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Caregivers of
Older Adults in Singapore:
An Overview and
Synthesis of
Empirical Studies



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Caregivers of Older Adults in Singapore: An Overview and Synthesis of Empirical Studies

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Key research and policy implications

- Understanding the scope and depth of research on caregivers of older Singaporeans provides the opportunity to develop key findings from existing studies for research and policy reference.
- There is an urgent need to conduct longitudinal and intervention studies on caregiver-care recipient dyads.
- The findings warrant the development and/or validation of measures of positive and negative aspects of caregiving in Singapore.
- Further studies should examine other measures related to the process, structure, and cost among formal and informal caregivers.
- Researchers should consider the investigation of less-studied formal caregiver groups, which include migrant healthcare professionals (e.g., nurses, nursing home staff) and foreign domestic workers.

REVIEW HIGHLIGHTS

- One hundred thirty-three eligible studies are summarised in this review.
- The included studies were largely quantitative studies (74%) that used a cross-sectional (65%), longitudinal (4%) or interventional (5%) study design.
- The majority of studies (90%) applied common descriptive and inferential statistics in their analysis; other notable analytical methods used were systems dynamics modelling and group-based trajectory modelling.
- A quarter of the eligible studies (24%) focused on informal family caregiving, while 17% involved formal caregiving in intermediate and long-term care settings (ILTC); the majority involved a combination of both settings (59%).
- Among the studies in ILTC settings (n=101), the majority were conducted in residential care settings (75%) such as community hospitals, nursing homes, inpatient hospices and sheltered homes; while the rest involved home-based care settings (17%) such as home medical care and foreign domestic workers; centre- or community-based care settings (5%) such as social daycare, dementia daycare; or a combination of all these (7%).
- In terms of the caregiver population, 67% of studies investigated informal caregivers such as family members (i.e., adult child, spouse, other relative) or close friends, whereas, 17% involved formal caregivers such as healthcare professionals (i.e., geriatricians, nurses, palliative care professionals, long-term care professionals, nursing aids) or foreign domestic workers; 16% involved both informal and formal caregivers.
- The review identified eight validation studies of instruments measuring specific caregiver outcomes. The majority of studies assessed relevant caregiver outcomes using available instruments from the literature. A summary table of commonly used questionnaires and measurement tools in studies among caregivers of older Singaporeans is provided.
- Our two-stage content analysis resulted in grouping the studies into 9 core themes, which we mapped into the four dimensions of the modified Donabedian model: structure, process, outcome, and cost.

BACKGROUND

Over the years, research on caregivers¹ of older adults has grown globally with the increased attention to ageing populations. This growing interest in caregiving research is expected, given that a large number of older adults will require care in the next decade [1]. The simultaneous decrease in death and birth rates over time [2] largely contributes to the demographic shift in most ageing societies. This demographic transition, combined with the increasing prevalence of chronic diseases in ageing populations [3], portrays a scenario that merits closer attention and supports the relevance of studies on informal and formal caregivers of older adults.

These defining trends in ageing populations also apply to Singapore where life expectancy at age 65 increased from 8.4 years in 1970 to 20.8 years in 2016 [4]. Moreover, the number of older adults is estimated to reach 900,000 by year 2030 [5] – almost twice its current number of 487,000 [6]. Its first batch of baby boomers (i.e., born in 1946–1964) had reached age 65 in 2012; by year 2016, 7.7% of residents were ≥65 years old [7]. In fact, Singapore registered the highest proportion of older adults ≥60 years old (18%) among selected western Pacific and southeast Asian countries in 2015 [3]. Aside from increased longevity, Singapore has seen a substantial drop in fertility rates from a high of 4.7 in the 1960s [8] to its current rate of 1.2 children per female [9], which is below the replacement level fertility of 2.1 [10].

The demographic shift in ageing populations such as Singapore is associated with an epidemiological transition that involves a gradual decline in infectious diseases and an increase in chronic conditions [11, 12]. A higher incidence of long-term degenerative conditions is expected in Singapore because age-related chronic conditions and disabilities are more common in ageing populations [13]. As individuals live longer with a number of health conditions [14, 15], they will inevitably and progressively require care from trusted family members or formal care providers. For many ageing societies, the first option is in limited supply given their sustained low birth rates and the shrinking size of the family. The strong desire of older adults to age in place [16] adds a layer of complexity to how health systems approach healthcare service delivery.

Responding to these challenges, the government and voluntary welfare organizations (VWOs) in Singapore have actively sought to improve the nation's capacity for eldercare [17]. A key initiative is the 'Action Plan for Successful Aging', which encourages older adults to age in place [18] and enables them to age well in their own communities through the expansion of home- and community-based services for older adults [19, 20]. Intermediate and long-term care (ILTC) services are also available for older adults who need further care at home after hospital discharge or those who live at home but are dependent in their day-to-day activities [21].

¹ In this brief, informal caregivers include unpaid family members, relatives, and friends; whereas formal caregivers include paid health or social care professionals such as home-care nurses and nursing home staff, and foreign domestic workers.

Despite the availability of formal care services for older adults, the primary caregiving role still falls on informal caregivers due to the underlying social policy framework, cultural values and social expectations of filial duties in Singapore [14, 22]. However, structural changes involving informal caregivers in the traditional family [23] influence the caregiving dynamics. The smaller size of the nuclear family in Singapore suggests that fewer adult children will be available to care for their older parents [14, 15]; this disproportion also increases a person's likelihood of being involved in caregiving [14, 24]. In addition, the increasing labour force participation among women in Singapore [25] limits the time they can allot to caregiving, despite traditional expectations. All these imply potential deviations from traditional caregiving arrangements and a greater diversity in individuals who would become informal caregivers.

Utility of summarising studies on caregivers of older Singaporeans

This research brief presents a systematic review and synthesis of empirical studies that assessed caregiver- or caregiving-related outcomes among informal and formal caregivers of older adults (≥ 60 years old) in Singapore. Briefly, the review will describe the following information from eligible studies: (a) study designs used, (b) caregiving research settings, (c) caregiver populations examined, (d) caregiver- or caregiving-related outcomes measured, (e) methods and tools used to measure these outcomes, and (f) common themes drawn from the literature.

The review seeks to provide a comprehensive description of the caregiver populations that support older Singaporeans and the common themes investigated around them. Such a study is especially useful in illustrating the role of informal caregivers and professional care providers in supporting the older adults as well as in clarifying the key research areas in caregiving for older Singaporeans that need greater consideration. The composite findings from this review ultimately contributes to informing future research and policy development that aim to address the demands of an ageing population.

The foregoing background on the older adult population and the common eldercare settings in Singapore provides the overall context for this brief. We continue with a presentation of the methodology and results of the review before culminating with a discussion of the relevant research and policy findings. The brief presents aggregate information² on the relevant caregiver studies identified in the review. We hope that the material can serve as an informative reference for the respective assessment needs of researchers and practitioners in both Singapore and the region.

² Full summary tables of the eligible studies are provided in the [Appendices](#).

METHODOLOGY

Data sources and search strategy

Our systematic review searched four major scientific literature databases including PubMed, PsycInfo, CINAHL®, and EconLit, which collectively covers the broad areas of medicine and public health, allied health, and social sciences. We conducted the main search in October 2016 followed by updated searches in March 2017 and December 2017. We also searched Google and Google Scholar for additional materials in the grey literature, including published reports that present empirical data on caregivers of older adults in Singapore. Finally, we performed one round of reference mining to find additional relevant studies from the reference lists of the final set of eligible studies including those of the background articles that we excluded.

We searched for empirical studies conducted among informal and formal caregivers of older adults in Singapore that assessed caregiver- or caregiving-related outcomes. Our search strategy³ – implemented in each database search – included indexed terms and equivalent free-text terms for the following key concepts: “informal and formal caregivers”, “older care recipients”, and “Singapore”. We defined “older care recipients” as persons aged ≥ 60 years, whereas, “caregivers of older persons” refer to both informal and formal caregivers.

Study selection

A study was included if it satisfied all of the following criteria: (1) focused on informal caregiving or formal caregiving in ILTC settings (i.e., formal caregiving in acute care settings were excluded); (2) involved empirical research; (3) conducted in Singapore; (4) involved at least one care recipient aged ≥ 60 years; (5) reported a caregiver or caregiving-related variable as the primary or secondary outcome. Only studies with available full-text articles in English were included in the review.

Data extraction

Table 1 shows the key data extracted and summarised from the eligible studies, and the rationale for data extraction. Aside from these, we also extracted the common methodologies and caregiving settings. We performed all data extraction using EndNote and Microsoft Excel.

³ Relevant materials on the search strategy and screening of articles are available for interested groups intending to perform a similar synthesis of caregiver studies (file is available upon request).

Table 1. Key data extracted and summarized from the included studies

Characteristics	Rationale
Author and affiliation	Identify research groups and key institutions
Year published	Provide chronological context and volume of relevant research over the years
Journal discipline	Inform scope of caregiving research
Aim and purpose	Identify main purpose of the study
Study design and methodology	Determine the frequency of the study designs (e.g., cross-sectional, longitudinal, intervention studies) and methodological approaches (e.g., qualitative, quantitative, and mixed methods)
Study setting	Describe the setting in which a study was conducted (e.g., informal caregiving at home, formal caregiving in ILTC settings)
Caregiver population	Identify informal and formal caregivers
Specific caregiver group	Identify specific subgroups of informal caregivers such as relatives (i.e., spouse, adult child, adult grandchild, parent, sibling) or a close friend and formal caregivers such as healthcare professionals (i.e., physician, nurse), eldercare workers (i.e., nursing aide, nursing home staff), and foreign domestic workers
Care recipient condition	Describe care recipient groups, e.g., community-based older adults; nursing home residents; older adults with ADL, neurodegenerative conditions (i.e., dementia, Alzheimer's, cognitive impairment, Parkinson's disease, ALS, stroke), cancer, end-of-life/advanced illness/palliative care; ICU patients; other (i.e., minor injuries, dialysis patients, hip fracture, chronic illness, infectious diseases, non-specific), other mental health condition (i.e., delirium, addiction, schizophrenia)
Sample size	Provide insight on the appropriateness of sample size in relation to the validity, and the statistical and clinical significance of study findings
Unit of sample	Provide insight on the study approach in investigating caregiver outcomes (e.g., perspective of care recipient, caregiver, or dyad)
Outcomes measured	Describe the primary and secondary outcomes measured
Core themes	Describe the central theme of the study (e.g., positive aspects of caregiving, burden of caregiving on caregiver, positive and negative aspects together) based on the outcomes investigated to facilitate classifying of studies accordingly

ADL, activities of daily living; ALS, amyotrophic lateral sclerosis; ILTC, intermediate and long-term care; ICU, intensive care unit

Data synthesis

We used content analysis to facilitate the synthesis of studies on caregivers of older Singaporeans. This method is suitable for aggregating data from qualitative and quantitative studies [26]. For each study, we initially coded the core theme based on the outcomes investigated and reduced the original themes to a smaller number of similar categories. We used a modified Donabedian model of the dimensions and cost of care [27] as an organising framework for the resulting categories to facilitate the presentation of findings from a health system perspective [28]. Briefly, Donabedian's framework describes the chain of care in terms of structure, process and outcome [28]; the modified Donabedian model extends this continuum to include economic costs [29]. Considering the dimensions and cost of care through the lens of this framework will then guide our understanding of the scope of research on caregivers of older Singaporeans.

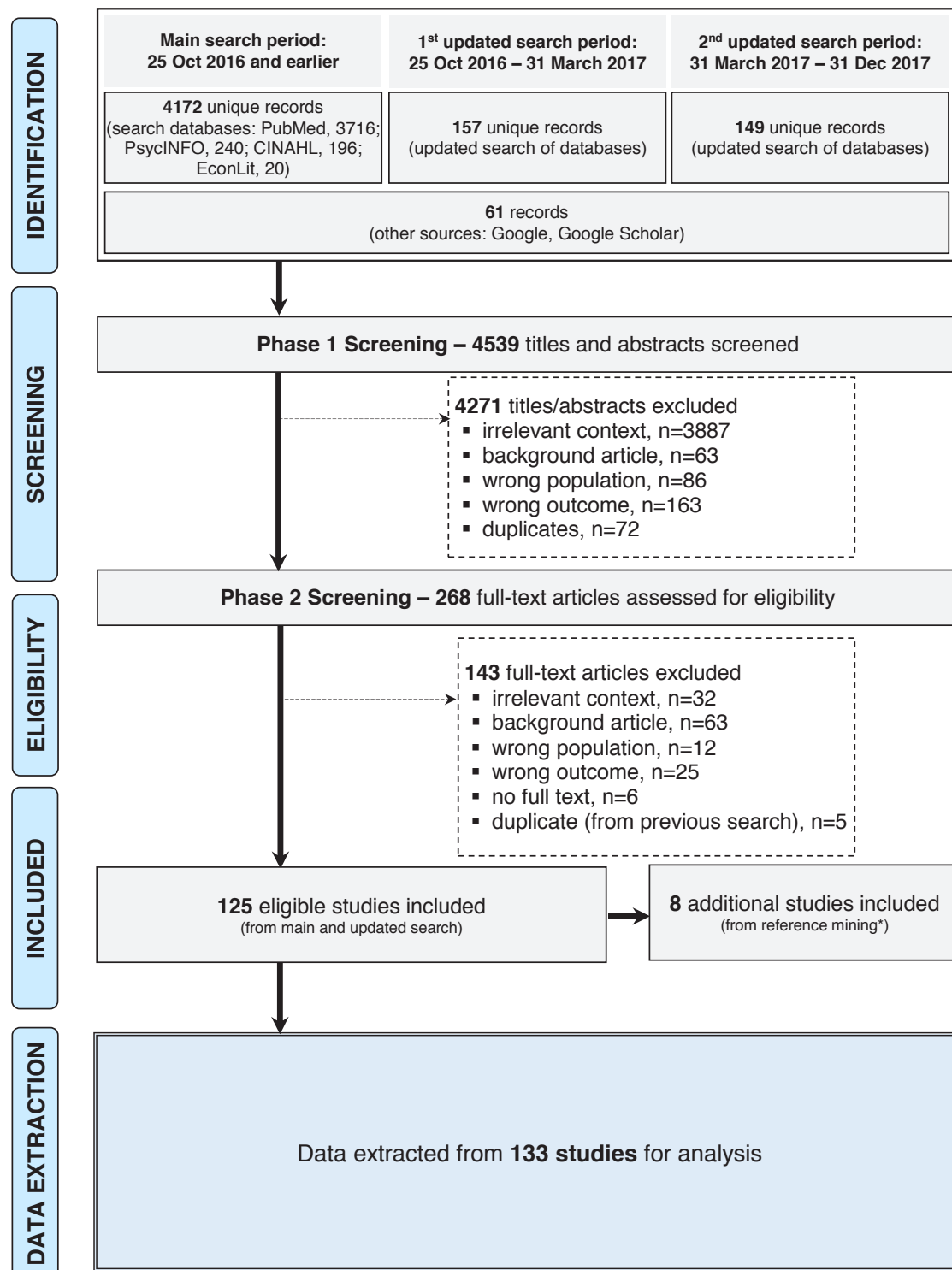
Hence, to organise the studies on caregivers of older Singaporeans using the modified Donabedian model, we coded themes related to the context and setting of caregiving in the structure dimension (e.g., attributes of material and human resources for the caregiver, the available infrastructures for caregivers). The process dimension involved relevant themes in the course of providing and receiving care (e.g., caregiving activities, characterising the caregiver's role and experiences); whereas the outcome dimension involved themes related to the effects of caregiving on the care recipient and caregiver (e.g., improvements in health outcomes, caregiver and care recipient satisfaction of the care provided and received). Finally, the cost dimension involved themes that investigated the financial and economic costs relevant to caregivers.

We anticipated a heterogeneous pool of eligible studies in our comprehensive review. This heterogeneity precluded any attempt to perform quantitative evidence synthesis from the different studies. Nevertheless, our narrative synthesis will enable a deeper understanding of the scope of research on caregivers of older Singaporeans, which can generate relevant insights useful for future investigations and initiatives.

RESULTS

Our review resulted in 133 eligible studies (Figure 1). Organising the studies according to their core themes helped describe the scope of studies on caregivers of older adults in Singapore and identified research gaps for future investigations (Appendix A). As expected, the number of caregiver studies in Singapore has increased over the years, which reached a high of 18 relevant studies in 2016 compared to <10 studies per year between 1987 and 2012 (Figure 2). The majority of studies were published in various medical specialty journals (37%) or geriatrics and gerontology journals (33%) with the remainder being published in either of the following areas: nursing (8%), public health (7%), psychology (4%), and social sciences (2%). The rest were institutional reports from the academia and government (9%).

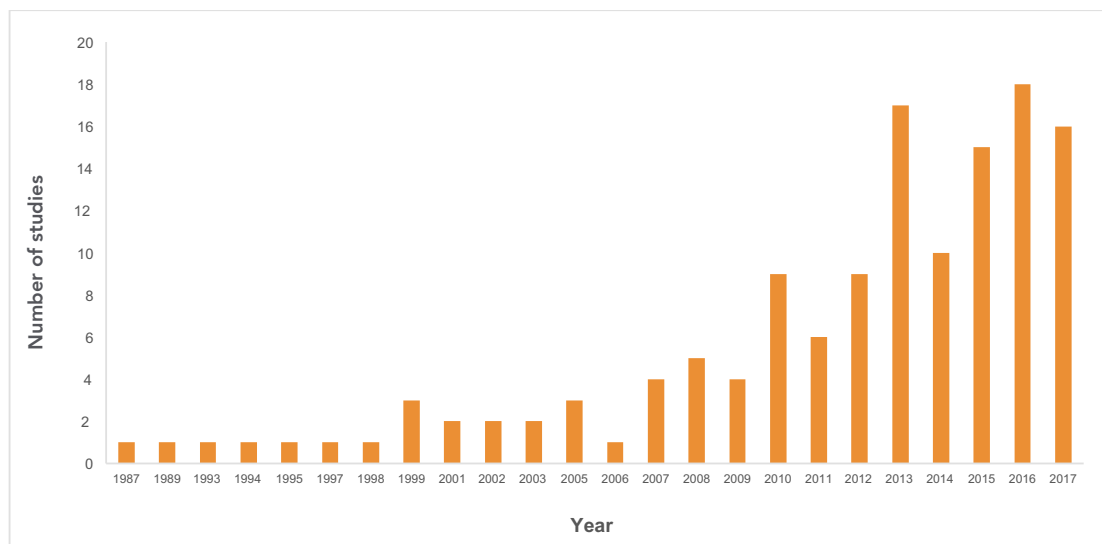
Figure 1. Review flow diagram



* One round of reference mining involves screening of the reference lists eligible studies and excluded background articles

Flow diagram template from: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097. For more information, visit www.prisma-statement.org

Figure 2. Caregiver studies in Singapore from 1987 to 2017



Over the years, entities from the National University of Singapore system (i.e., Duke-NUS Medical School, Faculty of Arts and Social Sciences, Yong Loo Lin School of Medicine, and the National University Health System), Tan Tock Seng Hospital, SingHealth, and the Institute of Mental Health have largely contributed (66%) to the literature on caregivers of older Singaporeans (Appendix B). Although the majority of studies used study-specific datasets (82%), a few key datasets on caregivers, such as the Singapore Survey on Informal Caregiving (SSIC), were also identified (Table 2).

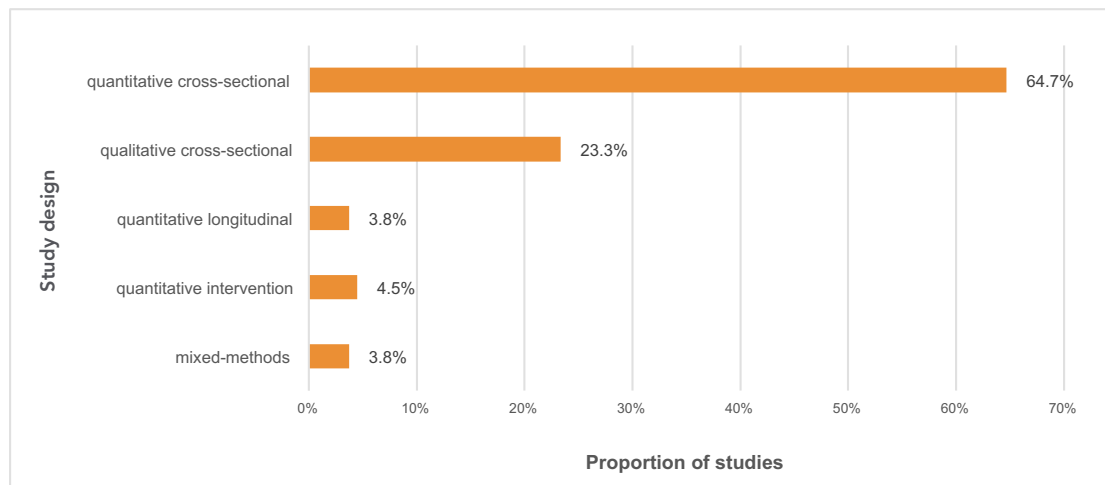
Table 2. Key datasets from the literature on caregivers of older Singaporeans

Datasets	Related Studies (not exhaustive)
Healthy Older People Every day (HOPE) Study	Tan JYS 2015 [30]
National Health Survey 2010	Ministry of Health 2010 [31]
National Survey of Senior Citizens 2011	Institute of Policy Studies 2011 [32]
Real-world Evaluation of Compliance And Preference in the treatment of Alzheimer’s disease (RECAP)	Pai MC 2015 [33]
Singapore Dementia Caregiver Profile Study	Tan L 2013; Tew CW 2011 [34, 35]
Singapore Mental Health Study	Chong 2012 [36]
Singapore Survey on Informal Caregiving (SSIC) 2010–2011	Chan 2013 [37]
Well-being of the Singapore Elderly (WiSE) study	Picco 2016; Vaingankar JA 2016 [38, 39]

Study design and methodology

Studies on caregivers of older Singaporeans were largely quantitative (Figure 3) – 65% were cross-sectional, with a few longitudinal studies (4%) and intervention studies (5%). While the majority of quantitative studies were observational, finding a few intervention studies suggests the expanding scope of investigations on caregivers of older Singaporeans.

Figure 3. Methodological approach and study design of eligible caregiver studies in Singapore, N=133



The quantitative studies (n=86) in this review largely used descriptive and inferential statistics in observational and intervention studies (87%) as well as in instrument validation studies (9%). Some of the studies (3%) used a systems dynamics approach; and one applied trajectory analysis in longitudinal data [40]. The 31 qualitative studies mostly used in-depth interviews (77%) and case studies (13%) as their main methodology; other methods included focus group discussions (7%) and open-ended questionnaires (3%). The specific analytical approaches reported in qualitative studies were thematic analysis and narrative synthesis. Recently (2012 onwards), a number of studies have also implemented a mixed-methods approach in investigating the experiences of specific groups of caregivers [41] including the role of migrant care workers (i.e., foreign healthcare workers such as nurses, nursing aides, and health attendants; foreign domestic workers [FDWs]) in Singapore [42]. We provide a more detailed summary table of the relevant study characteristics in Appendix A.

Study setting

The majority of studies involved a combination of informal and formal caregiving (59%). A number of studies focused on informal family caregiving of non-institutionalised Singaporeans (24%) or formal caregiving in ILTC settings (17%). We classified the studies conducted in ILTC settings (n=101) according to the specific categories of formal ILTC services in Singapore [21]: (a) residential care settings (75%) such as community hospitals, nursing homes, inpatient hospices and sheltered homes; (b) home-based care settings (17%) such as home medical care and FDWs; (c) centre- or community-based care settings (5%) such as social daycare, dementia daycare; or (d) a combination of all these long-term care services (7%).

Caregivers of older Singaporeans

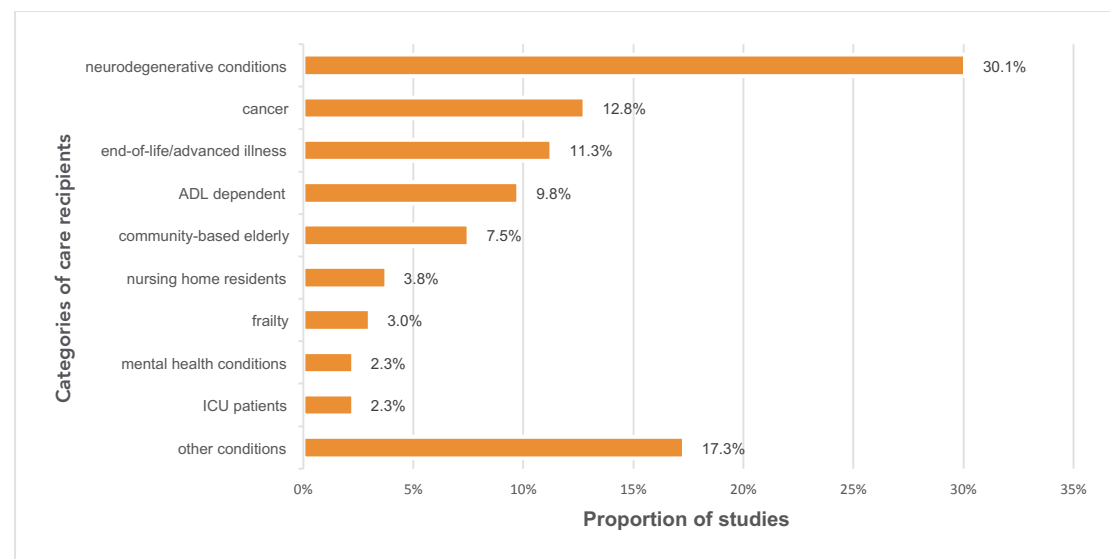
Figure 4 presents a summary of the common definitions of caregivers in the eligible studies. A large proportion of studies (74%) involved informal caregivers. The informal caregivers commonly identified were family members (e.g., adult child, spouse, other relative, etc.) or close friends. Studies among formal caregivers (16%) involved healthcare professionals, such as geriatricians, nurses, palliative care professionals and staff in long-term care services, nursing aides, and FDWs. Other studies investigated a combination of both informal and formal caregivers (10%).

Figure 4. Definitions of caregivers

Informal Caregivers	<ul style="list-style-type: none">• Personal involvement in caring for the patient• Spending >20 hours a week with the patient• Supporting the care recipient financially by themselves or with other relatives• Frequent collaborators in the care recipient's treatment• Main contact person in emergency cases• Most involved in providing direct care or ensuring provision of care for the care recipient (primary caregiver)• Most likely surrogate decision maker (secondary caregiver)• Residing with the care recipient to whom the recipient is dependent on for activities of daily living• Provides assistance in the self-care, medical needs, as well as informational, financial, and emotional support• Examples: Relative (i.e., spouse, adult child, adult sibling, parent, nephew/niece, nearest kin); Friend; Neighbor
Formal Caregivers	<ul style="list-style-type: none">• Eldercare workers in institutions providing intermediate and long-term care• Healthcare professionals in residential care facilities• Stay-in migrant female waged domestic worker attached to one employer and works for only a single household• Examples: Healthcare professionals (i.e., nurses, physicians, therapists); Professional caregivers (i.e., trained caregivers other than medical and allied health professionals); Foreign domestic workers

These caregiver groups provide care for various groups of care recipients (Figure 5). The majority of studies involved older Singaporeans with neurodegenerative conditions (30%) such as dementia, Alzheimer’s, cognitive impairment, Parkinson’s disease, Amyotrophic Lateral Sclerosis (ALS), and stroke. We also noted a group of other less-specific conditions including minor injuries, hip fracture, chronic illness, infectious diseases, and chronic kidney failure reported in other studies (17%). Other conditions of care recipients included cancer (13%) and end-of-life/advanced illness (11%). Some studies also involved caregivers of community-dwelling older adults (8%), nursing home residents (4%) and ICU patients (2%), as well as older adults with limitations in activities of daily living (10%), frailty (3%), and mental health conditions such as delirium, addiction and schizophrenia (2%).

Figure 5. Proportion of studies investigating categories of care recipients



ADL, activities of daily living; ALS, amyotrophic lateral sclerosis; ICU, intensive care unit

In terms of sample size, only 10% of the studies had a sample ≥ 1000 ; the majority had < 1000 respondents (i.e., care recipients, caregivers, dyads). Of the eligible studies, only 25% involved dyads of caregiver-care recipient respondents; most included caregiver (50%) or care recipient respondents (10%) alone. The rest of the studies (15%) involved case records or other secondary data sources.

Common measures and instruments

Most of the studies assessed relevant caregiver variables using available instruments from the literature. We also found eight studies on the psychometric validation of instruments measuring specific caregiver outcomes such as the Positive Aspects of Caregiving Scale [43], the Zarit Burden Interview [44], and the Caregiver Reaction Assessment [45], to name a few. We listed the commonly used questionnaires and measurement tools in Table 3 and provided a brief description of the common domains and constructs each instrument intends to measure. We grouped them based on whether a particular instrument measures a positive or a negative aspect of caregiving and a third group that includes measures of other constructs, which are mostly related to quality of life. Although the list is by no means exhaustive, it aims to provide an overview of available caregiver assessment tools used in previous works in Singapore and facilitate the use of accessible resources on caregiver research.

Table 3. Data collection tools for measuring caregiver- or caregiving-related outcomes

Questionnaires / Scales / Instruments	Constructs Measured	Items	Domains / Subscales	Rating Scale
Positive Aspects of Caregiving				
1 Brief Coping Orientations to Problems Experienced Scale (Brief COPE) [46]	Nature of coping strategies	28	Dispositional coping style; respondents rate their general use of coping strategies to manage stressful situations	4-point scale: 1 = I usually don't do this at all; 4 = usually do this a lot
2 Dementia Management Strategies Scale (DMSS) [47]	Management strategies of caregivers	28	3 subscales, e.g., criticism subscale refers to yelling, criticising, threatening and other related behaviours of the caregiver seen as the caregiver's management strategies	5-point scale: 0 = never; 4 = most of the time
3 Family Crisis Oriented Personal Evaluation Scales (F-COPES) [48]	Family's coping strategies in different crises	30	5 subscales (strategies): acquiring social support; reframing; seeking spiritual support; mobilising family to acquire and accept help; passive appraisal	5-point scale: 1 = strongly disagree; 5 = strongly agree
4 Gains in Alzheimer's Care Instrument (GAIN) [49]	Gains in dementia caregiving from the family caregiver's perspective	10	3 areas: personal growth (patience, strength, self-awareness, etc.); gains in relationships (relating better to the PWD); and higher level gains (positive changes in life philosophy, etc.)	4-point Likert scale: 0 = disagree a lot; 4 = agree a lot
5 General closeness scale [50]	Relationship between the caregiver and patient	4	Closeness between the caregiver and patient	4-point Likert-type scale: higher scores mean greater closeness
6 General Perceived Self-Efficacy Scale [48]	Self-efficacy (confidence in being a family caregiver)	10	Competence in coping across a wide range of demanding situations	4-point Likert-type scale: higher scores mean greater competence
7 McCloskey and Mueller Satisfaction Scale [51]	Job satisfaction among nurses	31	8 subscales derived from exploratory factor analysis	5-point Likert scale: 1 = very dissatisfied; 5 = very satisfied
8 Pearlin's scale [52]	Expressive social support from family and friends	8	Sample: 'You have someone whom you feel you can trust'; 'You have at least one friend/relative you can really confide in'	4-point scale: 1 = strongly disagree; 2 = disagree; 3 = agree; 4 = strongly agree
9 Perceived Social Support Scale [53]	Perceived emotional support	8	Includes perceived social support items	4-point scale: 1 = strongly disagree; 4 = strongly agree
10 Positive Aspects of Caregiving (PAC) [43]	Psychosocial benefits of caregiving	9	Includes self-affirmation, outlook on life	5-point Likert scale: 1 = disagree a lot; 5 = agree a lot

Questionnaires / Scales / Instruments	Constructs Measured	Items	Domains / Subscales	Rating Scale
Positive Aspects of Caregiving				
11	Individual resilience	25	Degree of resilience	7-point Likert scale
12	Caregivers' religious, spiritual thoughts, actions	15	2 subscales: beliefs and practices; social support from community	4-point scale: 0 = strongly disagree; 3 = strongly agree
Negative Aspects of Caregiving				
13	Objective and subjective caregiver burden	19	Objective burden (i.e., financial problems, personal activity limitations, etc.); Subjective burden (feelings, attitudes, etc.)	4-point scale: 1 = not at all; 4 = a lot
14	Domains of caregiver reaction	24	5 domains: impact on schedule; impact on finances; lack of family support; impact on health; caregiver esteem ^a	5-point scale: 1 = strongly disagree; 5 = strongly agree
15	Stress among caregivers	10	Stress	1 = yes; 0 = no
16	Care-related work interruptions	8	Experiences of care-related work interruptions	0-8; higher scores indicate more types of interruptions
17	Depressive symptoms	11	Frequency of depressive symptoms in the past week	none/rarely = 0; sometimes = 1; often = 2
18	Caregiver stress and depression	14	Depression and anxiety	4-point Likert-type scale
19	Burden of care	24	Financial burden; effect on - family routine, family leisure, family interaction, physical/mental health of other family members	3-point Likert scale
20	Burnout syndrome in the local palliative care setting	22	Emotional exhaustion (emotional overextension and exhaustion from work); Depersonalisation (impersonal and unfeeling response towards patients); Lack of personal accomplishment (feelings of competence and successful achievements at work)	7-point Likert scale: 0 = never; 6 = every day
21	Effects of care recipient's problematic behaviour on caregiver depressive symptoms	24	frequency of memory, mood, and behavioural problems of care recipients in the past week and the caregiver's reaction to these problems (also listed under care recipient questionnaires)	5-point scale (frequency): 0 = never occurred at all; 4 = daily or more often; (reaction): 0 = not at all; 4 = extremely

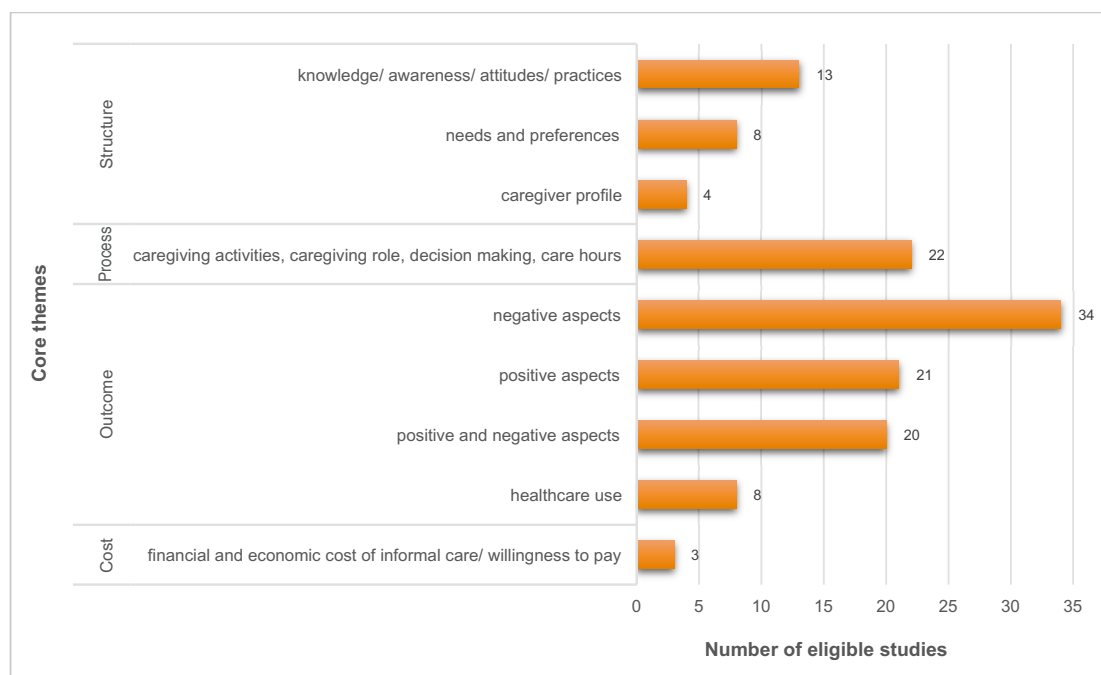
Questionnaires / Scales / Instruments	Constructs Measured	Items	Domains / Subscales	Rating Scale
22 World Mental Health Composite International Diagnostic Interview - Family Burden Module [36]*	Psychiatric disorders based on diagnostic criteria; additional modules collected information on social support and burden of caregiving	10	Subjective burden: "Taking into consideration your time, energy, emotions, finances and daily activities, would you say that [relative's] health problems affect your life?"; How much the relative(s) illness caused the respondent embarrassment, or to be worried, anxious or depressed; Objective burden: spent time helping with washing, dressing, paper work, etc.; financial costs in terms of money spent or earnings lost	4-point scale (subjective burden): 1= a lot; 4= not at all
23 Zarit Burden Inventory (ZBI) [44]	Perceived burden of providing care	22	self-report measure of role strain and personal strain	5-point scale: 0 = never; 4 = nearly always
Others				
24 CareGiver Oncology Quality of Life (CarGO-QoL) [56]	Caregiver quality of life	29	caregiver's physical health, mental health, social health, daily life and financial health	0-100 scale: 0 = lowest; 100 = highest quality of life
25 Caregiver Quality of Life Index – Cancer (CQOLC) [57]	Quality of life of caregivers of cancer patients	35	self-report measure of caregivers' quality of life measured	5-point Likert-type scale: 0 = not at all; 4 = very much
26 Lay Care-Giving for Adults Receiving Dialysis (LC-GAD) [58]	Types and quantity of caregiving activities	41	two sections include the Think-LC-GAD and the Task-LC-GAD	5-point Likert scale: 0 = never; 4 = nearly always
27 Quality of Life in Life Threatening Illness-Family Carer Version [56]	Caregiver quality of life	16	7 domains of caregiver's physical health, mental health, social health, daily life and financial health	0–10 scale: higher values indicating higher quality of life
28 Quality of Life, Family Version [56]	Caregiver quality of life	37	4 domains of caregiver's physical health, mental health, spiritual health, social health, daily life and financial health	0-10 scale: 0 = worst; 10 = best outcome
29 Resource Utilization in Dementia instrument (RUD)-Lite [59]	Monthly informal care time	NS	Items on the amount of time spent helping the patient with basic activities of daily living (ADL, toilet visits, eating, dressing, etc.) and instrumental ADL (shopping, food preparation, laundry, etc.)	amount of time in minutes per 24 hours
30 Short Form-36v2 Health Survey [60]	Generic health status	36	Perceptions of mental and physical health that reflect a person's health status and well-being	rating scales vary per item
31 World Health Organization Quality of Life Scale – Brief Version (WHOQoL-BREF) [48]	Quality of life	28	4 domains: physical health, psychological, social relationship, and environment	5-point Likert scale: rating scales vary per item

^a A subscale of the Caregiver Reaction Assessment measures caregiver esteem (i.e., a positive aspect of caregiving); ^b Caregivers respond for the care recipient; ADL, activities of daily living

Caregiving outcomes and core themes investigated

Our two-stage content analysis resulted in grouping the studies into 9 core themes (Figure 6) that were mapped into the four dimensions of the modified Donabedian model: structure, process, outcome, and cost [27]. We used this model only as a framework for discussion, not as the underlying framework of this review. The majority of the eligible studies investigated themes that we mapped into the outcome dimension (62%); whereas, 19% and 17% examined the structure and process dimensions, respectively. Only 2% of the studies investigated cost-related themes. The following is a brief discussion of the core themes under each dimension.

Figure 6. Frequency of the core themes investigated organised according to the modified Donabedian model of dimensions and cost of care



Structure: Eligible studies mapped to this domain (n=25) involved topics such as describing the knowledge, awareness, attitudes and specific practices on formal care services among caregivers of older Singaporeans (52%). Other themes include the needs and preferences of informal and formal caregivers in providing care for older adults (32%), and relevant descriptions of caregivers in Singapore including their relationships with the care recipient (16%).

Process: The eligible studies (n=22) that we mapped to the process dimension mainly reported on the caregiving activities and the role of caregivers. The process dimension also includes studies that explored the decision making process between caregivers and care recipients, as well as estimating the number of non-medical care hours needed by a specific population of older Singaporeans (e.g., those with ageing-related dementia) [61].

Outcome: 'Outcome' emerged as a widely investigated dimension of caregiver studies (n=83). Many studies investigated negative outcomes (41%) such as caregiver burden, depressive symptoms, stress levels, burnout, challenges at work, and vulnerabilities among low-income caregivers. Fewer studies (25%) investigated positive outcomes such as relief, gains, resilience, and job satisfaction among informal and formal caregivers. Studies that explored both the positive and negative aspects of caregiving were less common (24%). Such studies considered typical negative outcomes in addition to positive outcomes such as gains in caregiving, positive adaptation, satisfaction with social support, control over an upsetting situation, and other rewards from caregiving. Beyond the positive and negative aspects of caregiving, other outcomes investigated include components of healthcare utilization (10%).

Cost: The few studies (n=3) that examined themes related to cost focused on the financial and economic cost of informal care as well as the willingness of caregivers to pay for services to extend the life of older adult patients with cancer.

RESEARCH AND POLICY IMPLICATIONS

Altogether, the results of this systematic review, provides a rich source of insights for researchers and policymakers. As research findings must ultimately translate into relevant policies, we run through four key messages from the review that can help inform caregiver-related policies as well as guide future research on caregivers of older Singaporeans (Figure 7).

Figure 7. Potential next steps for research and policy

Study design and methodologies	Measurement approaches	Caregiver populations	Other caregiver themes
There is an urgent need to conduct longitudinal and intervention studies on caregiver-care recipient dyads.	Key findings warrant the development and/or validation of measures of positive and negative aspects of caregiving in Singapore.	Investigation of less-studied formal caregiver groups should be considered; these include migrant healthcare professionals (e.g., nurses, nursing home staff) and foreign domestic workers.	Researchers should examine other measures related to the process, structure, and cost among formal and informal.

Study design and methodologies

There is a dearth of longitudinal studies on caregivers of older Singaporeans. Compared to cross-sectional data, longitudinal data on informal caregivers, will provide the depth and breadth of information needed for caregiver-relevant policy formulation and implementation. Longitudinal studies can provide more detailed information necessary to enable targeted support to caregivers and address the emerging challenges to the healthcare system due to population ageing (e.g., increasing need for formal and informal caregivers while also supporting older Singaporeans to age in place).

Furthermore, longitudinal studies with a short follow-up duration can capture the impact of caregiving on the health and well-being of informal and formal caregivers as they go through various phases of caregiving with the changing needs of the care recipient [62]. Such investigations also require the use of methodological approaches that adequately consider and maximise the variations in variables related to the older adults and their caregivers over time. Group based trajectory modelling, for instance, enables mapping of the trajectories of outcomes among caregivers. This captures the variability of the changes over time in each health-, work- and caregiving-related outcome among caregivers as distinct, meaningful trajectories, in contrast to only summarising them as an average change over time or as a single growth curve [63]. Qualitative longitudinal studies on caregivers also provide detailed insights into important dimensions of the caregiving process, which cannot be meaningfully

understood using quantitative data alone (e.g., caregiver role in pain management, other unknown aspects of the caregiving transition). The value added of investigating dyads rather than focusing on the caregiver or care recipient alone should also be considered.

Intervention studies on informal and formal caregivers are also lacking. Prospective studies on interventions for caregivers can provide the necessary evidence to support the effectiveness of ongoing programmes and initiatives in improving clinically significant outcomes for the caregiver and care recipient. For example, a systematic review of intervention studies for caregivers of stroke survivors provided evidence on clinically significant outcomes (e.g., improved depressive symptoms) [64]. Another review on caregivers of dementia patients did not establish a definitive conclusion on the effectiveness of caregiver interventions; nevertheless, the review provided insights on interventions that have a positive effect such as counselling services [65].

Measurement approaches

It is evident from the review that most caregiver studies used study-specific data (82%) with a few studies using available datasets. For the most part, these studies gathered data from survey questionnaires that were developed based on existing caregiver assessment tools. As the study context guides the choice of measurement approaches, systematically investigating the psychometric properties of available caregiver instruments may be worthwhile to ensure their validity and reliability for use with caregivers of older Singaporeans. Such investigations provide the necessary rationale for the development of new measures that can adequately capture constructs that are unique to the Singapore context (e.g., caregiver resilience, caregiving networks). In this review, studies that focused on the development and/or psychometric assessment of instruments assessed the structural validity, construct validity, and internal consistency reliability of existing measures – many of which have resulted in shorter versions of these instruments [35, 43, 45, 57]. Similar studies in the future can consider testing the cultural validity of existing scales. Beyond using these common quantitative methods, the increasing importance of applying mixed-methods approaches in studies on health service delivery [66] suggests the need for developing capacity for conducting qualitative studies especially among emerging researchers in the field. This insight is relevant to the highly contextualised nature of caregiving.

Caregiver populations

Most caregiver studies investigated informal caregivers (67%) – the proportion of such studies would even be larger (83%) if we held the studies that investigated both informal and formal caregivers together. Although informal caregivers are central in caregiving research, it is also useful to consider other groups of caregivers such as migrant healthcare professionals and FDWs given their prominence in Singapore’s caregiving landscape. The latest Ministry of Health data from 2010 on the profile of nursing professionals in Singapore estimated that 20% of 29,300 nurses in Singapore were foreign nurses from India, China, and the Philippines [67]. In 2017, 70% of Singapore’s direct care workers (i.e., nurses, nursing aides, healthcare assistants, and allied healthcare professionals) were foreigners from the Philippines, China, Malaysia, Sri Lanka, and Myanmar; FDWs were also reported to augment the long-term care workforce in Singapore [68]. In fact, a number of studies have investigated the role of FDWs in caring for older Singaporeans [69-72]. Information on the caregiver populations investigated in previous studies can guide the development of new policies that aim to support families in obtaining the necessary caregiving assistance that they need.


Other caregiver themes

In the context of the modified Donabedian model of the dimensions and cost of care, most caregiver studies in the review measured themes related to the outcome dimension primarily because of the relative importance of outcome measures in informing immediately quantifiable targets (e.g., caregiver depression, stress, etc.). Fewer studies explored themes on the structures (e.g., caregiver needs, preferences) and processes (e.g., caregiver activities) relevant to caregiving, which are also needed to inform the development of new programmes and interventions.

Enabling evidence-based policy and practice for supporting caregivers of older Singaporeans

Distilling information from currently available caregiver studies is an instrumental first step towards defining the areas in need of further investigations (e.g., positive and negative aspects of caregiving; other caregiver populations). Our findings draw attention to the importance of using innovative methodological approaches in the design of new primary research studies on caregiving. These insights serve to inform future research, which ultimately contributes to building the evidence-base necessary to support the development of relevant policies and programmes.

Although our findings provide a rich overview of the scope of research on caregivers of older Singaporeans, the comprehensive scope of our review resulted in a heterogeneous pool of studies, which precluded the quality assessment of the studies we examined. The lack of information on the inherent quality of the studies described and analysed in this narrative is a major limitation in formulating research and policy recommendations based on the review findings.



Nevertheless, this review informs the development of full-scale systematic reviews or primary research studies with focused research questions on the structures, processes, outcomes and costs of caregiving. Such investigations can better enable evidence-based policies to support caregivers of older Singaporeans. Future studies on caregivers should consider applying standardised research methods in this area to facilitate structured evidence synthesis, which is equally important in developing policy and practice recommendations.

CONCLUSION

As the research community continues to address the needs of older Singaporeans, their caregivers merit as much attention. This caregiving narrative viewed through the lens of existing caregiver studies in Singapore provides an overview of the current state of caregiving research in one of the most rapidly ageing societies. Insights drawn from the review aims to guide further research that is needed to provide the necessary evidence for policies and programmes that can provide caregivers with the support that they need.

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Notes on the Appendices

This document provides supplementary material to the **Research Brief** on “Caregivers of Older Adults in Singapore: An Overview and Synthesis of Empirical Studies on Caregiver- or Caregiving-related Outcomes.”

We organized studies according to the core themes investigated (**Appendix A**). Separate summary tables for qualitative, quantitative (i.e., cross-sectional, longitudinal, intervention), and mixed-method studies are provided (**Appendices A1-A5**). For most studies, the core themes included the following: (1) Positive aspects of caregiving (e.g., relief, gains, resilience, job satisfaction); (2) Negative aspects of caregiving (e.g., burden, depressive symptoms, stress levels, burnout, stress, challenges at work, vulnerabilities among low-income caregivers); and (3) Positive and negative aspects of caregiving (e.g., burden, stress, coping, self-efficacy, disruptiveness, positive adaptation, financial concerns, social support satisfaction, social support number, stress and depression, general closeness, respite care, controlling upsetting thoughts, rewards). The qualitative studies included additional core themes such as: (1) caregiver profile; (2) caregiving activities, caregiving role, decision-making, care hours; (3) healthcare use; (4) knowledge/ awareness/ attitudes/ practices; and (5) needs and preferences of caregivers.

Most of the quantitative cross-sectional studies (Appendix A2) used study-specific data, unless specified in the Aim/Purpose column. Readers are advised to refer to the table footnotes for the full details of the data source listed in Appendix A2.

Appendix B provides a list of affiliated institutions of the studies in the review, while **Appendix C** lists other data collection tools used in the eligible studies to measure care recipient variables.

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Appendix A. Overview of studies on caregivers of older Singaporeans (N=133)

Appendix A1. Qualitative studies by core themes (n=31)

Appendix A2. Cross-sectional studies by core themes a (n=86)

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Appendix A4. Intervention studies by core themes (n=6)

Appendix A5. Mixed-method studies by core themes (n=5)

Appendix B. List of affiliated institutions

Appendix C. Other data collection tools for care recipient variables/outcomes

Appendix A. Overview of studies on caregivers of older Singaporeans (N=133)

Appendix A1. Qualitative studies by core themes (n=31)

First Author	Year	Aim/Purpose	Caregiver Population	Caregiver Group	Care Recipient Condition ^a	Sample Size	Unit of Sample ^b	Outcomes
Caregiver profile								
1 Devasahayam TW [1]	2003	Examining the growing need for creating a more family-friendly work environment for caregivers of the elderly in Singapore	informal caregivers	relative or friend: working female adult child	community-based elderly	20	caregiver	caregiver profile; reasons for caring; experiences of female caregivers; common experiences; struggles, coping strategies; state/community programs
Caregiving activities, caregiving role, decision making, care hours								
2 Lee A [2]	2002	Presenting case studies of families refusing to disclose cancer diagnosis to patients	both	relative or friend, healthcare professionals	cancer	2	care recipient	discussion with relatives on disclosure of cancer diagnosis
3 Chan CKL [3]	2009	Drawing attention to the need for early preparation for the end of life among mature adults	informal caregivers	relative or friend: spouse, adult child	community-based elderly	12	caregiver	caregiver views toward approaching the issues related to death
4 Ng GT [4]	2009	Providing feedback to service planners and program staff on service delivery and opportunities for improvement	informal caregivers	relative or friend	other	36	other	caregiver services provided; caregiver perceptions of barriers to service usage
5 Ho ZJM [5]	2010	Presenting a case study on end-of-life decision making	informal caregivers	relative or friend: spouse, adult child	end-of-life/advanced illness/palliative care	1	caregiver	key finding suggests that palliative care encompasses care of both the patient and the family
6 Tan JOA [6]	2011	Engaging healthcare professionals, patients and their families with medical ethics	formal caregivers	healthcare professionals: physician	end-of-life/advanced illness/palliative care	78	caregiver	insights on the end of life care, types of treatment decisions, role of family, ethical issues
7 Foo ASC [7]	2012	Investigating discrepancies in end-of-life decisions of older adults and their surrogates	informal caregivers	relative or friend	other	30	dyad	caregiver profile; reasons for caring; experiences of female caregivers; common experiences; struggles, coping strategies; state/community programs
8 Krishna LKR [8]	2013	Developing a theory of personhood	informal caregivers	relative or friend	cancer	1	care recipient	awareness of family caregivers of the treatment provided to the patient

First Author	Year	Aim/Purpose	Caregiver Population	Caregiver Group	Care Recipient Condition ^a	Sample Size	Unit of Sample ^b	Outcomes
9 Griva K [9]	2013	Identifying the focus of patient and family education approaches	both	relative or friend, healthcare professionals	other	59	caregiver	caregiver perspectives on decision making for dialysis patients
10 Ramanathan R [10]	2016	Exploring caregiver experiences in the process of placing an older relative into long-term care and how they are involved in caregiving after this transition	informal caregivers	relative or friend	nursing home residents	12	caregiver	caregiver experiences during patient's transition into a nursing home
11 Mehta KK [11]	2017	Exploring the dynamics of family caregiving for older adults from a work-life perspective, contextualized in the highly developed and rapidly ageing society that is Singapore	both	relative or friend, FDWs	other	75	caregiver	caregiver experiences and the impact of caregiving on the family caregivers and the FDWs
Healthcare use								
12 Low JA [12]	2013	Improving care in nursing homes and reducing unnecessary admissions to acute care hospital, esp. those nearing end of life	informal caregivers	relative or friend	end-of-life/ advanced illness/ palliative care	1	other	presence of physician at the end of life through telemedicine communication
13 Tan YY [13]	2015	Presenting the importance of end-of-life pathways to assist nurses in successful rapid discharge from hospital to home	formal caregivers	healthcare professionals: nurse, nursing aid	end-of-life/ advanced illness/ palliative care	14	caregiver	issues in facilitating rapid discharge
Knowledge/ awareness/ attitudes/ practices								
14 Pallawala PMDS [14]	2001	Introducing a new model of healthcare delivery	formal caregivers	healthcare professionals: nurse, geriatrician	other	1	other	caregiver feedback on the telegeriatric system
15 Setia M [15]	2011	Identifying a set of inter-related issues and challenges that are associated with the care and treatment of people with CI/ dementia	both	relative or friend, healthcare professionals: clinicians, community workers	neurodegenerative condition	30	other	caregiver perspectives on issues and challenges associated with care and treatment of cognitive impairment
16 Ng R [16]	2013	Highlighting the need for public education on the benefits and process of advance care planning in Singapore	informal caregivers	relative or friend	end-of-life/ advanced illness/ palliative care	18	caregiver	caregiver awareness, perception and attitudes toward advance care planning and advance medical directive

First Author	Year	Aim/Purpose	Caregiver Population	Caregiver Group	Care Recipient Condition ^a	Sample Size	Unit of Sample ^b	Outcomes
17 Lee YW [17]	2016	Assessing perspectives/experiences of caregivers of patients with Diabetes Mellitus and end-stage renal disease	informal caregivers	relative or friend	end-of-life/advanced illness/palliative care	20	caregiver	caregiver perspectives on multimorbidity, challenges and health care
18 Leow MQH [18]	2016	Providing insight on caregiver perceptions of psychoeducational intervention components	informal caregivers	relative or friend	cancer	12	caregiver	caregiver perceptions on the psychoeducational intervention
Needs and preferences								
19 Vaingankar JA [19]	2013	Examining needs of informal caregivers of people with dementia from their perspectives	informal caregivers	relative or friend	neurodegenerative condition	63	caregiver	caregiver needs
20 Ang K [20]	2015	Health service needs assessment among patients with Amyotrophic Lateral Sclerosis, caregivers and healthcare professionals	both	relative or friend, healthcare professionals	neurodegenerative condition	30	other	identified needs of caregivers and healthcare professionals (i.e., environmental concerns, social support)
Negative aspects of caregiving								
21 Mehta K [21]	1995	Presenting the dynamics of the socio-cultural context of aged care	informal caregivers	relative or friend: adult child	other	23	caregiver	caregiving strain
22 Chong PH [22]	2011	Documenting a local perspective of the identity of homecare nurses	informal caregivers	healthcare professionals: nurse, nursing aid	end-of-life/advanced illness/palliative care	10	caregiver	experience of palliative homecare nurses
23 Lee GL [23]	2013	Understanding the meaning of a good death	formal caregivers	relative or friend	cancer	25	caregiver	experience in living with and taking care of end-of-life advanced cancer patients
24 Suen J [24]	2017	Examining the lived experiences of low-income informal caregivers	informal caregivers	relative or friend	ADL dependent	19	caregiver	vulnerabilities of low-income caregivers
Positive aspects of caregiving								
25 Netto NR [25]	2009	Examining the positive aspects of family caregiving for patients with dementia	informal caregivers	relative or friend	neurodegenerative condition	12	caregiver	gains in dementia caregiving
26 Lee GL [26]	2015	Assessing adequacy of available instruments measuring QoL for caregivers of patients with advanced cancers	informal caregivers	relative or friend	cancer	26	caregiver	QoL domains; spiritual health; participant characteristics (for descriptive purposes; content adequacy of existing instruments)

First Author	Year	Aim/Purpose	Caregiver Population	Caregiver Group	Care Recipient Condition ^a	Sample Size	Unit of Sample ^b	Outcomes
Positive and negative aspects of caregiving								
27 Ramanathan R [10]	2018	Discussing the boundaries in intergenerational and multigenerational care in an aging society	informal caregivers	relative or friend	other	NA	caregiver	mutual help; dilemma in family care; impact of foreign maids in family dynamics; cost-benefits of hiring a maid
28 Yee CM [28]	2008	Discussing how to support the preferences of end-of-life patients for dying at home	both	relative or friend, healthcare professionals	cancer	14	caregiver	caregiver feedback (rewarding, burden, balanced) on the handbook on homecare for patient with cancer
29 Basnyat I [29]	2016	Investigating the impact of the relationship between primary caregiver and FDWs who help them support caregiving on coping with caregiver burden	both	relative or friend, FDWs	neurodegenerative condition	24	caregiver	obligations (i.e., appraisal process) burdens; caregivers' relief (e.g., problem focus); caregiver relief via mutual support between FDWs and caregivers
30 Penkunas MJ [30]	2016	Understanding the mechanisms by which community-based programs reduce caregiver stress	informal caregivers	relative or friend	other	32	caregiver	effects of caregiving on caregiver's personal lives, their views of the support they gained from the intervention, their desire for additional support, and their experiences with the intervention staff
31 Tam WJ [31]	2017	Examining challenges, coping strategies, and support FDWs need in caring for seniors	formal caregivers	FDWs	frailty	25	caregiver	challenges, coping strategies, support

^a **"Neurodegenerative conditions"** include dementia, Alzheimer's, cognitive impairment, Parkinson's disease, Amyotrophic Lateral Sclerosis; **"Other conditions"** include minor injuries, dialysis patients, hip fracture, chronic illness, and non-specific conditions; ^b **"Other unit of sample"** include expert panel, system data, institutions; ADL, activities of daily living; QoL, quality of life; FDW, foreign domestic worker

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Appendix A2. Cross-sectional studies by core themes (n=86)

First Author	Year	Aim/Purpose ^a	Caregiver Population	Caregiver Group	Care Recipient Condition ^b	Sample Size	Unit of Sample ^c	Sampling	Outcomes	
Caregiver profile										
1	Ministry of Health [32]	2010	Reporting summary findings from the National Health Survey (A)	informal caregivers	relative or friend	other	623	caregiver	random	caregiver profile; caregiving tasks
2	Kang SH [33]	2011	Reporting the results of the National Survey of Senior Citizens (B)	informal caregivers	relative or friend	community-based elderly	1005	care recipient	random	caregiver profile; caregiving tasks
3	Lee KS [34]	1994	Investigating the profile of patients with Parkinson's disease	informal caregivers	relative or friend	neurodegenerative condition	34	dyad	convenience	caregiver profile; occupation; attitudes towards patients
Caregiving activities, caregiving role, decision making, care hours										
4	Tew CW [35]	2011	Testing whether burden increases the odds of caregiver to prefer institutionalizing a relative with dementia (C)	informal caregivers	relative or friend	neurodegenerative condition	266	caregiver	convenience	choice of care setting; protective role of caregiver gains
5	Ansah JP [36]	2013	Providing an overview of available levers and demonstrating the interdependence of policies and system components (D)	informal caregivers	relative or friend	ADL dependent	NA	other	random	projected family eldercare hours
6	Khoo YC [37]	1987	Presenting the involvement of doctors in healthcare for the elderly	informal caregivers	relative or friend	other	127	caregiver	convenience	activities involving care for the elderly
7	Leong IYO [38]	2001	Comparing the practice of foregoing life support between the young old and old	informal caregivers	healthcare professionals: physician	ICU patients	282	care recipient	purposive	caregiver involvement in mechanisms of the decision to forgo life support
8	Ng GT [39]	2006	Reporting the results of the Singapore Family Caregiving Survey	informal caregivers	relative or friend	community-based elderly	323	caregiver	convenience	characteristics of caregivers; caregiving activities
9	Li LLM [40]	2007	Examining accuracy of surrogate decisions (i.e., reflect patient intentions/expectations)	informal caregivers	relative or friend	other	36	dyad	convenience	accuracy of decision with that of the care recipient
10	Ng GT [41]	2008	Sketching a broad picture of family caregivers in Singapore who look after the elderly, sick and disabled	informal caregivers	relative or friend	frailty	323	caregiver	convenience	characteristics of caregivers, caregiving activities

First Author	Year	Aim/Purpose ^a	Caregiver Population	Caregiver Group	Care Recipient Condition ^b	Sample Size	Unit of Sample ^c	Sampling	Outcomes
11 Kao YS [42]	2013	Determining the prevalence of non-disclosure of diagnosis to patients	formal caregivers	healthcare professionals: physician	end-of-life/ advanced illness/ palliative care	100	other	convenience	care-recipient awareness of cancer diagnosis vis-à-vis with care provider
12 Chong JA [43]	2015	Investigating the extent of involvement of patients and family members in decision making related to cancer management	informal caregivers	relative or friend	cancer	55	care recipient	convenience	disclosure of diagnosis; treatment decisions; ordering maximum ward management
13 Vaingankar JA [44]	2016	Estimating care burden among informal caregivers of older adults in a population-based study (E)	formal caregivers	healthcare professionals	neurodegenerative condition	693	caregiver	random	care participation of informal caregivers; care burden score
Financial and economic cost of informal care/ willingness to pay									
14 Ansah JP [45]	2016	Modelling the effects LTC policies on employment of primary family caregivers of elderly with disability (D)	informal caregivers	relative or friend	ADL dependent	NA	other	random	primary informal family caregiver labor market participation
15 Chong MS [46]	2013	Demonstrating informal care costs of caring dementia patients in Singapore	informal caregivers	relative or friend	neurodegenerative condition	165	dyad	convenience	cost of informal care
16 Malhotra C [47]	2015	Assessing willingness to pay for end-of-life care	informal caregivers	relative or friend	cancer	211	dyad	convenience	willingness to pay among caregivers and patients
Healthcare use									
17 Ansah JP [48]	2014	Modelling the effects of different LTC policies on healthcare utilization and demand for LTC (F)	informal caregivers	relative or friend	ADL dependent	NA	other	random	LTC utilization; total acute care visits; required number of healthcare professionals; deficits of LTC and acute care professionals
18 Heng KWJ [49]	2007	Investigating the reliability of discharge advice for minor head injury patients	informal caregivers	healthcare professionals: physician	other	100	care recipient	convenience	caregiver receipt of advice on head injury and recall among
19 Chua MT [50]	2008	Investigating the relationship between awareness of the community resources by the primary caregiver and the utilization of these resources for hospitalized elderly	informal caregivers	relative or friend	ADL dependent	30	caregiver	purposive	utilization of community resources for elderly by primary caregiver

First Author	Year	Aim/Purpose ^a	Caregiver Population	Caregiver Group	Care Recipient Condition ^b	Sample Unit of Sample ^c	Sampling	Outcomes
20 Lim J [51]	2012	Determining the extent and correlates of service use among dementia caregivers	formal caregivers	FDWs	neurodegenerative condition	caregiver	convenience	services use among caregivers
21 Yap R [52]	2014	Testing the feasibility of a comfort care kit for use of caregivers helping dying patients who cannot swallow	both	relative or friend, healthcare professionals: nursing home staff	end-of-life/advanced illness/palliative care	caregiver	convenience	caregiver utilization of the kit; perception of the feasibility/effectiveness of the kit
22 Picco L [53]	2016	Investigating the healthcare and societal costs of multimorbidity in older adults (E)	both	relative or friend, healthcare professionals: nursing home staff	community-based elderly	care recipient	random	impact of healthcare, societal costs; healthcare utilization on caregivers
Knowledge/ awareness/ attitudes/ practices								
23 Hermalin H [54]	2002	Identifying adverse outcomes and the extent to which vulnerable groups are doing relative to overall population (F)	informal caregivers	relative or friend	other	other	purposive	caregiver awareness of services for the elderly
24 Mamun K [55]	2005	Investigating restraint use in nursing homes in Singapore	informal caregivers	relative or friend	nursing home residents	care recipient	convenience	knowledge of restraint use among nurses
25 Thean H [56]	2007	Assessing oral health knowledge among staff working in a local nursing home	formal caregivers	healthcare professionals: nursing home staff	nursing home residents	caregiver	convenience	staff knowledge and training in denture care/maintenance
26 Tan EK [57]	2007	Investigating the relationship between knowledge of and attitude towards predictive genetic testing of Parkinson's Disease among patients and caregivers	informal caregivers	relative or friend	neurodegenerative condition	other	convenience	care-recipient/caregiver attitudes towards genetic testing
27 Janardhanan L [58]	2008	Evaluating a web-based tele-dermatology system in a nursing home	formal caregivers	healthcare professionals: nurse, aid	nursing home residents	caregiver	convenience	attitudes of nursing staff and specialists
28 Tiew LH [59]	2013	Clarifying values and importance of spirituality and care concepts in end-of-life care	both	relative or friend, healthcare professionals: hospice nurses	end-of-life/advanced illness/palliative care	caregiver	convenience	caregiver perspectives on spirituality and spiritual care
29 Ong EK [60]	2015	Assessing the need for continued use of the United Kingdom Liverpool Care Pathway in Singapore	informal caregivers	relative or friend	end-of-life/advanced illness/palliative care	other	convenience	caregiver awareness of patient prognosis; goal for comfort care; awareness of extent of care and parenteral hydration cessation

First Author	Year	Aim/Purpose ^a	Caregiver Population	Caregiver Group	Care Recipient Condition ^b	Sample Unit of Sample ^c	Sampling	Outcomes
30 Goh CE [61]	2016	Describing the attitudes and behaviours of nursing home caregivers in community-based LTC facilities	informal caregivers	relative or friend	nursing home residents	caregiver	purposive	nursing home staff attitudes towards and perceived behavioral control related to the provision of oral care
Needs and preferences								
31 Pai MC [62]	2015	Investigating caregiver and physician preference and patient compliance with transdermal monotherapy (G)	informal caregivers	relative or friend	neurodegenerative condition	care recipient	convenience	caregiver preference and satisfaction for oral and transdermal monotherapy
32 Ajay S [63]	2017	Assessing the level and correlates of caregiving-related needs among family caregivers of elderly Singaporeans (H)	informal caregivers	relative or friend	ADL dependent	dyad	random	caregiving-related needs (i.e., keeping care-recipient safe at home, etc.)
33 Lee A [64]	1998	Examining preference for end-of-life care informal caregivers	informal caregivers	relative or friend	cancer	care recipient	convenience	preference for the place of death among relatives
34 Ang YH [65]	1999	Investigating the perceived need for community geriatric services	informal caregivers	relative or friend	community-based elderly	dyad	convenience	perception of needs, utilization of services
35 Chai HZ [66]	2014	Understanding the factors that influence the decision by caregivers to continue feeding even at the end of life	informal caregivers	relative or friend	end-of-life/ advanced illness/ palliative care	dyad	convenience	decision-making preferences, perceptions of food, factors influencing attitudes toward food, family involvement, etc.
Negative aspects of caregiving								
36 Vaingankar JA [67]	2012	Identifying predictors of perceived burden (I)	informal caregivers	relative or friend: spouse, adult child	other	caregiver	random	perceived burden of caregivers
37 Malhotra C [68]	2012	Providing insights to help identify targeted interventions for improving caregiver mood (H)	informal caregivers	relative or friend: spouse, adult child	ADL dependent	dyad	random	caregiver depressive symptoms
38 Chan A [69]	2013	Reporting summary findings of the Survey on Informal Caregiving (H)	informal caregivers	relative or friend	ADL dependent	dyad	random	caregiver depressive symptoms
39 Malhotra R [70]	2014	Assessing mediating effect of older person's behavioral and psychological symptoms on the association of the older person's cognitive impairment and the caregiver's depressive symptoms (H)	informal caregivers	relative or friend	frailty	dyad	random	caregiver depressive symptoms

First Author	Year	Aim/Purpose ^a	Caregiver Population	Caregiver Group	Care Recipient Condition ^b	Sample Size	Unit of Sample ^c	Sampling	Outcomes
40 Ang S [71]	2017	Assessing moderating effect of expressive and instrumental social support from family and friends in the association of care-related work interruptions with depressive symptoms among working family caregivers of older adults (H)	informal caregivers	relative or friend	community-based elderly	662	dyad	random	caregiver depressive symptoms
41 Kua EH [72]	1989	Reporting the psychological distress of family caregivers of elderly patients	informal caregivers	relative or friend	frailty	60	dyad	convenience	psychiatric disorder of caregivers
42 Mahendran R [73]	1993	Presenting findings of a study on Filipino domestic helpers admitted to Woodbridge Hospital (state psychiatric hospital)	informal caregivers	relative or friend	other	44	other	convenience	caregiver (FDW) as patients - characteristics, family, social aspects, psychiatric illness
43 Kua EH [74]	1997	Presenting results of a study on stress among family caregivers of elderly Chinese patients with dementia	informal caregivers	relative or friend	neurodegenerative condition	50	dyad	convenience	probable psychiatric "caseness" of caregivers
44 Lim PPJ [75]	1999	Enabling appropriate interventions that can be implemented to reduce caregiving burden and delay institutionalization	informal caregivers	relative or friend	neurodegenerative condition	93	dyad	convenience	caregiver burden
45 Sahadevan S [76]	1999	Presenting findings on dementia cases in Singapore	informal caregivers	relative or friend	neurodegenerative condition	100	other	convenience	problems and difficulties of caregivers
46 Siew CW [77]	2003	Reporting findings from a large community-based study on the health of the elderly	informal caregivers	relative or friend	community-based elderly	41	caregiver	purposive	caregiver burden
47 Tan LL [78]	2005	Examining the impact of neuropsychiatric symptoms on distress in family and professional caregivers	informal caregivers	relative or friend	neurodegenerative condition	85	dyad	convenience	caregiver distress
48 Seng BK [79]	2010	Validating the Zarit Burden Interview	informal caregivers	relative or friend	neurodegenerative condition	246	caregiver	convenience	caregiver burden; psychometric properties of instrument measuring caregiver burden

First Author	Year	Aim/Purpose ^a	Caregiver Population	Caregiver Group	Care Recipient Condition ^b	Sample Size	Unit of Sample ^c	Sampling	Outcomes
49 Cheah WK [80]	2012	Validating the Zarit Burden Interview	informal caregivers	relative or friend	neurodegenerative condition	130	dyad	convenience	caregiver's perceived burden of providing care
50 Lim WS [81]	2014	Delineating the construct of worry about performance as a distinct dimension of burden in an Asian society	informal caregivers	relative or friend: spouse, adult child	neurodegenerative condition	130	dyad	convenience	caregiver burden (worry about performance)
51 Dong YH [82]	2014	Testing the feasibility and acceptability of the informant AD8 in detecting cognitive impairment in primary clinics	formal caregivers	professional caregivers	neurodegenerative condition	199	dyad	convenience	feasibility and acceptability of the AD8; average time of test administration
52 Quah S [83]	2014	Presenting the implications of the role of distress and QoL of caregivers in family caregiving situations	informal caregivers	relative or friend	mental health condition	47	caregiver	purposive	caregiver role distress and QoL
53 Siddiqui S [84]	2015	Developing a QoL questionnaire for use among older ICU patients	informal caregivers	relative or friend	ICU patients	28	other	convenience	caregiver expectations, mental, financial burden
54 Lau S [85]	2015	Testing the multi-dimensionality of the Zarit Burden Interview	informal caregivers	relative or friend	neurodegenerative condition	165	dyad	convenience	caregiver burden
55 Koh MYH [86]	2015	Describing the prevalence of burnout and psychological symptoms	formal caregivers	healthcare professionals: nurse, doctors, social workers	end-of-life/ advanced illness/ palliative care	273	caregiver	convenience	burnout; psychological morbidity
56 Rajasekaran T [87]	2016	Identifying predictors of caregiver-burden among elderly patients with cancer	informal caregivers	relative or friend: spouse, adult child	cancer	244	caregiver	convenience	caregiver's perceived burden of providing care
57 Griwa K [88]	2016	Comparing assisted peritoneal dialysis and self-care peritoneal dialysis in terms of the QoL and emotional distress of patients and caregivers	informal caregivers	relative or friend	other	111	caregiver	convenience	caregiver burden
58 Win KK [89]	2017	Describing care recipient and caregiver characteristics, caregiver-burden, in individuals with dementia	informal caregivers	relative or friend: spouse, adult child	neurodegenerative condition	458	dyad	convenience	caregiver burden

First Author	Year	Aim/Purpose ^a	Caregiver Population	Caregiver Group	Care Recipient Condition ^b	Sample Size	Unit of Sample ^c	Sampling	Outcomes
59 Vaingankar JA [90]	2016	Investigating the prevalence of psychiatric morbidity and its association with informal caregiver's socio-demographics and health status (E)	informal caregivers	relative or friend	community-based elderly	693	dyad	random	psychiatric morbidity of caregivers
60 Vaingankar JA [91]	2017	Determining the prevalence of behavioral and psychological symptoms of dementia (BPSD) among community-based older adults with dementia, the factor structure of BPSD and its correlates (E)	informal caregivers	relative or friend	neurodegenerative condition	339	dyad	random	Positive aspects of caregiving
Positive aspects of caregiving									
61 Tan JYS [92]	2015	Investigating the impact of spirituality on caregivers' QoL and its role as a possible mediator in the relationship (J)	informal caregivers	relative or friend	cancer	79	dyad	convenience	caregiver QoL
62 Win MK [93]	2010	Reporting an outbreak of influenza B among a highly immunised resident population in a welfare home in tropical Singapore, and discuss vaccine efficacy and the role of acute respiratory illness surveillance in outbreak prevention/control	formal caregivers	professional caregivers	infectious diseases	15	other	purposive	attack rate among nursing home staff
63 Guo S [94]	2010	Testing the effectiveness of methadone maintenance treatment in reducing opiate dependence among the elderly	informal caregivers	relative or friend	mental health condition	33	dyad	convenience	caregiver satisfaction with treatment regime
64 Yap P [95]	2010	Validating the Gain in Alzheimer Care Instrument	informal caregivers	relative or friend	neurodegenerative condition	238	caregiver	convenience	caregiver gains in dementia caregiving
65 Liew TM [96]	2010	Examining factors associated with gains in dementia caregiving	informal caregivers	relative or friend	neurodegenerative condition	340	caregiver	convenience	caregiver gains in dementia caregiving
66 Tan SB [97]	2010	Examining health-related QoL of caregivers for people with Parkinson's disease	informal caregivers	relative or friend: spouse, adult child	neurodegenerative condition	94	caregiver	convenience	caregiver QoL
67 Aloulou H [98]	2013	Providing insights on assisted living technology in nursing homes	informal caregivers	relative or friend	neurodegenerative condition	8	care recipient	purposive	caregiver relief

First Author	Year	Aim/Purpose ^a	Caregiver Population	Caregiver Group	Care Recipient Condition ^b	Sample Unit of Sample ^c	Sampling	Outcomes
68 Tay L [99]	2014	Assessing well-being of persons with dementia and inform clinical decision making	informal caregivers	relative or friend	neurodegenerative condition	dyad	convenience	QoL of patient and caregivers
69 Mahendran R [100]	2015	Comparing the factor structure of the Taiwanese version of the Caregiver Quality of Life Index-Cancer (CQOLC) with the original	formal caregivers	FDWs	cancer	caregiver	convenience	domains of QoL among caregivers; psychometric properties of the instrument among caregivers
70 Lim HA [101]	2016	Exploratory study investigating the QoL of caregivers of cancer patients receiving care in home hospice services	informal caregivers	relative or friend	end-of-life/advanced illness/palliative care	caregiver	purposive	caregiver QoL
71 Mukhopadhyay A [102]	2016	Assessment of patients' and family's satisfaction levels of the health care services delivered in the ICUs	informal caregivers	relative or friend	ICU patients	caregiver	convenience	satisfaction level of healthcare services delivered in the ICUs
72 Jeon YH [103]	2017	Testing whether European quality indicators for psychosocial care in dementia is a valid tool in residential aged care in other sites including Singapore	informal caregivers	relative or friend	neurodegenerative condition	other	purposive	validity of quality indicators
73 Jeyagurunathan A [104]	2017	Examining the mental health and QoL of primary caregivers of persons with mental illness	informal caregivers	relative or friend	other	caregiver	convenience	QoL and mental health of caregivers
74 Zheng Z [105]	2017	Exploring the current level of job satisfaction among psychiatric nurses working in a tertiary psychiatric institution; assessing the factors and the relationship between resilience and job satisfaction	informal caregivers	relative or friend	other	caregiver	convenience	job satisfaction, resilience
75 Lim HA [106]	2017	Examining the QoL of family caregivers of patients with cancer; comparing this with the QoL in other countries; association of socio-demographics and QoL impairment	informal caregivers	relative or friend	cancer	caregiver	convenience	caregiver QoL

First Author	Year	Aim/Purpose ^a	Caregiver Population	Caregiver Group	Care Recipient Condition ^b	Sample Size	Unit of Sample ^c	Sampling	Outcomes
76 Tan L [107]	2013	Validating the Dementia Management Strategies Scale (K)	informal caregivers	relative or friend	neurodegenerative condition	246	caregiver	convenience	psychometric properties of an instrument for measuring the dementia care strategy of caregivers
Positive and negative aspects of caregiving									
77 Malhotra R [108]	2012	Validating the Caregiver Reaction Assessment scale in Singapore (H)	informal caregivers	relative or friend	ADL dependent	1190	dyad	random	four domains: disturbed schedule/poor health, lack of finances, lack of family support, caregiver esteem
78 Østbye T [109]	2013	Investigating the role of foreign domestic workers in eldercare (H)	both	relative or friend, FDWs	ADL dependent	1190	dyad	random	satisfaction level of healthcare services delivered in the ICUs
79 Chan A [110]	2013	Estimating the health impact of providing care to older adults (H)	formal caregivers	healthcare professionals: nurse, nursing aid	ADL dependent	1190	dyad	random	depression; self-rated health; outpatient visits
80 Siow JYM [111]	2017	Testing the validity and reliability of the 9-item PAC scale among caregivers of older Singaporeans with functional limitations; Developing a shorter version of the PAC scale and test its psychometric properties and comparing the shorter-version with the 9-item PAC scale (H)	informal caregivers	relative or friend	ADL dependent	1132	caregiver	random	distribution of caregiver responses to PAC items, mean scores
81 Mehta K [112]	2005	Exploring factors that contribute to the level of stress of caregivers and the relationship between caregiver stress and the physical dependence of the care recipient	formal caregivers	healthcare professionals: palliative care	ADL dependent	61	dyad	purposive	stress levels, feelings and attitudes of caregivers
82 Lim J [113]	2011	Examining the factors associated with negative and positive adjustment outcomes among family caregivers of persons with dementia in Singapore	informal caregivers	relative or friend	neurodegenerative condition	136	caregiver	convenience	neurodegenerative condition

First Author	Year	Aim/Purpose ^a	Caregiver Population	Caregiver Group	Care Recipient Condition ^b	Sample Unit of Sample ^c	Sampling	Outcomes
83 Khoo SA [114]	2013	Investigating the prevalence, severity and impact of neuropsychiatric symptoms on caregiver distress and QoL in persons with dementia	informal caregivers	relative or friend	neurodegenerative condition	dyad	convenience	caregiver distress and QoL
84 Hong SI [115]	2013	Investigating the role of caregiver coping and caregiving style is critical to improving care for the person with dementia	informal caregivers	relative or friend	neurodegenerative condition	caregiver	convenience	caregiver burden; competence, general health, gains from caregiving
85 Humanitarian Organization for Migration Economics [116]	2015	Addressing research questions related to the characteristics and social circumstances of FDWs in Singapore; prevalence and severity of mental health problems; and their associations	informal caregivers	relative or friend	community-based elderly	caregiver	convenience	mental well-being of FDWs
86 Tay PKC [117]	2016	Investigating the burden, coping, self-efficacy, and QoL of family caregivers with dementia	formal caregivers	healthcare professionals: nurse, nursing aid	neurodegenerative condition	caregiver	convenience	burden of care, coping strategies, QoL and self-efficacy (i.e., the confidence that family members have in being a caregiver)

^a **Most studies used study-specific data**, unless specified in the Aim/Purpose – (A) National Health Survey; (B) National Survey of Senior Citizens; (C) Singapore Dementia Caregiver Profile Study; (D) Social Isolation, Health and Lifestyles Survey (SIHLS); (E) Well-being of the Singapore Elderly (WISE) study; (F) Multiple data sources for modelling; (G) Real-world Evaluation of Compliance And Preference in the treatment of Alzheimer's disease (RECAP); (H) Singapore Survey on Informal Caregiving (SSIC) 2010–2011; (I) Singapore Mental Health Study; (J) Healthy Older People Every day (HOPE) Study; (K) The Singapore dementia caregiver profile; ^b “**Neurodegenerative conditions**” include dementia, Alzheimer's, cognitive impairment, Parkinson's disease, Amyotrophic Lateral Sclerosis; “Other conditions” include minor injuries, dialysis patients, hip fracture, chronic illness, and non-specific conditions; ^c “**Other unit of sample**” include expert panel, system data, institutions; ADL, activities of daily living; FDW, foreign domestic worker; ICU, intensive care unit; LTC, long-term care; NA, not applicable; PAC, positive aspects of caregiving scale; QoL, quality of life

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Appendix A3. Longitudinal studies by core themes (n=5)

First Author	Year	Aim/Purpose	Caregiver Population	Caregiver Group	Care Recipient Condition ^a	Sample Size	Unit of Sample ^b	Sampling	Follow-up	Outcomes	
Negative aspects of caregiving											
1	Siddiqui MA [118]	2010	Investigating the factors that contribute to stress among caregivers	informal caregivers	relative or friend	other	76	caregiver	convenience	1st week of admission; 6 months after	caregiver stress levels
2	Malhotra R [119]	2016	Describing the depressive symptom trajectories among stroke survivor-caregiver dyads, predictors, and other factors that influence the level of the trajectories	informal caregivers	relative or friend: spouse, adult child	stroke	191	dyad	random	1st: on average 15.4 weeks post stroke; 2nd: on average 28.5 weeks post stroke	Positive aspects of caregiving
Positive aspects of caregiving											
3	Eom K [120]	2017	Developing an understanding of the separate effects of the caregiving relationship and formal long-term care service use on the well-being of the caregiver	informal caregivers	relative or friend	other	781	dyad	random	6 months (wave 2 of the study)	caregiver well-being (i.e., self-rated general health, stress level, QoL)
4	Leow MQH [121]	2014	Identifying predictors of change in QoL of caregivers of patients with advanced cancer	informal caregivers	relative or friend	cancer	93	caregiver	convenience	baseline and after 2 months	choice of care setting; protective role of caregiver gains
Positive and negative aspects of caregiving											
5	Tan YY [122]	2016	Auditing - developing and evaluating a terminal discharge framework in a Singapore tertiary hospital	both	relative or friend, healthcare professionals: nurses	cancer	21	other	convenience	3 months after the baseline audit	time taken to conduct a terminal discharge; communication with homecare team
^a "Other conditions" include minor injuries, dialysis patients, hip fracture, chronic illness, and non-specific conditions; ^b "Other unit of sample" include expert panel, system data, institutions; QoL, quality of life											

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Appendix A4. Intervention studies by core themes (n=6)

First Author	Year	Aim/Purpose	Caregiver Population	Caregiver Group	Care Recipient Condition ^a	Sample Size	Unit of Sample ^b	Sampling	Follow-up	Outcomes
Negative aspects of caregiving										
1	Sin GL [123]	2017	Measuring eldercare workers' perceived levels of stress and knowledge about caring for older persons with mental illness before, immediately after and three months after they underwent standardized training workshops on dementia and depression	formal caregivers	healthcare professionals	71	caregiver	convenience	pre-, post-workshop, and three months after (three-month follow-up)	perceived levels of stress and knowledge of healthcare professionals
2	Chua J [124]	2016	Finding a means to increase coping among Chinese dementia caregivers	informal caregivers	relative or friend	12	caregiver	convenience	pre-, 4 weeks intervention, 8 weeks (post) intervention	measures for anxiety, depression, and worry among caregivers
Positive aspects of caregiving										
3	Chong MS [125]	2014	Examining the impact of an innovative model of delirium care on patient outcomes	informal caregivers	relative or friend	234	care recipient	random	6 months and 12 months	caregiver satisfaction on delirium care and patient outcomes (i.e., caregivers consented, n=160)
Positive and negative aspects of caregiving										
4	Chew J [126]	2015	Evaluating a physical rehabilitation program for patients with dementia and their caregivers	informal caregivers	relative or friend	55	dyad	convenience	weekly during the course of the 8-week program	QoL, caregiver burden, goal attainment scaling among caregivers
5	Leow MQH [127]	2015	Evaluating the "Caring for the Caregiver Program"	informal caregivers	relative or friend	80	caregiver	random	weeks 3 and 6	caregiver QoL (primary); others outcomes: burden, disruptiveness, positive adaptation, financial concerns, social support satisfaction, stress and depression, general closeness, respite care, controlling upsetting thoughts, rewards

First Author	Year	Aim/Purpose	Caregiver Population	Caregiver Group	Care Recipient Condition ^a	Sample Size	Unit of Sample ^b	Sampling	Follow-up	Outcomes	
Others (Decision making)											
6	Low JA [128]	2009	Presenting results of a clinical practice quality improvement project	both	relative or friend, health care professionals: palliative care staff	end-of-life/advanced illness/ palliative care	655	care recipient	convenience	full duration of the one-month program	family's decision to disclose diagnosis

^a "Neurodegenerative conditions" include dementia, Alzheimer's, cognitive impairment, Parkinson's disease, Amyotrophic Lateral Sclerosis; "Other conditions" include minor injuries, dialysis patients, hip fracture, chronic illness, and non-specific conditions; ^b "Other unit of sample" include expert panel, system data, institutions; QoL, quality of life

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Appendix A5. Mixed-method studies by core themes (n=5)

First Author	Year	Aim/Purpose	Caregiver Population	Caregiver Group	Care Recipient Condition ^a	Sample Size	Unit of Sample ^b	Sampling	Follow-up	Outcomes	
Negative aspects of caregiving											
1	Ang SY [129]	2017	Determining work-related challenges faced by older nurses	formal caregivers	healthcare professionals: nurse, nursing aid	other	534	caregiver	convenience	not applicable	challenges faced at work among nurses
Positive and negative aspects of caregiving											
2	Tan SB [130]	2012	Investigating the caregiver experiences of people taking care of patients with Parkinson's	informal caregivers	relative or friend	neurodegenerative condition	21	caregiver	purposive	not applicable	caregiver experiences in providing care for patient with Parkinson's Disease (coping, adaptation, challenges, effects of caregiving, need for caregiver support)
3	Mahendran R [131]	2017	Evaluating a pilot intervention that involves a brief psycho-education support group	informal caregivers	relative or friend: spouse, adult child	cancer	97	caregiver	purposive	6 weeks after baseline	intervention outcomes for the participant: CoL, depression, anxiety
Others (Needs and preferences; caregiving activities, etc.)											
4	Huang S [132]	2012	Clarifying the roles of migrant care workers in Singapore	formal caregivers	relative or friend	healthcare professionals, foreign domestic workers	1160	caregiver	convenience	not applicable	experiences and in-depth meanings of health and healthcare in everyday contexts
5	Riley CM [133]	2012	Providing cost data on caregiving for persons with dementia	informal caregivers	relative or friend	neurodegenerative condition	16	other	purposive	not applicable	non-medical care needs at different stages of ageing-related dementia

^a "Neurodegenerative conditions" include dementia, Alzheimer's, cognitive impairment. Parkinson's disease. Amyotrophic Lateral Sclerosis; "Other conditions" include minor injuries, dialysis patients, hip fracture, chronic illness, and non-specific conditions; ^b "Other unit of sample" include expert panel, system data, institutions; CoL, quality of life

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Appendix B. List of affiliated institutions

Institution	Relevant Papers
1 Alexandra Hospital/Khoo Teck Puat Hospital	Ang YH [65]; Chan CKL [3]; Low JA [128]; Yap P [95]; Liew TM [96]; Tew CW [35]; Low JA [12]; Khoo SA [114]; Siddiqui S [84]
2 Asian Metacentre for Population and Sustainable Development Analysis	Devasahayam TW [1]
3 Duke-NUS Medical School*	Setia M [15]; Malhotra C [68]; Malhotra R [108]; Riley CM [133]; Lee GL [23]; Ansah JP [36]; Østbye T [109]; Chan A [110]; Chan A [69]; Malhotra R [70]; Ansah JP [48]; Quah S [83]; Malhotra C [47]; Penkunas MJ [30]; Ansah JP [45]; Malhotra R [119]; Ajay S [63]; Siow JYM [111]; Eom K [120]
4 Epidemiology and Disease Control Division	Ministry of Health [32]
5 Geriatric Education and Research Institute	Tam WJ [31]
6 HCA Hospice Care	Chong PH [22]; Yap R [52]
7 Humanitarian Organization for Migration Economics	Humanitarian Organization for Migration Economics [116]
8 Image & Pervasive Access Lab	Aloulou H [98]
9 Institute of Mental Health	Tan LL [78]; Guo S [94]; Vaingankar JA [67]; Vaingankar JA [19]; Vaingankar JA [90]; Picco L [53]; Vaingankar JA [44]; Jeyagurunathan A [104]; Vaingankar JA [91]; Zheng Z [105]
10 James Cook University, Singapore	Ramanathan R [10]
11 KK Women's and Children's Hospital	Ang SY [129]
12 Lee Kuan Yew School of Public Policy	Kang SH [33]
13 Nanyang Technological University	Janardhanan L [58]
14 National Cancer Centre Singapore	Ho ZJM [5]; Krishna LKR [8]; Tan YY [13]; Ong EK [60]; Rajasekaran T [87]; Tan YY [122]
15 National Cheng Kung University	Pai MC [62]
16 National Healthcare Group Polyclinics	Siew CW [77]
17 National Neuroscience Institute	Ang K [20]
18 National University Health System*	Thean H [56]; Mukhopadhyay A [102]
19 National University of Singapore*	Kua EH [72]; Lee KS [34]; Kua EH [74]; Pallawala PMDS [14]; Mehta K [112]; Ng GT [39]; Mehta K [27]; Ng GT [41]; Chua MT [50]; Netto NR [25]; Lim J [113]; Huang S [132]; Griva K [9]; Hong SI [115]; Tan L [107]; Lee GL [26]; Mahendran R [100]; Tan JYS [92]; Basnyat I [29]; Lee VYW [17]; Lim HA [101]; Goh CE [61]; Griva K [88]; Lim HA [106]; Mahendran R [131]
20 Singapore General Hospital/Singapore Health Services	Mamun K [55]; Tan EK [57]; Tan SB [97]; Siddiqui MA [118]; Tan SB [130]; Kao YS [42]; Chai HZ [66]; Leow MQH [127]; Leow MQH [18]; Sin GL [123]
21 Singapore Institute of Management University	Seng BK [79]
22 Singapore Medical Association	Khoo YC [37]
23 Singapore University of Social Sciences	Mehta KK [11]
24 Tan Tock Seng Hospital	Lee A [64]; Lim PPJ [75]; Sahadevan S [76]; Leong IYO [38]; Lee A [2]; Heng KWJ [49]; Win MK [93]; Cheah WK [80]; Ng R [16]; Chong MS [46]; Lim WS [81]; Tay L [99]; Chong MS [125]; Koh MYH [86]; Chew J [126]; Win KK [89]
25 The Hong Kong Polytechnic University	Ng GT [4]
26 The Lien Foundation	Tan JOA [6]
27 The University of Queensland	Chua J [124]

Institution	Relevant Papers
28 The University of Sydney	Jeon YH [103]
29 University College London	Lim J [51]
30 University of Cambridge	Suen J [24]
31 University of Michigan	Hermalin H [54]; Ang S [71]
32 Woodbridge Hospital	Mahendran R [73]
33 Yong Loo Lin School of Medicine*	Li LLM [40]; Foo ASC [7]; Tiew LH [59]; Dong YH [82]; Leow MQH [121]; Lau S [85]; Chong JA [43]; Tay PKC [117]
34 not specified	Mehta K [21]; Yee CM [28]

* Entities fall under the National University of Singapore system

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Appendix C. Other data collection tools for care recipient variables/outcomes

Cognitive Status

Clinical Dementia Rating (CDR)
Neuropsychiatric Inventory Questionnaire
Elderly Cognitive Assessment Questionnaire
Chinese Mini-Mental State Examination (CMMSE)
Self-Reporting Questionnaire (SRQ-20)
History and Aetiology Schedule – Dementia Diagnosis and Subtype (HAS-DDS)
Community Screening Interview for Dementia (CSI-D)
Abbreviated Mental Test (AMT)
Ascertain Dementia 8-item (AD-8)

Mental Health

Center for Epidemiological Studies-Depression (CES-D)
Geriatric Anxiety Inventory (GAI)
Generalized Anxiety Disorder (GAD-7)
Patient Health Questionnaire (PHQ-9)
General Health Questionnaire (GHQ-28)
Hospital Anxiety and Depression Scale (HADS)
Revised Memory and Behavior Problems Checklist (RMBPC)
World Mental Health Composite International Diagnostic Interview - Family Burden Module

Quality of Life

Quality of Life–Alzheimer Disease (QOL-AD)

Activities of Daily Living

Barthel Index
Older Americans Resources and Services (OARS) Multidimensional Functional Assessment Questionnaire

Other

General closeness scale
Functional Assessment of Chronic Illness Therapy – Spiritual Well-Being (FACIT-Sp-12)
Life Orientation Test-Revised (LOT-R)
Resilience Appraisal Scale (RAS)

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ACKNOWLEDGEMENTS

The authors thank Ms Nurliyana Daros for providing assistance in retrieving the full-text articles at the screening stage, as well as Professor Truls Østbye and Associate Professor Angelique Chan for providing valuable feedback during the early stages of conceptualising the review.

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