General Hospital Psychiatry 86 (2024) 33–49

Contents lists available at ScienceDirect

General Hospital Psychiatry

journal homepage: www.elsevier.com/locate/genhospsych

Review article

Psychological and social impacts of frontotemporal dementia on caregivers and family members – A systematic review

Ying Li Tan [a], Yee Kai Jeffrey Lo [a], Cyrus Su Hui Ho [b,c,*]

[a] Yong Loo Lin School of Medicine, National University of Singapore, Singapore 119228, Singapore
[b] Department of Psychological Medicine, Yong Loo Lin School of Medicine, National University of Singapore, Singapore 119228, Singapore
[c] Department of Psychological Medicine, National University Hospital, Singapore 119228, Singapore

ARTICLE INFO

Keywords:
Caregiver burden
Cost
Family members
Frontotemporal dementia
Psychological impacts
Social impacts

ABSTRACT

Introduction: Frontotemporal dementia (FTD) may impose substantial psychological and social burdens on caregivers and family members that are unique from other forms of dementia due to its distinctive clinical characteristics. This systematic review investigated these impacts on caregivers and family members.
Methods: A systematic search was conducted in the PubMed, Cochrane Library and Embase databases for relevant articles published from database inception to 23 March 2023. The methodological quality of the articles was evaluated using a checklist.
Results: Thirty-six articles (six qualitative and thirty quantitative), including 5129 participants, were included in this review. Like other forms of dementia, FTD caregivers had significant caregiver burden levels and psychological impacts. Caregiver burden was associated with behavioural symptoms (e.g., apathy and disinhibition) and motor symptoms. The costs of caring for a patient with FTD were found to be higher than those for Alzheimer's disease. FTD patients often face challenges in obtaining a correct diagnosis and experience significant delays and multiple misdiagnoses. Healthcare professionals may also be less familiar with FTD than with Alzheimer's, leading to delayed diagnosis. This can cause considerable stress and deprive patients and caregivers of early intervention.
Conclusion: FTD is associated with significant costs and caregiver burden levels, and the difficulties faced by caregivers and family members can be unique and challenging in different aspects when compared to other forms of dementia. Better education about FTD for family members and healthcare professionals is required to improve the quality of life for both patients and caregivers, and more support needs to be provided at all stages of the disease.

1. Introduction

1.1. Rationale

Frontotemporal dementia (FTD) refers to a group of clinically and neuropathologically heterogeneous neurodegenerative disorders characterised by aphasia or prominent changes in social behaviour and personality, accompanied by degeneration of the frontal and/or temporal lobes [1,2]. FTD encompasses three clinical subtypes: behavioural variant FTD (bvFTD) and two variants of primary progressive aphasia (PPA), namely semantic variant primary progressive aphasia (svPPA) and non-fluent variant primary progressive aphasia (nfvPPA) [3].

FTD is a common cause of early-onset dementia, with an incidence of 1.61–4.1 per 100,000 person-years. Age-adjusted prevalence peaks between 65 and 69 years at 42.6/100,000, and the age-adjusted prevalence for persons older than 65 years is double that for those between 40 and 64 years [4,5]. Due to the younger age of onset compared to other forms of dementia, such as Alzheimer's disease (AD), there may be significant differences in the effects of this disease on caregivers and family members due to the difference in patient profile and family structures.

Behavioural changes in bvFTD can include disinhibition, apathy, and loss of empathy. Disinhibition may present as behaviours that are deemed socially inappropriate, such as inappropriate touching or

* Corresponding author at: Department of Psychological Medicine, Yong Loo Lin School of Medicine, National University of Singapore, Singapore 119228, Singapore.
E-mail address: pcmhsh@nus.edu.sg (C.S.H. Ho).

https://doi.org/10.1016/j.genhosppsych.2023.11.011
Received 13 September 2023; Received in revised form 29 November 2023; Accepted 29 November 2023
Available online 3 December 2023

kissing, physical aggression, inappropriate sexual acts, and criminal behaviours. These symptoms of bvFTD are described in the international consensus criteria for bvFTD [6].

Under the umbrella term of FTD, PPA [7] is a clinical syndrome characterised by an isolated and gradual dissolution of language function, manifesting as speech apraxia or deficits in word finding, word usage, word comprehension or sentence construction. Depending on the type of aphasia, PPA can be further classified into svPPA and nfvPPA [8]. In svPPA, anomia and single-word comprehension deficits are the core features, with both essential for diagnosis. In nfvPPA, agrammatism in language production (short, simple phrases and omissions of grammatical morphemes) and effortful speech are the core criteria, and at least one should be present.

Many FTD caregivers are patients' family members and may not be adequately trained or prepared to care for these patients. While there are many studies on AD and its effects on caregivers and family members [9,10], to our knowledge, there has not been a systematic review on FTD. We believe that due to the earlier onset of FTD and the significant behavioural changes it involves, its effects on caregivers and family members can be different from those of other forms of dementia and can

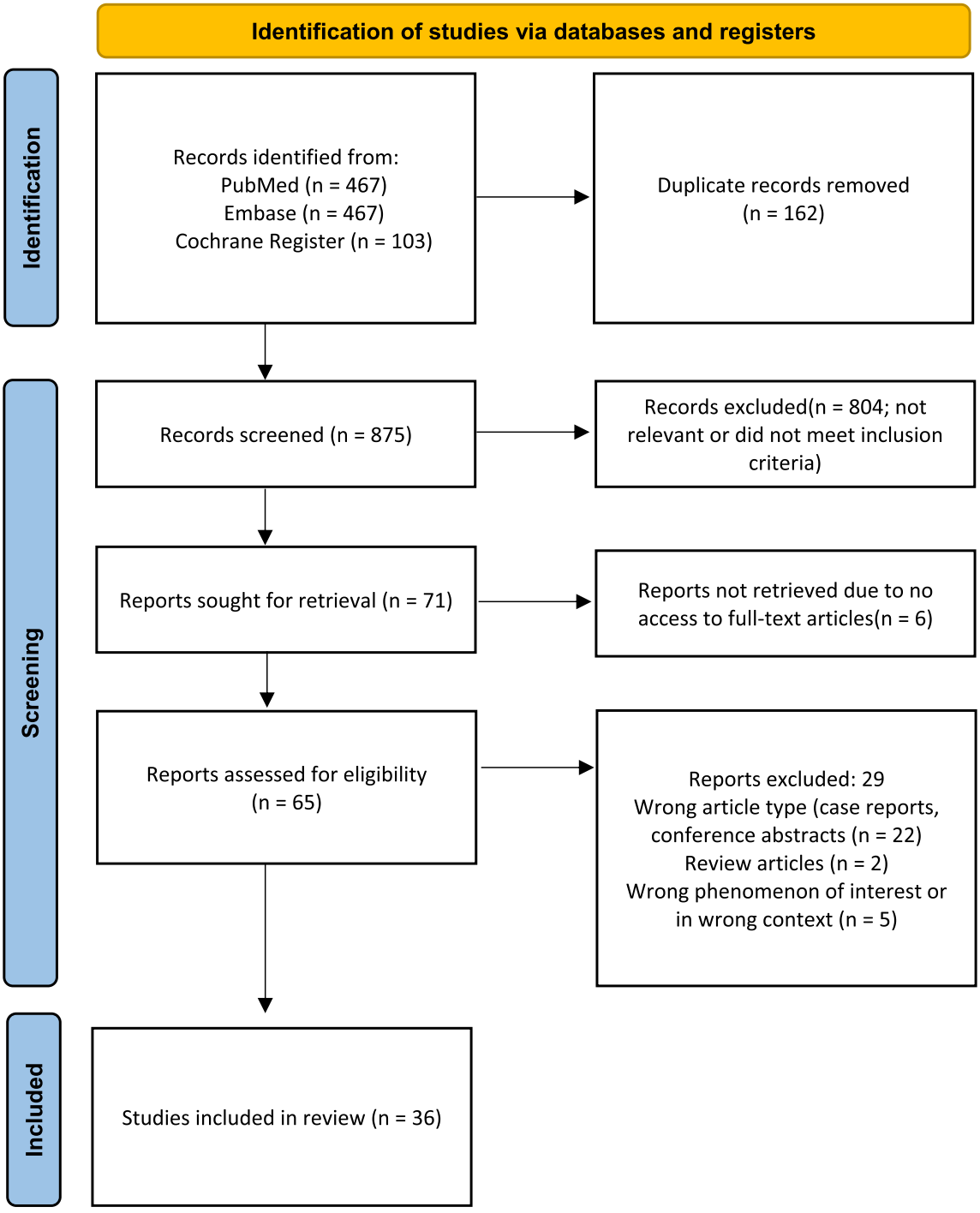

Fig. 1. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram summarising the systematic selection process.
From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD et al. The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews. BMJ 2021;372:n71; https://doi.org/10.1136/bmj.n71.

pose considerable challenges.

1.2. Objective

This systematic review aims to search for existing literature regarding this research question and identify gaps in the literature.

Identifying and understanding the various psychological and social impacts of FTD on caregivers and family members may facilitate increased quality of life for caregivers and patients with FTD by allowing more interventions and measures to be designed specifically for them. The study will also guide future researchers by identifying areas with a gap in knowledge about this topic.

2. Methods

A systematic review of FTD and its psychological and social impacts on caregivers was performed to identify the knowledge gap and areas that could benefit from future research. This systematic review was conducted using a protocol developed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 methodology (Fig. 1) [11].

The specific methodology of this protocol, including the search strategy, eligibility criteria, selection process and data collection process, is described below.

2.1. Search strategy

Searches were conducted online in PubMed (MEDLINE), Embase and Cochrane using pre-specified search terms. MeSH terms were also used in PubMed searches.

The SPIDER search strategy [12] was used to develop keywords for this search (see Table 1).

The keywords for this search strategy were FTD, frontotemporal lobe degeneration, caregivers, caregiver burden, family members, psychological effects, and social impacts. The specific search terms are in the Annex (Figs. 2–4).

The final search was performed on 23 March 2023. Articles from inception till 23 March 2023 were screened.

2.2. Data collection process

After performing the searches according to the search strategy, the titles, abstracts, keywords, publication dates, authors and journal names of the articles were identified and exported into Rayyan [13] to be screened for the eligibility criteria. Duplicates were removed.

2.3. Eligibility criteria

Two independent reviewers independently screened the titles and abstracts of the identified articles and selected articles based on the predetermined criteria. Any discrepancies between the reviewers were discussed and resolved by consensus.

The inclusion and exclusion criteria were determined based on the SPIDER tool (see Table 2) [12].

The full text was then obtained for articles that met these eligibility criteria. The full-text articles were then further screened for eligibility by two independent reviewers using the previously employed method.

Table 1
SPIDER search strategy.

Sample	Caregivers and family members of patients with frontotemporal dementia
Phenomenon of interest	Psychological and social impacts
Design	Questionnaire, survey, interview, focus group or observational study
Evaluation	Experiences, impact, needs and contributing factors
Research type	Qualitative, quantitative and mixed methods

Table 2
Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Sample Caregivers and family members of patients with FTD, including primary progressive aphasia	Sample Other forms of dementia FTD caregivers not differentiated or distinguished from the study population
Phenomenon of interest Psychological and social impacts Studies that identified the specific psychological and social impacts and the contributing factors	Phenomenon of interest Articles that did not include data on the specific psychological and social impacts and the contributing factors
Design Questionnaires, surveys, interviews, focus groups, cross-sectional studies or observational studies Comparative studies Articles written in English No date restrictions were imposed Articles older than ten years were included	Design Review articles, editorials, opinion pieces, case reports, case series and conference abstracts Ongoing trials Articles not in English
Evaluation Experiences, impact, needs and contributing factors	Evaluation Not applicable
Research type Qualitative, quantitative and mixed methods	Research type Not applicable

Abbreviation: FTD, frontotemporal dementia.

2.4. Synthesis methods

Characteristics of the included articles were then tabulated for easier visualisation. The findings reported in the full-text articles were extracted and analysed. The key points are summarised in Table 3.

2.5. Quality appraisal

The quality of the included studies was assessed using the Mixed Methods Appraisal Tool (MMAT) [14]. This was carried out independently by two review team members. The studies were split into quantitative non-randomised studies, quantitative descriptive studies, and qualitative studies. The ratings used for each criterion to better assess the quality of the included studies are presented in detail in Tables 4, 5 and 6 in the Annex.

3. Results

This systematic review included 36 papers, and a total of 5129 subjects were included in the studies. Most articles explored the level of caregiver burden, distress and other psychological symptoms in FTD and the associated factors; of these, two articles explored the changes in caregiver burden over 24 months in a longitudinal cohort study. Six articles reported qualitative unstructured interviews exploring the experiences of family members and caregivers of FTD patients. In general, the included papers were of adequate quality as measured by the MMAT, as shown in Tables 2, 3 and 4.

3.1. Level of caregiver burden

The Zarit burden index (ZBI) [51] was used in several articles to measure the caregiver burden experienced by caregivers and family

Table 3
Summary of included articles.

Author (year)	Participants	Country	Study design	Key results
Besser and Galvin (2020) [15]	698 FTD	United States	Quantitative descriptive study	44% of patients took more than one year; 65% saw three or more doctors; and 84% required three or more visits to establish an FTD diagnosis. 21% of patients received the wrong initial diagnosis of depression or other psychiatric conditions. Caregivers and patients thus lost a significant number of workdays just to seek a diagnosis.
Boutoleau-Bretonnière et al. (2008) [16]	26 FTD, 28 AD	France	Quantitative non-randomised study	In FTD, apathy, loss of appetite, eating dysfunction and motor symptoms were the most distressing to caregivers. In contrast, disinhibition and euphoria were the most distressing to caregivers of AD patients. Overall, the caregiver burden was higher in FTD than in AD, despite similar functional disability.
Chow et al. (2011) [17]	79 FTD	United States, Canada	Quantitative descriptive study	Half the respondents identified 'failure to recognize the early stage of illness as a dementia' as the most troublesome aspect, and 43% of respondents found it difficult to acquire an accurate diagnosis. Lack of awareness about early-onset dementias, even from healthcare professionals, also contributed to caregiver burden.
Custodio et al. (2015) [18]	18FTD, 44 AD, 44 VD, 30 non-dementia	Peru	Quantitative non-randomised study	In a three-month period, costs for patients with FTD were higher than those of patients with AD (US$1860 v. US$1500). In middle- and low-income countries such as Peru, the monthly cost of taking care of a patient with dementia was 2.5 times higher than the minimum wage. The level of clinical deterioration was associated with a significantly higher cost for the disease.
De Vugt et al. (2006) [19]	27FTD, 47 AD	Netherlands	Quantitative non-randomised study	Compared to AD caregivers, FTD caregivers had higher mean distress scores as measured by the NPI and higher levels of caregiver burden. Patients with FTD had significantly higher levels of agitation, apathy, disinhibition and aberrant motor behaviour than patients with AD.
Diehl-Schmid et al. (2013) [20]	94 FTD	Germany	Quantitative descriptive study	47% of FTD caregivers had mild to severe depression. Changes in the patients' behaviour and the interpersonal relations between caregivers and patients are associated with caregiver depression. The young age of onset of disease and financial difficulties led to significant strain on caregivers. The most important needs and requests of the caregivers included information and psychosocial support through educated staff, financial support and the education of medical staff about the disease.
Galvin et al. (2017) [21]	506 bvFTD, 202 PPA, 70 FTD-MMD, 51 PSP/CBS, 127 unspecified	United States	Quantitative non-randomised study	Caregivers reported lost workdays due to patient health issues (25.6%) or caregiver health issues (21.6%). Caregivers and patients still working full-time reported a median loss of 7.0 days over the previous four weeks due to FTD-related matters. The overall household income declined after diagnosis. There were no differences in the extent of loss of household income across FTD subtypes, caregiver types or patient genders. The overall estimated costs of AD were 53% lower than the reported costs of FTD.
Gentry et al. (2022) [22]	312 FTD	United States	Quantitative non-randomised study	Poorer clinical status of FTD patients correlates with HRQoL and higher caregiver burden. The findings also suggest that even mild FTLD features may have a negative impact on HRQoL.
Guger et al. (2021) [23]	46 bvFTD, 9svPPA, 6 nfvPPA	Austria	Quantitative non-randomised study	A diagnostic delay of around 30 months is not unusual in bvFTD, likely due to language impairment leading to earlier diagnosis. Caregiver burden was higher in bvFTD than in svPPA and nfvPPA at baseline, remained stable in bvFTD and nfvPPA and progressed in svPPA during two years of follow-up. Caregiver burden correlated significantly with neuropsychiatric symptoms and behavioural abnormalities but not with cognitive performance. This is the most probable reason why CSI and ZBI sum scores were higher in bvFTD than in svPPA and nfvPPA patients.
Huang et al. (2021) [24]	16 FTD, 369 AD	Taiwan	Quantitative non-randomised study	The 18-month complete follow-up group showed significantly higher ZBI scores in subjects diagnosed with FTD than in those diagnosed with AD. Patients with more severe dementia, with neuropsychiatric symptoms, being cared for by more than two caregivers or utilising social resources were associated with higher ZBI scores; a depressive mood of a caregiver also predicted higher ZBI scores.
Kaiser and Panegyres (2006) [25]	42 FTD, 36AD, 6 PPA, 16 others	Australia	Quantitative non-randomised study	There was a significant correlation between FTLD and BDI; however, this correlation was not found for AD and BDI. Spouses caring for patients with FTD reported higher rates of mild or worse-than-mild depression compared with spouses caring for patients with AD (75% in FTD, 50% in AD). Wives (53.4%) also reported slightly more depression than husbands (46.6%). No correlation was found between younger age of the spouse and level of depression as indicated by the BDI score.
Kaizik et al. (2017) [26]	90 FTD, 43 spouse 47 child	Australia	Quantitative non-randomised study	The severity of dementia was a key factor for spouse-caregiver burden, whereas depressive symptoms had the greatest effects on caregiver burden for child caregivers. Overall, spouse and child caregivers of FTD patients had similar levels of caregiver burden. As a group, both spouse and child caregivers of severe FTD patients had scores indicative of significant depressive symptoms.
Koyama et al. (2018) [27]	20 bvFTD, 23 SD	Japan	Quantitative non-randomised study	ZBI scores were highest in bvFTD, comparatively high in SD-R and lowest in SD-L caregivers. Caregiver burden was significantly correlated with BPSD scores in all groups and with decline in activities of daily living and instrumental activities of daily living in the bvFTD and SD-R groups. The most troubling symptoms for caregivers included personality changes and lack of empathy.

(*continued on next page*)

Table 3 (*continued*)

Author (year)	Participants	Country	Study design	Key results
Küçükgüçlü et al. (2017) [28]	44 FTD, 90 AD	Turkey	Quantitative non-randomised study	The total NPI and FAQ scores correlated significantly, and the MMSE score did not show a significant correlation with the AD and FTD caregiver burden. FTD and AD caregiver burdens were similar, despite higher average behavioural scores of patients with FTD. Daily activity functions and patients' neuropsychiatric symptoms contributed the most to caregiver burden. Apathy was the most frequently reported symptom but did not show the strongest correlation with caregiver burden in FTD.
Lima-Silva et al. (2015) [29]	20 bvFTD, 30 AD	Brazil	Quantitative non-randomised study	The most frequently reported symptoms in bvFTD were apathy (85%), irritability (65%), disinhibition (60%) and agitation/aggression (55%). Among patients with AD, depression (67%) and anxiety (63%) were most frequently reported. Apathy generated the highest distress, followed by disinhibition, irritability and aggression. The study suggests that in bvFTD, carers' distress and burden were associated with the cognitive and functional impairments of patients, whereas in AD, burden was associated with patients' depression symptoms. Overall, caregiver distress was higher in caregivers of FTD than AD, but caregiver burden was similar between the two.
Liu et al. (2017) [30]	82 FTD, 22 DLB, 110 AD	China	Quantitative non-randomised study	FTD patients had higher NPI and ZBI scores than DLB and AD patients, whose scores were similar. The factors influencing caregiver burden for each group were as follows. FTD: total NPI scores, agitation and aberrant motor behaviour; bvFTD: total NPI scores; DLB: total NPI scores; AD: total NPI scores, onset age, apathy and ADL. Caregivers of bvFTD patients had the highest levels of burden, which were significantly higher than for caregivers of nfvPPA, svPPA, DLB and AD patients.
Liu et al. (2018) [31]	131 FTD, 36 DLB, 325 AD	China	Quantitative non-randomised study	The PHQ-9, GAD-7 and PSQi scores for caregivers of FTLD patients were significantly higher than those for caregivers of AD patients. The FTLD group had similar ZBI scores to the DLB group, and both were significantly higher than those of the AD group. GAD-7 scores, PHQ-9 scores, delusions and apathy were correlated with caregiver burden in the DLB and FTLD groups.
Massimo et al. (2013) [32]	2 FTD	United States	Quantitative non-randomised study	FTD caregivers may suffer from identity change and loss of role and feel isolated due to the behavioural changes in FTD patients. The feeling most often expressed by caregivers was anger, which was related to the patients' embarrassing behaviours coupled with their sustained disinterest and lack of usual emotional responses to meaningful events or to the caregivers' expressions of emotion.
Merrilees et al. (2013) [33]	13 bvFTD, 9 SD	United States	Quantitative non-randomised study	Compared to the SD group, night-time behaviours were reported more frequently by caregivers for the bvFTD and were strongly correlated with caregiver distress. A greater number of bvFTD caregivers than SD caregivers reported negative aspects of sleep quality, and they used sleep medications more frequently.
Mioshi et al. (2009) [34]	79 FTD, 29 AD	United Kingdom	Quantitative non-randomised study	Depression was a cardinal feature in FTD caregivers, accounting for >58% of stress scores. Both depression and stress were significantly higher than in AD. Neither the severity of behaviour changes nor functional disability explained caregiver stress. Caregiver stress and depression were similar for both the community and the nursing-home FTD patients.
Mourik et al. (2004) [35]	63 FTD	Netherlands	Quantitative non-randomised study	Caregivers of patients living at home were more distressed by the behavioural problems of the FTD patients than caregivers of hospitalised patients. Female home caregivers scored highest on the NPI distress total score. In nursing homes, NPI distress scores were lower than for home caregivers, and there was no difference between male and female nursing-home caregivers. Depression then delusions were rated as the most distressing by caregivers. Apathy was the most frequently cited symptom (95%), followed by aberrant motor behaviour at 78% and disinhibition at 52%.
O'Connor et al. (2022) [36]	28 FTD, 17 SD, 23 AD	Australia	Quantitative non-randomised study	Frequency, severity and stress for compulsive behaviours and apathy did not differ across bvFTD, AD and SD. FTD home caregivers experienced more emotional burden than FTD caregivers in nursing homes. Aggression, compulsive behaviour, disinhibition and apathy were reported by over 90% of family carers. Almost a third of carers reported having strategies for self-care, suggesting they were able to identify the importance of their own wellbeing to providing effective behaviour support.
Otero and Levenson (2017) [37]	43 FTD, 43 AD	United States	Quantitative non-randomised study	Lower levels of visual avoidance were associated with higher levels of psychological distress for caregivers. The use of visual avoidance may serve as a marker of overall emotional functioning in patients, and the preservation of this emotion-regulating behaviour may help reduce the negative effects of caregiving.
Oyebode et al. (2013) [38]	6 FTD	United Kingdom	Qualitative	Witnessing and managing bizarre or strange changes, changed appetites and drives, loss of planning ability, loss of inhibition leading to social embarrassment, or risky behaviour were identified as distinct challenges.
Rasmussen et al. (2019) [39]	14 FTD	Norway	Qualitative	The findings suggest that family caregivers experience the pre-diagnostic stage of FTD as changes in the interpersonal relationship with their loved one. It was experienced as a complex and demanding situation, characterised by shame, irritation, guilt, exhaustion and fear. The changes were often subtle and difficult for family caregivers to explain to others.
Riedijk et al. (2008) [40]	63 FTD	Netherlands	Quantitative non-randomised study	After two years, patients reached maximum dementia severity with stable NPI levels. The FTD home caregivers tended to experience more burden over

(*continued on next page*)

Table 3 (*continued*)

Author (year)	Participants	Country	Study design	Key results
				time, whereas the caregivers of patients who had moved to nursing homes or died showed declining burden. Their overall caregiver burden decreased, and psychological wellbeing remained stable. Relationship closeness and getting along were preserved, whereas communication and sharing viewpoints on life were dramatically reduced.
Riedijk et al. (2006) [41]	63 FTD, 90 AD	Netherlands	Quantitative non-randomised study	Caregivers of FTD patients institutionalised after shorter dementia duration were most burdened and affected in their HRQoL. FTD patients at home suffered significantly more from anxiety, irritability and disinhibition. Overall, FTD patients at home experienced neuropsychiatric symptoms more frequently than FTD patients in nursing homes. FTD caregivers also had more trouble finding support in the healthcare system since FTD is much less prevalent and known than AD. No differences were found between spousal and child caregivers of FTD patients.
Roche et al. (2015) [42]	94 FTD	Germany	Quantitative descriptive studies	High levels of caregiver strain did not predict depression but predicted reduced quality of life. Caregivers' experience of strain was exacerbated by their use of dysfunctional coping, care recipients' intense care needs and poor financial resources. Caregivers' use of dysfunctional coping as a response to their strain increased their levels of depression. In contrast, the use of problem-focused coping strategies increased caregivers' quality of life.
Rognstad et al. (2020) [43]	11 FTD	Norway	Qualitative	Changes in behaviour and personality, such as tactlessness and aggression, were perceived as incomprehensible, frightening and increasingly difficult to manage. Family caregivers experienced challenges in finding suitable care facilities when they could not continue providing home care. Family caregivers often felt emotions of embarrassment, shame, guilt, loss and loneliness.
Sato et al. (2021) [44]	28 bvFTD, 14 SD-R, 24 SD-L, 43 AD	Japan	Quantitative non-randomised study	NPI scores in bvFTD patients were higher than in SD-L and AD patients. There were no significant differences in the total NPI score or the NPI subscale scores for disinhibition and apathy between the bvFTD and SD-R groups, although the bvFTD group had significantly higher scores than the SD-L group. The ZBI score was significantly higher in the bvFTD group than in the SD-L and AD groups and significantly higher in the SD-R group than in the SD-L group. The SD-R group had comparable ZBI scores to the bvFTD group. The NPI total score was significantly associated with the ZBI score in the bvFTD group.
Silverman et al. (2022) [45]	558 FTD	United States	Quantitative descriptive studies	Behavioural features tend to be less burdensome at later stages of dementia, which may suggest that caregivers in earlier stages may not have a good understanding of the disease or support network in place. By the time patients reach moderate dementia, caregivers may be more adept at managing and be more emotionally adjusted. Apathy and disinhibition showed the strongest associations with burden at every stage of the disease. Psychosis was the strongest predictor of burden at every stage of the disease.
Thorsen et al. (2023) [46]	16 YOD	Norway	Qualitative	Wives endured more stress longer than husbands, with greater emotional effects and negative health consequences, and their needs were more easily neglected. Husbands presented their needs more efficiently and obtained public relief earlier. Women cared for their spouses at home longer than men did and with greater effects on their working careers and health.
Uflacker et al. (2016) [47]	33 bvFTD, 15 lvFTD, 21 YOAD, 7sCJD	United States	Quantitative non-randomised study	bvFTD and sCJD caregivers had the highest caregiver burden, with caregiver burden in bvFTD comparable to that in sCJD. Mean NPI-Q caregiver distress scores were higher for bvFTD and sCJD than for YOAD. Across diagnoses, no statistically significant difference was found between patients living at home and those with other living arrangements. Living arrangements also did not statistically affect ZBI scores across diagnoses. Apathy and disinhibition were the most frequently reported neuropsychiatric symptoms.
Wong and Wallhagen (2012) [48]	61 FTD	United States	Quantitative descriptive studies	Patient symptom severity was negatively associated with caregiver mental health but not significantly associated with caregiver physical health. The most frequently reported patient symptoms included apathy/indifference (84%), loss of insight (75%), appetite/eating problems (75%) and social inappropriateness (67%). Caregivers reported the greatest emotional distress from patient apathy/indifference and loss of insight.
Wong, C et al. (2012) [49]	22 bvFTD, 31AD	United States	Quantitative non-randomised study	bvFTD caregivers experienced greater strain, greater emotional distress and lower perceived control than AD caregivers. While the bvFTD caregivers also reported higher levels of depression, this result did not reach statistical significance.
Wong, S et al. (2012) [50]	114 (31 SD-L 16 SD-R, 30PNFA, 37LPA)	Australia	Quantitative non-randomised study	On the NPI, symptoms of apathy were present in 39% of left SD, 56% of right SD, 33% of PNFA and 43% of LPA patients. Multiple regression analysis revealed that 17.9% of the variance in carer burden was uniquely explained by scores on carer-rated measures of apathy, even after accounting for diagnosis, disease duration and cognitive and language impairment. Most carers did not have elevated levels of depression, anxiety and stress, apart from carers of SD-R patients, who had increased stress, which may be related to the higher frequency of personality and behavioural changes in these patients.

Abbreviations: AD, Alzheimer's disease; BDI, Beck Depression Index; BPSD, behavioural and psychological symptoms in dementia; bvFTD, behavioural variant frontotemporal dementia; CBI, Caregiver Burden Inventory; DLB, dementia with Lewy bodies; FAQ, functional activities questionnaire; FTD, frontotemporal dementia; FTD-MND, frontotemporal dementia with motor neuron disease; FTLD, frontotemporal lobe degeneration; GAD-7, generalised anxiety disorder scale; HRQoL, Health-

Related Quality of Life; IADL, instrumental activities of daily living; LPA, logopenic aphasia; lvFTD, language-variant frontotemporal dementia; MMSE, mini-mental state examination; nfvPPA, non-fluent variant primary progressive aphasia; NPI, Neuropsychiatric Inventory; PHQ-9, patient health questionnaire-9; PNFA, progressive non-fluent aphasia; PSP/CBS, progressive supranuclear palsy/corticobasal syndrome; PSQi, Pittsburgh sleep quality index; SD, semantic dementia; SD-L, left semantic dementia; SD-R, right semantic dementia; sCJD, sporadic Creutzfeldt-Jakob disease; VD, Vascular dementia; YOAD, young-onset Alzheimer's disease; YOD, young-onset dementia; ZBI, Zarit Burden Interview.

members. The ZBI has been validated in individuals with dementia and their caregivers in various clinical situations and cultures [52].

FTD is associated with a high level of caregiver burden, with ZBI scores ranging from 9.33 to 44 [16,21–23,26,27,30,31,45,47]. The large variance in ZBI score may be explained by the different populations studied in individual studies. These include differences in caregiver types and different degrees of impairment in the studied populations.

3.1.1. Caregiver types

Two studies [20,26] found no statistically significant difference between child and spouse caregivers of patients with mild to moderate FTD or severe FTD. However, despite having similar overall levels of caregiver burden, the two groups were most affected by different FTD patient symptoms. Depressive symptoms had the greatest effect on child caregivers compared to the severity of dementia for spouse caregivers [26].

In a two-year longitudinal study, at-home caregivers of FTD patients tended to experience more burden over time, whereas caregivers whose patients had moved to nursing homes or died showed declining burden levels. Their overall caregiver burden decreased, and their psychological wellbeing remained stable. Relationship closeness and getting along were preserved, whereas communication and sharing viewpoints on life were dramatically reduced [40].

Female caregivers were also likely to suffer a greater caregiver burden [20,26,35,46]. Wives endured more stress than husbands, with a greater emotional effect and negative health consequences, and their needs were more easily neglected. Husbands tended to present their needs more efficiently and obtained public relief earlier. Women cared for their spouses at home longer than men did, with a more significant impact on their careers and health.

3.1.2. Disease severity and caregiver burden

Generally, greater disease severity was associated with increased caregiver burden [22,26,42,45]. Two studies [26,45] showed that there was a significant increase in the ZBI scores of caregivers dealing with severe FTD compared to those for mild to moderate FTD (15.3–15.5 for mild to moderate FTD v. 23.3–27.0 for severe FTD) [26].

Two studies [22,45] categorised disease severity on a scale using clinical dementia rating plus National Alzheimer's Coordinating Center (NACC) frontotemporal lobar degeneration (CDR® plus NACC FTLD); this scale gives a score from 0 (no impairment) to 3 (severe impairment) [53]. The ranges of ZBI scores for the different disease severities were as follows: 9.33–22.59 for CDR® plus NACC FTLD = 0.5, 22.29–33.43 for CDR® plus NACC FTLD = 1 and 35.25–39.5 for CDR® plus NACC FTLD = 2.

Caregivers of severely symptomatic patients (CDR® plus NACC FTLD = 3) showed lower caregiver burden, with a lower ZBI score of 11.8 [22]. This may be due to caregivers of severely symptomatic patients seeking additional support or transferring patients to care facilities, reducing their caregiver burden. Another study found that the caregivers of FTD patients who had suffered from FTD for the shortest periods felt most heavily burdened by the caring process in general [41].

However, although one might expect symptoms to worsen with disease severity, causing more caregiver burden and distress, Silverman et al. (2022) [45] found that towards the later stages of FTD, caregivers tend to be less burdened by the behavioural features of FTD. The study suggests that when patients reach moderate dementia, caregivers may become more adept at managing and more emotionally adjusted.

3.1.3. Comparisons within subtypes

There were also differences in caregiver burden levels between the individual subtypes of FTD. Three studies found that caregivers' ZBI scores for patients with bvFTD were significantly higher than those for patients with svPPA or nfvPPA [23,30,45]. In a 24-month longitudinal cohort study of FTD patients and their caregivers, caregiver burden was higher in bvFTD than in svPPA and nfvPPA at baseline, remained stable in bvFTD and nfvPPA and progressed in svPPA during two years of follow-up [23].

3.1.4. Comparisons with other dementias

Compared to AD caregivers, FTD caregivers experienced a higher level of caregiver burden, stress and anxiety [16,19,28–31,44,47,49]. In Mioshi et al. (2009) [34], the percentage of FTD caregivers presenting with high stress was approximately triple that of AD caregivers (31.1% in FTD, 10.3% in AD) [34]. One study found that ZBI scores for FTD caregivers were similar to those of caregivers of patients with dementia with Lewy bodies (DLB) (ZBI = 23.62 in FTD, ZBI = 22.58 DLB), both of which were higher than that found in AD (ZBI = 12.26) [31].

3.2. Patient symptoms contributing to caregiver burden

The neuropsychiatric index (NPI) [54] is designed to assess ten behavioural disturbances in dementia patients. These ten disturbances are delusions, hallucinations, dysphoria, anxiety, agitation or aggression, euphoria, disinhibition, irritability or lability, apathy and aberrant motor activity. The NPI is valid for assessing caregiver burden across various psychiatric diseases, including AD [55]. Koyama et al. (2018) [27] found that NPI was correlated with a higher ZBI score, indicating that more behavioural disturbances are associated with greater caregiver burden. The studies generally used the NPI, NPI-Distress or NPI-Questionnaire to assess which domains were the most frequently reported and the most distressing to caregivers.

Several studies listed apathy and disinhibition among the most reported behaviours in FTD [16,28,35,47,48], with apathy seen in 77% to 95.2% of patients [19,20,35,48] and disinhibition in 52.4% to 67% [19,35]. Seven studies found apathy to be the most distressing to caregivers [16,19,29,30,45,48,50]. However, one study showed that apathy did not affect caregiver burden in a mixed methods survey and interview of 28 FTD caregivers; rather, disinhibition, aggression and compulsive behaviours were the most distressing behaviours [36].

Motor symptoms were seen in 77.8% to 81.5% of FTD patients and were also associated with high distress and caregiver burden [19,35,41]. Motor symptoms were reported much more frequently in FTD patients than in AD patients, with one study finding that 81.5% of FTD patients suffered from motor symptoms compared to only 34% of AD patients [19]. Eating and swallowing difficulties were also identified to be distressing to caregivers [16,20,48]. In one study [20], 89% of caregivers said they would find this symptom distressing and burdensome if present.

One study found that depression in patients had the highest mean NPI-D score (mean = 4.0, SD = 0.5), although it occurred infrequently and was observed in only 15.9% (10/63) of the studied population [35]. Depression may also be more common in AD patients than in FTD patients (51.1% in AD, 25.9% in FTD) [19].

One study compared NPI scores between bvFTD and SD and found that agitation, apathy and disinhibition were the most distressing to bvFTD caregivers, while SD-L caregivers were most distressed by depressive symptoms. SD-R caregivers were most distressed by agitation, apathy and irritability and were not distressed by depressive

symptoms [44].

Otero and Levenson (2017) [37] explored the use of a laboratory-based assessment of visual avoidance [56–58] in predicting levels of caregiver distress and found that lower levels of visual avoidance were associated with higher levels of psychological distress for caregivers. The findings suggest that visual avoidance may serve as a marker of overall emotional functioning in patients and that preserving this emotion-regulating behaviour may help reduce the negative effects of caregiving.

Overall, apathy, disinhibition, motor symptoms or aberrant motor activity, and appetite or eating changes were commonly listed as the most frequent and distressing symptoms. These symptoms are less common in other forms of dementia but are often characteristic of FTD, leading to high caregiver stress and burden levels in FTD.

3.3. Caregiver depression

The studies generally found that caregivers of patients with FTD had high levels of depression [25,31,35]. However, there were varying data showing differences in the prevalence of depression in FTD caregivers compared to AD caregivers. One study found that the prevalence of depression among FTD caregivers was almost twice that in AD caregivers (57.8% v. 24.1%), even after controlling for caregiver age and length of symptoms [35]. Whereas another study showed no statistically significant difference in depression prevalence between caregivers of FTD patients and AD patients [49].

When caregiver depression was measured using Beck's Depression Inventory 2 (BDI-II), caregivers had a mean BDI-II score of 15.37, indicating that, on average, FTD caregivers had mild depression [20]. The study also showed that of the 94 participants, 25% had no depression (BDI-II = 0–8), 27% had minimal depression (BDI-II = 9–12), 21% had mild depression (BDI-II = 13–19), 19% had moderate depression (BDI-II = 20–28), and 7% had severe depression (BDI-II > 29).

Disease severity was found to have a significant effect on caregiver depression [24,26,31,48]. Kaizik et al. (2017) [26] found that for mild to moderate FTD, on average, there was no depression, anxiety or stress. For severe to profound FTD, caregivers had scores indicative of significant clinical depressive symptoms.

In Roche et al. (2015) [42], high levels of caregiver strain did not predict depression but did predict reduced quality of life. Caregivers' experience of strain was exacerbated by dysfunctional coping methods, care recipients with intense needs and poor financial resources. Caregivers' use of dysfunctional coping methods as a response to their strain increased their levels of depression. In contrast, using problem-focused coping strategies increased caregivers' quality of life.

3.4. Sleep

The behavioural disturbances and night-time disruptions present in FTD are also associated with poorer sleep quality in caregivers [33]. The Pittsburgh Sleep Quality Index (PSQI) [59] is a self-rated questionnaire that assesses sleep quality and disturbances over one month. Subjective sleep quality, latency, duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction are assessed. A global score of 0–21 is possible, with higher scores indicating poorer sleep quality.

In a study of 13 bvFTD and 9 semantic dementia caregivers [33], the average PSQI global score was 7.8 (SD = 4.2) for the bvFTD caregivers and 4.9 (SD = 2.5) for the semantic dementia caregivers, indicating poor sleep quality for the bvFTD caregivers and adequate sleep quality for the SD caregivers, on average. In addition, 92% of the bvFTD caregivers reported that they had experienced daytime dysfunction during the preceding month. Female caregivers, on average, had poorer sleep than male caregivers. Of the female bvFTD caregivers, 54% reported taking medicine for sleep, with 41% of these using sleep medication more than three times a week.

Further, the caregivers of patients with bvFTD reported poorer sleep quality than the SD caregivers. More bvFTD caregivers than SD caregivers reported negative aspects of sleep quality for themselves, and they used sleep medications more frequently [33]. Another study found that compared with AD caregivers, FTD caregivers had poorer quality sleep, with a significantly higher PSQI score (4.36 ± 3.73 in FTD v. 1.01 ± 1.44 in AD, $p = 0.000$) [31].

3.5. Other psychological impacts

Other psychological impacts of caring for FTD patients are less explored. In a semi-structured interview of 11 FTD family caregivers, Rognstad et al. (2020) [43] found that family caregivers felt embarrassed and ashamed, especially regarding their loved ones' behavioural disturbances [43]. Caregivers also felt significant stress and guilt when juggling looking after their family members with other household responsibilities and paid work. The aggression and tactlessness that occur as part of behavioural changes in FTD also scared some of the family members, and they found them very challenging to manage. Female family members mentioned feeling alone, as they often assumed more of the caring burden than their male relatives. Caregivers may also feel angry in response to patients' behaviours. Patients' emotional unresponsiveness is often perceived as inconsiderate or uncaring and angers the caregivers [32].

3.6. Costs and social impacts

A diagnosis of FTD imposes significant costs and social impacts on families and caregivers [18,20,21]. Costs can be direct costs, such as the costs of medical care, residential care, professional caregivers, respite care, or medical equipment and supplies, or indirect costs, such as family and friends' time doing unpaid home care or patients' or caregivers' lost wages.

FTD patients were generally younger than AD patients and more likely to still be in the workforce, leading to higher levels of lost wages among these patients and their family caregivers. Of the FTD caregivers, 25.6% reported lost workdays due to patient health issues, and 21.6% reported them due to caregiver health issues. One study reported that approximately 25% of caregivers and patients had lost >11 work days while seeking a diagnosis [15]. Overall household income also tended to decrease after a diagnosis of FTD [21]. One study [21] estimated that for FTD, the total direct and indirect costs were $119,654, compared to $64,168 for AD.

There were conflicting results on the proportion of direct and indirect costs in FTD. Custodio et al. (2018) [18] found that almost 90% of total expenditures were direct medical costs, while Galvin et al. (2017) [21] found that only 40% of total expenditures were direct medical costs. The differences may be due to variations in the estimation of indirect costs, as estimated wages were different for the two populations.

Men with FTD had higher indirect costs as they used more unpaid care and were more likely to have worked previously. Women had higher direct costs as they were more likely to move to nursing homes or other care facilities [21]. A higher level of clinical deterioration, as evaluated with the CDR scale, was associated with a significantly higher cost, indicating greater use of both healthcare and non-healthcare resources as FTD progresses [18].

3.6.1. Needs and other social impacts

In a study of 94 FTD caregivers, 50% of participants said their relationship with the patient worsened. However, 30% said the relationship was unchanged, and 20% reported an improved relationship. A worsened relationship was associated with a higher BDI-II score [20].

Information, education, and psychosocial support from staff knowledgeable in FTD and financial support were found to be the most helpful resources for FTD caregivers. However, these resources were often underutilised. Many caregivers could not attend intervention groups or

meetings because they could not leave their patients for a few hours or had paid work or other obligations. Online resources and support groups may benefit such caregivers [20].

3.7. Qualitative experiences

Several studies [15,17,32,38,39,43,46] sought to describe and assess the unique experiences and challenges that FTD caregivers and family members faced.

3.7.1. Pre-diagnostic experiences

Rasmussen et al. (2019) [39] explored the pre-diagnostic experiences of patients with FTD and their family caregivers via a qualitative semi-structured interview. Increasing silence and apathy were common presenting symptoms, and they caused family members and loved ones to feel distant from the patients.

Family members had difficulty in identifying and recognising that the early stages of FTD were due to dementia [17,39]. In retrospect, many family members realised they had been in denial during the initial stages of FTD. Often, they avoided thinking about the symptoms or talking about them with the patients. Many then struggled with feelings of guilt from not acting on the symptoms and seeking help earlier [39].

Family members also struggled to obtain help for the patients. Some felt too ashamed about the behavioural symptoms to seek help or found it difficult to explain the symptoms to doctors and others [39]. Adding to the challenges, the patients often refused to receive assistance from health services, and some even purposefully avoided home visits from health services by leaving the house.

Family members were often worried about the patients as the latter engaged in dangerous activities such as gambling, driving or cooking [38,39]. Family members also struggled to manage once the patients could no longer care for themselves. When the behavioural and personality changes became more severe, they felt as if they were living with a stranger and found it difficult to hold meaningful conversations with the patients; they felt they had to take on a different role in the relationship [32,38,39].

3.7.2. Diagnostic challenges

Patients and caregivers often face high levels of frustration and burden due to the time and resources required to receive an accurate FTD diagnosis [15,17]. Only 12% of patients were diagnosed with FTD by the first doctor they visited, and 44% received their diagnosis more than one year after their initial symptoms. Early FTD was frequently misdiagnosed as depression in all FTD phenotypes except progressive supranuclear palsy and corticobasal degeneration (PSP/CBS). Initial incorrect diagnoses of depression were made in 20% of bvFTD cases, 13% of PPA cases and 15% of FTD with motor neuron disease (FTD-MND) cases. AD was also a misdiagnosis in 8% of bvFTD, 12% of PPA, 2% of FTD-MND and 6% of PSP/CBS cases.

Despite feelings of shame and embarrassment, caregivers described feeling a sense of relief upon receiving the diagnosis of FTD [43]. They felt they could now understand the patients' behaviour better, and they found it easier to explain the disturbances to other family members and close friends, reducing the shame and stress experienced.

3.7.3. Care facilities

Caregivers can have significant difficulty finding suitable care facilities to meet the needs of patients with pronounced behavioural disturbances [43]. Also, facility staff may lack the experience and knowledge to manage the aggressive behaviours in FTD. Family caregivers also felt sorrow and guilt at seeing their family members in the care facilities or hearing their complaints about being unhappy and upset. Some said their family members were lonely and isolated in care facilities and that the entertainment and activities were often unsuitable for them [38,43].

4. Discussion

As with other forms of young-onset dementia, FTD caregivers often encounter professional and financial problems, psychosocial problems and problems obtaining a diagnosis [60,61]. This study highlighted several articles that found that the psychosocial and social impacts of FTD were different and unique compared to those of AD and other young-onset dementias. The behavioural symptoms and changes (e.g., agitation or aggression, apathy, aberrant motor behaviour and disinhibition) were the most distressing symptoms for FTD caregivers. This finding correlates with those of other studies [62,63] that found those behavioural symptoms and changes to be significantly associated with AD caregivers' burden levels and depressive symptoms. These are more common symptoms in FTD, which may help explain why FTD caregivers often have high levels of caregiver burden, distress, and depressive symptoms.

There are fewer studies on PPA and semantic dementia caregivers than on bvFTD caregivers. This may be because bvFTD is the most common clinical subtype of FTD, accounting for more than half of all FTD diagnoses [64]. Studies that did stratify participants based on clinical subtypes mostly found that caregiver burden was higher in bvFTD; however, this remains an area that could be further explored.

In caring for dementia patients, psychosocial support and information about dementia and dementia care are common and important needs of caregivers [65]. This study revealed that FTD caregivers may face more challenges in obtaining such support and information than other dementia patients due to the lower prevalence of FTD in the population and the lack of knowledge about it. Another study found that family carers of FTD patients were less satisfied than carers of early-onset AD patients with the information they had received about the disease and significantly less satisfied with the counselling and follow-up interviews [66]. FTD was also misdiagnosed as AD and depression in some cases, suggesting that physicians may be less familiar with the presentation of FTD and less confident about diagnosing it. Up to two-thirds of all dementia cases and 90% of early-stage dementia cases are missed in the primary care setting [67,68]. Due to the unique diagnostic challenges of FTD, it often goes undiagnosed or misdiagnosed, causing further harm to patients and caregivers. Therefore, more emphasis should be placed on educating the healthcare professionals who may be the first point of contact for these patients, both primary care physicians and specialists, about the characteristics of FTD and how it may present so that early referrals to the appropriate specialists can be provided.

The cost of caring for a patient with FTD was found to be higher than for AD. This may be due to FTD patients being diagnosed earlier; one study found that the mean age of symptom onset was between 49.5 and 58.2 years depending on the type of genetic mutation [69]. As such, FTD patients are more likely to be working and may not have built up enough financial resources at the time of diagnosis. Indirect costs often come in the form of missed workdays for patients and caregivers when seeking treatment or diagnosis or when patients ultimately become unable to work due to the severity of their disease.

However, it may be hard to compare the true cost of FTD over the natural history of the disease to that of AD because the prognoses of the two diseases are different. Although FTD may incur a higher cost than AD at similar disease stages, FTD patients have a shorter prognosis (median survival from retrospectively determined symptom onset, 8.7 $\pm$ 1.2 years v. 11.8 $\pm$ 0.6 years, $p < 0.0001$; median survival from initial clinic presentation, 3.0 $\pm$ 0.5 v. 5.7 $\pm$ 0.1 years, $p < 0.0001$) [70]. This may mean that the costs are ultimately similar after accounting for the longer duration of caring for someone with AD. However, the SD subtypes were found to have prognoses similar to AD, both lasting much longer than FTD. More longitudinal research could be done to explore the total long-term costs of FTD subtypes and other dementias to accurately assess the costs associated with the diseases.

4.1. Limitations and strengths

The studies included in this systematic review defined caregiver burden in different ways. Caregiver 'distress' or 'strain' were examples of the outcomes measured in some studies; these may be different to caregiver 'burden' as measured using the ZBI scale. Studies that obtained quantitative measures of caregiver burden, strain or distress also used different metrics, most commonly ZBI, CSI or NPI, making comparisons between studies less accurate. A meta-analysis could also not be performed due to the heterogenicity of the included studies. Furthermore, only English-language studies were included in this review, which might not include many studies that may provide culturally specific insights into the condition and associated caregiver burden.

Despite its limitations, one strength of this review was that it examined both qualitative and quantitative studies on the psychological and social impacts of FTD on caregivers and family members. The qualitative studies helped bring to light the unique challenges and experiences faced by caregivers of patients with FTD; these are often left out when structured surveys or questionnaires are conducted. This review highlights insights into caregivers' emotional journeys and may be used to craft future interventions to help address caregiver burden in FTD. Multiple studies of different methodologies, study designs, sample sizes, and geographic populations included in this study also helped to give a broader understanding of this topic, as many ways of measuring caregiver burden were explored. To our knowledge, this systematic review is the first to focus on the psychological and social impacts of FTD on caregivers.

5. Conclusion

The results of this study highlight the substantial psychological and social impacts faced by family members and caregivers of FTD patients and demonstrate that behavioural symptoms more commonly seen in FTD, especially apathy and disinhibition, are significantly associated with caregiver burden and distress. Patients and family members often face considerable difficulty in all stages of the disease, from diagnosis to the late stages. FTD education for family members and healthcare professionals is urgently required to improve the quality of life for both patients and caregivers, and more support needs to be provided at all stages of the disease as families struggle to cope with this debilitating illness.

Annex

Funding

This research received no specific grant from funding agencies in the public, commercial or not-for-profit sectors.

CRediT authorship contribution statement

Ying Li Tan: Conceptualization, Data curation, Formal analysis, Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing. **Jeffrey Lo Yee Kai:** Data curation, Investigation, Methodology, Writing – review & editing. **Cyrus Su Hui Ho:** Conceptualization, Methodology, Supervision, Writing – original draft, Writing – review & editing.

Acknowledgements

Nil.

DATABASE	PubMed (MEDLINE)
DATE	23/03/2023
STRATEGY	#1 AND #2 AND #3
#1	"frontotemporal dementia"[MeSH Terms] OR ("frontotemporal"[All Fields] AND "dementia"[All Fields]) OR "frontotemporal dementia"[All Fields] OR ("aphasia, primary progressive"[MeSH Terms] OR ("aphasia"[All Fields] AND "primary"[All Fields] AND "progressive"[All Fields]) OR "primary progressive aphasia"[All Fields] OR ("primary"[All Fields] AND "progressive"[All Fields] AND "aphasia"[All Fields])) OR ("frontotemporal lobar degeneration"[MeSH Terms] OR ("frontotemporal"[All Fields] AND "lobar"[All Fields] AND "degeneration"[All Fields]) OR "frontotemporal lobar degeneration"[All Fields] OR "ftld"[All Fields]) OR ("pick disease of the brain"[MeSH Terms] OR ("pick"[All Fields] AND "disease"[All Fields] AND "brain"[All Fields]) OR "pick disease of the brain"[All Fields] OR ("pick"[All Fields] AND "disease"[All Fields]) OR "pick disease"[All Fields])
#2	"familialities"[All Fields] OR "familiality"[All Fields] OR "familially"[All Fields] OR "familials"[All Fields] OR "familie"[All Fields] OR "family"[MeSH Terms] OR "family"[All Fields] OR "familial"[All Fields] OR "families"[All Fields] OR "family s"[All Fields] OR "familys"[All Fields] OR ("family"[MeSH Terms] OR "family"[All Fields] OR ("family"[All Fields] AND "members"[All Fields]) OR "family members"[All Fields]) OR ("spouse s"[All Fields] OR "spouses"[MeSH Terms] OR "spouses"[All Fields] OR "spouse"[All Fields]) OR ("child"[MeSH Terms] OR "child"[All Fields] OR "children"[All Fields] OR "child s"[All Fields] OR "children s"[All Fields] OR "childrens"[All Fields] OR "childs"[All Fields]) OR ("caregiver s"[All Fields] OR "caregivers"[MeSH Terms] OR "caregivers"[All Fields] OR "caregiver"[All Fields] OR "caregiving"[All Fields]) OR ("caregiver s"[All Fields] OR "caregivers"[MeSH Terms] OR "caregivers"[All Fields] OR "caregiver"[All Fields] OR "caregiving"[All Fields])
#3	"stress"[All Fields] OR "stressed"[All Fields] OR "stresses"[All Fields] OR "stressful"[All Fields] OR "stressfulness"[All Fields] OR "stressing"[All Fields] OR ("burden"[All Fields] OR "burdened"[All Fields] OR "burdening"[All Fields] OR "burdens"[All Fields]) OR ("caregiver burden"[MeSH Terms] OR ("caregiver"[All Fields] AND "burden"[All Fields]) OR "caregiver burden"[All Fields]) OR (("psychologic"[All Fields] OR "psychological"[All Fields] OR "psychologically"[All Fields] OR "psychologization"[All Fields] OR "psychologized"[All Fields] OR "psychologizing"[All Fields]) AND ("effect"[All Fields] OR "effecting"[All Fields] OR "effective"[All Fields] OR "effectively"[All Fields] OR "effectiveness"[All Fields] OR "effectivenesses"[All Fields] OR "effectives"[All Fields] OR "effectivities"[All Fields] OR "effectivity"[All Fields] OR "effects"[All Fields])) OR ("social change"[MeSH Terms] OR ("social"[All Fields] AND "change"[All Fields]) OR "social change"[All Fields] OR ("social"[All Fields] AND "impacts"[All Fields]) OR "social impacts"[All Fields])
Filters	English

Fig. 2. Search strategy for PubMed (MEDLINE).

DATABASE	Cochrane Library	
DATE	23/03/2023	
STRATEGY	#4 OR #7	
	ID	Search
	#1	MeSH descriptor: [Frontotemporal Dementia] explode all trees
	#2	MeSH descriptor: [Aphasia, Primary Progressive] explode all trees
	#3	(caregiver OR burden OR family OR distress OR psychological)
	#4	(#1 OR #2) AND #3
	#5	Frontotemporal dementia
	#6	Primary progressive aphasia
	#7	(#5 OR #6) AND #3
	#8	#4 OR #7
Filters	English, Trials	

Fig. 3. Search strategy for Cochrane library.

DATABASE	Embase
DATE	23/03/2023
STRATEGY	#1 AND #2 AND #3 AND [english]/lim
#1	'frontotemporal dementia'/exp OR 'primary progressive aphasia'/exp OR (frontotemporal AND dementia) OR (primary AND progressive AND aphasia)
#2	'family'/exp OR 'caregiver'/exp OR family OR caregiver
#3	'social impact'/exp OR 'burden'/exp OR stress OR psychological OR distress
#4	#1 AND #2 AND #3 AND [english]/lim
Filters	English

Fig. 4. Search strategy for Embase.

Table 4
Mixed Methods Appraisal Tool (MMAT) assessment of qualitative studies.

Author (year)	S1. Are there clear research questions?	S2. Do the collected data allow to address the research questions?	1.1. Is the qualitative approach appropriate to answer the research question?	1.2. Are the qualitative data collection methods adequate to address the research question?	1.3. Are the findings adequately derived from the data?	1.4. Is the interpretation of results sufficiently substantiated by data?	1.5. Is there coherence between qualitative data sources, collection, analysis, and interpretation?
Massimo et al. (2013) [32]	Y	Y	Y	Y	Y	Y	Y
Oyebode et al. (2013) [38]	Y	Y	Y	Y	Y	Y	Y
Rognstad et al. (2020) [43]	Y	Y	Y	Y	Y	Y	Y
Rasmussen et al. (2019) [39]	Y	Y	Y	Y	Y	Y	Y

(*continued on next page*)

Table 4 (*continued*)

Author (year)	S1. Are there clear research questions?	S2. Do the collected data allow to address the research questions?	1.1. Is the qualitative approach appropriate to answer the research question?	1.2. Are the qualitative data collection methods adequate to address the research question?	1.3. Are the findings adequately derived from the data?	1.4. Is the interpretation of results sufficiently substantiated by data?	1.5. Is there coherence between qualitative data sources, collection, analysis, and interpretation?
Thorsen et al. (2023) [46]	Y	Y	Y	Y	Y	Y	Y
O'Connor et al. (2022) [36]	Y	Y	Y	Y	Y	Y	Y

Abbreviations: Y, Yes; N, No.

Table 5
Mixed Methods Appraisal Tool (MMAT) assessment of quantitative non-randomised studies.

Author (year)	S1. Are there clear research questions?	S2. Do the collected data allow to address the research questions?	3.1. Are the participants representative of the target population?	3.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)?	3.3. Are there complete outcome data?	3.4. Are the confounders accounted for in the design and analysis?	3.5 During the study period, is the intervention administered (or exposure occurred) as intended?	Notes
Boutoleau-Bretonnière et al. (2008) [16]	Y	Y	Y	Y	Y	Y	Y	
Custodio N et al. (2015) [18]	Y	Y	Y	Y	Y	Y	Y	
De Vugt et al. (2006) [19]	Y	Y	Y	Y	Y	Y	Y	
Galvin JE et al. (2017) [21]	Y	Y	**N**	Y	Y	Y	Y	Participants recruited via announcements on the association for Frontotemporal Degeneration website, newsletter, social media, and email blasts. May not include patients or caregivers who do not subscribe to the website.
Gentry MT et al. (2022) [22]	Y	Y	Y	Y	Y	Y	Y	
Guger M et al. (2021) [23]	Y	Y	Y	Y	Y	Y	Y	
Huang WC et al. (2021) [24]	Y	Y	**N**	Y	Y	Y	Y	Stopped following up if the patients did not visit the dementia clinic for >6 months, refused the assessment, became **nursing home residents**, or expired. Patients who transitioned to NH were not followed up.
Kaiser and Panegyres (2006) [25]	Y	Y	Y	Y	Y	Y	Y	
Kaizik C et al. (2017) [26]	Y	Y	Y	Y	Y	Y	Y	
Koyama A et al. (2018) [27]	Y	Y	Y	Y	Y	Y	Y	
Küçükgüçlü Ö et al. (2017) [28]	Y	Y	Y	Y	Y	Y	Y	
Lima-Silva et al. (2015) [29]	Y	Y	**N**	Y	Y	Y	Y	Inclusion criteria may exclude younger FTD patients, and those with motor symptoms which can be common in FTD.
Liu, S. et al. (2017) [30]	Y	Y	**N**	Y	Y	Y	Y	Patients who had too few visits to obtain

(*continued on next page*)

Table 5 (*continued*)

Author (year)	S1. Are there clear research questions?	S2. Do the collected data allow to address the research questions?	3.1. Are the participants representative of the target population?	3.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)?	3.3. Are there complete outcome data?	3.4. Are the confounders accounted for in the design and analysis?	3.5 During the study period, is the intervention administered (or exposure occurred) as intended?	Notes
								adequate information were excluded. May not pick up mild cases who require fewer follow-up visits in early stages.
Liu, S. et al. (2018) [31]	Y	Y	Y	Y	Y	Y	Y	
Merrilees et al. (2013) [33]	Y	Y	Y	Y	Y	Y	Y	
Mioshi et al. (2009) [34]	Y	Y	Y	Y	Y	Y	Y	
Mourik et al. (2004) [35]	Y	Y	Y	Y	Y	Y	Y	
O'Connor et al. (2022) [36]	Y	Y	Y	Y	Y	Y	Y	
Otero and Levenson (2017) [37]	Y	Y	Y	Y	Y	Y	Y	
Riedijk et al. (2008) [40]	Y	Y	Y	Y	Y	Y	Y	
Riedijk et al. (2006) [41]	Y	Y	Y	Y	Y	Y	Y	
Sato et al. (2021) [44]	Y	Y	Y	Y	Y	Y	Y	
Uflacker et al. (2016) [47]	Y	Y	Y	Y	Y	Y	Y	
Wong, C et al. (2012) [49]	Y	Y	Y	Y	Y	Y	Y	
Wong, S et al. (2012) [50]	Y	Y	Y	Y	Y	Y	Y	

Abbreviations: Y, Yes; N, No.

Table 6
Mixed Methods Appraisal Tool (MMAT) assessment of quantitative descriptive studies.

Author (year)	S1. Are there clear research questions?	S2. Do the collected data allow to address the research questions?	4.1. Is the sampling strategy relevant to address the research question?	4.2. Is the sample representative of the target population?	4.3. Are the measurements appropriate?	4.4. Is the risk of nonresponse bias low?	4.5. Is the statistical analysis appropriate to answer the research question?	Notes
Besser and Galvin (2020) [15]	Y	Y	Y	Y	Y	Y	Y	
Chow et al. (2011) [17]	Y	Y	Y	Y	Y	Y	Y	
Diehl-Schmid J et al. (2013) [20]	Y	Y	Y	**N**	Y	Y	Y	Participants were recruited from a FTD caregiver support group. Does not include caregivers who are not part of or have no access to the support group.
Roche et al. (2015) [42]	Y	Y	Y	Y	Y	Y	Y	
Silverman et al. (2022) [45]	Y	Y	Y	Y	Y	Y	Y	
Wong and Wallhagen	Y	Y	Y	Y	Y	Y	Y	

(*continued on next page*)

Table 6 (*continued*)

Author (year)	S1. Are there clear research questions?	S2. Do the collected data allow to address the research questions?	4.1. Is the sampling strategy relevant to address the research question?	4.2. Is the sample representative of the target population?	4.3. Are the measurements appropriate?	4.4. Is the risk of nonresponse bias low?	4.5. Is the statistical analysis appropriate to answer the research question?	Notes
(2012) [48]								

Abbreviations: Y, Yes; N, No.

Table 7
PRISMA 2020 checklist.

Section and topic	Item #	Checklist item	Location where item is reported
Title			
Title	1	Identify the report as a systematic review.	1.
Abstract			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Abstract
Introduction			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	1.1
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	1.2
Methods			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	2.3
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	2.1
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Figs. 2, 3 and 4
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	2.3
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	2.3, 2.4
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	2.3
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	2.3
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	2.5
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	N.A
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	2.4
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	2.4
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	2.4
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	N.A
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N.A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N.A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	N.A
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	N.A
Results			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	3.
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	N.A
Study characteristics	17	Cite each included study and present its characteristics.	Table 1.
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Tables 2, 3 and 4
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Table 1.
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	N.A

(*continued on next page*)

Table 7 (*continued*)

Section and topic	Item #	Checklist item	Location where item is reported
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N.A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N.A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N.A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N.A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N.A
Discussion			
	23a	Provide a general interpretation of the results in the context of other evidence.	4.
Discussion	23b	Discuss any limitations of the evidence included in the review.	4.1
	23c	Discuss any limitations of the review processes used.	4.1
	23d	Discuss implications of the results for practice, policy, and future research.	5.
Other information			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	N.A
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	N.A
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N.A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	6.1, 6.2
Competing interests	26	Declare any competing interests of review authors.	N.A
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	N.A

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: https://doi.org/10.1136/bmj.n71.
Abbreviations: N.A, Not applicable.
For more information, visit: http://www.prisma-statement.org/.

References

[1] Mackenzie IRA, et al. Nomenclature for neuropathologic subtypes of frontotemporal lobar degeneration: consensus recommendations. Acta Neuropathol (Berl) 2009;117:15–8.
[2] Mendez MF, Selwood A, Mastri AR, Frey WH. Pick's disease versus Alzheimer's disease: a comparison of clinical characteristics. Neurology 1993;43:289.
[3] Warren JD, Rohrer JD, Rossor MN. Frontotemporal dementia. BMJ 2013;347:f4827.
[4] Coyle-Gilchrist ITS, et al. Prevalence, characteristics, and survival of frontotemporal lobar degeneration syndromes. Neurology 2016;86:1736–43.
[5] Knopman DS, Roberts RO. Estimating the number of persons with frontotemporal lobar degeneration in the US population. J Mol Neurosci 2011;45:330–5.
[6] Rascovsky K, et al. Sensitivity of revised diagnostic criteria for the behavioural variant of frontotemporal dementia. Brain 2011;134:2456–77.
[7] Mesulam M-M. Primary progressive aphasia. Ann Neurol 2001;49:425–32.
[8] Gorno-Tempini ML, et al. Classification of primary progressive aphasia and its variants. Neurology 2011;76:1006–14.
[9] Terum TM, et al. The relationship of specific items on the neuropsychiatric inventory to caregiver burden in dementia: a systematic review: neuropsychiatric disturbances in dementia and caregiver burden. Int J Geriatr Psychiatry 2017;32:703–17.
[10] Van Den Kieboom R, Snaphaan L, Mark R, Bongers I. The trajectory of caregiver burden and risk factors in dementia progression: a systematic review. J Alzheimers Dis 2020;77:1107–15.
[11] Page MJ, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;n71. https://doi.org/10.1136/bmj.n71.
[12] Cooke A, Smith D, Booth A. Beyond PICO: the SPIDER tool for qualitative evidence synthesis. Qual Health Res 2012;22:1435–43.
[13] Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. Syst Rev 2016;5:210.
[14] Pace R, et al. Testing the reliability and efficiency of the pilot mixed methods appraisal tool (MMAT) for systematic mixed studies review. Int J Nurs Stud 2012;49:47–53.
[15] Besser LM, Galvin JE. Diagnostic experience reported by caregivers of patients with frontotemporal degeneration. Neurol Clin Pract 2020;10:298–306.
[16] Boutoleau-Bretonnière C, Vercelletto M, Volteau C, Renou P, Lamy E. Zarit burden inventory and activities of daily living in the behavioral variant of frontotemporal dementia. Dement Geriatr Cogn Disord 2008;25:272–7.
[17] Chow TW, Pio FJ, Rockwood K. An international needs assessment of caregivers for frontotemporal dementia. Can J Neurol Sci 2011;38:753–7.
[18] Custodio N, et al. Cost-of-illness study in a retrospective cohort of patients with dementia in Lima, Peru. Dement Neuropsychol 2015;9:32–41.
[19] De Vugt ME, et al. Impact of behavioural problems on spousal caregivers: a comparison between Alzheimer's disease and frontotemporal dementia. Dement Geriatr Cogn Disord 2006;22:35–41.
[20] Diehl-Schmid J, et al. Caregiver burden and needs in frontotemporal dementia. J Geriatr Psychiatry Neurol 2013;26:221–9.
[21] Galvin JE, Howard DH, Denny SS, Dickinson S, Tatton N. The social and economic burden of frontotemporal degeneration. Neurology 2017;89:2049–56.
[22] Gentry MT, et al. Quality of life and caregiver burden in familial frontotemporal lobar degeneration: analyses of symptomatic and asymptomatic individuals within the LEFFTDS cohort. Alzheimers Dement J Alzheimers Assoc 2020;16:1115–24.
[23] Guger M, et al. Caregiver burden in patients with behavioural variant frontotemporal dementia and non-fluent variant and semantic variant primary progressive aphasia. J Neural Transm Vienna Austria 2021;1996(128):1623–34.
[24] Huang WC, Chang MC, Wang WF, Jhang KM. A comparison of caregiver burden for different types of dementia: an 18-month retrospective cohort study. Front Psychol 2021;12:798315.
[25] Kaiser S, Panegyres PK. The psychosocial impact of young onset dementia on spouses. Am J Alzheimers Dis Other Demen 2006;21:398–402.
[26] Kaizik C, et al. Factors underpinning caregiver burden in frontotemporal dementia differ in spouses and their children. J Alzheimers Dis JAD 2017;56:1109–17.
[27] Koyama A, et al. Caregiver burden in semantic dementia with right- and left-sided predominant cerebral atrophy and in behavioral-variant frontotemporal dementia. Dement Geriatr Cogn Disord Extra 2018;8:128–37.
[28] Küçükgüçlü Ö, Söylemez BA, Yener G, Barutcu CD, Akyol MA. Examining factors affecting caregiver burden: a comparison of frontotemporal dementia and Alzheimer's disease. Am J Alzheimers Dis Other Demen 2017;32:200–6.
[29] Lima-Silva TB, et al. Neuropsychiatric symptoms, caregiver burden and distress in behavioral-variant frontotemporal dementia and Alzheimer's disease. Dement Geriatr Cogn Disord 2015;40:268–75.
[30] Liu S, et al. The effects of behavioral and psychological symptoms on caregiver burden in frontotemporal dementia, Lewy body dementia, and Alzheimer's disease: clinical experience in China. Aging Ment Health 2017;21:651–7.
[31] Liu S, et al. Caregiver burden, sleep quality, depression, and anxiety in dementia caregivers: a comparison of frontotemporal lobar degeneration, dementia with Lewy bodies, and Alzheimer's disease. Int Psychogeriatr 2018;30:1131–8.
[32] Massimo L, Evans LK, Benner P. Caring for loved ones with frontotemporal degeneration: the lived experiences of spouses. Geriatr Nurs 2013;34:302–6.
[33] Merrilees J, Hubbard E, Mastick J, Miller BL, Dowling GA. Sleep in persons with frontotemporal dementia and their family caregivers. Nurs Res 2014;63:129–36.
[34] Mioshi E, Bristow M, Cook R, Hodges JR. Factors underlying caregiver stress in frontotemporal dementia and Alzheimer's disease. Dement Geriatr Cogn Disord 2009;27:76–81.
[35] Mourik JC, et al. Frontotemporal dementia: behavioral symptoms and caregiver distress. Dement Geriatr Cogn Disord 2004;18:299–306.

[36] O'Connor CMC, Fisher A, Cheung SC, Caga J, Piguet O. Supporting behaviour change in younger-onset dementia: mapping the needs of family carers in the community. Aging Ment Health 2022;26:2252–61.
[37] Otero MC, Levenson RW. Lower visual avoidance in dementia patients is associated with greater psychological distress in caregivers. Dement Geriatr Cogn Disord 2017;43:247–58.
[38] Oyebode JR, Bradley P, Allen JL. Relatives' experiences of frontal-variant frontotemporal dementia. Qual Health Res 2013;23:156–66.
[39] Rasmussen H, Hellzen O, Stordal E, Enmarker I. Family caregivers experiences of the pre-diagnostic stage in frontotemporal dementia. Geriatr Nurs 2019;40:246–51.
[40] Riedijk S, et al. Frontotemporal dementia: change of familial caregiver burden and partner relation in a Dutch cohort of 63 patients. Dement Geriatr Cogn Disord 2008;26:398–406.
[41] Riedijk SR, et al. Caregiver burden, health-related quality of life and coping in dementia caregivers: a comparison of frontotemporal dementia and Alzheimer's disease. Dement Geriatr Cogn Disord 2006;22:405–12.
[42] Roche DClinPsy L, Croot K, MacCann C, Cramer B, Diehl-Schmid J. The role of coping strategies in psychological outcomes for frontotemporal dementia caregivers. J Geriatr Psychiatry Neurol 2015;28:218–28.
[43] Rognstad M-K, et al. Behavioural disturbances in patients with frontotemporal lobe degeneration focusing on caregiver burden at home and in nursing homes. J Clin Nurs 2020;29:1733–43.
[44] Sato S, et al. Characteristics of behavioral symptoms in right-sided predominant semantic dementia and their impact on caregiver burden: a cross-sectional study. Alzheimers Res Ther 2021;13:166.
[45] Silverman HE, et al. The contribution of behavioral features to caregiver burden in FTLD spectrum disorders. Alzheimers Dement J Alzheimers Assoc 2022;18:1635–49.
[46] Thorsen K, Johannessen A. How gender matters in demanding caring for a spouse with young-onset dementia. A narrative study. J Women Aging 2023;35:81–97.
[47] Uflacker A, Edmondson MC, Onyike CU, Appleby BS. Caregiver burden in atypical dementias: comparing frontotemporal dementia, Creutzfeldt-Jakob disease, and Alzheimer's disease. Int Psychogeriatr 2016;28:269–73.
[48] Wong CC, Wallhagen MI. Frontotemporal dementia: the impact of patient behavioral symptoms on the physical and mental health of family caregivers. Dement Geriatr Cogn Disord Extra 2012;2:516–28.
[49] Wong C, et al. The experience of caregiving: differences between behavioral variant of frontotemporal dementia and alzheimer disease. Am J Geriatr Psychiatry 2012;20:724–8.
[50] Wong S, et al. Apathy and its impact on carer burden and psychological wellbeing in primary progressive aphasia. J Neurol Sci 2020;416.
[51] Zarit SH, Reever KE, Bach-Peterson J. Relatives of the impaired elderly: correlates of feelings of burden. Gerontologist 1980;20:649–55.
[52] Hébert R, Bravo G, Préville M. Reliability, validity and reference values of the Zarit burden interview for assessing informal caregivers of community-dwelling older persons with dementia. Can J Aging Rev Can Vieil 2000;19:494–507.
[53] Miyagawa T, et al. Utility of the global CDR ® plus NACC FTLD rating and development of scoring rules: data from the ARTFL/LEFFTDS consortium. Alzheimers Dement 2020;16:106–17.
[54] Cummings JL, et al. The neuropsychiatric inventory: comprehensive assessment of psychopathology in dementia. Neurology 1994;44:2308.
[55] Cummings J. The neuropsychiatric inventory: development and applications. J Geriatr Psychiatry Neurol 2020;33:73–84.
[56] Mason EC, Richardson R. Looking beyond fear: the extinction of other emotions implicated in anxiety disorders. J Anxiety Disord 2010;24:63–70.
[57] Smilek D, Carriere JSA, Cheyne JA. Out of mind, out of sight: eye blinking as indicator and embodiment of mind wandering. Psychol Sci 2010;21:786–9.
[58] Rothbart MK, Ziaie H, O'Boyle CG. Self-regulation and emotion in infancy. New Dir Child Adolesc Dev 1992;1992:7–23.
[59] Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh sleep quality index: a new instrument for psychiatric practice and research. Psychiatry Res 1989;28:193–213.
[60] Antoine P, Pasquier F. Emotional and psychological implications of early AD diagnosis. Med Clin North Am 2013;97:459–75.
[61] van Vliet D, de Vugt ME, Bakker C, Koopmans RTCM, Verhey FRJ. Impact of early onset dementia on caregivers: a review. Int J Geriatr Psychiatry 2010;25:1091–100.
[62] Dauphinot V, et al. Risk factors of caregiver burden among patients with Alzheimer's disease or related disorders: a cross-sectional study. J Alzheimers Dis 2015;44:907–16.
[63] Cheng S-T, Lam LCW, Kwok T. Neuropsychiatric symptom clusters of Alzheimer disease in Hong Kong Chinese: correlates with caregiver burden and depression. Am J Geriatr Psychiatry 2013;21:1029–37.
[64] Johnson JK, et al. Frontotemporal lobar degeneration: demographic characteristics of 353 patients. Arch Neurol 2005;62.
[65] Queluz FNFR, et al. Understanding the needs of caregivers of persons with dementia: a scoping review. Int Psychogeriatr 2020;32:35–52.
[66] Rosness TA, Haugen PK, Engedal K. Support to family carers of patients with frontotemporal dementia. Aging Ment Health 2008;12:462–6.
[67] Valcour VG, Masaki KH, Curb JD, Blanchette PL. The detection of dementia in the primary care setting. Arch Intern Med 2000;160:2964.
[68] Parmar J, et al. Diagnosis and management of dementia in primary care: exploratory study. Can Fam Physician Med Fam Can 2014;60:457–65.
[69] Moore KM, et al. Age at symptom onset and death and disease duration in genetic frontotemporal dementia: an international retrospective cohort study. Lancet Neurol 2020;19:145–56.
[70] Roberson ED, et al. Frontotemporal dementia progresses to death faster than Alzheimer disease. Neurology 2005;65:719–25.