



Research article

Social network effect on land transfer willingness of the rural elders: Evidence from China

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ABSTRACT

The elders in China's rural areas are facing challenges in maintaining agricultural production due to the outflow of rural laborers. The Transfer of land could alleviate the burden of land-based livelihoods for rural elders, but their decisions regarding land transfer are influenced by their social networks within the context of Chinese rural society. This study investigates how social networks impact the willingness of rural elders to transfer land. Using survey data from 782 rural elders in 32 villages across 11 provinces in China, this paper applies multilinear and binary logistic regression models. The results indicate that the willingness of rural elders to transfer land is affected by their social network: (1) Internal network scale, network heterogeneity, and frequency of external network relationships have a significantly positive influence on rural elders' willingness to transfer land, while frequency of internal network relationships has a significantly negative influence. (2) There are group differences in the above impacts, and these significant impacts occur only among male elderly individuals aged 60–69 years old or living in central and western regions. (3) Social networks primarily influence rural elders' willingness to transfer land through three mechanisms: information consultation, interpersonal trust, and material resource acquisition. A larger internal social network scale, higher heterogeneity within the network, and more frequent interactions with members of external networks lead to greater access to useful information, higher levels of trust in others, increased material resources availability, and an increased likelihood of transferring land. These findings can inform government policies aimed at improving practices related to land transfers and old age security for rural elders.

1. Introduction

In many countries, land transfer has been developed in response to rapid urbanization, industrialization, and labor force transfer. However, amidst China's urbanization, land transfer faces challenges such as rural labor outflow and population aging, where land refers to farmland. Since 2000, a large number of young and middle-aged laborers from rural China have migrated to urban areas due to the ongoing process of urbanization. In 2020, approximately 510 million people in China resided in rural areas, with 170 million (33.33 %) working away from their hometowns [1]. Chen et al. [2] projected a 45 % decrease in China's rural labor force between

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2010 and 2030, while urban labor is expected to increase by 34 %. Furthermore, the rural population in China is aging at a faster rate compared to urban areas. According to China's seventh national census, the proportion of elderly individuals aged 60 years and over in rural areas reached 23.81 % in 2020, nearly 8 % higher than in cities [3]. The acceleration of land transfer among the rural elderly has been driven by the phenomena of rural hollowing and accelerated aging. The younger generation of rural laborers are increasingly reluctant to participate in agricultural production, while the elderly lack sufficient farming capacity as a result of physical and technical capabilities, leading to unsustainable farmland management.

Since the initiation of national reform and opening up in 1978, the Chinese government has progressively expanded rural land reform and implemented measures that have significantly facilitated land transfer and enhanced agricultural production efficiency [4]. The household contract responsibility system (HCRS), which separates ownership and management rights for land property, was first introduced in China in 1978. This system involves agricultural management, which combines centralization and decentralization. The term "centralization" refers to the ownership of the village collective, whereas "decentralization" refers to the management rights of the family. Subsequently, farmers were granted land management rights. The 1988 amendment to the Constitution of the People's Republic of China included a clause allowing for the lawful transfer of land management rights. The People's Republic of China's Law on Rural Land Contracting, enacted in 2002, explicitly permits the transfer of contracted land without affecting its designated purpose. Consequently, China's land transfer rate increased from 2.6 % in 1996 to 35.1 % in 2016. The data from China's third agricultural census in 2016 revealed that 96 % of agricultural households were small-scale farmers operating in a decentralized manner, while only 4 % operated on a large scale. Additionally, it was found that 33.6 % of agricultural operators are aged 55 and over [5]. Therefore, investigating the willingness of Chinese rural elders to transfer their land holds significant practical implications.

From both theoretical and practical perspectives, land transfer encompasses two directions: land transfer-out and land transfer-in. However, this study exclusively focuses on land transfer-out and does not address land transfer-in; the term "land transfer" specifically refers to land transfer-out. Previous studies have demonstrated that land transfer has a positive impact on economic and social development. A well-functioning land transfer market can reduce the incidence of land abandonment, particularly in underdeveloped areas [6]. Land transfer also facilitates the realization of economies of scale in agriculture and enhances agricultural production efficiency, thereby promoting sustainable agricultural development [7,8]. Rural land transfer also contributes to improving women's household status [9]. Furthermore, studies have indicated that reducing farmers' attachment to their land can expedite the pace of land transfer [10]. With the comprehensive implementation of basic endowment insurance for urban and rural residents in China, the dependence of rural elders on land can be reduced, and a reasonable land rent can serve as compensation for the loss of land [11]. The combination of these factors includes the migration of young people from rural areas, the decreasing ability of elderly individuals in rural areas to maintain their land, and the reliance on endowment insurance as a primary source of livelihood, which incentivizes rural elders to transfer land.

The predominant focus of land transfer research lies in the willingness of farmers to transfer their land and the factors influencing this decision. Chen et al. [12] found that 56.46 % of farmers in China are willing to transfer their land. Factors such as farmers' traits [13], family status [14], land endowment [15], risk expectations, and cognitive level [16] have been identified as influencing the willingness to transfer land [17]. The increasing proportion of non-agricultural income and its stability have also been shown to enhance farmers' willingness to transfer land [13,18]. Furthermore, cultural factors such as language have also been observed to impact how farmers transfer their land, with a preference for transferring land to neighbors who speak the same dialect [19]. Studies examining the relationship social pension, medical insurance, and farmers' willingness to transfer land indicate that insured farmers are more likely than uninsured ones to do so [20]. Wang et al. [21] revealed that farmers' inclination towards transferring their land is influenced by their perception of the value of land transfers, familiarity with regulations on land transfer, and advice from reputable locals or family members. Li and Zhong [22] found that confirming land rights can increase farmers' readiness to transfer their lands by reducing uncertainty. In addition, Gao et al. [23] identified a herd effect in the land transfer behavior of Chinese rural residents, wherein individual land transfer decisions were influenced by the collective behavior of other individuals within the village.

The existing studies have offered explanations for farmers' land transfer based on personal characteristics, family characteristics, cognitive level, risk expectation, cultural environment, and social security system. However, the impact of social network on land transfer intention has not been thoroughly explored in existing studies. In China, rural areas are characterized by a typical social pattern of acquaintances, which creates social networks that strongly influence farmers' decisions [24]. Social networks can bring material resources [25], information resources [26], and spiritual support that are crucial for individual decision-making [27]. The study contributes to broadening the application scope of social network theory and elucidating the influencing factors on rural elderly people's willingness to transfer land. The findings of this study will also facilitate the improvement of land transfer policies and old age security policies in China and other countries, alleviate the agricultural burden on elderly people, enhance economic support for the elderly, and promote large-scale land management. The specific research ideas in this paper are as follows: Firstly, a binary logistic regression model was utilized to examine the impact of social networks on the willingness of rural elderly to transfer their land and the heterogeneity of their group. Subsequently, binary logistic regression models and multilinear regression models were constructed to investigate the mechanisms and pathways through which social networks influence land transfer among rural elderly. Lastly, recommendations for enhancing land transfer policies were proposed based on the study's findings.

The contributions of our study to this research field are as follows: (1) The focus of this study is on rural elders, and examining rural land transfer from the perspective of elderly individuals holds practical significance for enhancing the likelihood of rural land transfer and improving agricultural production efficiency; (2) The research adopts a novel perspective by analyzing the impact of four dimensions of social network scale, network heterogeneity, the frequency of internal network relationships, and the frequency of external network relationships on the willingness of rural elders to transfer land in the context of acquaintance society in rural China from a social network perspective. (3) The research content is innovative, as it categorizes rural elderly into groups based on gender,

age, and region to further explore the differential effects of social networks on land transfer among different elderly groups in rural areas. (4) The research mechanism is original by selecting three relevant mediating variables - information consultation, interpersonal trust, and material resource acquisition - to analyze their impact on rural elders' willingness to transfer land through social networks.

2. The concept of social network and its relationship with rural land transfer

Social networks are composed of diverse interpersonal networks, encompassing two key dimensions: structure and relationship strength. The structure dimension is primarily assessed through indicators such as network scale, density, and heterogeneity, while relationship strength refers to the frequency of interactions and the level of intimacy between individuals [28]. In rural China, social networks are formed through the interaction of blood ties, kinship, geography, and occupation, exhibiting characteristics of small-world networks [29,30]. Many economic activities among Chinese farmers take place within their family or local residents, with transactions often occurring through acquaintances [24]. According to rational smallholder theory, farmers seek out sufficient information and engage in transactions within a trustworthy environment in order to adhere to the principle of profit maximization when making decisions [31]. Social networks can assist farmers in obtaining information, building trust, and serving as implicit guarantees [32,33]. In Chinese rural society where "guanxi" (interpersonal relationships) holds significant value, social networks may impact farmers' economic behaviors related to land transfer [30]. The theory of planned behavior posits that individual behavior is influenced by its behavioral intention. In conclusion, social networks continue to impact farmers' land transfer behavior by shaping their willingness to transfer. The influence mechanism of social networks encompasses three primary pathways (information transmission, trust promotion, and resource access) and two dimensions (relationship structure and relationship strength).

Firstly, social networks serve as conduits for transmitting information [34]. They can play an essential role in assisting rural elders in accessing the necessary information and resources to make informed decisions [35,36]. It has been demonstrated that the larger an individual's social network scale, the higher the network heterogeneity, leading to increased access to diverse information and greater susceptibility to multicultural influence [37,38]. Therefore, for rural elders with conservative beliefs and limited openness to new ideas, a larger social network scale or higher network heterogeneity results in increased quantity and variety of information obtained, greater acceptance of new ideas, and stronger willingness to transfer land. The frequency of interaction within social networks determines the flow of information [39]. Thus, the frequency of network relationships becomes a crucial indicator affecting both the quantity and quality of information obtained from social networks. Specifically, there are two types of social network relationships: internal (family members and close relatives) and external (less frequent communication). External network relationships surpass internal ones by providing new, non-repetitive information and resources [40]. Therefore, by enhancing both the quantity and quality of information received, social networks can improve cognitive abilities among rural elders while reducing their fear of unknown risks which in turn affects their willingness to transfer land.

Secondly, social networks play a crucial role in fostering interpersonal trust [41]. Rural areas in China are characterized by a society based on personal connections, leading to numerous informal aspects in the rural land rental market [29]. Many land transfer transactions take place between acquaintances within the same village [42]. It is evident that the willingness of rural elders to transfer land is linked to the level of interpersonal trust within their social network, which stems from interpersonal interactions. The higher the frequency of interaction between rural elders and members of their social networks, the higher their level of interpersonal trust [43]. An increase in interpersonal trust can reduce transaction costs, such as information gathering and contract oversight in rural elders' land transactions, thereby making them more inclined to transfer land to individuals they trust.

Thirdly, social networks serve as a covert channel for resource acquisition [44,45]. The larger the scale of social networks, the greater the availability of resources [46]. With the expansion of social networks, increased material and economic support for rural elders reduces their reliance on land for their livelihoods, thereby increasing the likelihood of land transfer [30]. Social network heterogeneity also positively contributes to access to material support; the greater the heterogeneity in rural elders' social network, the wider variety of resources they obtain [31,47]. Both internal and external network relationships within social networks function as avenues for resource access [48]. Increased communication frequency between rural elders and network members leads to more resource exchanges and reciprocal behaviors. This results in higher satisfaction with material needs, reduced dependence on land for livelihoods, and an increased propensity to transfer land.

In general, the three dimensions of social network scale, network heterogeneity, and the frequency of communication within network relationships directly impact rural elders' information transmission, interpersonal trust, and resource acquisition while indirectly influencing their willingness to transfer land. A larger network scale, greater network heterogeneity, and increased communication frequency within network relationships lead to a higher quantity and diversity of available information for rural elders, an elevated level of interpersonal trust, an increased likelihood and quantity of material resource acquisition, as well as a heightened willingness to transfer land.

3. Materials and methods

3.1. Data description

The data used in the statistical analyses were gathered through a farm household survey carried out by a research team from Northwest University during 2019–2020. The survey specifically examined the willingness of the rural elders towards transfer land. Employing a multi-stage stratified sampling method that prioritized geographic representation [18,49,50], the survey followed these sampling steps: Initially, 3–4 representative provinces were randomly chosen in China's eastern, central, and western regions. In

China, population distribution and land transfer are correlated with the economic development level of these three major regions, exhibiting certain regularities. The closer to the east, the higher the economic and social development, the denser the population distribution, the lower the reliance on land, and the greater degree of land transfer. Secondly, 1–3 representative cities were randomly selected in each province. Thirdly, 1–2 districts and counties were randomly selected in each city. Finally, 1–6 villages were randomly selected in each district and county, and 30 rural elders aged 60 and above being randomly chosen in each village. In total, a sample of 1169 rural elders from 11 provinces, 19 cities, and 32 villages were included in the survey. After excluding 32 invalid response samples (including one from Shandong Province, 12 samples from Jiangsu Province, and 19 samples from Xinjiang Uygur Autonomous Region), a total of 1137 valid questionnaires were collected with an effective response rate of 97.3 % (see Table 1 and Fig. 1). After excluding questionnaires from rural elders whose land had been requisitioned and those who had not rented other people’s arable land, a total of 782 samples were utilized for statistical analysis.

3.2. Regression models

To empirically test the theoretical model (Fig. 2), we employed the following two analytical methods:

(1) Binary logistics regression. Binary logistic regression offers the advantage of efficiently addressing multicategorical issues and is suitable for causal inference analysis when the dependent variable is a dichotomous dummy variable. The binary logistics regression model is employed to examine the impact of social networks on rural elders’ willingness to transfer land, with the willingness of rural elders to transfer land being defined as a binary variable taking the value of 1 if they are willing to transfer land and 0 otherwise. The following presents the basic regression formula:

$$WTL = \alpha + \beta_1 NS_i + \beta_2 SIN_i + \beta_3 SEN_i + \beta_4 NH_i + \beta_5 FINR_i + \beta_6 FENR_i + \gamma Control + \varepsilon \tag{1}$$

In this equation, WTL represents the willingness of rural elders to transfer land; NS, SIN, SEN, NH, FINR, and FENR are indicators of the independent variable social network. Specifically, NS represents network scale, SIN represents the scale of internal network, SEN represents the scale of external network, NH represents network heterogeneity, FINR represents the frequency of internal network relationships, and FENR represents the frequency of external network relationships. β reflects the partial regression coefficient to be estimated for each indicator’s influence on the dependent variable. Control variables are denoted as Control. α is used to represent the constant term in this equation and ε denotes the random error.

(2) Multiple linear regression. Multiple linear regression is an appropriate method for examining the combined causal effects of multiple independent variables on a continuous dependent variable. In this study, multiple linear regression is employed to investigate the influence of social networks on rural elders’ willingness to transfer land, specifically examining the impact of social networks on information consultation (IC), interpersonal trust (IT), and the acquisition of material resource (AMR) mechanisms. The following formula represents the multiple linear regression model:

$$IC = \alpha + \beta_7 SIN_i + \beta_8 SEN_i + \beta_9 NH_i + \beta_{10} FINR_i + \beta_{11} FENR_i + \gamma Control + \varepsilon \tag{2}$$

$$IT = \alpha + \beta_{12} SIN_i + \beta_{13} SEN_i + \beta_{14} NH_i + \beta_{15} FINR_i + \beta_{16} FENR_i + \gamma Control + \varepsilon \tag{3}$$

Table 1
The geographical distribution of the surveyed villages in China.

Region	Province	City	District	Village	Sample size	
Eastern region	Hebei	Shijiazhuang	Xingtang	Dongcigou	32	
			Shandong	Weifang	Anqiu	Dongbei
	Dezhou	Qihe		Xijie	29	
	Zibo	Zichuan		Majiazhuang	31	
	Jiangsu	Changzhou		Tianning	Sanhekou	18
	Fujian	Longyan	Shanghang	Chadi	31	
			Fuzhou	Minhou,	Houmei, Lubei	61
	Central region	Shanxi	Shuozhou	Shanyin	Beiwangzhaung	30
				Jinzhong	Jiexiu, Taigu	Zhujiabao, Hu
		Henan	Zhoukou	Fugou,	Caojia, Zhuqiao	62
Chuanhui						
Hubei		Xinyang	Luoshan	Yufan	30	
			Suizhou	Sui	Cheshuigou	30
			Jingzhou	Gongan	Shuidesi	30
Hunan	Changsha	Yuhua	Lianhua	30		
		Western region	Shaanxi	Baoji	Fengxiang	Hanfeng, Xiaotang, Song, Tangzhizhuang, Dongbai, Kangjiashuang
Yanan	Zichang			Wangjiaping, Wujiashaizi, Yanger, Guojiayayao, Shangfengjiashuang, Guojiaping	276	
Yunnan	Dehong		Longchuan	Longan	31	
			Xinjiang	Kuitun	Tianbeixinqu	Wulian
			Shihezi	Shihezi	Shangsangong	11

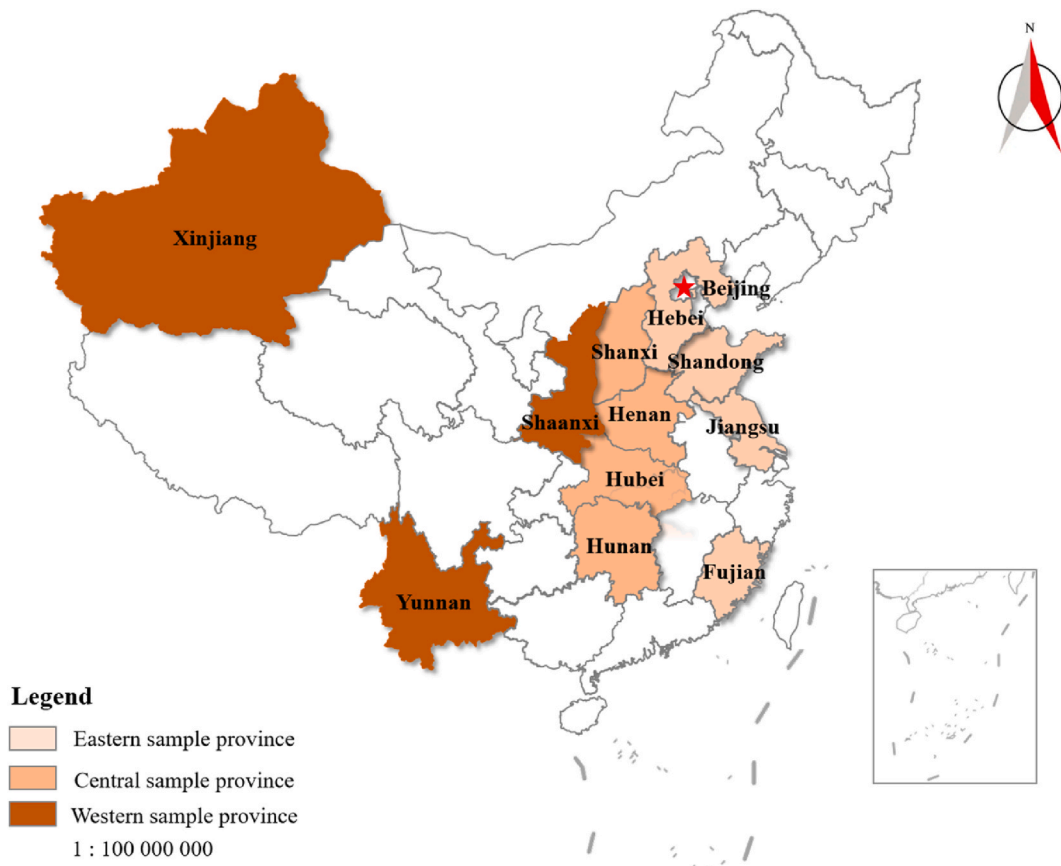


Fig. 1. Geographical distribution of study area.

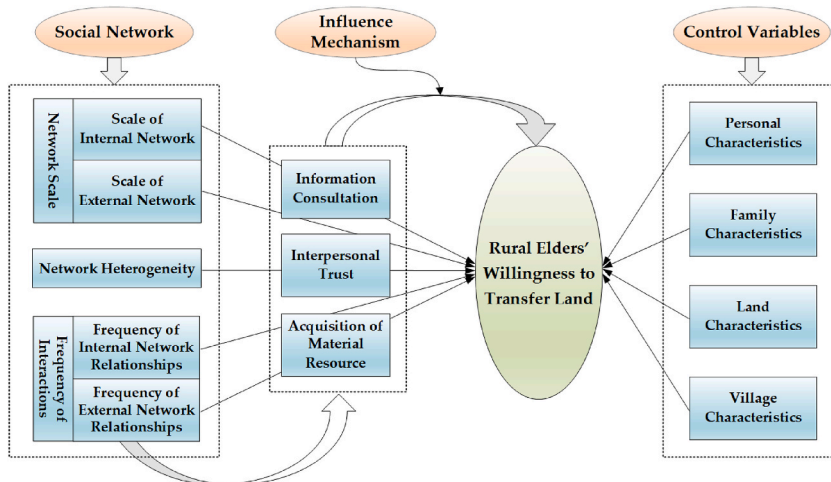


Fig. 2. The theoretical framework of this study.

$$AMR = \alpha + \beta_{17} SIN_i + \beta_{18} SEN_i + \beta_{19} NH_i + \beta_{20} FINR_i + \beta_{21} FENR_i + \gamma Control + \varepsilon \tag{4}$$

3.3. Model specification for explaining the willingness of rural elders to transfer land

Table 4 presents the definitions of variables utilized in the empirical analysis and provides summary statistics. This section offers a detailed description of the acquisition and measurement of key variables.

- (1) Land transfer willingness. The study’s dependent variable is the willingness of rural elders to transfer land, which is determined by asking them “Are you willing to transfer out your land?”. Responses indicating “yes” are assigned a score of 1, while all other responses are scored as 0.
- (2) Social network. Social network serves as the primary independent variable in this study. Measurable social network items are classified into three dimensions: network scale, network heterogeneity, and frequency of network relationships. The first dimension pertains to network scale, which is measured using China’s New Year greetings network to assess the social networks of rural elders through separate inquiries about “How many people do you greet each other with, how many are kinships, and how many are non-kinships?” The scale of the social network is determined by the combined magnitude of both kinship and non-kinship networks, with the former representing internal connections and the latter representing external connections. In China, the period of “New Year’s greetings” presents an optimal opportunity for individuals to cultivate and broaden their social connections. The scale of an individual’s Chinese New Year Greeting Network and the professional roles or positions held by its members serve as reliable indicators of an individual’s network of social relationships [51,52].

The second dimension refers to the network heterogeneity variable. Wang [53] study on social networks and the network heterogeneity proposed by Lin and Erickson [54] is represented by the disparity between the occupational prestige scores of network members with the highest and lowest evaluations. The social network members typically belong to the New Year’s Greetings network, categorized into six occupational classes based on EGP (Erikson-Goldthorpe-Portocarero) classification framework in Hong [55]: farmers, skilled or manual workers, service personnel, individual industrial and commercial households, office workers, managers and professionals (including cadres of state organs, middle-level cadres, senior heads of enterprises and organizations, professional technical personnel). Refer to Table 2 for the classification of these six occupational classes. The higher the classification, the greater the occupational prestige. Subsequently, we identify individuals with the highest and lowest occupational prestige members in each sample social network and calculate the difference between their scores as a measure of network heterogeneity.

The third dimension refers to the frequency of network relationships. In an academic context, one or more dimensions from acquaintance time, interaction frequency, intimacy, reciprocity, and communication material investment are selected to assess the strength of relationship [56]. This study distinguishes between members of internal and external network relationships based on intimacy or “the pattern of differential order”. Members with internal network relationships include “immediate families” and “extended families”, while those with external network relationships encompass “distant relatives”, “neighbors”, “friends”, and “villagers”. The total communication frequencies for both internal and external network relationships are aggregated to establish the overall communication frequency for each type. The total communication frequency for internal network relationships ranges from 0 to 6, whereas that for external network relationships ranges from 0 to 12 (Table 3).

- (3) Control Variable. In accordance with previous research [4,15,42,49], in order to address endogeneity issues, we categorize control variables into four levels: 1) individual level (including gender, age, health, education, work experience, and land support); 2) household level (including marriage, children, and income); 3) land level (including land area, land transfer price, and land rights registration), and 4) village level (including village terrain, distance, economic level, and region). Definitions of variables and descriptive statistics can be found in Table 4.

4. Results

4.1. Multicollinearity test

After conducting the regression analysis, this study considers the potential internal correlation between the variables of social network scale, network heterogeneity, frequency of internal network relationships, and frequency of external network relationships

Table 2
Occupational names and their corresponding scores.

Professional Name	Score	Professional Name	Score	Professional Name	Score
Government worker	8	Legal worker	7	Driver	4
Party worker	8	Self-employed	6	Nanny	3
Business owner	8	Salesmen and manager	6	Builder	3
Workers in state-owned enterprises	7	Temporary workers of government agency or enterprise	5	Farmer	2
Teacher	7	Service personnel in entertainment venues	4	–	–
Police	7	Gatekeeper or security guard	4	–	–

Table 3

The allocation of interaction frequency between elderly individuals in rural areas and their network members.

Relationship Types	Identity	Never	Seldom	Sometimes	Often
The communication frequency of internal network relationships	Immediate families	0	1	2	3
	Extended families	0	1	2	3
The communication frequency of external network relationships	Distant relatives	0	1	2	3
	Neighbors	0	1	2	3
	Friends	0	1	2	3
	Villagers	0	1	2	3

Table 4

Variable definitions and descriptive statistics.

Variable Type	Variable Name	Definition and Assignment	Mean	S.D.
Dependent variable	Land transfer willingness	Whether rural elderly are willing to transfer out their land (yes = 1; no = 0)	0.61	0.49
Social network	Network scale	Number of kinships and non-kinships visiting during the Spring Festival	24.85	23.57
	Internal network scale	Number of kinships visiting during the Spring Festival	17.91	13.90
	External network scale	Number of non-kinships visiting during the Spring Festival	6.95	16.49
	Network heterogeneity	The difference in professional reputation scores between the highest and lowest scores	1.93	2.24
		The frequency of internal network relationships	The communication frequency of internal network relationships	5.17
	The frequency of external network relationships	The communication frequency of external network relationships	9.29	2.29
Personal characteristics	Gender	Gender of rural elderly (male = 1; female = 0)	0.50	0.50
	Age	Age of rural elderly	68.71	6.09
	Health	Self-assessed health status of rural elderly (very poor = 1; poor = 2; average = 3; good = 4; very good = 5)	3.09	0.97
	Education	The years of schooling for elderly rural residents (years)	4.04	3.46
	Work experience	Whether the rural elderly have migrant work or business experience (yes = 1; no = 0)	0.35	0.48
	Land support	How much does land support your old age? (very little = 1; little = 2; average = 3; large = 4; very large = 5)	3.18	1.07
Family characteristics	Marriage	Whether rural elderly currently have a spouse (yes = 1; no = 0)	0.76	0.42
	Children	How many children do the rural elderly have? (persons)	2.91	1.11
	Income	The logarithm of annual household income (yuan ^a)	9.13	0.84
Land characteristics	Land area	The actual area of land cultivated by the household (mu ^b)	7.20	71.62
	Land transfer price	Annual circulation price of land in the village (yuan)	407.90	415.44
	Land rights registration	Whether land affirms authority to register (yes = 1; no = 0)	0.89	0.32
Village characteristics	Village terrain	Plains = 1; Hills or mountains = 0	0.56	0.50
	Distance	The distance between the village and the market town (km)	4.45	4.66
	Economic level	Economic level of the village in the township (below average = 1; average = 2; above average = 3)	2.20	0.50
	Region	East = 1; Central = 2; West = 3	2.40	0.75

Note: ^a 1 yuan is equivalent to 0.1391 dollars or 0.1431 euros; ^b 1 mu is approximately equal to 667.667 square meters or 0.067 ha.

among rural elders. The variance inflation factor (VIF) is used as an indicator to assess the degree of multicollinearity between these variables. Generally, a VIF value higher than 3 indicates some level of multicollinearity, while a VIF value exceeding 10 suggests serious multicollinearity. Due to space limitations, only “network scale” is selected as the dependent variable, with the remaining variables serving as explanatory variables in Table 5. Model 0 results indicate that the covariance between these variables falls within reasonable limits.

4.2. Basic regression analysis

The results of Table 6 present the findings from the basic regression analysis. Model 1 serves as a benchmark regression model, including only control variables. Model 2 incorporates social network variables into Model 1. Building on Model 2, Model 3 further specifies internal and external network scales for network scale. The estimation results of Model 1 indicate that, at the individual level, all variables except gender have a significant impact on the willingness of rural elders to transfer land. Specifically, age, education, and work experience exhibit a significant positive effect on rural elders’ willingness to transfer land, while health and land support demonstrate a significant negative effect. Furthermore, marital status, land transfer price, and village terrain significantly influence the willingness of rural elders to transfer land.

After Model 2 inputs social network variables into Model 1, Nagelkerke R² increases from 0.163 to 0.197, an increase of 20.9%. This demonstrates the significant influence of social networks on the land transfer willingness of rural elders. The estimation results of Model 2 indicate that, in addition to the network scale variable, other variables within the social network dimension also have a significant impact on the land transfer willingness of rural elders. Network heterogeneity and the frequency of external network

Table 5
Assessment of multicollinearity.

Model 0		Covariance Statistic	
		Tolerances	VIF
Network scale	Network heterogeneity	0.891	1.123
	The frequency of internal network relationships	0.592	1.690
	The frequency of external network relationships	0.616	1.624
	Gender	0.655	1.526
	Age	0.669	1.494
	Health	0.898	1.114
	Education	0.732	1.366
	Work experience	0.780	1.283
	Land support	0.896	1.116
	Marriage	0.778	1.285
	Children	0.726	1.376
	Income	0.741	1.350
	Land area	0.965	1.036
	Land transfer price	0.679	1.473
	Land rights registration	0.860	1.162
	Village terrain	0.695	1.439
	Distance	0.613	1.631
Economic level	0.812	1.232	
Region	0.734	1.363	

relationships positively affect the willingness of rural elders to transfer land, while the frequency of internal network relationships has a significant negative effect. The estimation results of Model 3 indicate that, following the subdivision of the network scale variable into internal and external network scale variable, the internal network scale variable exhibits a statistically positive effect on rural elders' willingness to transfer land, while the effect of the external network scale variable is found to be statistically insignificant.

4.3. Heterogeneity analysis

To further investigate the group differentiation of social networks in relation to the land transfer willingness of rural elders, this study categorizes rural elders into groups based on gender, age and region as presented in Table 7. Upon grouping by gender, the results from Models 4 and 5 indicate that network heterogeneity and the frequency of internal network relationships significantly impact only male rural elders. However, there is no gender disparity in the influence of network scale and the frequency of external network relationships on the land transfer willingness of rural elders. Following grouping by age, Model 6 and Model 7 reveal that significant effects of internal network scale, frequency of internal network relationships, and frequency of external network relationships on land transfer willingness are observed only within the 60–69 year old age group. After grouping by region, Model 8 and Model 9 demonstrate that significant impacts of social networks on land transfer intention among rural elders prior to grouping are sustained solely in central and western regions but not in eastern regions.

4.4. Influence mechanism analysis

Based on the previous analysis, it is evident that farmers seek to gather comprehensive information and engage in trade within a trustworthy environment to safeguard their own interests. Social networks, serving as a conduit for information dissemination, interaction, and resource acquisition, can facilitate rural elders' access to information, foster trust, and diminish their reliance on land. Therefore, in order to further explore the mechanism through which social networks impact the willingness of rural elders to transfer land, this study selects three mediating variables - information consultation¹, interpersonal trust², and material resource acquisition³ - and analyzes them using multilinear and binary logistic regression (Table 8). The first factor is information consulting. Model 10 demonstrates a significant positive influence of network heterogeneity and the frequency of external network relationships on information consultation, as well as a significant negative impact of internal network scale on information consultation. Thus, social network affect the capacity of rural elders to acquire information through dimensions such as internal network scale, network heterogeneity, and the frequency of external network relationships, subsequently influencing their willingness to transfer land.

The second factor is interpersonal trust. Model 11 demonstrates that the social network significantly influences interpersonal trust through the dimensions of the internal network scale, external network scale, and the frequency of external network relationships. Thus, the social network impacts rural elders' level of interpersonal trust via the internal network scale and the frequency of external network relationships, subsequently affecting their willingness to transfer land.

The third factor is the acquisition of material resources. Model 12 demonstrates that external network scale, network heterogeneity, and the frequency of external network relationships significantly positively impact the acquisition of material resources. However, the internal network scale does not have a significant effect on the land transfer intention of rural elders. This indicates that social networks affect rural elders' access to material resources and their willingness to transfer land through network heterogeneity and the frequency of external network relationships.

Table 6
Binary logistic regression analysis of determinants influencing the willingness of factors of rural elders to transfer land.

Variable Type	Variables	Model 1	Model 2	Model 3
Social network	Network scale		0.005 (0.004)	
	Internal network scale			0.022*** (0.008)
	External network scale			-0.006 (0.006)
	Network heterogeneity		0.087** (0.040)	0.080** (0.040)
	The frequency of internal network relationships		-0.264** (0.117)	-0.289** (0.118)
	The frequency of external network relationships		0.159*** (0.045)	0.160*** (0.045)
Personal characteristics	Gender	-0.224 (0.189)	-0.121 (0.194)	-0.099 (0.195)
	Age	0.052*** (0.016)	0.052*** (0.016)	0.052*** (0.016)
	Health	-0.183** (0.083)	-0.165* (0.084)	-0.161* (0.085)
	Education	0.052* (0.026)	0.042 (0.027)	0.035 (0.027)
	Work experience	0.779*** (0.184)	0.594*** (0.190)	0.618*** (0.191)
	Land support	-0.270*** (0.079)	-0.310*** (0.082)	-0.310*** (0.082)
	Marriage	-0.385* (0.213)	-0.382* (0.217)	-0.419* (0.218)
Family characteristics	Children	-0.074 (0.083)	-0.041 (0.086)	-0.047 (0.086)
	Income	-0.141 (0.105)	-0.220** (0.109)	-0.211* (0.109)
	Land area	0.001 (0.001)	0.002 (0.001)	0.002 (0.001)
Land characteristics	Land transfer price	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
	Land rights registration	-0.168 (0.276)	-0.174 (0.282)	-0.142 (0.284)
	Village terrain	-0.525*** (0.188)	-0.619*** (0.195)	-0.657*** (0.197)
Village characteristics	Distance	-0.035 (0.022)	-0.037* (0.022)	-0.037 (0.022)
	Economic level	0.075 (0.168)	0.188 (0.174)	0.185 (0.175)
	Region			
	Middle	-0.017 (0.268)	-0.078 (0.273)	-0.101 (0.275)
	West	0.034 (0.261)	0.068 (0.266)	-0.116 (0.278)
Constant		-0.215 (1.539)	-0.017 (1.593)	-0.028 (1.598)
-2 logarithmic likelihood		946.622	923.675	916.922
Nagelkerke R ²		0.163	0.197	0.207

Note: Standard errors are presented in parentheses; * indicates P < 0.1, ** indicates P < 0.05, *** indicates P < 0.01.

4.5. Robustness test

In order to test the robustness of the primary regression results, this study employs a varying sample size method to re-examine the estimation results (Table 9). Three operational approaches are utilized for the changing sample size method. Firstly, the sample of rural elders over 85 years old is excluded and the age of the sample is restricted to 85 years old and below, as detailed in Model 13. This is based on the consideration that the social network scale of rural elders over 85 years old is gradually diminishing, and their willingness to transfer land is primarily influenced by their physical health condition rather than their social network. Secondly, individuals aged 60 and 61 who have recently entered old age are excluded due to their better physical functioning and stronger ability to manage land independently, resulting in weaker influence of social networks on their willingness to transfer land. Thirdly, random sampling is used to select 80 % of samples from the total pool of 782 samples, resulting in a dataset of 626 samples. Models 13–15 demonstrate that the significance levels, directional effects, and coefficient magnitudes of respective variables remain consistent with basic regression results, thus passing robustness testing.

Table 7
Grouping estimation of the effect of social networks on the rural elders' willingness to transfer land.

Variables	Model 4 Female	Model 5 Male	Model 6 Age ≥70	Model 7 Age = 60–69	Model 8 Eastern Region	Model 9 Central and Western Regions
Internal network scale	0.024* (0.012)	0.026** (0.012)	0.015 (0.013)	0.026** (0.011)	−0.004 (0.025)	0.030*** (0.009)
External network scale	−0.016 (0.015)	−0.004 (0.007)	−0.012 (0.012)	−0.005 (0.007)	0.039 (0.036)	−0.009 (0.006)
Network heterogeneity	0.001 (0.056)	0.165*** (0.062)	0.096 (0.069)	0.082 (0.050)	−0.129 (0.165)	0.085* (0.044)
The frequency of internal network relationships	0.004 (0.170)	−0.561*** (0.188)	−0.068 (0.200)	−0.392** (0.158)	0.444 (0.368)	−0.326** (0.134)
The frequency of external network relationships	0.173*** (0.066)	0.125* (0.070)	0.112 (0.075)	0.167*** (0.061)	−0.005 (0.162)	0.210*** (0.050)
Control variables	Control	Control	Control	Control	Control	Control
Constant	−2.770 (2.371)	1.420 (2.455)	1.479 (1.877)	3.948 (1.422)	−11.404 (7.302)	1.961 (1.744)
−2 logarithmic likelihood	457.116	423.067	344.214	552.752	94.758	772.234
Nagelkerke R ²	0.218	0.299	0.175	0.249	0.547	0.216

Note: Standard errors are presented in parentheses; * indicates P < 0.1, ** indicates P < 0.05, *** indicates P < 0.01.

Table 8
Mechanism test of social network's influence on rural elders' willingness to transfer land.

Variables	Model 10 Information Consultation	Model 11 Interpersonal Trust	Model 12 Material Resource Acquisition
Internal network scale	−0.006** (0.003)	−0.019** (0.008)	−0.004 (0.005)
External network scale	0.005** (0.002)	0.015** (0.007)	0.007* (0.004)
Network heterogeneity	0.043*** (0.016)	−0.003 (0.049)	0.077** (0.030)
The frequency of internal network relationships	−0.024 (0.047)	0.218 (0.143)	0.113 (0.087)
The frequency of external network relationships	0.131*** (0.019)	0.489*** (0.057)	0.116*** (0.035)
Control variables	Control	Control	Control
Constant	0.896 (0.672)	7.998 (2.029)	1.259 (1.235)
R ²	0.173	0.244	0.216

Note: Model 10–12 presents the results of multilinear regression; Standard errors are shown in parentheses; * indicates P < 0.1, ** indicates P < 0.05, *** indicates P < 0.01.

Table 9
Robustness test.

Variables	Model 3 Basic model	Model 13 Age ≤ 85	Model 14 Age ≥ 62	Model 15 Random sample
Internal network scale	0.022*** (0.008)	0.021*** (0.008)	0.032*** (0.010)	0.022** (0.009)
External network scale	−0.006 (0.006)	−0.004 (0.006)	−0.006 (0.006)	−0.006 (0.007)
Network heterogeneity	0.080** (0.040)	−0.081** (0.040)	0.071* (0.042)	0.081** (0.043)
The frequency of internal network relationships	−0.289** (0.118)	−0.300** (0.118)	−0.316** (0.126)	−0.309** (0.129)
The frequency of external network relationships	0.160*** (0.045)	0.161*** (0.045)	0.189*** (0.049)	0.172*** (0.049)
Control variables	Control	Control	Control	Control
Constant	−0.028 (1.598)	0.119 (1.669)	0.256 (1.824)	0.705 (1.918)
−2 logarithmic likelihood	916.922	912.832	819.963	922.065
Nagelkerke R ²	0.207	0.198	0.236	0.200

Note: Standard errors are presented in parentheses; * indicates P < 0.1, ** indicates P < 0.05, *** indicates P < 0.01.

5. Discussion

This present study utilizes sample survey data from 782 rural elders aged 60 years and above in China to gain a deeper understanding of the impact of social networks on the willingness of rural elders to transfer land, as well as its influencing mechanism. This is achieved through the application of binary logistic regression and multilinear regression models. The key findings of this study are outlined as follows:

5.1. Basic discussion: The influence of social networks on willingness to transfer land

Social networks exert influence on the willingness of rural elders to transfer land through three dimensions. The first dimension pertains to network scale, where overall network scale does not yield a significant effect on the land transfer willingness of rural elders. However, the scale of internal networks exhibits a significant positive impact on their land transfer willingness, while the negative effect of external network scale is not significant. This may be attributed to the offsetting effects of internal and external network scales. The second dimension involves network heterogeneity, which demonstrates a significant positive effect on the land transfer willingness of rural elders. As network heterogeneity increases, so does the willingness of rural elders to transfer land, aligning with existing literature [34,39,47,57]. This is because the multiculturalism resulting from network heterogeneity has a positive impact on rural elders' access to diverse information and their acceptance of new ideas [38]. The third dimension pertains to the frequency of network relationships. The willingness of rural elders to transfer land is significantly and negatively influenced by the frequency of internal network relationships, while it is significantly and positively affected by the frequency of external network relationships. This finding aligns with previous research by Bian, which demonstrated that weak-tie (external network) members in an individual's social network are better positioned to provide valuable information for job seeking compared to strong-tie (internal network) members [48]. Specifically, internal network members such as spouses and offspring contribute to sharing agricultural labor with rural elders; thus, more frequent interaction within the internal network reduces the burden of land labor for rural elders, subsequently decreasing their willingness to transfer land [58]. Conversely, external social network members like friends play a crucial role in enabling rural elders to access heterogeneous information and engage in social activities. Increased interaction with external network members allows them to acquire more information about land transfer, reducing their reliance on farming for livelihood and consequently increasing their willingness to transfer land [59].

5.2. Heterogeneity discussion: Different groups of rural elderly

From a gender perspective, there is a significant gender disparity in the impact of network heterogeneity and frequency of internal network relationships on land transfer willingness among rural elders, with the effect being pronounced only for male elders and not for females. This result aligns with previous research indicating that compared to rural male elders, rural female elders allocate less time to off-farm labor and exhibit a lower propensity for migration in pursuit of off-farm employment opportunities, lead relatively isolated lifestyles, maintain simplistic interpersonal relationships, and exhibit a less prominent response to network heterogeneity in terms of land transfer willingness [50]. As the number of male rural laborers working outside the home increases, women assume primary responsibility for agricultural labor while their male spouses provide diminished support; consequently, internal network members inherently contribute less to female laborers' farming activities—a result consistent with prior studies [59–61].

From an age perspective, the impact of social networks on the willingness of rural elders to transfer land is significant only among individuals aged 60–69, while it is not statistically significant for those aged 70 and above. This can be attributed to the fact that compared to rural elders aged 70 and above, those aged 60–69 are more capable of engaging with network relationship members and are more susceptible to the scale and frequency of network relationships. Additionally, the physical health of the rural elders aged 70 and above as well as their spouses is deteriorating, leading to a weaker ability for internal network members such as spouses to assist in maintaining the land; hence they are less influenced by network relationships.

From a regional perspective, the significant impact of social networks on the land transfer intentions of the rural elderly individuals prior to grouping is only evident in the central and western regions, rather than in the eastern regions. This can be attributed to higher levels of economic development and marketization in the eastern region compared to the central and western regions, as well as greater economic status and information acquisition capabilities among elderly individuals in rural areas within the eastern region. Higher levels of market-oriented development may result in the influence of land transfer in rural areas by information on the land transfer market. In contrast, in rural areas with lower levels of market-oriented development, elderly people are more reliant on social networks due to poorly developed land transfer markets in the central and western parts of the country [20].

5.3. Mechanism discussion: Information consultation, interpersonal trust, and material resource acquisition

Social networks influence the willingness of rural elders to transfer land through three mechanisms. Firstly, the social network impacts the capacity of rural elders to acquire information by influencing internal network scale, network heterogeneity, and the frequency of external network relationships, which in turn affects their willingness to transfer land. This is because network heterogeneity increases the diversity of information obtained by rural elders. More frequent contact with internal network relationships leads to limited information dissemination and lower quality of information obtained [48]. Conversely, more frequent contact with external network relationships has a contrasting effect compared to internal network relationships, consistent with previous studies [38]. Secondly, the social network influences the degree of interpersonal trust among rural elders through internal network scale and

frequency of external network relationships, subsequently affecting their willingness to transfer land. This finding aligns with previous studies indicating that higher interaction frequency with external network members enhances interpersonal trust and consequently improves rural elders' willingness to transfer land [42,61]. Lastly, social networks affect rural elders' access to material resources and thus their willingness to transfer land through factors such as network heterogeneity and frequency of external network relationships. External network members are better positioned than internal ones in providing high-quality material resources across multiple categories for rural elders; therefore increased interaction frequency with external networks results in improved acquisition of material resources.

5.4. Other factors affecting willingness to transfer land

The willingness of rural elders to transfer land is significantly and positively influenced by age, education level, work experience, and land transfer price. Conversely, it is significantly and negatively influenced by health, land dependency level, marital status, and village topography. These findings are consistent with previous research [15,62]. This is due to the fact that as people age, there tends to be a deterioration in physical health and capacity for physical labor, which reduces their ability to maintain land. The social network scale, heterogeneity, and frequency of interaction among rural elderly people with work experience have significantly enhanced their ability to access information and material resources, thereby indirectly promoting their willingness to transfer land [18,41,62]. The higher the land transfer price based on rational small-scale farming, the stronger the willingness to transfer land. Rural elders without spouses are more inclined to transfer land compared to those with spouses due to the essential role that spouses play in family labor forces and land management. Additionally, rural elders in plain areas exhibit a greater willingness to transfer land compared to those in mountainous and hilly areas, which is associated with the higher economic development status of plain areas. In regions with higher levels of economic development, rural elderly individuals demonstrate a greater propensity for transferring land.

6. Conclusions and policy recommendations

The key findings of our study are as follows: (1) The willingness of rural elders to transfer land is significantly influenced by their social network. Network scale, network heterogeneity, and the frequency of external network relationships positively impact their willingness, while the frequency of internal network relationships reduces it. (2) There are group differences in the above impacts, and these significant impacts occur only among male elderly individuals aged 60–69 years old or living in central and western regions. (3) Social networks primarily influence rural elders' willingness to transfer land through information consultation, interpersonal trust, and material resource acquisition. (4) Other control variables such as age, health, education level, work experience, land transfer price, and village terrain also significantly affect elders' willingness to transfer land.

These findings have important implications for policy development. First, it is essential to enhance community building and encourage social organizations to provide information, consultation, and companionship services for the elderly. Additionally, utilizing scientific and technological methods to increase the frequency of interaction between rural elders and external social networks will help diversify the social networks of rural elders, particularly those in central and western regions of the country. Secondly, fostering a positive social culture, enhancing trust in rural areas, and improving the willingness of the rural elders to transfer land are crucial. Thirdly, there is a need to improve security mechanisms for rural elders by addressing financial and service security issues in order to reduce their overreliance on land during old age. Lastly, adhering to market mechanisms by establishing reasonable prices for land transfer will safeguard the property rights and interests of rural elders.

This study still has limitations. Firstly, due to data limitations, this paper does not analyze the land transfer behavior of rural elders and its alignment with their willingness to transfer land. In the future, we will conduct additional research to acquire data on the land transfer behavior of the rural elders, and further investigate the influencing factors of their land transfer behavior as well as the disparity between their willingness and actual behavior. Additionally, our cross-sectional data is unable to capture changes and influencing factors of rural elders' land transfer willingness over different periods. Therefore, we plan to carry out a follow-up survey in order to delve deeper into the factors that influence rural elders' decision-making and behavior regarding land transfer.

Note

1. The questionnaire inquired: "Is assistance readily available when you need to discuss important matters with others?" Responses were assigned the following values: 1: "never obtained"; 2: "rarely obtained"; 3: "sometimes can be obtained"; 4: "most of the time can be obtained"; 5: "always available". A higher score indicates better access to information.
2. The respondents were surveyed on their level of trust in distant relatives, close relatives, neighbors, residents of the same village, and friends as part of the interpersonal trust variable. These six items underwent factor analysis to derive an overall value representing the interpersonal trust of the rural elderly sample.
3. The variable of material resource acquisition was generated by aggregating the scores from two questions, "Can you receive financial assistance from others when facing financial difficulties?" and "Can you obtain help with housework or farm work when needed?". Responses were assigned the following values: 1: "never get"; 2: "rarely get"; 3: "sometimes can be obtained"; 4: "most of the time can be obtained"; 5: "always available". A higher score indicates better access to resources.

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Ethics statement

Our study data have been ethics approved by the School of Public Administration, Northwest University, China.

Informed consent statement

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Data availability statement

Data will be made available on request.

CRedit authorship contribution statement

Jianliang Nie: Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Ziyue Dong:** Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Formal analysis, Conceptualization. **Le Tang:** Writing – review & editing, Validation, Software, Investigation. **Jinlin Liu:** Writing – review & editing, Visualization. **Yufeng Wu:** Writing – review & editing, Validation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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