing to different: study designs, operational definition, study population, and geographical locations where it is explored. As the systematic review reported, the prevalence of frailty varies enormously (range 4.0–59.1%), where the weighted prevalence was 9.9% for physical frailty and 13.6% for the broad phenotype of frailty [5]. Of note, we observed women tend to be pre-frail or frail than men, which was supported by well-known evidence from previous studies [15, 27, 28]. This is not unexpected given that women have lower baseline levels of muscle mass and lower levels of neuroendocrine and hormonal factors [29], and older women are more sensitive to muscle strength alterations throughout ageing [30, 31]. In addition, compared with age-matched men, older women have greater co-morbidity, geriatric syndromes and disability [32], which means they may accumulate more deficits that predispose them to reaching frailty.

Our results also concluded that older adults relied heavily on self-care. This finding was consistent with previous researches that found people may tend to using self-care when the disease was not very severe [33, 34], especially for the elderly [35, 36] who relied more on self-care to save the economic and time cost involved in seeking professional health care. Additionally, the number of retail pharmacies in urban and rural areas has increased rapidly and has reached nearly 0.23 million in 2016 [37], which highly improved the accessibility of pharmacies and medicine. Moreover, we

Table 3 Multivariate logistic regression of the association between frailty and health care utilization in men and women, controlling for covariates

	Self-care (Model 1)		Outpatient (Model 2)		Inpatient (Model 3)	
	Men	Women	Men	Women	Men	Women
	OR 95% CI		OR 95% CI		OR 95% CI	
Frailty						
Robust	1	1	1	1	1	1
Pre-frail	**2.180 (1.845, 2.576)*****	**2.206 (1.932, 2.518)*****	**2.655 (2.156, 3.269)*****	**1.879 (1.601, 2.206)*****	**2.860 (2.317, 3.530)*****	**2.273 (1.906, 2.710)*****
Frail	**1.959 (1.457, 2.634)*****	**2.086 (1.649, 2.639)*****	**3.573 (2.564, 4.978)*****	**3.226 (2.513, 4.143)*****	**2.972 (2.094, 4.219)*****	**3.687 (2.820, 4.820)*****
Age						
60–64	1	1	1	1	1	1
65–69	1.157 (0.923, 1.450)	1.164 (0.981, 1.381)	1.092 (0.816, 1.463)	1.116 (0.908, 1.370)	1.027 (0.759, 1.390)	**1.285 (1.017, 1.624)***
70–74	1.173 (0.928, 1.482)	**1.303 (1.083, 1.569)****	1.243 (0.923, 1.676)	1.073 (0.859, 1.340)	1.305 (0.960, 1.773)	**1.376 (1.073, 1.765)***
≥ 75	1.009 (0.792, 1.287)	**1.281 (1.046, 1.569)***	0.953 (0.695, 1.307)	0.804 (0.626, 1.033)	**1.452 (1.062, 1.985)***	**1.530 (1.170, 2.001)****
Marital status						
Married	1	1	1	1	1	1
Single	1.383 (0.959, 1.997)	1.018 (0.803, 1.291)	1.442 (0.923, 2.253)	1.187 (0.893, 1.578)	1.309 (0.833, 2.057)	0.834 (0.607, 1.145)
Living arrangement						
1	0.809 (0.533, 1.228)	1.016 (0.784, 1.318)	0.678 (0.398, 1.154)	0.854 (0.622, 1.171)	0.795 (0.472, 1.338)	1.019 (0.720, 1.441)
2	1.115 (0.907, 1.371)	1.113 (0.943, 1.314)	1.310 (0.995, 1.725)	1.242 (1.011, 1.525)	0.981 (0.749, 1.285)	1.149 (0.917, 1.439)
≥ 3	1	1	1	1	1	1
Residence						
Rural	0.883 (0.661, 1.179)	0.857 (0.688, 1.067)	0.970 (0.666, 1.412)	**1.594 (1.207, 2.105)****	0.978 (0.678, 1.411)	1.307 (0.973, 1.755)
Urban	1	1	1	1	1	1
Education						
No education	1.080 (0.850, 1.371)	**1.297 (1.060, 1.587)***	0.962 (0.708, 1.307)	1.119 (0.875, 1.432)	0.948 (0.696, 1.290)	1.218 (0.934, 1.587)
Primary	0.977 (0.815, 1.170)	1.181 (0.981, 1.422)	0.988 (0.785, 1.245)	1.128 (0.897, 1.419)	0.839 (0.664, 1.060)	0.989 (0.776, 1.261)
Junior or above	1	1	1	1	1	1
Income						
Q1	1.170 (0.881, 1.554)	0.850 (0.671, 1.078)	0.801 (0.553, 1.160)	**0.629 (0.474, 0.833)****	**0.411 (0.285, 0.593)*****	**0.339 (0.252, 0.457)*****
Q2	**1.320 (1.007, 1.729)***	0.923 (0.723, 1.178)	0.998 (0.707, 1.410)	**0.678 (0.508, 0.904)****	**0.503 (0.358, 0.706)*****	**0.363 (0.267, 0.493)*****
Q3	1.205 (0.931, 1.559)	0.950 (0.755, 1.196)	1.239 (0.895, 1.717)	0.905 (0.689, 1.187)	0.751 (0.549, 1.028)	**0.577 (0.435, 0.766)*****
Q4	1	1	1	1	1	1
Type of health insurance						
UEBMI	1	1	1	1	1	1
URRBMI	1.614 (0.805, 3.237)	1.121 (0.883, 1.423)	1.700 (0.618, 4.681)	0.985 (0.734, 1.320)	1.316 (0.480, 3.607)	1.017 (0.754, 1.372)
Others	1.116 (0.579, 2.150)	**0.536 (0.295, 0.972)***	1.694 (0.644, 4.457)	1.155 (0.569, 2.345)	1.801 (0.684, 4.742)	**0.345 (0.121, 0.989)***
None	0.956 (0.349, 2.621)	1.055 (0.644, 1.729)	1.538 (0.385, 6.134)	1.006 (0.547, 1.851)	1.058 (0.249, 4.501)	0.462 (0.204, 1.046)

OR odds ratio, *CI* confidence interval, *Single* not married/divorced/widowed or others, *Income* personal yearly income, *Q1–Q4* quartile 1–4, *UEBMI* Urban Employee Basic Medical Insurance, *URRBMI* Urban and Rural Residents Basic Medical Insurance

Bold values highlight statistical significance,*$P < 0.05$, **$P < 0.01$, **$P < 0.001$

found women were more likely to use self-care than men. Previous evidence indicated that older women were more knowledgeable about different approaches to self-care, and they were more committed than men to home remedies or over-the-counter medications [38]. In the cultural and social atmosphere of China, older females take on larger roles and responsibility in taking care of their partner and children, they place greater priority on self-care over professional care for common problems [39]. However, such behaviour is associated with potential risk if greater commitment to self-care forestalls receipt of more effective care [40]. Therefore, the establishment of a robust pharmacovigilance

system should be considered, in which pharmacists play an important role in providing professional advice to patients.

Our finding that pre-frail or frail older adults had higher odds risk of using outpatient and inpatient care was in line with some findings [41, 42] and with another study which found frailty predicted utilization of many types of health care services, specifically visits to an outpatient clinic and hospital admissions [43]. Importantly, we found the influence of frailty on outpatient utilization tended to be stronger in older men, whereas the influence for inpatient utilization was greater in older women. Generally, across the lifespan, women accumulated deficits at a higher rate than men but tolerated them better [44]. Although women report a greater desire for seeing physicians, women's use of outpatient care can be limited and affected more significantly by economic status [45]. They seem to be more willing to turn to self-care rather than professional care until their diseases were very severe, which may result in more health risk and higher frequency of admission when they become frailer. Such a comment may be viewed as speculative, but the important evidence indicating that the effect of frailty on risk of death was strongest in the frailest women has been confirmed [17]. Considering the burden and the various adverse outcomes associated with frailty in ageing population, implementing the gender-specific screening and multidisciplinary treatments of frailty is crucial.

Some limitations of this study should be mentioned. First, this study is limited by the cross-sectional design which allows the interpretation of associations rather than causation; Second, the measure of frailty we used was based upon the "frailty as an accumulation of deficits", and other models of frailty, such as the "frailty as a phenotype", may show different associations. And third, the data on health care utilization were self-reported by participants, which may generate recall bias.

Conclusions

In summary, frailty is highly prevalent health condition among Chinese elderly. Women were more likely to be frail and use self-care than men. Also, our findings emphasize that frailty is strongly associated with health care utilization in older population and the impact varies between genders. Therefore, gender-specific frailty interventions and integrated care plans will be needed to reduce the various adverse burden on older people.

Author contributions ZJ designed the study, performed the statistical analysis and drafted the initial manuscript, LZ and SL provided the concept and design of study and provided intellectual input into article. JJ and WZ were involved in the analysis and interpretation of data and revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

Funding Our work was supported by two grants of National Natural Science Foundation of China (Grant numbers: 71673169 and 71673170).

Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

Ethical approval This study was approved by the Academic Research Ethics Committee of Shandong University. In addition, this study was performed in accordance with the ethical principles of the Declaration of Helsinki.

Informed consent Informed consent was obtained from all individual participants included in the study.

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