

BMJ Open Impact of additional community services provision on dementia caregiver burden: an interrupted time-series analysis of 12-year interRAI assessments in Hong Kong

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ABSTRACT

Objectives To evaluate the impact of providing additional dementia caregiver support services on caregiver burden.

Design Interrupted time-series analysis using territory-wide panel data.

Settings All public-funded district elderly community centres in Hong Kong (HK).

Participants Primary caregivers for older adults (age over 65 years) living with dementia assessed through International Residential Assessment in HK between 1 October 2004 and 31 September 2016. Paid caregivers were excluded.

Interventions In April 2014, US\$280 million was allocated to provide additional psychological support, education and respite care for dementia caregivers in HK.

Main outcome measures Caregiver burden was measured by two age-standardised rates: (1) caregivers in emotional distress; and (2) caregivers with long care time in a week (more than 20 hours a week). We fitted the two time-series into Autoregressive Integrated Moving Average models to evaluate intervention impacts, with follow-up analyses to consider a 6-month transition period of policy implementation. Segmented linear regressions and Holt-Winter exponential smoothing models were used as sensitivity analyses.

Results 36 689 dementia caregivers were included in this study, of which 14.4% caregivers were distressed and 31.9% were long-hours caregivers after the policy intervention in April 2014. Providing additional caregiver service significantly reduced standardised rates of caregivers in distress (β (95% CI) = -3.93 (-7.85 to -0.01), $p < 0.05$), but the effect was not sustained ($p = 0.183$). There was no significant impact on the level of age-standardised rates of caregiver with long care time (β (95% CI) = -4.25 (-9.61 to 1.10), $p = 0.120$). Also, there was no significant delay of intervention impacts.

Conclusion Our study finds that strengthening caregiver services provision could reduce distress rates among primary caregivers for older adults living with dementia. Expanding community services for caregiver could be a solution to the escalating burden of informal care for people living with dementia.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This is a large, ecological study to evaluate the impact of caregiver support policies on the prevalence of dementia caregiver burden, using a 12 years, territory-wide routine database of Hong Kong Chinese population.
- ⇒ We found that strengthening community-based caregiver support services could immediately lower the age-standardised distress rates among dementia caregiver, but the effect was not sustained over time.
- ⇒ The introduction of caregiver support policies did lower the age-standardised rates of dementia caregivers who provided intensive care, but the effect was not statistically significant.
- ⇒ Despite its contribution, this study failed to establish causality with its ecological nature, and study results should be interrupted with attention not to attribute the characteristics of a population to individual caregivers.

INTRODUCTION

Ageing population, along with the epidemiological trend of increasing prevalence of dementia,¹ have brought the burden of dementia caregiving to the forefront of academic attention. To expand the capacity of healthcare system, informal care provided by spouses, adult children, other family members and friends has become essential in ensuring continuous care for patients.² Sörensen and Conwell,³ however, point out that inadequate caregiver support may put the risk on the sustainability of continuous care, since dementia caregiving is often perceived as more stressful than caring for a person with other diseases. The decline in cognitive function and functional dependence associated with dementia requires more resourceful and skilful care, as well as lengthened care hours.^{3 4} Burden associated with dementia

care could cause negative physical,⁵ mental⁶ and social consequences⁷ to the caregiving dyads, leading to the suspension of home care, and even institutionalisation of the older adults.

Territory-wide interventions in supporting dementia caregivers (such as policy intervention allocating additional funds to provide caregiver subsidy and social care services) are common in developed regions. However, there is scarcity of literature reviewing the effects and impacts of such interventions. Systematic reviews identified evidence on the cost-effectiveness of individual-level, group-based, technology-based and multicomponent caregiver support interventions.^{8–10} However, only a scarce number of studies reflect the effectiveness of interventions from an ecological perspective, which is important when considering the impact of a territory-wide policy intervention. Literature discussing the consequences of caregiver-support policies on caregiver burden is mainly qualitative^{11–13} or providing descriptive statistics in different policy contexts without empirical analysis.¹⁴ Recently, Ding and colleagues¹⁵ attempted to evaluate the impact of caregiver-friendly workplace policy with a time-series approach. This study evaluates the effectiveness of a caregiver support programme in improving health-related outcomes in caregiver employers in a 12-month period. However, the small sample size (n=21) limited the generalisability of their study. The research gap still awaits to be filled with ecological evidence in a more representative sample.

Hong Kong shares the challenge of rising prevalence of dementia, with the number of older adults with dementia is estimated to account for 13% of all older citizens in 2030.¹⁶ In face of the surging needs for dementia care in the community, the Hong Kong government has earmarked an extra amount of HK\$2200 million (US\$280 million) recurrent fund to employ additional headcounts for social workers and welfare workers dedicated for dementia caregiver services in all the 41 District Elderly Community Center in Hong Kong April 2014 onwards. The policy was implemented along amendments of the service agreements with public-funded community care providers to reflect the shift of focus to supporting dementia caregivers. Additional services spots were provided to cater for the increasing services needs of people with dementia, including newly set-up counselling services and home care trainings for dementia caregivers, group-based psychological support groups, respite care services and providing living allowances to the caregivers from low-income families.^{17,18}

In Hong Kong, the profile of all older adults and their caregiver is collected routinely through the International Residential Assessment (interRAI) Minimal Data Set – Home Care Assessment when they are seeking government-funded community care services. InterRAI is a valid and reliable assessment tool widely used in North America (Canada and multiple states in the USA), Europe (Italy, Switzerland, Finland, Estonia, etc) and Asia/Pacific Rim (Hong Kong, Singapore, Japan,

Australia and New Zealand). The assessment is routinely administered by trained personnel to collect information of the older adults and their caregivers to understand their care needs and allocate long-term care services.¹⁹ Previous study was conducted to understand the profile of dementia caregiver burden with this dataset.²⁰ In the current practice, interRAI assessments are conducted by trained assessors serving in community-based social care institutes, including elderly centres that were allocated with additional fund to provide caregiver supports after the policy implementation in April 2014.

In this study, we use a 12-year interRAI database to investigate the impact of strengthening caregiver support policies on dementia caregiver burden between 1 October 2004 and 1 September 2016 in Hong Kong. We hypothesised that prevalence and the trend of caregiver burden of older adults with dementia would differ before and after the additional allocation of funds in enhanced social care for dementia caregivers April 2014 onwards.

METHODS

Subjects

This is a retrospective time-series analysis involving community-dwelling older adults (defined as 65 years old or above at the time of assessment) with dementia who had their first interRAI from 1 October 2004 to 31 September 2016 in Hong Kong. Primary caregivers (defined as the person who is responsible for most of the care-taking for the older adults at the time of assessment) were identified by the accredited assessor from public-funded care institutes. Paid caregivers (eg, maids) were excluded. We adopted an ecological design to measure the prevalence of caregiver burden in Hong Kong and to allow geographical comparison with other developed regions.

Patient and public involvement

There is no patient and public involved in the development of research question, interpretation of results and data dissemination.

Variables

We extracted information of assessment date, age and sex of the older adults, the total number of hours the primary caregiver would spent on caregiving tasks in 7 days, whether the primary caregiver is in emotional distress and unable to care and the demographic information of the caregiving dyads to allow meaningful interpretations.

Caregiver burden was measured with two indicators: the emotional distress of the primary caregiver and the total time spent on caregiving every week. Caregiver burden is a multidimensional concept that reflects the negative consequences of caregiving,²¹ which could be measured subjectively (negative emotion response due to caregiving tasks) or objectively (time–cost of caregivers). To capture both perspectives of dementia caregiver burden, we indicated a primary caregiver as in burden if

he or she 'provides more than 20 hours of caregiving in a week' (which is the eligibility criteria to apply for caregiver subsidy,¹⁷ or 'reported to be unable to continue care and was feeling distress due to caregiving' at the time of assessment. Population average of the time devoted by the caregiver in a week was also quoted.

Statistical analysis

We used R with RStudio V1.1.453 for all the statistical analysis in this study with the significance level set at 5%. Crude rates and age-standardised rates of dementia caregiver burden were calculated for each months between 1 October 2004 and 31 September 2016, using the number of people who cared for more than 20 hours in a week, and the number of caregivers who expressed emotional strain, respectively. Age-standardised caregiver burden rates were calculated using direct standardisation with reference to the age distribution of the older adults in September of 2004 ('65–74 years', '75–84 years' and '80 years or above', which is the baseline of this panel data.²² Missing values were imputed using 'last observation carried forward' method.²³ Descriptive statistics of the outcomes before and after the policy implementation was calculated, and t-test was used to compare the difference wherever appropriate. The formulae used in the rate calculation were as the following.

Equation 1:

$$\text{Age - standardized rate of burden} = \sum_{i=1}^3 \frac{d_i}{p_i} \times w_i$$

where for age-group i , d_i is the age-specific caregiver burden count, p_i is the population size for the age–sex specific group and w_i is the weight for that group.

Intervention analysis was done with Autoregressive Integrated Moving Average model (ARIMA) forecasting and segmented linear regressions to examine the effect of policy intervention on the prevalence of distress caregivers and caregivers with long care time in this population. Non-seasonal, stationary ARIMA model was well adopted in health and social science in forecasting time-series data for its stability and simplicity.²⁴ It is often adopted in interrupted time-series analysis, which a single intervention is expected to intervene the level/trend of the outcome indicator.²⁵ In this study, the stationarity of the times-series were examined using Dicky-Fuller test and by visual examination of autocorrelation plots. Differencing was done when the time-series is not stationary in prior to formulating the ARIMA models. We used the statistical function *auto.arima* in R to select the best fitting ARIMA model by comparing the values of Akaike's information criterion (AIC).²⁶ We adopted monthly estimates in this study to allow creation of more than 100 time-points in the time-series and therefore to capture the potential seasonality and postintervention impacts using ARIMA models. Effect of the intervention was estimated by including a step change and a ramp function in the transfer function of the ARIMA model.²⁷ Considering a 6-month transition period for the policy to be fully enacted, we further conducted a series of sensitivity analysis to include lagged

terms up to 6 months in the best-fitted ARIMA model. Then, the model estimates and model fits were compared against the best-fitted ARIMA model for evaluation.

In addition, we used segmented linear regressions and Holt-Winter seasonal exponential smoothing method as sensitivity analyses. In both analyses, we decomposed the preinterventional time-series with an additive model, and the seasonal component was adjusted in prior to fitting into the regressions. In the segmented regression, seasonality-adjusted and age-standardised caregiver burden rate (Y_t) was regressed against time, a binary variable denoting immediate impact of policy change at April 2014, and a continuous variable denoting trend after policy impact adopting the methodology used by Selvaraj and colleagues²⁸ (equation 2). In the sensitivity analysis using Holt-Winter method, seasonality-adjusted preintervention time-series were fitted in an additive dump trend model, and postintervention caregiver burden rates were forecasted and compared against the observed rates. In all the analyses, model coefficients, 95% CIs and corresponding p values were quoted when appropriate to estimate policy intervention.²⁹ Model residuals were checked against the assumptions of having a mean of zero, being normally distributed and have no autocorrelations with lags by plotting the histogram and autocorrelation function plots.

Equation 2:

$$Y_t = \alpha + \beta_1 \text{time}_t + \beta_2 \text{policy change}_t + \beta_3 \text{time after intervention}_t + \epsilon_t$$

where Y_t is the age-standardised rate of burdens after adjusted for seasonality,

α is the intercept,

β is the model coefficients and

ϵ_t is the error term.

RESULTS

Among the 63 448 older adults with dementia who had their first interRAI assessment between 1 October 2004 and 31 September 2016, we excluded the 19 164 older adults who has no caregiver, and 7595 employed a domestic helper/maid as their primary caregiver. A total of 36 689 who had at least one unpaid caregiver and their information was included in this analysis. More than half of the care recipients were female and aged over 75 years. Close to 40% of the primary caregivers lived with the older adults who received care, and most of them were children (67.3%) or spousal caregivers (25.2%). Most of the caregivers provided emotional support (98.3%) and instrumental activities of daily living care (92.8%, including shopping), while close to 70% provided support to the activities of daily living items (including feeding) for the older adults. After the policy intervention in April 2014, the mean weekly time devoted by the caregiver in this sample was 18.02 hours (SD=20.49), 14.4% of the primary caregiver expressed they were in distress and 31.9% of them devoted more than 20 hours a week in

Table 1 Demographic information of the caregiving dyads (n=36 689)

	Overall	Stratified by policy intervention time		
		Before intervention	After intervention	P value
n	36 689	27 791	8898	
Information of the older adults applying for service				
Female	22 391 (61.0)	17 127 (61.6)	5264 (59.2)	<0.001
Age (years)				<0.001
65–74	4906 (13.4)	3856 (13.9)	1050 (11.8)	
75–84	17 197 (46.9)	13 309 (47.9)	3888 (43.7)	
85 or above	14 586 (39.8)	10 626 (38.2)	3960 (44.5)	
Information of the primary caregiver				
Live with the older adult	14 383 (39.2)	10 588 (38.1)	3795 (42.7)	<0.001
Relationship with older adult				
Child	24 700 (67.3)	18 805 (67.7)	5895 (66.3)	
Spouse	9250 (25.2)	6785 (24.4)	2465 (27.7)	
Other relative	2163 (5.9)	1743 (6.3)	420 (4.7)	
Friend/neighbour	576 (1.6)	458 (1.6)	118 (1.3)	
Provided emotional care	36 081 (98.3)	27 325 (98.3)	8756 (98.4)	0.636
Provided IADL care	34 064 (92.8)	25 783 (92.8)	8281 (93.1)	0.366
Provided ADL care	25 647 (69.9)	19 212 (69.1)	6435 (72.3)	<0.001
Caregiver who cared 20+ hours in a week	10 448 (30.9)	7974 (30.6)	2474 (31.9)	<0.05
Caregiving time in a week mean (SD)	15.93 (17.87)	15.32 (16.98)	18.02 (20.49)	<0.001
Unable to continue care and distress	4478 (12.2)	3194 (11.5)	1284 (14.4)	<0.001
Year of assessment				
2004	509 (1.4)			
2005	2450 (6.7)			
2006	2901 (7.9)			
2007	3141 (8.6)			
2008	3117 (8.5)			
2009	2889 (7.9)			
2010	3122 (8.5)			
2011	2680 (7.3)			
2012	1062 (2.9)			
2013	3756 (10.2)			
2014	4093 (11.2)			
2015	4159 (11.3)			
2016	2810 (7.7)			

ADL care: care for activities of daily living items, including feeding and bathing, etc; IADL care: care for instrumental activities of daily living items, including shopping and cooking etc.

informal caregiving. [Table 1](#) summarises the information of the dementia caregiving dyads included in this study. During the study period, the mean caregiving hours in a week increased from 14.4 hours per week to 18.1 hours a week between 2004 and 2016. Age-standardised rate of caregiver who was distress and unable to continue care was 9.67% in October 2004 and lately increased to 15.2% in September 2016, while that of caregiver devoted more than 20 caregiving hours in a week was 28.0% in the

October 2004 and 32.4% in the September 2016. Online supplemental tables S1 and S2 compare the demographic information of caregivers by the disease diagnosis of the care recipients and the year of assessment. Online supplemental table S3 gives the time-series of crude and age-standardised rates of distress caregivers and caregiver with long care time.

ARIMA (0,1,1) were fitted to describe the time-series of age-standardised rates of distress caregivers, and

Table 2 Model estimates of the fitted ARIMA models before policy intervention

Age-standardised rate of caregiver burden in terms of caregiver distress (per 100 population)		
ARIMA (0, 1, 1)	Coeff. (95% CI)	P value
MA1 (1)	-0.90 (-0.94 to 0.84)	<0.001
Policy implementation	-3.93 (-7.85 to 0.01)	<0.05
Trend change	0.15 (-0.07 to 0.37)	0.183
Age-standardised rate of caregiver burden in terms of caring for 20 hours or more in a week (per 100 population)		
ARIMA (0, 1, 1)	Coeff. (95% CI)	P value
MA1 (1)	-0.89 (-0.98 to 0.80)	<0.001
Policy implementation	-4.25 (-9.61 to 1.10)	0.120
Trend change	-0.01 (-0.32 to 0.30)	0.941

AR, autoregression; ARIMA, Autoregressive Integrated Moving Average; MA, moving average; SMA, seasonal moving average.

caregivers with long care time (table 2). Additional provision of dementia caregiver services imposed an immediate reduction in distress caregiver rates (β (95% CI)=-3.93 (-7.85 to -0.01), $p<0.05$) and a non-significant decrease in long care time caregiver rates (β (95% CI)=-4.25 (-9.61 to 1.10), $p=0.120$). The impact of the policy intervention was not sustained in both time-series (β (95% CI)=0.15 (-0.07 to 0.37), $p=0.183$ in distress caregiver rates; β (95% CI)=-0.01 (-0.32 to 0.30), $p=0.941$ in time-burden caregiver rates). Online supplemental table S4 and supplemental figure S1 describe the ARIMA model estimates for non-dementia caregivers. Online supplemental table S5 and figure 1 illustrate the comparison of postinterventional forecast and observed values in the fitted models. Both time-series were stationary according to Dickey-Fuller test (p value <0.01 for distress caregiver rates, and $p<0.05$ for time-burdened caregiver rates).

Using segmented linear regression models, we identified a similar reduction of age-standardised rates following the policy intervention in 2014. Providing extra

caregiver support services posed an immediate impact on both outcomes (β (95% CI)=-4.37 (-4.50 to -1.25), $p<0.01$ in distress caregiver rates and β (95% CI)=-4.40 (-8.59 to -0.20), $p<0.05$ in long care time caregiver rates. There was no sustained effect of the policy intervention in both times-series ($p>0.05$) (table 3). Online supplemental table S6 and online supplemental figure S2 describe the regression models for non-dementia caregivers, and figure 2 outlines the comparison of postinterventional forecast and observed values in the fitted regressions among dementia caregivers. Another sensitivity analysis was done using the Holt-Winter exponential smoothing model to forecast postintervention values for distress caregiver rates and time-burdened caregiver rates, as illustrated in figure 3 (for dementia caregiver), online supplemental figure S3 (for non-dementia caregiver) and online supplemental table S7. We compared the model fits of ARIMA, segmented linear regression and Holt-Winter model in online supplemental table S8, and online supplemental figures S4-S9 show the histograms and correlograms of residuals for each of the models for assumption checking.

In subsequent sensitivity analyses considering lagged terms up to 6 months, we concluded that the original ARIMA fitted the best in both time-series for distress caregiver rates and time-burdened caregiver rates, with the lowest AIC values (online supplemental table S9). Online supplemental table S10 shows that lagged terms of policy intervention were not significant ($p>0.05$) in both time-series, indicating there is no observable delay for the policy implementation to take place. Online supplemental table S11 gives another sensitivity analysis to detect an alternative change point in April 2012, and the results indicated a non-significant impact on the outcomes of interest.

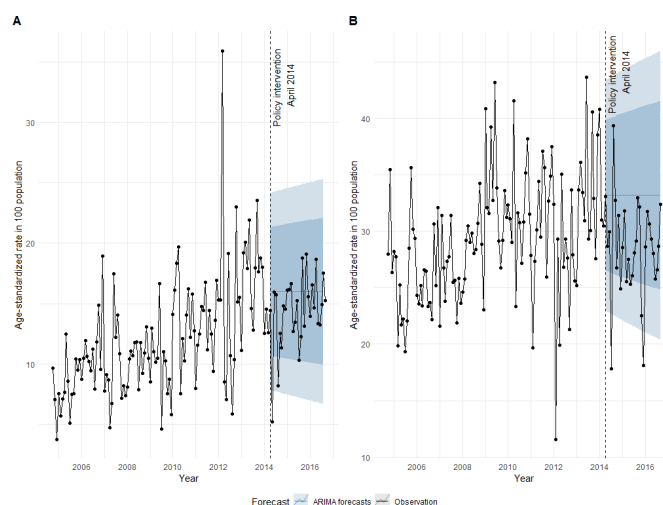


Figure 1 (A) age-standardised rate of caregiver distress using ARIMA forecasting. (B) Age-Standardised rates of caregiver who provided more than 20 hours of care in a week using ARIMA forecasting. ARIMA, Autoregressive Integrated Moving Average.

DISCUSSION

This study is the first study to investigate whether a policy intervention of strengthening social care support services in April 2014 could alleviate the burden of the primary caregivers for older adults living with dementia in Hong

Table 3 Model statistics of the segmented linear regressions**Age-standardised rate of caregiver burden in terms of caregiver distress (per 100 population)**

	Coefficient (95% CI)	P value
Intercept	6.55	
Time	0.08 (0.06 to 0.10)	<0.001
Policy implementation	-4.37 (-4.50 to 1.25)	<0.01
Trend change	0.07 (-0.10 to 0.23)	0.420

Age-standardised rate of caregiver burden in terms of caring for 20 hours or more in a week (per 100 population)

	Coefficient (95% CI)	P value
Intercept	24.7	
Time	0.06 (0.04 to 0.09)	<0.001
Policy implementation	-4.40 (-8.59 to 0.20)	<0.05
Trend change	-0.08 (-0.30 to 0.14)	0.470

Kong, using a 12-year panel database routinely collected from the interRAI assessments. Our study compared the age-standardised rates of caregiver burden before and after policy intervention using two indicators, in order to capture the impacts of social care support on the negative consequences of dementia care on the caregivers' emotional distress and the number of hours they spent on the caregiving tasks. This study identified an immediate and significant reductions of caregiver burden rates following the introduction of policies to strengthen community care supports for older adults living with dementia and their caregivers in April 2014, after adjusted for seasonality and standardised by age distribution. Despite the alleviation effect of the policy intervention did not sustain, our study confirms that population-wide intervention to facilitate access to community care services are beneficial to reduce the cost of dementia care in the population level, in terms of emotional distress and number of hours spent on dementia caregiving.

Prevalence of caregiver burden measures in comparison with international estimates

Hong Kong demonstrated a relatively lower rate of caregiver burden rate and less average caregiving time in compared with other countries and regions. In the USA, 40% of caregiver was reported to have high caregiver burden, and the average caregiving time of primary caregivers for people living with dementia was 21.9 hours per week.^{5 30} Instead, Hong Kong has an average distress caregiver rate of 14.4% and a mean caregiver time of 18.02 hours per week after April 2014, which is much lower than that in the Western world. Cultural influence in stress evaluation and the recognition of caregiver roles might be accountable of this difference. Hong Kong has a majority of Chinese population, which account for 92% according to the 2016 by census.³¹ Instead, Hong Kong has an average caregiver burden distress caregiver rate of 14.4% as measured in emotional distress and a mean caregiver time of 18.03 hours per week after April 2014,

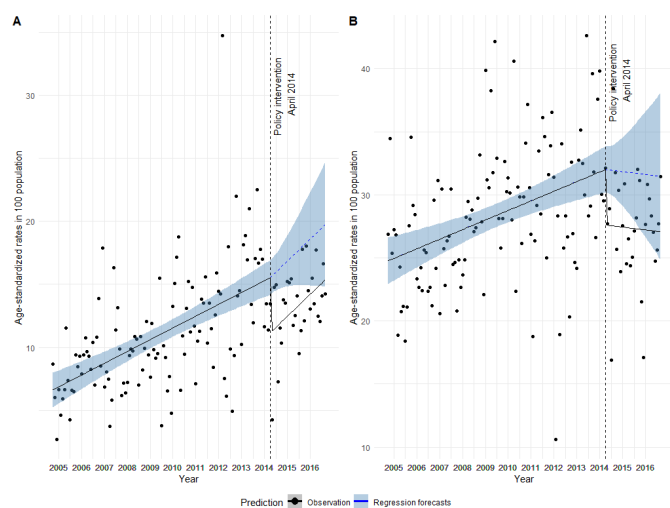


Figure 2 (A) Age-standardised rate of caregiver distress using segmented linear regression. (B) Age-standardised rate of caregiver who provided more than 20 hours of care in a week using segmented linear regression.

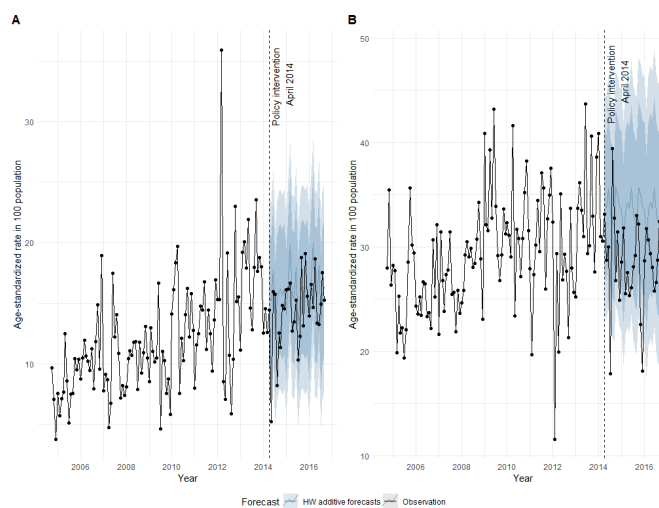


Figure 3 (A) Age-standardised rate of caregiver distress using Holt-Winters method. (B) Age-standardised rate of caregiver who provided more than 20 hours of care in a week using Holt-Winters method.

which is much lower than that in the Western world. Cultural influence in stress evaluation and the recognition of caregiver roles might be accountable of this difference. Hong Kong has a majority of Chinese population, which account for 92% according to the 2016 by-census.³¹ Decades of caregiver research tells us that Asian are more resilient to the negative emotions resulting from excessive care loads, when comparing with their white and American counterparts.^{32–34} Decades of caregiver research tells us that Asian are more resilient to the negative emotions resulting from excessive care loads, when comparing with their white and American counterparts.^{32–34} Embedded in the core values of the Chinese culture, there is filial responsibility encouraging children to care for the senior members of the family adults and cultural obligation for the Chinese people to care for their frail, old-age spouses. With this connection, Chinese people may be with high preparedness for the caregiving role and less expressed emotional distress as the feeling of preparedness may protect caregivers from the emotional strains due to caregiving tasks.³⁵

Hong Kong was also found to be have a lower level of caregiver burden in comparing with other Asia-pacific regions such as Singapore (burden rate: 24.5%, mean caregiving time per week: 38.1 hours)³⁶ and Taiwan (burden rate: 42.86%, mean caregiving time per week: 77.4 hours).³⁷ Plausible explanation for this may be the active roles of trained domestic helpers in home care. As this study reveals, domestic helpers and maid was responsible for close to 12% of the major caregiving role for older adults living with dementia. The heavy involvement in the caregiving chores of domestic helpers in dementia caregiving might be accountable for the relatively less hours spent on caregiving in the Hong Kong population, while comparing with the other developed regions and Asia-Pacific jurisdictions.

Protective role of social care services on dementia caregiver burden

The improved access to dementia caregiver educations after policy intervention might be accountable for the decline of distress caregiver rates in April 2014. Educational support interventions, such as caregiver trainings on daily caregiving skills and symptoms management for their care-recipients, helps to establish the competence of dependent people's caregivers and allows the caregivers to better manage and cope with the strain from their caregiving roles.³⁸ Psychoeducational interventions including counselling sessions led by social workers equip caregivers for handling the excessive burden associating with their caregiving experience.³⁹ Psychoeducational interventions including counselling sessions led by social workers equip caregivers for handling the excessive burden associating with their caregiving experience.³⁹ Sufficient communication and ongoing educational supports could as well help frail care recipients to improve their hospital discharge experience.⁴⁰ Sufficient communication with family and ongoing educational supports could as

well help frail care recipients to improve their hospital discharge experience⁴⁰ and may therefore alleviate the burden due to community exclusion and communicating with healthcare professionals when the care recipients discharge from care institutes. These additional caregiver support provided by district elderly centres could help to relieve the level of caregiver burden from a population perspective.

However, the intervention effect on the age-standardised rates of distress caregivers of older adults with dementia was not sustained over time. One plausible reason might be the unmet service demand of community-based service. Up to February 2019, the average waiting time of day care centres service in Hong Kong is 12 months, while that of Integrated Home Care Service is 18 months.⁴¹ The long waiting time of community service for the old age could be attributed by the limited services accessibility, together with the scarce manpower and resources for service delivery in community. Limited service provision may also lead to restricted service duration to the caregivers. A review by Carretero *et al*³⁸ concluded that the service agency should expand the type of caregiver support services they provided and extend the duration of the service provision in order to allow the caregiver to rest sufficiently and to 'decrease the caregivers' excessive burden levels'. With this connection, service accessibility and availability ought to be improved in order to sustain the policy effect on reducing the caregivers' burden level.

Strengths and weaknesses

Our study provided the first evaluation of the policy intervention prioritising ageing-in-place of older adults and strengthening the community service to the informal caregivers in Hong Kong. Our study covers the information of caregivers of all older adults who applied for publicly funded community care services during the study period, and therefore this study could capture the picture of caregivers who were seeking for social services before and after the policy intervention. Also, the interrupted time-series design of this study examines the association between the policy intervention while taking account on the naturally occurring influence of time trend, seasonality and noises of the caregiver burden. Also, assumptions were tested in our linear models, and no evidence of auto-correlation was observed. Furthermore, we compared the rate of caregiver burden before and after policy intervention using both objective (total number of hours spent on care) and subjective measure (caregiver expressed emotional distress) of caregiver burden measures to give a more comprehensive evaluation of ageing-in-place policies on caregiver burden.

This study could not establish causality between ageing-in-place policies and reduction of caregiver burden in the Hong Kong population due to its observational study nature. However, the association it suggested could shed lights on further research on the relationship between additional community service places and caregiver burden. This study was done using a secondary dataset,

and therefore, there were missing data (one datapoint was imputed among 432 observations), and we were unable to include more covariates in the analysis (eg, demographic and socioeconomic information of caregivers), nor adopting a standardised scale in measuring the caregiver burden. Another limitation was that the actual social care service utilisation of individual caregivers after the policy intervention was unknown, which limited us from investigating the association between social care services uptake and caregiver burden level. Also, actual number of informal caregivers in Hong Kong was not known. Therefore, we standardised the rates of caregivers with high caring time per week and rates of burnout caregivers with reference to the baseline population. The length our time-series limited its ability to evaluate long-term impacts of the policy intervention too. Based on our findings, further research would be needed to do understand the characteristics of caregivers that response to the community support services and who does not. Furthermore, international studies may be needed to confirm the generalisability of the effect of this policy intervention.

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Contributors All authors were responsible for sourcing data and research question conceptualisation; CYC and PYKC designed and conducted the statistical analysis; CYC drafted the manuscript; all authors reviewed and revised the manuscript before submission. ELYW is responsible for the overall content as guarantor. The guarantor accepts full responsibility for the finished work and/or the conduct of the study, had access to the data, and controlled the decision to publish.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Ethical approval for this study was obtained from The Chinese University of Hong Kong Survey and Behavioural Research Ethics Committee (SBRE-19-031).

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Data availability statement Data may be obtained from a third party and are not publicly available. The datasets generated and analysed during the current study are not publicly available due them containing information that could compromise research participant privacy/consent but are available from the Social Welfare Department of Hong Kong on reasonable request.

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