Availability of family care resources, type of primary caregiving and home death among the oldest-old: A population-based retrospective cohort study in China

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ABSTRACT

Place of death is one of the quality indicators for end-of-life (EOL) care, and most people prefer to die at home. This study investigated the association between availability of family care resources, type of primary caregiving and home death. A sample of 21,677 deceased oldest-old consisting of 5,224 octogenarians, 8,489 nonagenarians, and 7,964 centenarians, was derived from the 1998–2018 Chinese Longitudinal Healthy Longevity Survey. Marital status, number of children and living with family members were indicators for the availability of family care resources. After accounting for other covariates, number of children (4–6 vs. 0–3: adjusted odds ratio [95% CI]: 1.81 [1.54 to 2.13]); >6 vs. 0–3: 2.63 [2.09 to 3.31]) and living with family members (28.29 [23.89 to 33.49]) were positively associated with informal caregiving (all P < 0.001). Number of children (4–6 vs. 0–3: 1.19 [1.03 to 1.38]); >6 vs. 0–3: 1.19 [1.03 to 1.38]) and informal caregiving (11.43 [9.58 to 13.64]) were associated with increased odds of dying at home (all P < 0.05). The association between availability of family care resources (number of children: β [95% CI], % mediated: 0.05 [0.04 to 0.07], 55.6%; living with family members: 0.14 [0.13 to 0.15], 46.7%) and home death was partially mediated by the type of primary caregiving. Our results suggest that the availability of family care resources played a significant role in making home death possible through informal caregiving. Therefore, continuous policy efforts on the different roles of specific family care resources are warranted to train and support family caregivers to facilitate culturally appropriate EOL services, such as dying at preferred place.

1. Introduction

Place of death has been considered a benchmark for quality of end-of-life (EOL) care (De Roo et al., 2014; De Schreye et al., 2017; Toscani, 1996), and dying in a favorite place is one of indicators of good death (Miyashita et al., 2007). Because being cared at home enables people to be surrounded by a familiar and comfortable environment, enjoy more “normal” life, and have greater autonomy (Siew Tzuh Tang, 2003), most people with incurable diseases would express a desire to die in their homes (Barbara Gomes et al., 2013). Over the past years, trends in home death have considerably changed worldwide (Chino et al., 2015). In China, the rate of home death decreased from 72.7% in 2001 to 23.0% in 2011 were observed (Dasch et al., 2015). Among the centenarians in England, the prevalence of home death annually increased by 0.24% from 2001 to 2010 (Evans et al., 2014). Similar trends were also observed among the cancer patients in England that the prevalence of home death annually increased by 0.87% from 2003 to 2010 (Gao et al., 2013). In Germany, decreased trends in the home death from 27.5% in 2001 to 23.0% in 2011 were observed (Dasch et al., 2015). In China, the rate of home death decreased from 72.7% in 2009 to 71.9% in 2017 (Weng et al., 2021). Because tremendous variation in the intensity of EOL care exist in different countries (Orlovic et al., 2017), numerous people cannot always die at home as they wish (Burge et al., 2015).

The underlying causes of variation in place of death encompass a range of factors, including the availability of health and family care resources (Cohen et al., 2015). A conceptual model explained three
caregiving has been largely overlooked in the literature, and studies that care (Choi et al., 2021), family members may partially exert in belief that dying in their homes promises the spirit of the dead to have cross-national study affirmed that family caregiving was positively associated with home death in the United States and European countries (Ailshire et al., 2021).

However, the empirical evidence on the association between the availability of family care resources and home death is limited and mixed across different countries (Reyniers et al., 2015); and current research on place of death mostly originated in developed countries (Cross, Kaufman, et al., 2020; Cross, Warrach, 2019; Hudson et al., 2018). In China, home death has special cultural meanings; people believe that dying in their homes promises the spirit of the dead to have a place to rest, also known as “the fallen leaves can return to their roots” (S. T. Tang, 2000). Prior studies reported that home was the most common place of death (D. Gu et al., 2007; Weng et al., 2021; Weng et al., 2018). One previous study showed that home is the most preferred place of death among terminal-stage cancer patients in China (Gu et al., 2015), while evidence showed that over 60% of cancer patients died at hospitals in China (Li et al., 2020a, 2020b).

As a developing country with the largest population in the world, China is facing critical aging of its population. As of 2020, people aged 65 or older constituted 13.5% of the Chinese population (National Bureau of Statistics, 2021). Further, the oldest-old (individuals aged 80 years and older) that has less access to specialist or palliative care is the fastest-growing population segment in China (Jin et al., 2021; Liu et al., 2018; Lloyd et al., 2016), raising challenges to the Chinese health system, especially the long-term and EOL care systems. The Chinese government has emphasized integrating home-based care, community-based and institutional care to improve continuity of care and system performance. However, home and community-based services are limited due to lack of sufficient well-trained workforce and reimbursement incentives (Feng et al., 2020; Glinskaya & Feng, 2018).

As a matter of fact, caregiving of the oldest-old in China is primarily done by their family members (Cai et al., 2017), which is an essential determinant of home death (Ailshire et al., 2021; Costa et al., 2016). To inform current policy efforts for the long-term and EOL care services, it is significant to determine how family care resources and type of primary caregiving during the last year of life influence the place of death among the oldest-old in China. Previous studies demonstrated that potential family care availability could facilitate home death (Escobar Pinzon et al., 2011; Lei et al., 2021). Because older adults with greater availability of family care resources are more likely to receive informal care (Choi et al., 2021), family members may partially exert influence on place of death by providing EOL care. One study found that the positive association between being married or living with children and home death disappeared after accounting for the receipt of caregiving from family members (Ailshire et al., 2021). Thus, informal caregiving may play a mediation role on the association between availability of family care resources and home death. However, the mediation role of informal caregiving has been largely overlooked in the literature, and studies that focus on the oldest-old in China are still limited. Therefore, using data from the Chinese Longitudinal Healthy Longevity Survey (CLHLS), this study aims to examine (1) the association between availability of family care resources, type of primary caregiving, and home death among the oldest-old in China, and (2) the mediation role of type of primary caregiving on the association between the availability of family care resources and home death (Fig. 1).

2. Methods

2.1. Data and study population

The CLHLS is an ongoing, nationally representative survey of Chinese older adults. As the largest longitudinal survey of centenarians, nonagenarians, and octogenarians, the CLHLS randomly selected half of the counties and cities in 22 of the 31 provinces, covering about 85% of the total population in China (Shen & Zeng, 2014; Zeng, Feng, Hesketh, et al., 2017). The CLHLS was initially carried out in 1998, and later surveys were conducted in 2000, 2002, 2005, 2008/2009, 2011/2012, 2014, and 2017/2018. Each wave is a cross-sectional study. Details of the study design and data quality assessment of the CLHLS are fully described elsewhere (Yi et al., 2008). The ethical approval of the CLHLS was obtained from The Research Ethics Committees of Peking University and Duke University, and all the survey respondents gave informed consent (Zeng, Feng, Hesketh, et al., 2017).

The data used in the current study were derived from the first eight waves of the CLHLS. From the 1998 baseline to the latest 2018 follow-up survey, 28,560 individuals died. We excluded respondents who died in 2018 due to the small sample of deceased persons (n = 195). In addition, we excluded respondents younger than 80 (n = 1,898) because current study focuses on the oldest-old. Deceased respondents with an unclear place of death were also excluded (n = 368). Among the decedents, those who did not receive care from anyone were dropped (n = 785). We also excluded decedents who had missing information on the primary caregiver (n = 105) or other covariates (n = 3,532) used in the current study. Finally, a total of 21,677 decedents who died from 1998 to 2017 were included (Fig. 2).

2.2. Measures

Home death is the primary outcome of this study. Therefore, respondents’ place of death was categorized as home and outside the home (hospitals or nursing homes) as a small sample of the oldest-old died in the nursing homes (n = 520).

The availability of family care resources included being married during the last year of life, number of children (0–3, 4–6, >6), and living with family members (Choi et al., 2021; Gomes & Higginson, 2006; Lei et al., 2021). Deceased oldest-old with family members (i.e., spouse, children and their spouses, grandchildren and their spouses, and other family members) or friends as their primary caregivers during the last year of life were considered informal care groups. Meanwhile, those primarily cared for by social workers or nurses were categorized into formal care groups. Therefore, the type of primary caregiving was set as a binary variable.

Based on the Anderson healthcare utilization model and findings of previous studies (Andersen, 1995; Cabanero-Martinez et al., 2019; Priloreau et al., 2016; Puechli et al., 2019), we included the following
variables as covariates: age at death (80–89, 90–99, and ≥ 100 years) and gender, residence rurality (urban vs. rural), attainment of education (illiterate vs. received at least one year of schooling), once had a white-collar job before retirement, annual per capita household income (2000–4999, 5000–18000, and more than 18,000 Chinese Yuan), financially independent and timely medication before death, being bedridden before death, activities of daily living (ADLs) performance. The ADLs disability was examined using the Katz index, including bathing, transferring in and out of bed, dressing, eating, toileting, and continence (Katz et al., 1963). Deceased participants who required assistance in one or more of the six activities were considered having ADLs disabilities (Gu & Zeng, 2004; Zeng et al., 2017). We also included census region (Eastern, Central, Western, and Northeast) and year of death as control variables. All other variables were binary indicators except for age at death, household income per capita, number of children, timely medication, census region, and year of death.

2.3. Statistical analysis

First, the oldest-old’s characteristics by place of death were presented as percentages. Pearson’s Chi-square tests were then conducted to examine the bivariate association between individual characteristics and place of death. Following a three-step framework proposed by Baron and Kenny (Baron & Kenny, 1986), we performed binary logistic regression models to examine the mediation role of type of primary caregiving in the association between the availability of family care resources and home death. In the first step, the type of primary caregiving was regressed on the availability of family care resources. In the second step, home death was regressed on the availability of family care resources. In the third step, home death was regressed on the availability of family care resources and type of primary caregiving. The mediation role of type of primary caregiving in the association between availability of family care resources and home death exists if (1) an indicator for the availability of family care resources is associated with the type of primary caregiving in the first step, (2) the indicator is associated with home death in the second step, and (3) the type of primary caregiving is associated with home death in the third step. Multicollinearity was examined using the variance inflation factor, and it was not considered a problem in the models because each value was less than 5 (O’Brien, 2007).

Given the fact that both the outcome variable and mediator variables were binary variables, we used the binary_mediation command to compute the direct, indirect, and total effects accounting by the mediator variables (Ender, 2010). The bias-corrected bootstrap approach (1000 replications) produced 95% confidence intervals (CIs). The mediation effect is significant if confidence intervals do not contain zero (Ender, 2010). Coefficients were presented because the calculation of the indirect effect is a result of coefficients from two binary logistic regressions rather than the outcome variables. All statistical analyses were conducted using Stata/SE 15.0. The significance level was set at a P value of 0.05.

3. Results

3.1. Descriptive statistics

As shown in Table 1, about 90.4% of decedents died at home. About 39.2% of the oldest-old were nonagenarians, 62.0% of the oldest-old were female, and 58.7% of the oldest-old lived in rural areas. About 11.9% of the oldest-old were married, and 44.4% of the included oldest-old had 4 to 6 children. Moreover, 86.7% of the oldest-old lived with family members, but 95.5% of the included oldest-old were cared by informal caregivers. Oldest-old who had more children (died at home vs. died outside home: 0–3: 33.2% vs. 42.6%; 4–6: 44.9% vs. 39.9%; >6: 22.0% vs. 17.5%), lived with family members (88.9% vs. 66.1%), and primarily received informal care (formal: 1.9% vs. 29.2%; informal: 98.1% vs. 70.8%) were more likely to die at their homes, while the oldest-old who were married during the last year of their life were more likely to die in hospitals or nursing homes (11.4% vs. 17.0%).

3.2. Association between availability of family care resources, type of primary caregiving and home death

Table 2 presents the adjusted odds ratios (AORs) and 95% confidence intervals (CIs) from the binary logistic regression models assessing the association between availability of family care resources, type of primary caregiving and home death. Results from model 1 show that marital status was not statistically related to the type of primary caregiving. However, decedents who had more children (AOR [95% CI]: 4–6 vs. 0–3: 1.81 [1.54 to 2.13]; >6 vs. 0–3: 2.63 [2.09 to 3.31]) and lived with family members (28.29 [23.89 to 33.49]) were more likely to be cared by informal caregivers. Both the indicators were also positively associated with home death after adjustment for the type of primary caregiving (model 4). Model 4 shows that compared to decedents who primarily received formal care, those primarily cared by informal caregivers were more likely to die at home (11.43 [9.58 to 13.64]). As shown in Table 2, the direct effects of the number of children and living with families in model 4 were less strong than those in model 2, which implies that the type of primary caregiving partially mediates the association between the availability of family care resources and home death.

3.3. Mediation role of type of primary caregiving between the availability of family care resources and home death

We examined the mediation role of the type of primary caregiving between the two indicators of availability of family care resources and home death (Table 3). Family caregiving significantly mediates the association between availability of family care resources and home death. The association between the number of children (β [95% CI], % mediated: 0.05 [0.04 to 0.07], 55.6%), living with families (0.14 [0.13 to 0.15], 46.7%) and home death among the oldest-old were partially mediated by the type of primary caregiving, respectively.

4. Discussion

Using data from the CLHLS, this study extended existing evidence through examining the association between the family care availability and place of death and supplemented limited evidence on national estimates of family caregiving use and place of death for the oldest-old in China. Our study demonstrated that marital status, number of children, and living with family members were significantly associated with home death, broadly supporting findings of prior work (Gomes & Higginson, 2006; Lei et al., 2021; Li, Jiang, et al., 2020). We also examined the
Table 1
Characteristics of the included oldest-old by place of death.

| Characteristic                        | Overall (N = 21,677) | died at home (N = 19,590) | died outside home (N = 2,087) | P Value |
|---------------------------------------|-----------------------|---------------------------|-------------------------------|---------|
| Age at death, y                       |                       |                           |                               |         |
| 80-89                                 | 5,224 (24.1)          | 4,499 (23.0)              | 725 (34.7)                    | <0.001  |
| 90-99                                 | 8,489 (39.2)          | 7,726 (39.4)              | 763 (36.6)                    |         |
| ≥100                                  | 7,964 (36.7)          | 7,365 (37.6)              | 599 (28.7)                    |         |
| Gender                                |                       |                           |                               |         |
| Male                                  | 8,249 (38.1)          | 7,238 (37.0)              | 1,011 (48.4)                  | <0.001  |
| Female                                | 13,428 (62.0)         | 12,352 (63.1)             | 1,076 (51.6)                  |         |
| Marital status                        |                       |                           |                               |         |
| Unmarried                             | 19,090 (88.1)         | 17,357 (88.6)             | 1,733 (83.0)                  | <0.001  |
| Married                               | 2,587 (11.9)          | 2,233 (11.4)              | 354 (17.0)                    |         |
| Residence rurality                    |                       |                           |                               |         |
| Urban                                 | 8,963 (41.3)          | 7,357 (37.6)              | 1,606 (77.0)                  | <0.001  |
| Rural                                 | 12,714 (62.7)         | 12,233 (62.4)             | 481 (23.0)                    |         |
| Attainment of education                |                       |                           |                               |         |
| Illiterate                            | 15,763 (72.7)         | 14,595 (74.5)             | 1,168 (56.0)                  | <0.001  |
| At least one year of schooling         | 5,914 (27.3)          | 4,995 (25.5)              | 919 (44.0)                    |         |
| Once had white-collar job before retirement, yes | 932 (4.3)          | 637 (3.3)                 | 295 (14.1)                    | <0.001  |
| Annually per capita household income * |                       |                           |                               | <0.001  |
| <2000                                 | 5,213 (24.0)          | 4,791 (24.5)              | 422 (20.2)                    |         |
| 2,000-4,999                           | 5,218 (24.1)          | 4,858 (24.8)              | 360 (17.2)                    |         |
| 5,000-18,000                          | 6,001 (27.7)          | 5,426 (27.7)              | 575 (27.6)                    |         |
| >18,000                               | 5,245 (24.2)          | 4,515 (23.0)              | 730 (35.0)                    |         |
| Financially independent, yes          | 2,323 (10.7)          | 1,574 (8.0)               | 749 (35.9)                    | <0.001  |
| Temporily medication                  |                       |                           |                               | <0.001  |
| No                                    | 4,053 (18.7)          | 3,858 (19.7)              | 195 (9.3)                     |         |
| Yes                                   | 16,856 (77.8)         | 15,003 (76.6)             | 1,853 (88.8)                  |         |
| Was not ill                           | 768 (3.5)             | 729 (3.7)                 | 39 (1.9)                      | <0.001  |
| Number of children                    |                       |                           |                               | <0.001  |
| 0-3                                   | 7,387 (34.1)          | 6,497 (33.2)              | 890 (42.6)                    |         |
| 4-6                                   | 9,618 (44.4)          | 8,786 (44.8)              | 832 (39.9)                    |         |
| >6                                    | 4,672 (21.6)          | 4,407 (22.0)              | 365 (17.5)                    |         |
| Living with family members, yes       | 18,786 (86.7)         | 17,406 (88.9)             | 1,380 (66.1)                  | <0.001  |
| Type of primary caregiving            |                       |                           |                               | <0.001  |
| Formal caregiving                     | 981 (4.5)             | 371 (1.9)                 | 610 (29.2)                    |         |
| Informal caregiving                   | 20,696 (95.5)         | 19,219 (98.1)             | 1,477 (70.8)                  |         |
| Being bedridden before death, yes     | 16,143 (74.5)         | 14,567 (74.4)             | 1,576 (75.5)                  | 0.250   |
| Disability in ADLs, yes               | 17,856 (82.4)         | 16,108 (82.2)             | 1,748 (83.8)                  | 0.081   |
| Census region                         |                       |                           |                               | <0.001  |
| Eastern                               | 8,716 (40.2)          | 7,788 (39.8)              | 928 (44.5)                    |         |
| Central                               | 5,050 (23.3)          | 4,674 (23.9)              | 376 (18.0)                    |         |

Note: a, presented in Chinese Yuan; ADLs, activities in daily livings.

The results of this study are in line with findings of previous studies that demonstrated home was the most frequent place of death among Chinese older adults (Cai et al., 2017; Gu et al., 2007; Weng et al., 2021), which is quite different from findings of studies based on the many European countries in which hospitals or nursing homes is the most common place of death (Ailshire et al., 2021; Cabanero-Martinez et al., 2019; Houttekier et al., 2010; Orlovic et al., 2017). In addition to the differences in sociodemographic factors of study samples, this discrepancy could also be attributed in part to the cross-country variation in the availability of healthcare resources or organizational differences in service provision of EOL care (Cohen et al., 2015; Reynolds et al., 2015). For example, greater availability of hospital beds is often associated with an increased likelihood of hospital death (Tolle et al., 1999). Likewise, more nursing home beds might increase the likelihood of nursing home death (Houttekier et al., 2010). This finding suggests that the greater rate of home death may reflect that EOL care for older adults is likely less institutionalized in China. Another possible explanation is the likelihood of home death increased with age (Gisquet et al., 2016; Jennings et al., 2020) since our study focused on the oldest-old in China.

We found that informal caregiving accounted for the highest proportion of care received by the oldest-old. A similar finding was also reported by prior work from the United States, indicating that families and unpaid caregivers provide most of care (Ornstein et al., 2017). Particularly in China, the rooted traditional culture of “filial piety” indicates that children should show respect for their parents and shoulder the responsibility to care for them (Schei-Adlung, 2015). Our findings showed that the number of children was positively associated with informal caregiving, which is consistent with findings of a recent study on the association between adult child availability and informal care use (Choi et al., 2021). However, contrary to expectations, our study did not find a significant association between marital status and family caregiving. Most of the oldest-old did not have a spouse (88.1%) during the first year of their life. Although 11.9% of the participants had a spouse, their spouses might have disability in ADLs because of their advanced age (82.4% of the included oldest-old), which means limited ability to provide care. Therefore, compared to the spouse’s availability, the children’s availability may better predict the type of care used among the oldest-old in China.

Similar to a cross-national study that examined the association...
Collar job before retirement, annually household income per capita, financially independent, timely medication, being bedridden before death, disability in ADLs, cared at their homes. Notably, being married was negatively related with families) and home death, indicating that caregiving from children institution as the proper care setting because of burdensome care they have to undertake, especially for spouses of advanced age who may be physically and cognitively unable to provide care (Brazil et al., 2005; Choi et al., 2021).

Our study has several limitations. First, unlike many previous studies that focused on a disease-specific population group, the data used in this study were from a nationally representative survey of Chinese older adults. Because of the tremendous missing values of the cause of death, we did not include this variable that has been proven to be an important predictor of place of death (Jennings et al., 2020; Loucka et al., 2014). Second, the survey questionnaire did not include information on transitions between the place of care. Thus, we could only provide information on the place of death at the moment. Third, caregiving experience (e.g., burden and challenges) was not captured in the survey, which limits our understanding of the heterogeneity in the mechanism that different family care resources influence place of death.

### Table 2

| Characteristic                              | Model 1                                          | Model 2                                          | Model 3                                          | Model 4                                          |
|--------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|
|                                            | Primary caregiving                               | Home death                                       | Primary caregiving                               | Home death                                       |
|                                            | OR (95% CI) P value                             | OR (95% CI) P value                             | OR (95% CI) P value                             | OR (95% CI) P value                             |
| Marital status (Ref: Unmarried)            | 0.91 (0.70, 1.19) 0.508                        | 0.84 (0.72, 0.97) 0.022                        | 0.84 (0.72, 0.98) 0.027                        | 0.84 (0.72, 0.98) 0.027                        |
| Number of children (Ref: 0-3)              | 1.81 (1.54, 2.13) <0.001                        | 1.31 (1.17, 1.46) <0.001                        | 1.17 (1.04, 1.32) 0.010                        | 1.19 (1.03, 1.38) 0.019                        |
| >6                                         | 2.63 (2.09, 3.31) <0.001                        | 1.42 (1.23, 1.63) <0.001                        | 2.52 (2.17, 2.92) <0.001                        | 2.52 (2.17, 2.92) <0.001                        |
| Living with family members (Ref: No)       | 28.29 (23.89, 33.49) <0.001                      | 5.57 (4.93, 6.29) <0.001                        | 5.57 (4.93, 6.29) <0.001                        | 5.57 (4.93, 6.29) <0.001                        |
| Type of primary caregiving (Ref: Formal caregiving) |  | 19.62 (16.74, 22.99) <0.001                      | 11.43 (9.58, 13.64) <0.001                      | 11.43 (9.58, 13.64) <0.001                      |

### Table 3

| Availability of family care resources | β  | 95% CI | % Total |
|--------------------------------------|----|--------|---------|
| Indirect effect                      | 0.05 | (0.04, 0.07) | 55.6   |
| Direct effect                        | 0.04 | (0.01, 0.06) | 44.4   |
| Total effect                         | 0.09 | (0.06, 0.12) | 100    |

### Notes

- All models were adjusted for the oldest-old's age at death, gender, residence rurality, attainment of education, once had a white-collar job before retirement, annually household income per capita, financially independent, timely medication, being bedridden before death, disability in ADLs, census region and year of death. Full models with all covariates were provided in Appendix Table 1.

5. Conclusion

The study contributes to understanding the association between availability of family care resources, type of primary caregiving, and home death. Our findings reveal that family members may facilitate the home death mainly by offering informal caregiving. However, availability of spouses and children care resources showed heterogeneous results, suggesting that children play an integral role in providing EOL care and home death among the oldest-old. To develop a caregiving environment that could relieve caregivers’ burden and meet individual or their family needs, policymakers could provide more supportive services for the oldest-old and their family caregivers. In addition, differences in the availability of family care resources must be considered when promoting long-term care and EOL care support.

Consent for publication

Not applicable.

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Author contributions

Zhong Li, Zihui Xiong, Weiyian Feng: Conceptualization, Methodology, Software, Data curation, Formal analysis; Visualization, Investigation; Zihui Xiong: Writing- Original draft preparation; Zhong Li, Weiyian Feng: Funding acquisition; Zhong Li, Weiyian Feng Supervision, Writing- Reviewing and Editing. All authors read and approved the final manuscript. Zhong Li has full access to all of the data in this study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Ethics approval and consent to participate

This CLHLS study was apporved by the institutional review board of the Peking University and Duke University (IRB00001052-13074), each
wave is independent with different participants recruited. Written/Oral informal consent was obtained from the respondents or the next-of-kins in the baseline and follow-up surveys. The Institutional Review Board of the Nanjing Medical University considered the analysis of public and anonymous data to be exempt.

Declaration of competing interest

None.

Data availability

Data will be made available on request.

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We thank all the staff involved the CLHLS data collection and management.

Appendix Table 1. Association between availability of family care resources, type of primary caregiving and home death

| Characteristic                        | Model 1                                      | Model 2                                      | Model 3                                      | Model 4                                      |
|--------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|
|                                      | Primary caregiving                           | Home death                                  | Home death                                  | Home death                                  |
|                                      | OR (95% CI)                                  | P value                                     | OR (95% CI)                                  | P value                                     |
| Marital status (Ref: Unmarried)      |                                              |                                              |                                              |                                              |
| Married                              | 0.91 (0.70, 1.19)                            | 0.508                                       | 0.84 (0.72, 0.97)                            | 0.022                                       |
| ≥100                                 | 0.74 (0.60, 0.90)                            | 0.003                                       | 1.26 (1.10, 1.44)                            | 0.001                                       |
| Number of children (Ref: 0-3)        |                                              |                                              |                                              |                                              |
| 4-6                                  | 1.81 (1.54, 2.13)                            | <0.001                                      | 1.33 (1.17, 1.46)                            | <0.001                                      |
| >6                                   | 2.63 (2.09, 3.31)                            | <0.001                                      | 1.42 (1.23, 1.63)                            | <0.001                                      |
| Living with family members (Ref: No)|                                              |                                              |                                              |                                              |
| Yes                                  | 28.29 (23.89, 33.49)                         | <0.001                                      | 5.57 (4.93, 6.29)                            | <0.001                                      |
| Type of primary caregiving (Ref: Formal caregiving) | 19.62 (16.74, 22.99) | <0.001                                      | 11.43 (9.58, 13.64)                          | <0.001                                      |
| Age at death, y (Ref: 80-89)         |                                              |                                              |                                              |                                              |
| 90-99                                | 0.92 (0.76, 1.12)                            | 0.409                                       | 1.33 (1.18, 1.51)                            | <0.001                                      |
| ≥100                                 | 0.74 (0.60, 0.90)                            | 0.003                                       | 1.26 (1.10, 1.44)                            | <0.001                                      |
| Gender (Ref: Male)                   |                                              |                                              |                                              |                                              |
| Female                               | 0.65 (0.54, 0.78)                            | <0.001                                      | 0.81 (0.71, 0.92)                            | <0.001                                      |
| Residence rurality (Ref: Urban)      |                                              |                                              |                                              |                                              |
| Rural                                | 3.80 (3.21, 4.51)                            | <0.001                                      | 3.68 (3.28, 4.14)                            | <0.001                                      |
| Attainment of education (Ref: Illiterate) |                                              |                                              |                                              |                                              |
| At least one year of schooling       | 0.59 (0.49, 0.72)                            | <0.001                                      | 0.75 (0.66, 0.85)                            | <0.001                                      |
| Once had a white-collar job before retirement (Ref: No) |                                              |                                              |                                              |                                              |
| Yes                                  | 0.58 (0.43, 0.78)                            | <0.001                                      | 0.60 (0.50, 0.72)                            | <0.001                                      |
| Annually household income per capita  |                                              |                                              |                                              |                                              |
| (Ref: < 2,000)                       | 1.91 (1.53, 2.39)                            | <0.001                                      | 1.18 (1.01, 1.39)                            | 0.042                                       |
| 2,000-4,999                          | 1.03 (0.84, 1.27)                            | 0.773                                       | 0.80 (0.69, 0.94)                            | 0.007                                       |
| 5,000-18,000                         | 0.85 (0.64, 1.07)                            | 0.156                                       | 0.49 (0.40, 0.59)                            | <0.001                                      |
| Financially independent (Ref: No)    |                                              |                                              |                                              |                                              |
| Yes                                  | 0.85 (0.64, 1.07)                            | 0.156                                       | 0.49 (0.40, 0.59)                            | <0.001                                      |
| Timely medication (Ref: No)          |                                              |                                              |                                              |                                              |
| Yes                                  | 0.69 (0.55, 0.85)                            | <0.001                                      | 0.45 (0.38, 0.53)                            | <0.001                                      |
| Was not ill                          | 1.09 (0.61, 1.95)                            | 0.790                                       | 0.74 (0.49, 1.12)                            | 0.160                                       |
| Being bedridden before death (Ref: No)|                                              |                                              |                                              |                                              |
| Yes                                  | 1.04 (0.86, 1.27)                            | 0.666                                       | 1.00 (0.88, 1.14)                            | 0.995                                       |
| Disability in ADLs (Ref: No)         |                                              |                                              |                                              |                                              |
| Yes                                  | 0.80 (0.63, 1.01)                            | 0.061                                       | 0.99 (0.85, 1.16)                            | 0.892                                       |
| Census region (Ref: Eastern)         |                                              |                                              |                                              |                                              |
| Central                              | 1.31 (1.07, 1.60)                            | 0.010                                       | 1.06 (0.92, 1.21)                            | 0.448                                       |
| Western                              | 1.45 (1.20, 1.75)                            | <0.001                                      | 1.23 (1.08, 1.40)                            | <0.001                                      |
| Year of death (Ref: 1998–1999)       |                                              |                                              |                                              |                                              |
| 2000-2001                            | 1.31 (0.96, 1.78)                            | 0.094                                       | 1.05 (0.85, 1.31)                            | 0.650                                       |
| 2002-2004                            | 0.89 (0.66, 1.21)                            | 0.424                                       | 1.01 (0.82, 1.25)                            | 0.003                                       |
| 2005-2007                            | 3.54 (2.49, 5.03)                            | <0.001                                      | 1.41 (1.12, 1.77)                            | 0.003                                       |
| 2008-2010                            | 1.53 (1.10, 2.11)                            | 0.010                                       | 1.45 (1.15, 1.82)                            | 0.002                                       |
| 2011-2013                            | 1.74 (1.22, 2.50)                            | <0.001                                      | 1.99 (1.53, 2.57)                            | <0.001                                      |
| 2014-2017                            | 4.48 (2.88, 6.95)                            | <0.001                                      | 2.36 (1.76, 3.18)                            | <0.001                                      |
| Prob > Chi²                          |                                              |                                              |                                              |                                              |
| <0.001                               | <0.001                                       | <0.001                                      | <0.001                                       | <0.001                                      |
| Log likelihood                       | −2593.8794                                  | −5385.2589                                  | −5078.3123                                  | −5003.507                                   |
| Pseudo R²                            | 0.3507                                       | 0.2159                                      | 0.2606                                       | 0.2715                                      |

Note: a, presented in Chinese Yuan; ADLs, activities in daily livings.

List of abbreviations

EOL end-of-life

CLHLS Chinese Longitudinal Health Longevity Survey

ADLs activities of daily livings

AOR adjusted odds ratio

CI confidence interval
Prioleau, P. G., Soones, T. N., Ornstein, K., Zhang, M., Smith, C. B., & Wajnberg, A. (2016). Predictors of place of death of individuals in a home-based primary and palliative care program. *Journal of the American Geriatrics Society, 64*, 2317-2321. https://doi.org/10.1111/jgs.14465

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