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Stated preferences for family physician contract services: A survey of the elderly in rural China

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5 **Stated preferences for family physician contract services: A survey of the elderly**
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7 **in rural China**
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ABSTRACT

Objective A number of factors contribute to the utilization of Family Physician Contract Services (FPCS) in China. This study aims to measure the preference of the elderly for the FPCS and identify the key factors (and their relative importance) that may guide policymakers in more accurately providing the FPCS.

Participants and methods A discrete choice experiment (DCE) was performed to elicit the preferences for FPCS among the rural elderly in China. Attributes and levels were established based on qualitative methods. Four attributes were included: service type, service package, physician's reputation, and annual contract costs. A D-efficient design was used to create a set of profiles that represented FPCS. The survey was conducted face to face using a sample of participants aged 60 and above in rural areas of Anhui Province. The data were analyzed using a latent class logit (LCL) model.

Results A total of 545 valid questionnaires were included in the analysis. The average age of the participants was 69.44 (SD 5.80). Two latent classes were identified with the LCL model. All four attributes proved statistically significant at the level of both the population mean and the two classes. The rural elderly showed a preference for FPCS with a good reputation, lower annual contract costs, the basic service with the add-on of chronic disease service, and home visit. Age, gender, education, self-reported health status, and the number of chronic diseases were found to be associated with latent class membership.

Conclusion In this study, the physician's reputation had the largest impact on the rural elderly's choice of FPCS. Recommendations included the need to strengthen family physician

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4 team training, greater attention devoted to improvement at the medical technical level and
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6 family physician service approaches, and increased FPCS efficiency for the care of the rural
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8 elderly.
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12 **Keywords** family physician contract services, discrete choice experiment, rural elderly, latent
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14 class logit model, Chinese healthcare
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Strengths and limitations of this study

- ▶ A discrete choice experiment was used to provide preference information on family physician contract services of rural elderly in China.
- ▶ We explored preference heterogeneity according to the respondents' sociodemographic characteristics.
- ▶ This study only estimated the preference of rural elderly people for the family physician contract services in a single province of China.

INTRODUCTION

To achieve efficient and quality care, a multi-tiered healthcare system is widely adopted around the world with primary care as the first point of contact for people in need of healthcare.¹ In China, the general population is free to choose health care facilities without being restricted by a gatekeeping mechanism. However, residents prefer to seek care in second or tertiary hospitals rather than in primary care facilities. This is despite primary care facilities providing care that is usually more accessible and less costly.^{2,3} In the health system in China, primary care facilities consist of township hospitals and village clinics in rural areas.

To strengthen primary care facilities and direct patients toward the lower levels of care, the Chinese government proposed to establish a hierarchical diagnosis and treatment system in a new round of medical reform in 2009.⁴ And the Family Physician Contract Services (FPCS) were established in June 2016. The target groups of FPCS included the general and priority population which includes the elderly, women, children, and patients with chronic diseases. Residents voluntarily sign a contract with a chosen family physician, and in turn receive treatment and primary health care services in a community setting from the family physician team. This team consists of general practitioners, nurses, and public health workers.⁵ Contracted residents pay some of the annual contract costs and public medical insurance covers the remainder. Following the implementation of this national policy, 10 model cities were initially selected to implement a pilot program of FPCS in 2016, and then the program

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4 was expanded to more cities. The government increased financial investment in primary care
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6 facilities to facilitate the implementation of the FPCS.⁶ The annual contract costs varied from
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8 region to region.
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15 By 2017 the contract sign-up rates for the general and priority groups had reached 35% and
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17 65%, respectively.⁷ Whilst these numbers are not low, evidence suggested that patients had
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19 not been successfully redirected from high-level hospitals to primary care as intended by the
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21 policy.⁷⁻¹¹ A study found that 70% of the respondents preferred tertiary hospitals over family
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23 physician for first-contact care.⁸ Patients' reluctance to visit family physician has been a
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25 significant obstacle to the success of FPCS and the promotion of primary care.³
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35 In order to effectively implement FPCS, it is important to understand how Chinese patients
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37 feel about FPCS from a consumer perspective. Research on patient preference for FPCS is
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39 limited. Only two studies (one study is set in Shanghai and the other is set in Sichuan)
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41 explored this topic focusing on eliciting the factors that influence patients' decisions to use
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43 family physician.^{12,13} However, these studies did not allow participants to trade-off between
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45 factors and thus could not generate their relative importance.
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54 This study used a discrete choice experiment (DCE) survey to elicit patient preferences for
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56 the factors (or attributes) associated with FPCS among the rural elderly in China. It aimed to
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4 answer three questions: (1) what factors affect patient choice to use FPCS?; (2) what is the
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6 relative importance between these factors?; and (3) how much are they willing to pay for a
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8 desirable feature of the FPCS? The findings have important implications for policymakers
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10 aiming to improve the utilization of FPCS and the delivery of precision healthcare services
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12 for the elderly in China.
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21 **METHODS**

22 **Discrete Choice Experiment Design**

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25 The DCE approach has been widely adopted in eliciting patient preference in healthcare.^{3,14-16}
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27 We selected the attributes and their corresponding levels through a systematic review of
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29 journal articles and policy documents about FPCS as well as expert consultations (experts in
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31 the field of health economics and primary healthcare research).¹⁷⁻¹⁹ Four attributes were
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33 included in the DCE: service type (clinic visit, home visit), service package (basic service,
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35 basic service and chronic disease service, basic service and traditional Chinese medicine
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37 (TCM) service, basic service and personalized service), physician's reputation which refers to
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39 the physician's skill level, service attitude and the patient's trust (good, average, poor), and
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41 annual contract costs is the patient pays to utilize the services (20CNY/3 USD, 40 CNY/6
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43 USD, 60 CNY/9 USD, 80CNY/12 USD; the average annual exchange rate between USD and
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45 CNY in 2019 was USD 1 = CNY 6.908²⁰). A more detailed explanation of attributes and
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47 levels (eTable 1) and service packages (eTable 2) is in the supplementary document.
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4 The number of attributes and levels ($4^2 \times 3^1 \times 2^1$) was deemed impractical for a full-factorial
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6 design due to a large number of choice tasks.²¹ Therefore, we used the Ngene software
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8 (version 1.1.2, ChoiceMetrics) to create an efficient design that maximized the D-efficiency¹⁷.
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11 The final questionnaire consisted of six pairs of choice sets. An opt-out option was included
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13 for each choice set. Compared to those that do not present an opt-out option, DCE that have
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15 opt-out options have resulted in a lower risk of overestimating attribute influence.²²⁻²⁴
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18 Respondents were asked to choose plan 1, plan 2, or the opt-out option.
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25 To test the respondents' comprehension of the task and assess the validity of the questionnaire,
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27 one rationality test choice set was added.²⁵ In the test choice set, plan 2 is dominated by plan 1
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29 across all attributes. The respondent was considered to have failed the test if they did not
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31 choose the plan 1.^{26,27} Multiple versions of the questionnaire were generated, each with a
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33 computer-generated random sequence of the choice sets. To test the quality and feasibility of
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35 the questionnaire, we conducted a pilot test of 50 volunteers in a community to test the
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37 understanding, and the validity of the questionnaire content as well as the time it takes to
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39 complete the questionnaire. Subsequently, we made minor adjustments to the content of the
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41 questionnaire. Face-to-face interviews with participants were used for pilot tests and formal
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43 data collection.
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54 **Data collection**

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57 This study was conducted in Anhui Province, located in the southeast of China. The province
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4 has a population of over 63 million and the majority of the residents are middle or lower
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6 income earners. We used a multi-stage stratified random sampling method to select one city
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8 from each of the three geographical areas (south, central, and north). Three to five rural towns
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10 were randomly selected from each city. All the elderly permanent residents (defined as an
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12 annual resident of six months or more) were invited to participate in the survey. Face-to-face
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14 interviews were conducted with participants at the village clinics or in their homes. The
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16 participants were instructed to answer the survey questions carefully as each of their choices
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18 would contribute to the development of relevant FPCS policies. Socio-demographic
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20 information also was collected including: age, gender, education, marital status, household
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22 composition, self-reported health status, and the number of chronic diseases. Data collection
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24 was conducted from July to August in 2019. This research project was approved by the Ethics
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26 Committee of Anhui Medical University (No: 2020H011).
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39 **Statistical analysis**

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42 DCE data were analyzed based on the random utility theory,²⁸ wherein the utility that
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44 respondent i derives from choosing alternative j in choice set t is given by
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$$48 \quad U_{ijt} = X_{ijt}\beta_i + \varepsilon_{ijt}; i = 1, \dots, 545; j = 1, 2, 3; t = 1, \dots, 6$$

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51 where β_i is a vector of coefficients, and X_{ijt} is a vector of variables representing attributes
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53 of alternative j . If the random term ε_{ijt} is assumed to be independently and identically
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55 distributed according to the type I extreme value distribution, then the model becomes the
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57 conditional logit (CLOGIT).²⁹ The latent class logit (LCL) model was also used to explore the
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4 preference heterogeneity among the respondents.³⁰ It provided a framework for understanding
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6 the latent segmentation of respondent preferences. The number of classes was determined
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8 based on the Bayesian Information Criterion (BIC).³¹ Both models were estimated using the
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10 Stata software (version 16, StataCorp).²⁹ Statistical significance was set at $\alpha = 0.05$.
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18 The attribute “cost” was analyzed as a continuous variable and other attributes were included
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20 as dummy variables due to their categorical nature. Under the LCL model, we estimated
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22 preference coefficients for each class and then produced their weighted average over classes
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24 as the overall population mean. A positive regression coefficient suggested that respondents
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26 preferred an increased value for an attribute, whereas a negative coefficient suggested that
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28 respondents preferred a decreased value for an attribute.
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38 We calculated the relative importance (RI) of each attribute as the proportion of the sum of its
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40 utility ranges to obtain an understanding of the difference each attribute could represent in the
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42 total utility of the program design.³²⁻³⁴ The formula is as follows:
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$$RI_k = \left(\frac{A_k}{\sum_{k=1}^4 A_k} \right) \times 100\%$$

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48 where A_k is the difference between the highest and lowest score among attributes for the k
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50 th attribute. We then estimated the mean RI for each class and the population mean.
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58 We also derived the relative value attached to each attribute, which is potentially useful for
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4 pricing policy making because it measures respondents' willingness to pay (WTP) for a
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6 desirable feature of the service.^{35,36} We derived WTP as the negative ratio of the non-cost
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8 attribute coefficient to the contract costs coefficient.
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15 A posterior analysis was undertaken to know who the respondents are in a specific class ²⁹.

16 We estimated the posterior probability of respondent *i* for each class by using the Bayes rule.

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18 We estimated the posterior probability of respondent *i* for each class by using the Bayes rule.
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20 A multinomial logit (MNL) model was estimated to describe each class using individual
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22 characteristics. The explanatory variables used in the classes' characterization are
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24 documented in the supplement (eTable 3). After the MNL regression, the average marginal
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26 effect for each variable was estimated for each class. Finally, we produced a profile of
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28 membership in each class by estimating the expected values of the statistically significant
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30 predictors in the membership function.³⁷
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40 **Patient and public involvement**

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43 Patients were the participants in this study, and not involved in creating the survey instrument
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46 in this study.
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RESULTS

Sample Characteristics

A total of 545 questionnaires were included in the analysis (Table 1) with a response rate of 97.85%. The average age of the participants was 69.44 ±5.80 years. A slight majority (53.05%) of them were male. A little more than half of the respondents had an education level of primary school or above (58.53%). The vast majority of the respondents (77.06%) were married and 55.96% of all the participants lived with spouses. A little more than one-third (32.48%) and only 4.04% respectively of the respondents indicated that they were healthy and very healthy on the day of the survey. A total of 70.83% of the respondents reported at least one chronic disease.

Table 1. Sample demographic characteristics (n=545)

	n (%) / Mean (SD)
Age (in years)	69.44(5.80)
Gender	
Male	289(53.03)
Female	256(46.97)
Education	
No school education	226(41.47)
Primary school	217(39.82)
Junior high school or above	102(18.71)
Marital status	
Married	420(77.06)
Other ^a	125(22.94)
Household	
Single	86(15.78)
Spouse only	305(55.96)
Other ^b	154(28.26)
Self-reported health status	
Very unhealthy	20(3.67)
Unhealthy	187(34.31)
Moderately healthy	139(25.5)

Healthy	177(32.48)
Very healthy	22(4.04)
Number of chronic diseases	
0	159(29.17)
1	196(35.96)
2	107(19.63)
≥3	83(15.23)

SD: standard deviation.

^a : Other marital status includes unmarried, widowed and divorced

^b : Other household members include children only or spouse and children

Preferences

LCL dominated CLOGIT estimates (reported in eTable 4 in the supplement) based on BIC so only the former results are reported. A two-class LCL model was chosen based on BIC and its estimates were reported in Table 2. Class 1 accounted for 83.1% and class 2 for 16.9% of the population. Apart from the service package attribute in class 2, all four attributes were statistically significant in each class. Those in class 1 prioritized service package and annual contract costs more than class 2. By contrast, those in class 2 gave greater priority to service type and physician's reputation.

The total sample and both classes preferred home visit as opposed to clinic visit, a "good" physician's reputation, and lower contract costs. The population mean and class 1 preferred the service package that included an add-on of the chronic disease service to the basic service.

Table 2. The two-class latent class logit model estimates and willingness to pay

	Class 1		Class 2		Mean preference ^b		
	Est	SE	Est	SE	Est	SE	
Share	0.831***	0.019	0.169***	0.019			
Asc1	2.799***	0.478	-0.309***	0.479	1.937***	0.400	
Asc2	2.649***	0.477	-2.248***	0.415	1.823***	0.397	
Service type							
	Clinic visit ^a						
	Home visit	0.629***	0.136	0.769***	0.211	0.653***	0.114
Service package							
	Basic service ^a						
	+ Chronic disease service	1.183***	0.151	0.575	0.408	1.081***	0.145
	+ Traditional Chinese medicine service	0.442*	0.257	0.522	0.328	0.455**	0.216
	+ Personalized service	0.669***	0.2	0.456	0.318	0.633***	0.176
Physician's reputation							
	Poor ^a						
	Average	1.148***	0.441	1.580***	0.343	1.221***	0.364
	Good	2.404***	0.405	2.696***	0.301	2.454***	0.332
Annual contract costs							
		-0.025***	0.006	-0.016**	0.006	-0.023***	0.005
Willingness to pay (CNY)^c							
Service type							
	Clinic visit ^a						
	Home visit	25.192**	11.463	47.935**	24.389	29.029**	9.914
Service package							
	Basic service ^a						
	+ Chronic disease service	47.378**	17.1	35.827	24.959	45.429**	14.857
	+ Traditional Chinese medicine service	17.678**	6.612	32.541	23.211	20.186**	6.643
	+ Personalized service	26.769*	13.808	28.440	21.792	27.051**	12.079
Physician's reputation							
	Poor ^a						
	Average	45.969*	24.567	98.501**	46.602	54.831**	21.103
	Good	96.258**	31.002	168.066**	66.766	108.373***	27.03

ASC: alternative specific constant; Est: Estimate; SE: standard error

*** p<0.01; ** p<0.05; * p<0.1

^a: reference

^b: weighted average of coefficients over two classes

^c: According to the Organization for Economic Co-operation and Development (OECD) data (<https://data.oecd.org/conversion/exchange-rates.htm>), the average annual exchange rate between USD and CNY in 2019 was: USD 1 = CNY 6.908, Accessed March 30, 2021.

Relative importance

We derived the relative importance score for each attribute for the population and the two classes (Figure 2). For the population, physician's reputation was the most influential attribute. The second was annual contract costs. Service type was the least important. Class 1 was the same as the mean population. Class 2 regarded physician's reputation as the most important and service package proved the least important.

Willingness to pay

We also estimated WTP for each attribute level (Table 2). On average, respondents were willing to pay 29 CNY (4 USD) more for a "home visit" than a "clinic visit". They also were willing to pay 45 CNY (7 USD) more for a "basic service with chronic disease service", 20 CNY (3 USD) more for a "basic service with TCM service", and 27 CNY (4 USD) more for a "basic service with personalized service" than the "basic service". Moreover, they were willing to pay an additional 55 CNY (8 USD) for a physician with "average" reputation and 108 CNY (16 USD) for one with "good" reputation than a physician with a "poor" reputation.

Class membership profile

We reported the results in the form of average marginal effects for ease of interpretation (eTable 5 in the supplement). The results suggested that age, gender, education, self-reported health status, and the number of chronic diseases were statistically significant predictors of

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4 class membership. Respondents who were older than 65, male, with a lower education level,
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6 self-reported to be “healthy”, and with less than one chronic disease were more likely to be
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9 assigned to class 1. The expected values for the five significant predictors are in Figure 3.
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DISCUSSION

The underuse of primary care services has become one of the major challenges the Chinese healthcare system is facing today. Whilst the FPCS proposed in 2016 seems promising, patients still preferred visiting high-level hospitals even for mild diseases. Understanding patient preference for the attributes associated with FPCS is therefore important as this allows us to make more informed policy design to improve the appeal of the services and retain patients at primary care. To this aim, this study carried out a DCE survey to examine elderly residents' preferences for FPCS.

Our results suggested that all four attributes (service type, service package, physician's reputation, annual contract costs) had a significant impact on patient choice. At the population mean, the physician's reputation scored highest in relative importance. Physicians' medical skill level and service attitudes have been recognized as important indicators of healthcare quality.^{9,38,39} Other study has shown that patients also preferred doctors from public hospitals because they believed that the doctors possessed greater skills than those from a primary care clinic.⁴⁰

The annual contract cost was the second most important attribute. This preference also could be explained in part by the fact that FPCS is a public health service project and funded by social medical insurance. As reported in a study that the importance of out-of-pocket was

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4 ranked next to the travel time in the severe scenario.⁴¹ Other literature results also suggested
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6 that although the contract cost was not the most important attribute, increasing the contract
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8 costs would significantly decrease the willingness to sign a contract.³⁸ Therefore, it is
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10 suggested that more financial support may be helpful to increase the signing rate of FPCS.
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18 The elderly preferred services for chronic diseases over personalized services. More than 70%
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20 of the rural elderly suffered from at least one chronic disease. Many studies have indicated
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22 that the family physician system has been effective for the management of chronic diseases
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24 because it provided continuous, personalized, and comprehensive services in addition to
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26 integrated prevention and treatment.⁴²⁻⁴⁴ Furthermore, the rural elderly have had a low
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28 education level, which often complicates an understanding and acceptance of an appropriate
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30 combination of personalized services.⁴⁵ The majority of the participants in this study did not
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32 choose traditional Chinese medicine service over other services package, despite its proven
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34 effectiveness for the cure and treatment of chronic disease in other studies.⁴⁶⁻⁴⁷ Therefore, an
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36 argument could be made for the need to offer an additional chronic disease service to the
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38 original basic service.
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51 Although the elderly preferred home visit compared to clinic visit, this attribute was the least
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53 important which is consistent with those from previous studies.⁴⁵ Some expressed concerns
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55 about home visit, including the lack of appropriate medicine provided as well as the lack of
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57 relationship with the doctors. They also worried that home visit would reveal their poor
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4 physical health to others. Therefore, policymakers could focus on the improvement of the
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6 quality of services provided rather than a wider range of service types.
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13 The heterogeneous nature of preferences is an important consideration for policymakers who
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15 strive to improve the delivery of personalized primary healthcare services. In this study,
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17 gender, age, education, self-reported health status, and the number of chronic diseases were
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19 identified as important indicators of that heterogeneity. Results from previous studies were
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21 consistent with our findings.^{5,12,48,49} Healthy older men with lower education levels who did
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23 not have chronic diseases were more likely to focus on the quality of the services they chose.
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25 However, younger women with chronic diseases and who had higher levels of education
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27 prioritized service types and their costs. Thus, efforts should be made to improve the quality
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29 of FPCS, make the costs of service reasonable and provide personalized service types to the
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31 elderly patients with different characteristics.
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43 **CONCLUSION**

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46 Our study suggests that the reputation of the doctor could be one of the most important factors
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48 for elderly patients in their choice of family physician contract services. The findings suggest
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50 a need to strengthen the training of the family physician team to meet the potential demand
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52 for their services. Particular attention should be paid to developing the physicians' medical
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54 skills and doctor-patient communication skills as the ways to improve service quality. Annual
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56 contract costs and the service package options could also be important factors in deciding to
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4 utilize family physician contract services.
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10 **LIMITATIONS**

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13 This study had several limitations. Firstly, we were unable to include more attributes because
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16 of the limitations inherent to a DCE; the total number of attributes and levels that could be
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19 reasonably included while maintaining respondent comprehension and data quality was
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22 limited.⁵⁰ Secondly, the reliance on self-reported data created the risk of hypothetical bias.
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25 Thirdly, this study only estimated the preference of rural elderly people for the FPCS in a
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28 single province of China. Nevertheless, expanding the research to other provinces and
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31 undertaking comparison between rural and urban areas are on our research agenda.
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13 and RZ conducted the survey.
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16

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35 University (No: 2020H011).
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39 **Data availability statement** The datasets used and/or analyzed during the current study are
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41 available from the corresponding author on reasonable request.
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Figure1. An example of one choice set used in the discrete choice experiment

Attributes	Plan1	Plan 2
Service type	Home visit	Home visit
Service package	Basic service + Chronic disease service	Basic service + Personalized service
Physician's reputation	Good	Average
Annual contract costs	40 CNY (6 USD)	80 CNY (12 USD)
Which would you choose?	<input type="checkbox"/>	<input type="checkbox"/>
<p>Now suppose you can also choose not to sign up with a family physician, noting that your diseases would not get better, what would you prefer?</p>		
<p>1. I would still prefer the plan I choose above <input type="checkbox"/></p>		
<p>2. I would choose neither <input type="checkbox"/></p>		

Figure 2. Relative importance score of the attributes at the two classes and mean population

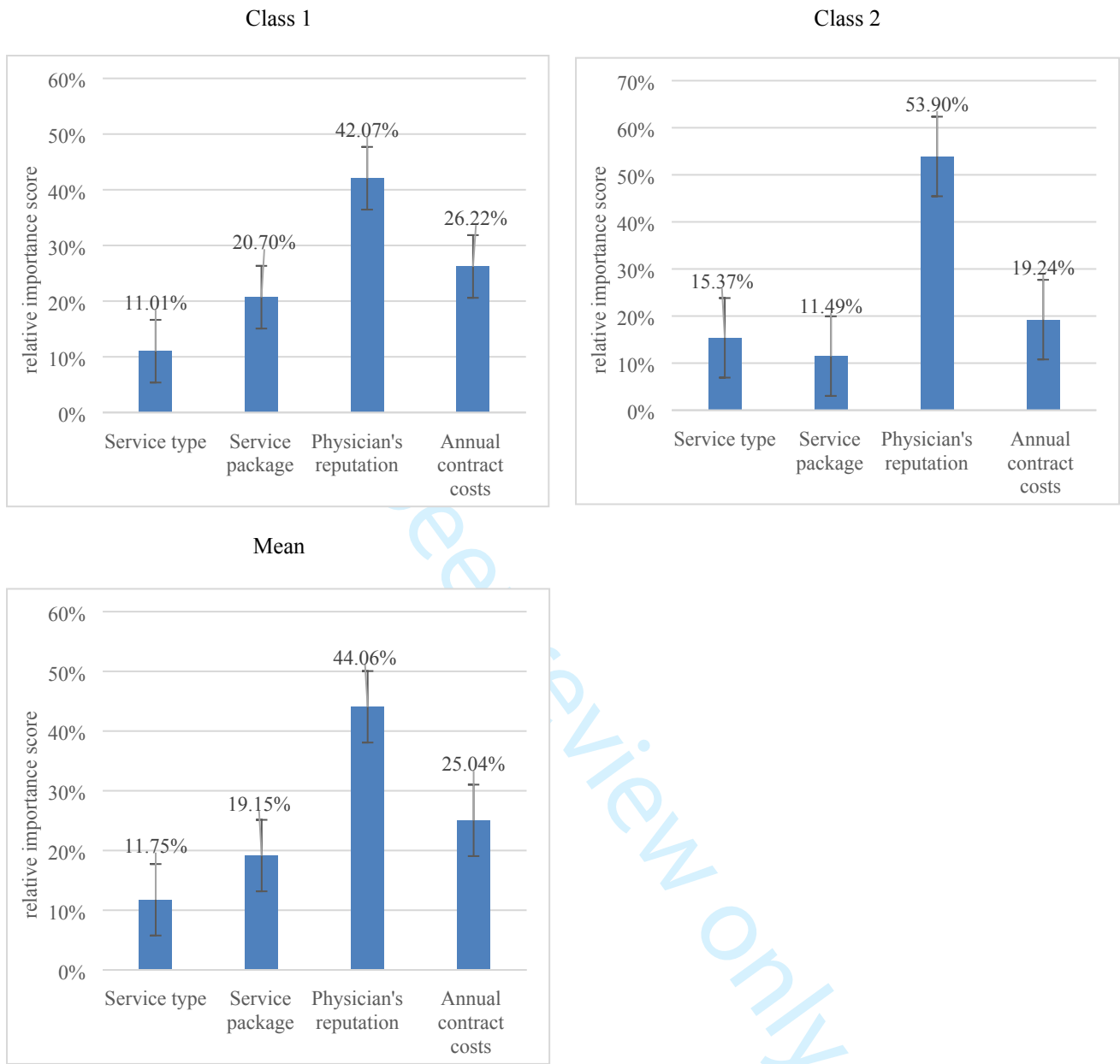
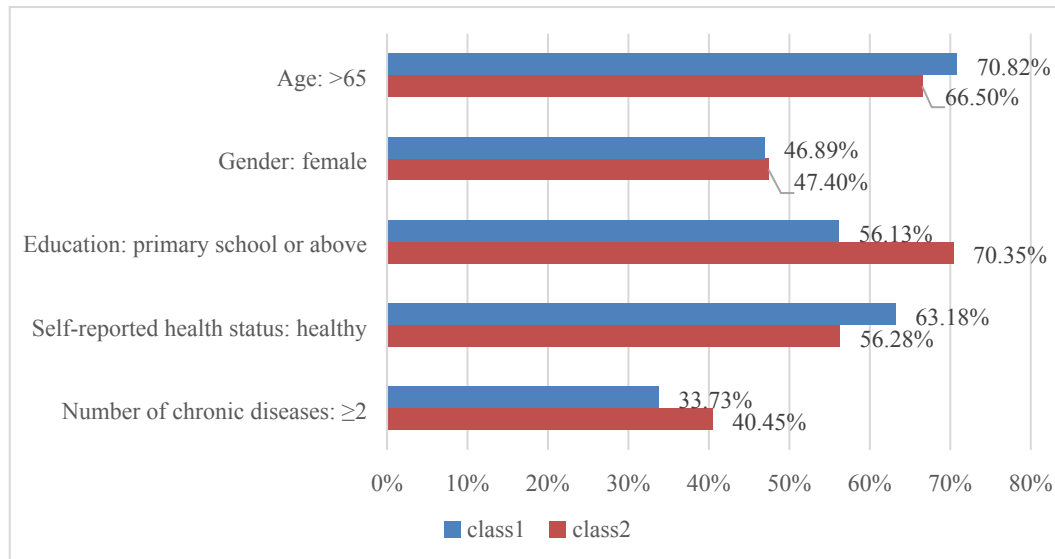


Figure 3. Profile of latent class membership at the two classes

reference: Age \leq 65; Gender=male; Education=no school education; Self-reported health status=unhealthy; Number of chronic diseases \leq 1

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5 **supplemental materials:**
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7 **eTable 1 The detailed explanation of attributes and levels**

8 **eTable 2 The content of family physician contract service package**

9 **eTable 3 Variables of classes characterization**

10 **eTable 4 Elder's preference for family doctor contract services based on conditional logit model**

11 **eTable 5 Class membership: average marginal effects**
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eTable 1 The detailed explanation of attributes and levels

Attributes	Explanations
Service type	Medical services type provided by the family physician to the elderly, including 2 levels: 1= Clinic visit 2= Home visit
Service package	Medical services were provided by family physician such as diagnosis and treatment of common and frequently-occurring diseases, as well as treatment of chronic diseases and traditional Chinese medicine (TCM) with a definite diagnosis, including 4 levels: 1= Basic service 2= Basic service +Chronic diseases service 3= Basic service +Traditional Chinese medicine (TCM) service 4= Basic service +Personalized service
Physician's reputation	Reflecting the reputation of family physician and his or her team, the patient's trust in the family physician, or the evaluation of the family physician services by others. The evaluation content includes the physicians' technical level, service attitude, and so on, including 3 levels: 1= Good 2= Average 3= Poor

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5 Annual contract costs^a Patients sign contracts with family physician and pay a certain cost every year to enjoy the
6 corresponding services provided by family physician, including 4 levels:
7 1= 20 CNY(3 USD)
8 2= 40 CNY(6 USD)
9 3= 60 CNY(9 USD)
10 4= 80 CNY(12 USD)
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14 ^a: The average annual exchange rate between USD and CNY in 2019 was: USD 1 = CNY 6.908(Organisation for Economic Co-operation and Development data. Available
15 online: <https://data.oecd.org/conversion/exchange-rates.htm>. Accessed March 30, 2021)
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eTable 2 The content of family physician service package

Service package	Content	
Basic service	<p>Basic health service:</p> <ul style="list-style-type: none"> • The treatment of common and frequent occurring diseases, nursing care, and the treatment of chronic diseases with a clear diagnosis • First aid care • Home medical and referral services such as home visits, home nursing, home beds, etc. • Rehabilitation medical services • Traditional Chinese medicine services <hr/> <p>Public health service:</p> <ul style="list-style-type: none"> • Resident health records, health guidance, health education • One physical exam per year for people over 65 years old • Follow up guidance and one physical examination for patients with severe mental illness 	
Basic service +Chronic diseases service	<p>Physical exam (height, weight, vision, blood pressure, body temperature, electrocardiogram, color doppler ultrasound (limited to one site), blood glucose/blood lipid, liver and kidney function, hematuria routine)</p> <hr/> <p>Whole-course standardized services (mainly for patients with chronic diseases such as hypertension and diabetes)</p> <hr/> <p>Long-term prescription service (continuation of the prescription and medication service of the higher level hospital)</p> <hr/> <p>One time expert diagnosis and treatment per year</p>	
Basic service +Traditional Chinese medicine (TCM) service	<p>Annual cupping therapy</p> <hr/> <p>Annual treatment of winter diseases in summer</p> <hr/> <p>Annual fumigation</p> <hr/> <p>Annual cervical, shoulder, and lumbar traction</p>	<p>A maximum of three choices</p>

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	Annual physical therapy	
Basic service +Personalized service	<p>According to their own health needs, residents are free to choose the combination of chronic disease services offered and TCM services offered, with a maximum of three choices. Examples of combinations include:</p> <ul style="list-style-type: none"> • Annual diagnosis and treatment of chronic disease by expert + Annual TCM cupping + Annual TCM fumigation • Annual diagnosis and treatment of chronic disease by expert + Annual TCM treatment of winter diseases in summer • Annual physical examination of chronic diseases + Annual TCM fumigation • Long-term prescription of chronic disease + Annual TCM cupping + Annual TCM cervical, shoulder, and lumbar traction • Whole-course standardized services of chronic disease + Annual TCM cervical, shoulder, and lumbar traction + Annual TCM physical therapy • Annual diagnosis and treatment of chronic disease by expert + Annual TCM cupping + Annual TCM physical therapy • Annual chronic disease long-term prescription + Annual TCM fumigation 	

eTable 3 Variables of classes characterization

Variables	Variable assignment
Age	0= ≤65* 1= >65
Gender	0= Male* 1= Female
Education	0= No school education* 1= Primary school or above
Self-reported health statu ^a	0= Unhealthy* 1= Healthy
Number of chronic diseases	0= ≤1* 1= ≥2

^a: Self- reported health statu is the physical health status of the respondents on the day of the survey. Likert scale was used to measure their physical health status. 1-5 is very unhealthy, unhealthy, moderately healthy, healthy, and very healthy respectively. Unhealth includes very unhealthy and unhealthy, healthy includes moderately healthy, healthy, and very healthy.

*: reference

eTable 4 Preference for family doctor contract services based on conditional logit model

		Est	SE
ASC1		2.378***	0.185
ASC2		2.254***	0.178
Service type	Clinic visit ^a		
	Home visit	0.608***	0.060
Service package	Basic service ^a		
	+ Chronic disease service	1.105***	0.076
	+ Traditional Chinese medicine service	0.463***	0.086
	+ Personalized service	0.559***	0.104
Physician's reputation	Poor ^a		
	Average	0.376**	0.164
	Good	1.609***	0.151
Annual contract costs		-0.026***	0.002
Number of observations			9810
Log pseudolikelihood			-2656.7801

ASC: Alternative specific constant; Est: Estimate; SE: Standard error

*** p<0.01; ** p<0.05; * p<0.1

^a: reference

eTable 5 Class membership: average marginal effects

	Class1		Class2	
	Est	SE	Est	SE
Age: >65	0.035***	0.009	-0.035***	0.009
Gender: Female	-0.030***	0.008	0.030***	0.008
Education: Primary school or above	-0.100***	0.007	0.100***	0.007
Self-reported health statu: Healthy	0.028***	0.009	-0.028***	0.009
Number of chronic diseases: ≥ 2	-0.031***	0.009	0.031***	0.009

Est: Estimate; SE: Standard error

Reference: Age ≤ 65 ; Gender=male; Education=no school education; Self-reported health statu=unhealth; Number of chronic diseases ≤ 1

*** p<0.01; ** p<0.05; * p<0.1

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Stated preferences for family doctor contract services: A survey of the rural elderly in Anhui province, China

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1 ABSTRACT

2 **Objective** A number of factors contribute to the utilization of Family Doctor Contract
3 Services (FDCS) in China. This study aims to measure the preferences of the elderly for the
4 FDCS and identify the key factors (and their relative importance) that may guide
5 policymakers in more accurately providing the FDCS.

6 **Participants and methods** A discrete choice experiment (DCE) was performed to elicit the
7 preferences for FDCS among the rural elderly in China. Attributes and levels were established
8 based on qualitative methods. Four attributes were included: service type, service package,
9 physician's reputation, and annual contract costs. A D-efficient design was used to create a set
10 of profiles that represented FDCS. The survey was conducted face to face using a sample of
11 participants aged 60 and above in rural areas of Anhui Province. The data were analyzed
12 using a latent class logit (LCL) model.

13 **Results** A total of 545 valid questionnaires were included in the analysis. The average age of
14 the participants was 69.44 (SD 5.80). Two latent classes were identified with the LCL model.
15 All four attributes proved statistically significant at the level of both the population mean and
16 the two classes. The rural elderly showed a preference for FDCS with a relatively good
17 reputation, lower annual contract costs, the basic service with the add-on of chronic disease
18 service, and home visit. Age, gender, education, self-reported health status, and the number of
19 chronic diseases were found to be associated with latent class membership.

20 **Conclusion** In this study, the physician's reputation had the largest impact on the rural
21 elderly's choice of FDCS. Policy recommendations included the need to strengthen family

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22 doctor team training, devote greater attention to improving the family doctor's medical skills
23 and service approaches, and increased FDCS efficiency for the care of the rural elderly.
24 **Keywords** family doctor contract services, discrete choice experiment, rural elderly, latent
25 class logit model, Chinese healthcare

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4 **27 Strengths and limitations of this study**
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7 28 • The first study to examine patient preferences for the contents of services within the
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10 29 Family Doctor Contract Services scheme
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13 30 • A carefully designed and implemented discrete choice experiment to generate reliable
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16 31 preference data from a vulnerable group in China
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19 32 • Possible hypothetical bias and data quality issues caused by fatigue and cognitive
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22 33 constraints
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25 34 • Results only representative of the rural region of Anhui province
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36 INTRODUCTION

37 To achieve efficient and quality care, a multi-tiered healthcare system is widely adopted
38 around the world with primary care as the first point of contact for people in need of
39 healthcare.¹ In China, the general population is free to choose healthcare facilities without
40 being restricted by a gatekeeping mechanism. However, residents prefer to seek care in
41 secondary or tertiary hospitals rather than in primary care facilities. This is despite primary
42 care facilities providing care that is usually more accessible and less costly.^{2,3} In the health
43 system in China, primary care facilities consist of township hospitals and village clinics in
44 rural areas.

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46 To strengthen primary care facilities and direct patients to the primary medical institutions for
47 treatment, the Chinese government proposed to establish a hierarchical diagnosis and
48 treatment system in a new round of medical reform in 2009.⁴ And the Family Doctor Contract
49 Services (FDCS) scheme was established in June 2016 to strengthen the gatekeeping
50 mechanism. The target groups of FDCS included the general and priority population which
51 includes the elderly, women, children, and patients with chronic diseases. Residents
52 voluntarily sign a contract with a chosen family doctor team, and in turn receive treatment and
53 primary healthcare services in a community setting. This family doctor team consists of
54 general practitioners, nurses, and public health workers. The contract is of one year duration
55 with its fee charged annually according to the chosen services. Part of the contract is covered
56 by the government, thus the annual contract fee varied from region to region depending on the

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4 57 financial revenue of the regional government. Following the implementation of this national
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6 58 policy, 200 model cities were initially selected to implement a pilot program of FDCS in
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9 59 2016, and then the program was expanded to more cities. The government increased financial
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11 60 investment in primary care facilities to facilitate the implementation of the FDCS.
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18 62 By 2017 the contract sign-up rates for the general and priority groups had reached 35% and
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20 63 65%, respectively.⁵ Whilst these numbers are not low, evidence suggested that patients had
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22 64 not been successfully redirected from high-level hospitals to primary care as intended by the
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24 65 policy.^{5,6} A study found that 70% of the respondents preferred tertiary hospitals over family
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26 66 doctor for first-contact care.⁶ Reluctance of patients to visit family doctor has been a
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28 67 significant obstacle to the success of FDCS and the promotion of primary care.³
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38 69 In order to effectively implement FDCS, it is important to understand how Chinese patients
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40 70 feel about FDCS from a consumer perspective. There has been a growing number of studies
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42 71 on consumer preferences for the attributes of primary care services in China.^{2,7-9} The general
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44 72 finding is that, when choosing primary care facilities, Chinese patients value the quality and
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46 73 attitude of doctors, out-of-pocket costs, travel time, total visit time, etc. These results cannot
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48 74 be directly transferred to the case of FDCS as it is a primary care service in the form of
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50 75 contract with specific types of services agreed upon signing. The research on FDCS has been
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52 76 focused on its implementation¹⁰⁻¹⁴ and policy impact.¹⁵⁻¹⁸ There is also a small number of
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54 77 studies on the association between patient characteristics and usage of FDCS.^{19,20} Only one
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4 78 study elicited consumer preference for the attributes of FDCS by undertaking a discrete
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6 79 choice experiment (DCE) with 609 rural residents in Shandong Province, China.²¹ However,
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9 80 it did not include any attribute related to the contents of the services such as type of services
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12 81 and the service packages.
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18 83 The DCE method has been used extensively to evaluate patient choice within healthcare
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20 84 systems.^{22,23} It is a technique for eliciting stated preferences, using hypothetical scenarios with
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23 85 products (or services) described by various attributes and levels, and asks respondents to
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26 86 choose their most preferred. The method is particularly useful when evaluating policy within
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29 87 markets with restricted choice, and where the characteristics driving real choices are not
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32 88 observed or attributes of interest are not measured or lack variation (e.g: the price in the real
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34 89 market often does not vary much within a period of time). Moreover, estimates are not
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37 90 affected by confounding factors given they are extracted from a controlled experiment. These
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39 91 advantages of DCEs well suited the objectives of this research.
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45 93 In this study we undertook a DCE to elicit patient preferences for the attributes associated
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48 94 with FDCS among the rural elderly in Anhui province, China. While the FPCS program aims
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51 95 for full population coverage, at the current stage the focus is the priority groups primarily
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54 96 including the elderly and those with chronic conditions. These two groups also largely overlap
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57 97 each other. In Anhui province, where our study was carried out, over 90 percent of the people
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59 98 who signed up the program fell into these two groups. Other priority groups are pregnant
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4 99 women and women in childbed, and children with likely different care needs. To design a
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6 100 DCE with attributes that are general enough to accommodate the care needs from all the
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9 101 groups is not only challenging but also less useful in helping design targeted policies. We
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12 102 therefore focused on elderly people in this study.
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18 104 We aimed to answer three questions: (1) what factors affect patient choice to use FDACS?; (2)
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21 105 what is the relative importance between these factors?; and (3) how much are they willing to
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24 106 pay for a desirable feature of the FDACS? The findings have important implications for
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27 107 policymakers aiming to improve the utilization of FDACS and the delivery of precision
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29 108 healthcare services for the elderly in China.
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110 **METHODS**

111 **Discrete Choice Experiment Design**

112 The DCE approach has been widely adopted in eliciting patient preference in healthcare.^{24,25}
113 We selected the attributes and their corresponding levels through a systematic review of
114 journal articles and policy documents about FDCS as well as expert consultations (experts in
115 the field of health economics and primary healthcare research).^{26,27} Four attributes were
116 included in the final DCE (Figure 1): The first is “service type”, representing the type of
117 medical services provided by the family doctor to the elderly, including clinic visit and home
118 visit. The second is “service package”, representing the content of the services, including four
119 levels: basic service, basic service and chronic disease service, basic service and traditional
120 Chinese medicine (TCM) service, and basic service and personalized service. The third is
121 “physician’s reputation” which refers to the residents’ evaluation of the skill level, service
122 attitude and quality of the family doctor team. The levels of this attribute include relatively
123 good, average, and relatively poor. The fourth is annual contract costs, representing the out-
124 of-pocket cost for signing up to the contract. It is a relatively small component of the total
125 costs which are mainly covered by the government. The levels include 20 CNY (3 USD), 40
126 CNY (6 USD), 60 CNY (9 USD), and 80 CNY (12 USD); the average annual exchange rate
127 between USD and CNY in 2019 was 1 USD = 6.908 CNY.²⁸ The levels chosen in our study
128 reflect the actual contract costs in those rural regions where we sampled. A detailed
129 explanation of attributes and levels (eTable 1) and service packages (eTable 2) as well as the
130 final questionnaire are in the supplementary document.

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7 132 The number of attributes and levels ($4^2 \times 3^1 \times 2^1$) was deemed impractical for a full-factorial
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9 133 design due to a large number of choice tasks.²⁹ Therefore, we used the Ngene software
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12 134 (version 1.1.2, ChoiceMetrics) to create an efficient design that maximized the D-efficiency²⁷.
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15 135 An opt-out option was included for each choice set. Compared to those that do not present an
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17 136 opt-out option, DCE that have opt-out options have resulted in a lower risk of overestimating
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20 137 attribute influence.³⁰ Respondents were asked to choose plan 1, plan 2, or the opt-out option.

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25 139 To test the respondents' comprehension of the task and assess the validity of the
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28 140 questionnaire, one rationality test choice set was added. In the test choice set, plan 2 is
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31 141 dominated by plan 1 across all attributes. The respondent was considered to have failed the
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33 142 test if they did not choose the plan 1.³¹ Multiple versions of the questionnaire were generated,
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36 143 each with a computer-generated random sequence of the choice sets. To test the quality and
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39 144 feasibility of the questionnaire, we conducted a pilot test of 50 volunteers in a community to
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42 145 test the understanding, and the validity of the questionnaire content as well as the time it takes
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45 146 to complete the questionnaire. In the pilot, we considered one additional attribute called
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48 147 "diagnosis and treatment time" and there were eight choice sets. While the participants could
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51 148 understand the choice tasks well, it turned out to be difficult for them to trade-off across five
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54 149 attributes and some also found it cognitively demanding to complete eight choice sets (plus
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57 150 the testing one). We therefore decided to drop the "diagnosis and treatment time" attribute
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60 152 which was considered the least important attribute by most participants in the pilot and to
reduce the number of choice sets from eight to six. We made some other minor adjustments

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4 153 on wording based on the feedback from the pilot testing. Face-to-face interviews with
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6 154 participants were used for both pilot tests and formal data collection.
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11 156 **Data collection**

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16 157 This study was conducted in Anhui Province, located in the southeast of China. The province
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18 158 has a population of over 63 million and the majority of the residents are middle-or-lower
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21 159 income earners. Multi-stage random sampling was used to choose a representative sample of
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24 160 the rural elderly population in Anhui which is traditionally divided into three geographical
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26 161 areas: the northern, central and southern region (Figure 2). We first randomly selected three
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29 162 cities, Fuyang, Lu'an, and Xuancheng, from each region, and then randomly selected a county
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32 163 from each city: Yingzhou, Jin'an, and Jingxian. According to the sample size requirement of
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34 164 DCE studies, we aimed for around 200 respondents in each county. We did so by randomly
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36 165 choosing two villages in Yingzhou (a relatively populous county), four villages in Jin'an, and
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39 166 four villages in Jingxian. Respondents were eligible for our study if they: (1) were over 60
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42 167 years old; (2) had spent more than 6 months in the current year at the registered place of
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45 168 residence; and (3) could complete the questionnaire independently. From July to August in
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47 169 2019, a team of trained postgraduate students from Anhui Medical University visited the
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50 170 chosen ten villages. With the help of the village committee, eligible respondents were
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53 171 identified, and face-to-face interviews were conducted either at the village committee office
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55 172 or at the respondent's home. At the start of an interview, respondents were told that their
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58 173 participation were completely voluntary, and they were allowed to leave the interview at any
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10 176 When selecting the interviewers, we chose the students from the local counties where data
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16 178 dialect. A standard interview manual was used in the training workshop where the selected
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19 179 students were paired to simulate the interview process (one student played the role of the
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22 180 interviewer while the other the interviewee). These students had another chance to practice at
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25 181 the pilot stage when the interview manual was also updated.

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30 183 The interview manual mainly included: (1) the introduction about the family doctor contract
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33 184 services program, (2) the explanation on the types of services to be provided after signing the
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36 185 contract, (3) the structure of the questionnaire and the detailed definition of each attribute of
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39 186 the DCE, and (4) instructions on how to help participants understand the choice task through
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42 187 the warm-up exercise. The manual also explained the interview steps and the order of the
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45 188 choice sets to be presented. There were instructions on terminating the interview if it was
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48 189 clear that the participant could not understand the choice tasks or found it difficult to
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51 190 complete the choice tasks.

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55 192 The participants were instructed to answer the survey questions carefully as each of their
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58 193 choices would contribute to the development of relevant FDCE policies (this is a “cheap talk”
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4 194 approach to engage the participants).³² Socio-demographic information was also collected
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6 195 including: age, gender, education, marital status, household composition, self-reported health
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9 196 status, and the number of chronic diseases. This research project was approved by the Ethics
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12 197 Committee of Anhui Medical University (No: 2020H011).

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18 199 **Statistical analysis**

20 200 DCE data were analyzed based on random utility theory, where the utility that respondent i
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24 201 derives from choosing alternative j in choice set t is given by

$$27 202 \quad U_{ijt} = X_{ijt}\beta_i + \varepsilon_{ijt}; i = 1, \dots, 545; j = 1, 2, 3; t = 1, \dots, 6$$

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30 203 where β_i is a vector of coefficients, and X_{ijt} is a vector of variables representing attributes
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33 204 of alternative j . If the random term ε_{ijt} is assumed to be independently and identically
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36 205 distributed according to the type I extreme value distribution, then the model becomes the
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39 206 conditional logit (CLOGIT). The latent class logit (LCL) model was also used to explore the
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42 207 preference heterogeneity among the respondents.³³ It provided a framework for understanding
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45 208 the latent segmentation of respondent preferences. The number of classes was determined
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48 209 based on the Bayesian Information Criterion (BIC).³⁴ Both models were estimated using the
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51 210 Stata software (version 16, StataCorp).³⁵ Statistical significance was set at $\alpha = 0.05$.

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55 212 The attribute “cost” was analyzed as a continuous variable and other attributes were included
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58 213 as dummy variables due to their categorical nature. Under the LCL model, we estimated

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6 215 as the overall population mean. A positive regression coefficient suggested that respondents
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9 216 preferred an increased value for an attribute, whereas a negative coefficient suggested that
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12 217 respondents preferred a decreased value for an attribute.

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18 219 We calculated the relative importance (RI) of each attribute as the proportion of the sum of its
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20 220 utility ranges to obtain an understanding of the difference each attribute could represent in the
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22 221 total utility of the program design.³⁶ The formula is as follows:

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$$RI_k = \left(\frac{A_k}{\sum_{k=1}^4 A_k} \right) \times 100\%$$

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31 223 where A_k is the difference between the highest and lowest score among attributes for the k^{th}
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33 224 attribute. We then estimated the mean RI for each class and the population mean.

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40 226 We also derived the relative value attached to each attribute, which is potentially useful for
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42 227 pricing policy making because it measures respondents' willingness to pay (WTP) for a
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44 228 desirable feature of the service.³⁷ We derived WTP as the negative ratio of the non-cost
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47 229 attribute coefficient to the contract costs coefficient.

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54 231 A posterior analysis was undertaken to know who the respondents are in a specific class³⁵.

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57 232 We estimated the posterior probability of respondent i for each class by using the Bayes rule.

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4 233 A multinomial logit (MNL) model was estimated to describe each class using individual
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6 234 characteristics. The covariates used in the classes' characterization are documented in the
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9 235 supplement (eTable 3). After the MNL regression, the average marginal effect for each
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11 236 variable was estimated for each class. Finally, we produced a profile of membership in each
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14 237 class by estimating the expected values of the statistically significant predictors in the
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17 238 membership function.³⁸
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23 240 **Patient and public involvement**

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26 241 Patients were the participants in this study, and not involved in creating the survey instrument
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29 242 in this study.
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4 **244 RESULTS**

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7 **245 Sample Characteristics**

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10 **246** The questionnaire was administered to 612 elderly residents, among which 12 were urban
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12 **247** dwellers living in the village at the time of data collection, 44 were incomplete, and 11 failed
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14 **248** the rationality test. A total of 545 questionnaires were included in the analysis (Table 1). The
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16 **249** average age of the participants was 69.44 ±5.80 years. A slight majority (53.05%) of them
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18 **250** were male. A little more than half of the respondents had an education level of primary school
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20 **251** or above (58.53%). The vast majority of the respondents (77.06%) were married and 55.96%
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22 **252** of all the participants lived with spouses. A little more than one-third (32.48%) and only
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24 **253** 4.04% of respondents indicated that they were healthy or very healthy respectively on the day
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26 **254** of the survey. A total of 70.83% of the respondents reported to have at least one chronic
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28 **255** disease.

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36 **256 Table 1. Sample demographic characteristics (n=545)**

	n (%) / Mean (SD)
Age (in years)	69.44(5.80)
Gender	
Male	289(53.03)
Female	256(46.97)
Education	
No school education	226(41.47)
Primary school	217(39.82)
Junior high school or above	102(18.71)
Marital status	
Married	420(77.06)
Other ^a	125(22.94)
Household	
Single	86(15.78)
Spouse only	305(55.96)
Other ^b	154(28.26)
Self-reported health status	

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Very unhealthy	20(3.67)
Unhealthy	187(34.31)
Moderately healthy	139(25.5)
Healthy	177(32.48)
Very healthy	22(4.04)
Number of chronic diseases	
0	159(29.17)
1	196(35.96)
2	107(19.63)
≥3	83(15.23)
Region	
Yingzhou, Fuyang (north)	197 (36.15)
Jin'an, Lu'an (central)	176 (32.29)
Jingxian, Xuancheng (south)	172 (31.56)

257 SD: standard deviation.

258 ^a: Other marital status includes unmarried, widowed and divorced

259 ^b: Other household members include children only or spouse and children

260

261 Preferences

262 LCL dominated CLOGIT estimates (eTable 4 in the supplement) based on BIC so only the
 263 former results are reported. A two-class LCL model was chosen based on BIC and its
 264 estimates were reported in Table 2. Class 1 accounted for 83.1% and class 2 for 16.9% of the
 265 population. Apart from the service package attribute in class 2, all four attributes were
 266 statistically significant in each class. Those in class 1 prioritized service package and annual
 267 contract costs more than class 2. By contrast, those in class 2 gave greater priority to service
 268 type and physician's reputation.

269

270 The total sample and both classes preferred home visit as opposed to clinic visit, a “relatively
 271 good” physician's reputation, and lower contract costs. The population mean and class 1

272 preferred the service package that included an add-on of the chronic disease service to the
 273 basic service.

274 **Table 2. The two-class latent class logit model estimates and willingness to pay**

		Class 1		Class 2		Mean preference ^b	
		Est	SE	Est	SE	Est	SE
Share		0.831***	0.019	0.169***	0.019		
Asc1		2.799***	0.478	-0.309***	0.479	1.937***	0.400
Asc2		2.649***	0.477	-2.248***	0.415	1.823***	0.397
Service type	Clinic visit ^a						
	Home visit	0.629***	0.136	0.769***	0.211	0.653***	0.114
Service package	Basic service ^a						
	+ Chronic disease service	1.183***	0.151	0.575	0.408	1.081***	0.145
	+ Traditional Chinese medicine service	0.442*	0.257	0.522	0.328	0.455**	0.216
	+ Personalized service	0.669***	0.2	0.456	0.318	0.633***	0.176
Physician's reputation	Relatively poor ^a						
	Average	1.148***	0.441	1.580***	0.343	1.221***	0.364
	Relatively good	2.404***	0.405	2.696***	0.301	2.454***	0.332
Annual contract costs		-0.025***	0.006	-0.016**	0.006	-0.023***	0.005
Willingness to pay (CNY)^c							
Service type	Clinic visit ^a						
	Home visit	25.192**	11.463	47.935**	24.389	29.029**	9.914
Service package	Basic service ^a						
	+ Chronic disease service	47.378**	17.1	35.827	24.959	45.429**	14.857
	+ Traditional Chinese medicine service	17.678**	6.612	32.541	23.211	20.186**	6.643
	+ Personalized service	26.769*	13.808	28.440	21.792	27.051**	12.079
Physician's reputation	Relatively poor ^a						
	Average	45.969*	24.567	98.501**	46.602	54.831**	21.103
	Relatively good	96.258**	31.002	168.066**	66.766	108.373***	27.03

275 ASC: alternative specific constant; Est: Estimate; SE: standard error

276 *** p<0.01; ** p<0.05; * p<0.1

277 ^a: reference

278 ^b: weighted average of coefficients over two classes

279 ^c: According to the Organization for Economic Co-operation and Development (OECD) data

280 (<https://data.oecd.org/conversion/exchange-rates.htm>), the average annual exchange rate between USD

281 and CNY in 2019 was: USD 1 = CNY 6.908, Accessed March 30, 2021.

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283 **Relative importance**

284 We derived the relative importance for each attribute for the population and the two classes
285 (Figure 3). For the population, physician's reputation was the most influential attribute. The
286 second was annual contract costs. Service type was the least important. Class 1 was the same
287 as the mean population. Class 2 regarded physician's reputation as the most important and
288 service package proved the least important.

289

290 **Willingness to pay**

291 We also estimated WTP for each attribute level (Table 2). On average, respondents were
292 willing to pay 29 CNY (4 USD) more for a "home visit" than a "clinic visit". They also were
293 willing to pay 45 CNY (7 USD) more for a "basic service with chronic disease service", 20
294 CNY (3 USD) more for a "basic service with TCM service", and 27 CNY (4 USD) more for a
295 "basic service with personalized service" than the "basic service". Moreover, they were
296 willing to pay an additional 55 CNY (8 USD) for a physician with "average" reputation and
297 108 CNY (16 USD) for one with "relatively good" reputation than a physician with a
298 "relatively poor" reputation.

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300 **Class membership profile**

301 We reported the results in the form of average marginal effects for ease of interpretation
302 (eTable 5 in the supplement). The results suggested that age, gender, education, self-reported
303 health status, and the number of chronic diseases were statistically significant predictors of

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4 304 class membership. Respondents who were older than 65, male, with a lower education level,
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6 305 self-reported to be “healthy”, and with less than one chronic disease were more likely to be
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9 306 assigned to class 1. The expected values for the five significant predictors are in Figure 4.
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4 **308 DISCUSSION**

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7 **309** The underuse of primary care services has become one of the major challenges the Chinese
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9
10 **310** healthcare system is facing today. Whilst the FDCS proposed in 2016 seems promising,
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12 **311** patients still preferred visiting high-level hospitals even for mild diseases. Understanding
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15 **312** patient preference for the attributes associated with FDCS is therefore important as this allows
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18 **313** us to make more informed policy design to provide more effective basic health services and
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20 **314** guide residents to the primary health service institutions. To this aim, this study carried out a
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23 **315** DCE survey to examine elderly residents' preferences for FDCS.
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29 **317** Our results suggested that all four attributes (service type, service package, physician's
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32 **318** reputation, annual contract costs) had a significant impact on patient choice. The rural elderly
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35 **319** most valued the physician's reputation, defined as the competence and attitude of family
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38 **320** doctors. This finding is consistent with previous non-DCE studies which reported that patients
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41 **321** preferred doctors from secondary or tertiary hospitals because they believed that they possess
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44 **322** greater skills than those from primary care clinics.³⁹ It is also in line with another DCE study
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47 **323** of FDCS conducted in rural area of Shandong Province which included two attributes
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50 **324** measuring competence and attitudes of doctors separately.²¹

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54 **326** The annual contract cost was the second most important attribute. As reported in a study that
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57 **327** the importance of out-of-pocket was ranked next to the travel time in the severe health state
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4 328 scenario.⁹ The Shandong DCE study also suggested that increasing the contract cost would

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6 329 significantly decrease the willingness to sign a contract with the family doctor team.²¹

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13 331 Our study is the first to examine the patient preferences for the service contents of the FDCS.

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15 332 The rural elderly preferred services for chronic diseases over personalized services. Many

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18 333 studies have indicated that the family doctor system has been effective in the management of

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20 334 chronic diseases as it provides continuous, personalized, and comprehensive services in

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23 335 addition to integrated prevention and treatment.⁴⁰⁻⁴² Over 70% of the participants in our study

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25 336 suffered from at least one chronic disease. Furthermore, the rural elderly have had a low

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28 337 education level, which often complicates the understanding and acceptance of an appropriate

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30 338 combination of personalized services.⁴³ The majority of the participants in this study did not

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33 339 choose traditional Chinese medicine service over other services package, despite its proven

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35 340 effectiveness for the cure and treatment of chronic disease in other studies.^{44,45} Therefore, an

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38 341 argument could be made for the need to offer an additional chronic disease service to the

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41 342 basic service.

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48 344 Although the rural elderly preferred home visit compared to clinic visit, this attribute was the

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50 345 least important which is consistent with those from previous studies.⁴³ Some expressed

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53 346 concerns about home visit, including the lack of appropriate medicine provided as well as the

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56 347 lack of relationship with the physicians. They also worried that home visit would reveal their

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4 348 poor physical health to others. Therefore, policymakers could focus on improving the quality
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6 349 of services provided rather than a wider range of service types.
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13 351 The heterogeneous nature of preferences is an important consideration for policymakers who
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15 352 strive to improve the delivery of personalized primary healthcare services. In this study,
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18 353 gender, age, education, self-reported health status, and the number of chronic diseases were
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20 354 identified as important indicators of that heterogeneity. Results from previous studies were
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23 355 consistent with our findings.⁴⁶⁻⁴⁹ Healthy older men with lower education levels who did not
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26 356 have chronic diseases were more likely to focus on the quality of the services they chose.
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29 357 However, younger women with chronic diseases and who had higher levels of education
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31 358 prioritized service types and their costs. Thus, efforts should be made to improve the quality
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34 359 of FDCCS, make the costs of service reasonable and provide personalized service types to the
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36 360 elderly patients with different characteristics.
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4 **363 CONCLUSION**
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7 **364** Our study suggests that the reputation of the physician could be one of the most important
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10 **365** factors for elderly patients in their choice of family doctor contract services. The findings
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12 **366** suggest a need to strengthen the training of the family doctor team to meet the potential
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15 **367** demand for their services. Particular attention should be paid to developing the doctors'
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17 **368** medical skills and doctor-patient communication skills as ways to improve service quality.
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20 **369** Annual contract costs and the service package options could also be important factors in
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23 **370** deciding to utilize family doctor contract services.
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4 **373 LIMITATIONS**
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7 374 The research team have made extensive efforts to ensure the quality of data. Only 11 of the
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9 375 participants failed the rationality test suggesting the methods implemented were effective and
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11 376 participants were overall engaged with the choice tasks. Nevertheless, this study still has
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13 377 several limitations. First, we were unable to include more attributes because of the limitations
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15 378 inherent to a DCE; the total number of attributes and levels that could be reasonably included
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17 379 while maintaining respondent comprehension and data quality was limited.⁵⁰ Second, the
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19 380 reliance on self-reported data created the risk of hypothetical bias. Third, the quality of the
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21 381 data may be affected by fatigue and cognitive constraints since the participants are the elderly
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23 382 with chronic conditions and a low education level. Fourth, this study only estimated the
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25 383 preference of rural elderly for the FDCC in a single province of China. Expanding the
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27 384 research to other provinces and undertaking comparison between rural and urban areas are
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29 385 warranted.
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10
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12
13
14 391 and RZ conducted the survey.
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16

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20
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22
23 395 WGRC201901).
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28 396 **Competing Interests** None declared.
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31 397 **Patient consent for publication** Not required.
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34 398 **Ethics approval** This research was approved by the Ethics Committee of Anhui Medical
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36 399 University (No: 2020H011).
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40 400 **Data availability statement** The datasets used and/or analyzed during the current study are
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42 401 available from the corresponding author on reasonable request.
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3 529 **Figure 1. An example of one choice set used in the discrete choice experiment**

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5 531 **Figure 2. Locations of sampling**

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7 533 **Figure 3. Relative importance of the attributes within each latent class and at the mean**

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9 535 **Figure 4. Profile of latent class membership for each class**

10 536 **Note:** reference: Age \leq 65; Gender=male; Education=no school education; Self-reported health
11 status=unhealthy; Number of chronic diseases \leq 1

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13 538 %: The posterior probability of being assigned to a class.

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Attributes	Plan1	Plan 2
Service type	Home visit	Home visit
Service package	Basic service + Chronic disease service	Basic service + Personalized service
Physician's reputation	Relatively good	Average
Annual contract costs	40 CNY (6 USD)	80 CNY (12 USD)
Which would you choose?	()	()
<p>Now suppose you can also choose not to sign up with a family doctor, noting that your diseases would not get better, what would you prefer?</p>		
<p>1. I would still prefer the plan I choose above ()</p>		
<p>2. I would choose neither ()</p>		

Figure 1. An example of one choice set used in the discrete choice experiment

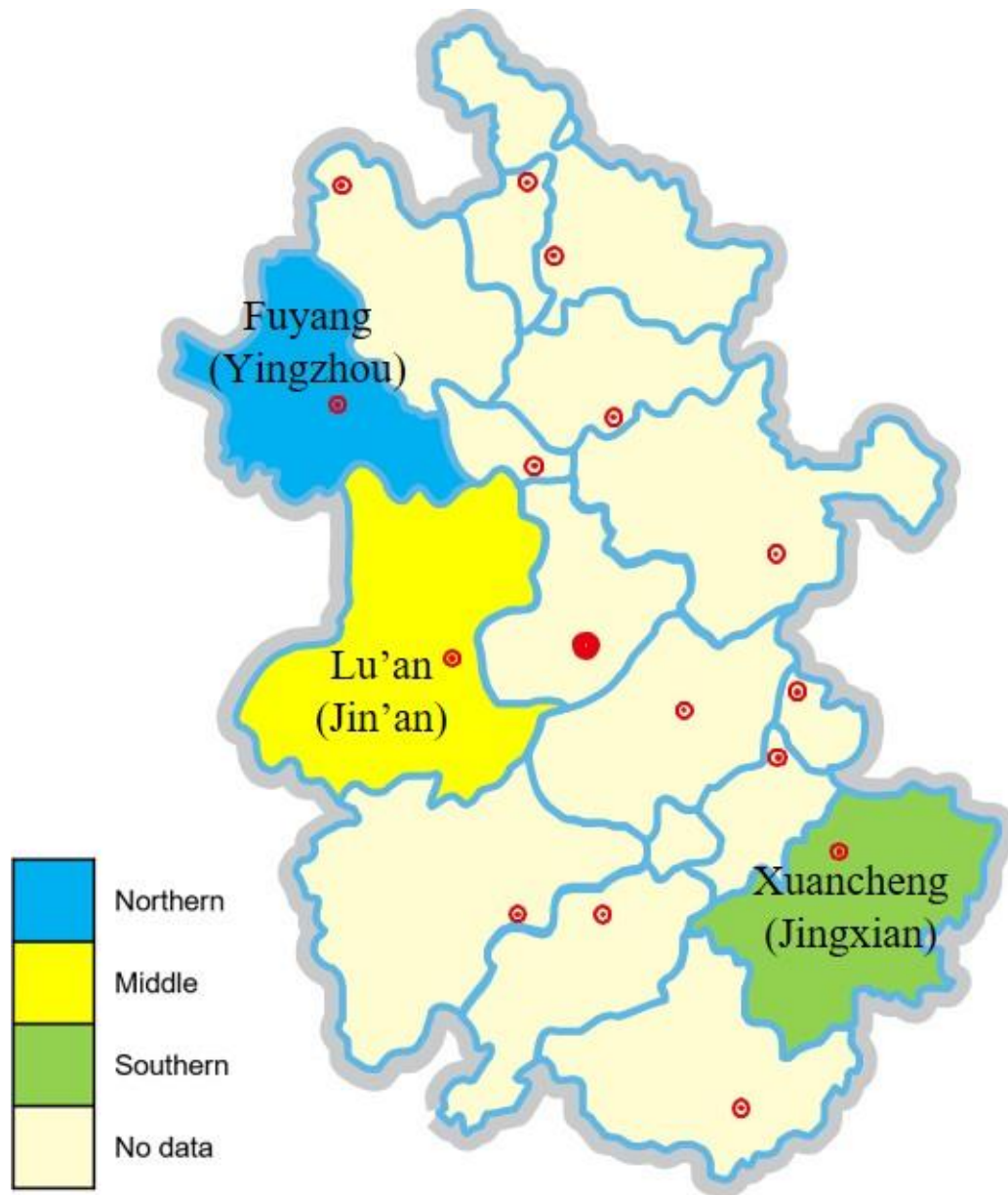


Figure 2. Locations of sampling

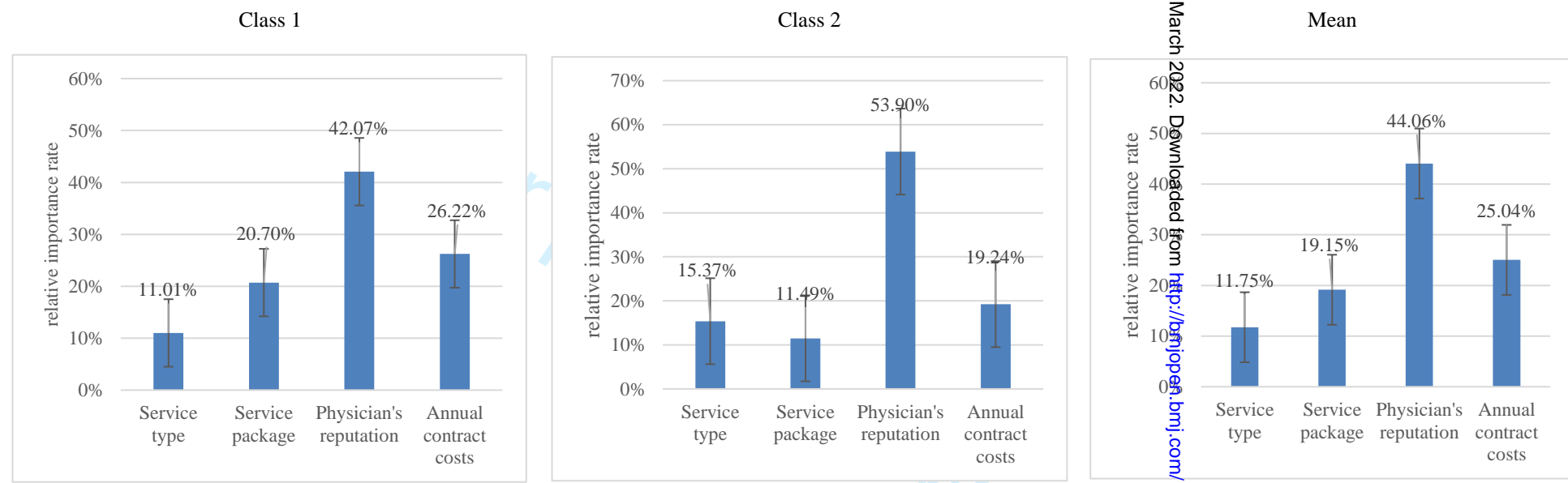


Figure 3. Relative importance of the attributes within each latent class and at the mean

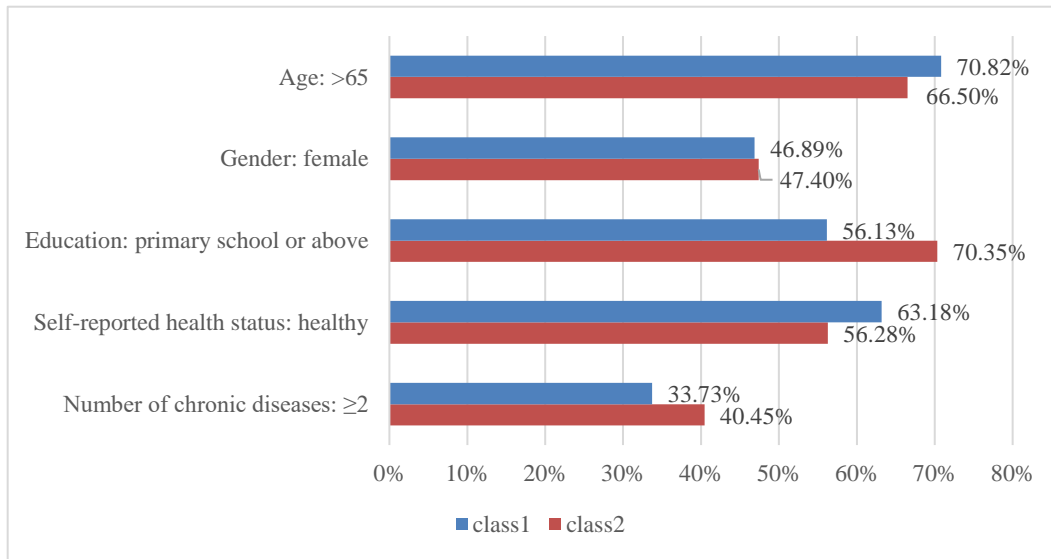


Figure 4. Profile of latent class membership for each class

Note: reference: Age≤65; Gender=male; Education=no school education; Self-reported health status=unhealthy; Number of chronic diseases≤1

#: The posterior probability of being assigned to a class.

1 **Supplemental materials:**

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3 **eTable 1 The detailed explanation of attributes and levels**

4 **eTable 2 The content of family doctor contract service package**

5 **eTable 3 Covariates in the membership function**

6 **eTable 4 Preference estimates based on the conditional logit model**

7 **eTable 5 Average marginal effects of covariates on class memberships**

8 **Final questionnaire (the translated version)**

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eTable 1 The detailed explanation of attributes and levels

Attributes	Explanations
Service type	Medical services type provided by the family doctor to the elderly, including 2 levels: 1= Clinic visit 2= Home visit
Service package	Medical services were provided by family doctor such as diagnosis and treatment of common and frequently-occurring diseases, as well as treatment of chronic diseases and traditional Chinese medicine (TCM) with a definite diagnosis, including 4 levels: 1= Basic service 2= Basic service +Chronic diseases service 3= Basic service +Traditional Chinese medicine (TCM) service 4= Basic service +Personalized service
Physician's reputation	The residents' evaluation of the quality of physicians. More specifically, this attribute describes different levels of medical training experience and expertise, service attitude and care quality from the family doctor team, including 3 levels: 1= Relatively Good 2= Average 3= Relatively Poor
Annual contract costs ^a	Annual contract costs is the contracted fees per year paid by the contracted residents out-of-pocket to the family doctor team. The levels of contract cost attribute were determined according to actual cost standard in rural Anhui, including 4 levels: 1= 20 CNY(3 USD) 2= 40 CNY(6 USD) 3= 60 CNY(9 USD) 4= 80 CNY(12 USD)

^a: The average annual exchange rate between USD and CNY in 2019 was: USD 1 = CNY 6.908(Organisation for Economic Co-operation and Development data. Available online: <https://data.oecd.org/conversion/exchange-rates.htm>. Accessed March 30, 2021)

eTable 2 The content of family doctor service package

Service package	Content	
Basic service	<p>Basic health service:</p> <ul style="list-style-type: none"> • The treatment of common and frequent occurring diseases, nursing care, and the treatment of chronic diseases with a clear diagnosis • First aid care • Home medical and referral services such as home visits, home nursing, home beds, etc. • Rehabilitation medical services • Traditional Chinese medicine services <hr/> <p>Public health service:</p> <ul style="list-style-type: none"> • Resident health records, health guidance, health education • One physical exam per year for people over 65 years old • Follow up guidance and one physical examination for patients with severe mental illness 	
Basic service +Chronic diseases service	<p>Physical exam (height, weight, vision, blood pressure, body temperature, electrocardiogram, color doppler ultrasound (limited to one site), blood glucose/blood lipid, liver and kidney function, hematuria routine)</p> <hr/> <p>Whole-course standardized services (mainly for patients with chronic diseases such as hypertension and diabetes)</p> <hr/> <p>Long-term prescription service (continuation of the prescription and medication service of the higher level hospital)</p> <hr/> <p>One time expert diagnosis and treatment per year</p>	
Basic service +Traditional Chinese medicine (TCM) service	<p>Annual cupping therapy</p> <hr/> <p>Annual treatment of winter diseases in summer</p> <hr/> <p>Annual fumigation</p> <hr/> <p>Annual cervical, shoulder, and lumbar traction</p> <hr/> <p>Annual physical therapy</p>	<p>A maximum of three choices</p>
Basic service +Personalized service	<p>According to their own health needs, residents are free to choose the combination of chronic disease services offered and TCM services offered, with a maximum of three choices. Examples of combinations include:</p> <ul style="list-style-type: none"> • Annual diagnosis and treatment of chronic disease by expert + Annual TCM cupping + Annual TCM fumigation • Annual diagnosis and treatment of chronic disease by expert + Annual TCM treatment of winter diseases in summer • Annual physical examination of chronic diseases + Annual TCM fumigation • Long-term prescription of chronic disease + Annual TCM cupping + Annual TCM cervical, shoulder, and lumbar traction • Whole-course standardized services of chronic disease + Annual TCM cervical, shoulder, and lumbar traction + Annual TCM physical therapy • Annual diagnosis and treatment of chronic disease by expert + Annual TCM cupping + Annual TCM physical therapy • Annual chronic disease long-term prescription + Annual TCM fumigation 	

eTable 3 Covariates in the membership function

Variables	Variable assignment
Age	0= ≤ 65 * 1= > 65
Gender	0= Male* 1= Female
Education	0= No school education* 1= Primary school or above
Self-reported health statu ^a	0= Unhealthy* 1= Healthy
Number of chronic diseases	0= ≤ 1 * 1= ≥ 2

^a: Self- reported health statu is the physical health status of the respondents on the day of the survey. Likert scale was used to measure their physical health status. 1-5 is very unhealthy, unhealthy, moderately healthy, healthy, and very healthy respectively. Unhealth includes very unhealthy and unhealthy, healthy includes moderately healthy, healthy, and very healthy.

*: reference

eTable 4 Preference estimates based on the conditional logit model

		Est	SE
ASC1		2.378***	0.185
ASC2		2.254***	0.178
Service type	Clinic visit ^a		
	Home visit	0.608***	0.060
Service package	Basic service ^a		
	Basic service + Chronic disease service	1.105***	0.076
	Basic service + Traditional Chinese medicine service	0.463***	0.086
	Basic service + Personalized service	0.559***	0.104
Physician's reputation	Relatively poor ^a		
	Average	0.376**	0.164
	Relatively good	1.609***	0.151
Annual contract costs		-0.026***	0.002
Number of observations			9810
Log pseudolikelihood			-2656.7801

ASC: Alternative specific constant; Est: Estimate; SE: Standard error

*** p<0.01; ** p<0.05; * p<0.1

^a: reference

eTable 5 Class membership: average marginal effects

	Class1		Class2	
	Est	SE	Est	SE
Age: >65	0.035***	0.009	-0.035***	0.009
Gender: Female	-0.030***	0.008	0.030***	0.008
Education: Primary school or above	-0.100***	0.007	0.100***	0.007
Self-reported health statu: Healthy	0.028***	0.009	-0.028***	0.009
Number of chronic diseases: ≥ 2	-0.031***	0.009	0.031***	0.009

Est: Estimate; SE: Standard error

Reference: Age \leq 65; Gender=male; Education=no school education; Self-reported health statu=unhealth; Number of chronic diseases \leq 1

*** p<0.01;** p<0.05;* p<0.1

For peer review only

Questionnaire

Dear residents:

In order to improve the quality and efficiency of family doctor contract services, and to understand the elderly residents' choices for the use of family doctor contract services, this study hopes to generate knowledge regarding your service needs. Each of your choices is very important. We ensure that your answers are kept confidential. Thank you very much for your cooperation!

If you are willing to help us complete the question and answer, please sign your name! Thank you very much!

一、 Demographic characteristics

1. **Gender:** ①Male; ②Female

2. **Date of birth:** _____ Year _____ Month

3. **Education:**

①No school education; ②Primary school; ③Junior high school; ④High school/ technical secondary school; ⑤ College; ⑥Bachelor degree and above

4. **Your marital status:**

①Unmarried; ②Married; ③Widowed; ④Divorced; ⑤Other

5. **Who do you live with now?**

①Living alone; ②Living with spouse; ③Living with children; ④Living with spouse and children; ⑤Other

6. **What is your main source of income?**

①Labor income; ②Retirement pension; ③Minimum living allowance; ④Support by relatives; ⑤Property income (renting/selling a house/land, etc.); ⑥Others (career insurance, laid-off living expenses, retired living expenses, etc.)

7. **In 2018, how much is your own economic income (including various sources) (excluding other family members)?**

①<6500 CNY; ②6500-14999 CNY; ③15000-24999 CNY; ④25000-75000 CNY; ⑤>75000 CNY

8. **In 2018, how much did you spend on medical treatment (personal payment) in total?**

①<500 CNY; ②500-999 CNY; ③1000-1999 CNY; ④2000-4999 CNY; ⑤5000-9999 CNY; ⑥>10000 CNY

9. **Have you participated in the following medical insurance? (Multiple choice)**

①Not insured; ②Urban employees' basic medical insurance; ③Urban residents' basic medical insurance; ④New rural cooperative medical care; ⑤Medical insurance for urban and rural residents

10. **Have you purchased commercial medical insurance?**

①Yes; ②No

11. **What is your evaluation of your health in the past year?**

① Very unhealthy; ②Unhealthy; ③Moderately healthy; ④Healthy; ⑤Very healthy

- 1 **12. If you give a score to your health status, from 0 to 100 (0 represents the worst status, 100 represents the best**
2 **status), would you score your health status now?_____**
3
- 4 **13. Do you suffer from the following chronic diseases diagnosed by medical institutions at the county level and**
5 **above (please mark × if not; multiple choices are allowed)?**
6
7 ①Type 1 or 2 diabetes; ②High blood pressure; ③High blood lipids; ④Chronic hepatitis; ⑤Heart disease
8 (coronary heart disease/angina pectoris, etc.); ⑥Malignant tumor, location; ⑦Chronic lung disease (tuberculosis,
9 chronic obstructive pulmonary disease, etc.); ⑧Others
10
11
- 12 **14. What do you think of the severity of your chronic disease?**
13
14 ①Almost effect; ②Slight degree; ③Generally serious; ④Seriously; ⑤Very serious
15
- 16 **15. How do you evaluate the effect of diagnosed chronic diseases on your life?**
17
18 ① Almost impact; ②Slight impact; ③General impact; ④Comparative impact; ⑤Serious impact
19
- 20 **16. Have you taken medicines on time and in quantity for a long period of time in the past year?**
21
22 ①Yes; ②No
23
24
25

26 二、 Family doctor contract service knowledge and willingness to sign

- 27 **1. How many minutes does it take from your home to the nearest village clinic?**
28
29 ① <15; ②15-30; ③>30
30
- 31 **2. Are you willing to conduct the first diagnosis at a village clinic?**
32
33 ① Unwilling; ②It doesn't matter; ③Yes
34
- 35 **3. What is the longest time (minutes) you are willing to wait for a clinic visit in the village?**
36
37 ① <5; ②5-10; ③11-20; ④21-30; ⑤>30
38
- 39 **4. Have you ever had a referral experience from a village clinic to a higher-level institution?**
40
41 ① Yes; ②No
42
- 43 **5. Are you satisfied with the services of village doctors?**
44
45 ① Very dissatisfied; ②Not satisfied; ③General; ④Satisfied; ⑤Very satisfied
46
- 47 **6. Are you aware of Family Doctor Contract Services?**
48
49 ① Yes; ②No
50
- 51 **7. Are you willing to sign a contract with a regular family doctor team? (Select "①" to jump to 10)**
52
53 ① Unwilling; ②Yes but worries; ③Yes
54
- 55 **8. Have you signed up for Family Doctor Contract Services? (Choose "①" to continue to answer 9, choose "②"**
56 **to skip to 10)**
57
58 ① Yes; ②No;
59
- 60 **9. What is the main reason you signed the family doctor team?**

①The community doctor is fixed and understands the patient's condition; ②Convenient service (short distance for treatment/short waiting time/easy to make an appointment); ③Low price and low cost; ④Good service attitude; ⑤Other, please specify

10. What is the main reason for you not to sign a family doctor team?

① I don't understand the policy of Family Doctor Contract Services; ②Do not trust the family doctor who may delay the process of my recovery; ③Difficulty in referral; ④The level of diagnosis and treatment in village clinic is low; ⑤Medical equipment in the village clinic is out of date; ⑥Insufficient medicines are provided; ⑦Worry that the free choice of medical treatment will be affected after signing the contract; ⑧Others, please specify

三、 Preference measure

Suppose you now have two Family Doctor Contract Services plans to choose from, plan 1 and plan 2. There are differences between the two plans in terms of service type, service package, doctor's reputation, and annual contract costs. It is assumed that, except for the four attributes listed, the other conditions of plan 1 and plan 2 are the same. Please choose one plan that you prefer based on your personal preferences. Each of your choices will affect the formulation of policies related to family doctor contract service. Please consider your choices carefully.

◇ Warm -up choice set

Attributes	Plan1	Plan 2
Service type	Home visit	Clinic visit
Service package	Basic service	Basic service
Physician's reputation	Average	Relatively poor
Annual contract costs	80 CNY (12 USD)	40 CNY (6 USD)
Which would you choose?	()	()
Now suppose you can also choose not to sign up with a family doctor, noting that your diseases would not get better, what would you prefer?		
1. I Would still prefer the plan I choose above ()		
2. I Would choose neither ()		

1. Choice set 1

Attributes	Plan1	Plan 2
Service type	Clinic visit	Clinic visit
Service package	Basic service + Personalized service	Basic service + Traditional Chinese medicine (TCM) service
Physician's reputation	Relatively poor	Relatively poor
Annual contract costs	20 CNY (3 USD)	40 CNY (6 USD)
Which would you choose?	()	()
Now suppose you can also choose not to sign up with a family doctor, noting that your diseases would not get better, what would you prefer?		
1. I Would still prefer the plan I choose above ()		
2. I Would choose neither ()		

2. Choice set 2

Attributes	Plan1	Plan 2
Service type	Home visit	Clinic visit
Service package	Basic service	Basic service + Chronic disease service
Physician's reputation	Relatively poor	Relatively poor
Annual contract costs	80 CNY (12 USD)	80 CNY (12 USD)
Which would you choose?	()	()
Now suppose you can also choose not to sign up with a family doctor, noting that your diseases would not get better, what would you prefer?		
1. I Would still prefer the plan I choose above ()		
2. I Would choose neither ()		

3. Choice set 3

Attributes	Plan1	Plan 2
Service type	Home visit	Home visit
Service package	Basic service + Chronic disease service	Basic service + Personalized service
Physician's reputation	Relatively good	Average
Annual contract costs	40 CNY (6 USD)	80 CNY (12 USD)
Which would you choose?	()	()
Now suppose you can also choose not to sign up with a family doctor, noting that your diseases would not get better, what would you prefer?		
1. I Would still prefer the plan I choose above ()		
2. I Would choose neither ()		

4. Choice set 4 (test choice set)

Attributes	Plan1	Plan 2
Service type	Home visit	Home visit
Service package	Basic service	Basic service
Physician's reputation	Relatively good	Relatively good
Annual contract costs	40 CNY (6 USD)	80 CNY (12 USD)
Which would you choose?	()	()
Now suppose you can also choose not to sign up with a family doctor, noting that your diseases would not get better, what would you prefer?		
1. I Would still prefer the plan I choose above ()		
2. I Would choose neither ()		

5. Choice set 5

Attributes	Plan1	Plan 2
Service type	Clinic visit	Home visit

1	Service package	Basic service + Personalized service	Basic service + Personalized service
2	Physician's reputation	Average	Relatively good
3	Annual contract costs	60 CNY (9 USD)	60 CNY (9 USD)
4	Which would you choose?	()	()
5	Now suppose you can also choose not to sign up with a family doctor, noting that your diseases would not get better, what would you prefer?		
6	1. I Would still prefer the plan I choose above ()		
7	2. I Would choose neither ()		

6. Choice set 6

Attributes	Plan1	Plan 2
Service type	Clinic visit	Home visit
Service package	Basic service + Traditional Chinese medicine (TCM) service	Basic service + Traditional Chinese medicine (TCM) service
Physician's reputation	Relatively good	Average
Annual contract costs	80 CNY (12 USD)	20 CNY (3 USD)
Which would you choose?	()	()
Now suppose you can also choose not to sign up with a family doctor, noting that your diseases would not get better, what would you prefer?		
1. I Would still prefer the plan I choose above ()		
2. I Would choose neither ()		

7. Choice set 7

Attributes	Plan1	Plan 2
Service type	Home visit	Clinic visit
Service package	Basic service + Traditional Chinese medicine (TCM) service	Basic service
Physician's reputation	Average	Relatively good
Annual contract costs	60 CNY (9 USD)	60 CNY (9 USD)
Which would you choose?	()	()
Now suppose you can also choose not to sign up with a family doctor, noting that your diseases would not get better, what would you prefer?		
1. I Would still prefer the plan I choose above ()		
2. I Would choose neither ()		

8. You have completed all the choice tasks, are you clear about the decision making process? (If you choose ①/②, skip to 10)

① Very unclear; ②Unclear; ③General; ④Clear; ⑤Very clear

9. Do you find these choice tasks difficult? (If you choose ①/② to continue to answer 10, choose ③/④/⑤ to skip to 11)

①Very difficult; ②Difficult; ③General; ④Easy; ⑤Very easy

10. Why do you feel that the selection process is unclear/difficult? _____.

11. Which of the following criteria did you choose when you made your choice?

①Look at each option carefully; ②Look only at the most important option for me, please explain _____; ③
The options you care about are different each time; ④Others, please specify _____.

12. Please rate the four attributes in the plan according to their importance (tick \checkmark in the corresponding box)

Attribute	Very unimportant	Unimportant	General	Important	Very Important
Service type					
Service package					
Doctor's reputation					
Annual contract costs					

13. Is the survey subject certain when making the choices? (Filled by investigator)

① Very uncertain; ②Uncertain; ③Neither; ④Certain; ⑤Very certain

Thank you again for participating in our survey!

Interviewer: _____ Survey date: ____ year ____ month ____ day

Quality control officer: _____ Audit date: ____ year ____ month ____ day

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1	See manuscript
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3-4	
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6-9	
Objectives	3	State specific objectives, including any prespecified hypotheses	9	
Methods				
Study design	4	Present key elements of study design early in the paper	10-12	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	12-14	
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	12-14	
		<i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls		
		<i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants		
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed	-	
		<i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case		
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	-	
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	-	
Bias	9	Describe any efforts to address potential sources of bias	-	
Study size	10	Explain how the study size was arrived at	12-14	

Continued on next page

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	4-16
		(b) Describe any methods used to examine subgroups and interactions	4-16
		(c) Explain how missing data were addressed	4-16
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed	4-16
		<i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed	4-16
		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(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	-
		(b) Give reasons for non-participation at each stage	-
		(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	7-18
		(b) Indicate number of participants with missing data for each variable of interest	7-18
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	-
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	-
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	-
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	-
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	8-21
		(b) Report category boundaries when continuous variables were categorized	-
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-

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Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	2-25
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	26
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	2-25
Generalisability	21	Discuss the generalisability (external validity) of the study results	2-25
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	27

*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.