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Dynamic Coupling Association of Care Partner Quality of Life and Cognitive and Depressive Symptoms Experienced by Persons Living with Dementia

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Abstract

Background/Objectives: Persons living with dementia (PLwD) receive informal care services from loved ones, commonly referred to as care partners (CPs). While the symptoms (e.g., depressive affect, cognitive impairment) experienced by PLwD are recognized to influence CP wellbeing, longitudinal investigations into the association of CP QoL and PLwD symptoms have yet to be fully explored. The present study sought to address this gap and highlight how CP QoL and PLwD symptoms systematically covary over time. **Methods**: Participants were composed of 33 dyads (PLwD and their CP) who partook in the Voices in Motion project, a social-cognitive intervention for dementia. CP QoL (WHOQOL-BREF), PLwD depressive symptomology (Patient Health Questionnaire-9) and PLwD global cognitive functioning (Mini-Mental State Examination) were assessed every three to four weeks in an intensive repeated-measures design. Time-varying covariation models using multilevel modeling examined systematic covariation between CP QoL and PLwD symptoms between and within dyads. **Results**: Increased CP psychological and social QoL were both associated with increased PLwD global cognitive functioning between dyads and vice versa ($p < 0.05$). Within dyads, increased CP social QoL was associated with improved PLwD depressive symptoms ($p < 0.05$), while increased CP environmental QoL was associated with increased depressive symptoms ($p < 0.05$). **Conclusions**: Significant coupling associations were observed both between and within dyads. Such results highlight the association between CP QoL and the symptoms experienced by their care recipient and provide important, novel longitudinal contributions to the literature.

Keywords: dementia; quality of life; care partners; dyadic intervention; cognition; depressive symptoms

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1. Introduction

Over 55 million individuals globally are living with dementia, and this figure is projected to rise to over 130 million by 2050 [1]. Dementia is an umbrella term that encompasses a collection of neurocognitive conditions that are characterized by cognitive, behavioral, and psychological changes accompanied by difficulties with activities of daily

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living. The progressive nature of dementia leads to individuals requiring significant care from formal health care systems as well as informal care from loved ones [2]. In the United States, informal care provided by family, friends, and other unpaid caregivers has been indicated to comprise the majority of care received by persons living with dementia (PLwD) [2]. Moreover, the annual global number of hours spent providing informal caregiving services for PLwD at home was estimated to be over 80 billion in 2018, with this number anticipated to increase in the coming decades [3].

Individuals adopting the responsibilities of providing informal care services are commonly referred to as care partners (CPs) [4,5]. CPs can have negative experiences and elevated levels of stress when caring for a loved one with dementia. The transactional model of stress and coping has received empirical support for explaining the relationship between CP stress and caregiving [6–8]. This model suggests that CPs evaluate the stressfulness of their interactions with their care recipient and then appraise whether the level of stress and challenges they encounter is manageable by resources they have available or if other coping strategies are required [6,7,9].

There is substantial evidence demonstrating there exists a close, bidirectional relationship between CPs' caregiving experiences, such as caregiver distress and burnout, and the various symptoms experienced by their care recipients with dementia, including psychosis, affective and behavioral symptoms, memory and executive functioning impairments, overall disease severity, and negative changes to global cognitive functioning [10–13]. The bidirectional influences between CPs and PLwD in this dyadic relationship can be problematic as it can transition into a powerful positive feedback loop that exacerbates CPs' negative caregiving experiences and, in turn, the symptoms experienced by PLwD [10,11]. However, despite the negative effects of this interconnected relationship between caregiving experiences and dementia symptoms, this relationship can also be an important target to support and benefit both CPs and PLwD [10,11].

Quality of Life (QoL), as defined by the World Health Organization, refers to one's subjective perceptions about their position in life relative to the context of one's culture and values as well as their personal goals and expectations. QoL is a multidimensional concept that extends beyond physiological functioning and represents a holistic approach to understanding health and wellbeing [14]. It is also broader and more comprehensive than other concepts associated with CP wellbeing such as perceived distress or burden, as it pertains to multiple aspects of one's wellbeing beyond their specific caregiving experiences. CPs of individuals with chronic diseases can often feel isolated, be tasked with numerous responsibilities, and experience other difficulties like sleep disruption, depression, and anxiety, all of which contribute to their QoL [15]. Rees et al. [15] reviewed the available literature on QoL of CPs of individuals with chronic diseases and emphasized in their review that CP QoL is significantly associated with their care recipients' clinical outcomes. A more recent qualitative study by Hazzan et al. [16] explored how QoL of CPs of individuals with dementia relates to the care they provide and highlights that both the quality-of-care CPs perceived giving and their own personal QoL were not only affected by the availability and accessibility of additional supports but also by the needs and symptoms of their care recipient.

Previous reviews have illustrated that in CP-PLwD dyads, CP QoL is associated with the health and wellbeing of PLwD and there have been investigations into how the symptoms experienced by PLwD influence CP QoL [17–21]. However, despite previous research exploring how PLwD factors impact CP QoL, the available literature has not extensively explored this association, particularly within dyads. Moreover, while the connection between PLwD symptoms and CPs' caregiver-specific experiences has been well-established in the literature, research into how CP QoL more broadly is associated

with PLwD symptoms is relatively lacking. Of the literature that does exist regarding the relationship between PLwD symptoms and CP QoL, much of the research has been cross-sectional, highlighting a key limitation of the current literature.

Thus, the present investigation sought to address these gaps by using a longitudinal intensive repeated-measures study design to explore whether there exists time-varying, systematic covariation between CP QoL domains and symptoms experienced by their care recipient with dementia. Time-varying covariation model designs permit the testing of coupled change to explore how two variables move together across time within dyads [22,23]. An examination of the systematic fluctuation between these two variables reveals whether there exists process-based change within dyads between a CP's QoL and the symptoms experienced by their care recipient with dementia [23]. In other words, such models of coupled change demonstrate how changes in CP QoL correspond to changes in PLwD symptoms for a dyad at any given point in time. To accomplish this, we utilized data from the Voices in Motion (ViM) project—a social-cognitive intervention that sought to utilize the known benefits of music- and socialization-based interventions to promote psychological and cognitive health for PLwD [24]. The measurement-burst design of ViM, a novel design relative to previous music-based interventions, permitted the evaluation of the within-dyad time-varying covariation of CP QoL and symptoms experienced by their care recipient with dementia [25]. This approach also permitted dyads to effectively serve as their own controls and allowed the examination of change in the key study variables relative to their own personal average.

Given the breadth of evidence demonstrating associations between CP caregiving experiences and PLwD symptoms, we hypothesized that this relationship would extend to CP QoL. We anticipated that CP QoL would systematically covary with their care recipients' experienced symptoms and made the directional hypothesis that on occasions where CP QoL was higher relative to their typical average or the sample average, there would be a corresponding improvement in their care recipients' symptoms. Thus, we predicted that on occasions where PLwD symptoms were elevated relative to their personal or sample average, there would be a corresponding decrease in CP QoL.

2. Materials and Methods

2.1. Participants

Participants for this study were composed of dyads consisting of PLwD and their CP who partook in ViM. ViM, which was approved by the Human Research Ethics Review Board at the University of Victoria (HREB#20-0329), was an intergenerational choir composed of local high school students, PLwD, and their CP. Only CP and PLwD participants were included in analyses, as the current study exclusively focused on these dyadic relationships. Participants were recruited from the local community by means of flyers posted in community centers, doctors' offices, and local churches. Initial eligibility for ViM was assessed over the phone, with requirements including having a diagnosis of dementia from a physician and having a CP that was willing and able to participate in the choir and data collection. Exclusionary criteria consisted of recent stroke (self-reported, physician-diagnosed) and/or taking prescribed medications (such as benzodiazepines) known to affect cognition [25–27]. Although primarily targeted for those diagnosed with Alzheimer's Disease, individuals with other subtypes of dementia were permitted to participate in the ViM project and were included in the current study. A total number of 34 dyads participating in the ViM project were initially included for the current study; however, one PLwD and their respective CP were excluded from analysis due to the inability to complete required assessments, leaving a final sample of 33 dyads, 29 of whom had Alzheimer's Disease and four with other non-Alzheimer's Disease dementia types. All participants provided

consent to participate in the ViM project and data analysis and were given opportunities throughout the project to ask questions about their participation.

2.2. Procedure

ViM was composed of three different choral seasons that were approximately 3.5 months each and separated by summer and winter breaks, with the entire duration of the study lasting 18 months. Choral seasons consisted of 2 h weekly choir practices held at two local churches in Victoria, BC. Each choir practice was led by a professional conductor (BMus, DipEd, MMus) and included a warmup, rehearsal, and approximately 30 min of free socialization time at the end of practice. ViM adopted a rolling sample recruitment strategy where new participants could join at the start of each new choral season. Due to the significantly reduced quantity of data in later choral seasons and thus a distinct lack of power, the current analysis is restricted to each participant's first personal season of participation.

Participants underwent baseline assessments at the start of their first choral season, after which a longitudinal intensive repeated-measures design was adopted to collect data every three to four weeks within each choral season. This provided up to four assessments within each dyad's personal first season, which permitted the investigation of dynamic change in key outcomes. Each date for a data collection session was chosen by participants themselves to reduce disruption to daily lives and testing effects for PLwD as well as limit the attrition within ViM.

2.3. Measures

2.3.1. CP QoL

CP QoL was assessed by the WHOQOL-BREF. This 26-item questionnaire prompted CPs to respond to questions about their perceived QoL across four distinct domains: environmental surroundings (eight items), psychological health (six items), physical health (seven items), and satisfaction in social relationships (three items). Participants rated their responses on a five-point scale that ranged from 1 = "very poor" to 5 = "very good". A total sum score for each domain was derived separately, with higher scores reflecting greater perceived QoL for that domain. The WHOQOL-BREF scoring protocol was followed to compute QoL domain scores [14]. In accordance with the WHOQOL scoring protocol, QoL items 1 and 2 were not included in the domain total scores. QoL domain scores from individuals' items were then calculated and multiplied by four to be comparable with scores derived from the WHOQOL-100. Averages were then calculated for domain scores, with the scores of each domain ranging from 4 to 20. Missingness of WHOQOL data was also handled based on this WHOQOL-BREF scoring protocol.

2.3.2. PLwD Global Cognitive Functioning

The Mini-Mental State Examination (MMSE), a well-validated and reliable scale for assessing global cognitive functioning, was used to proxy the cognitive symptoms experienced by PLwD participants. This measure is appropriate for evaluating cognitive abilities in seniors, particularly for seniors with cognitive deficits, as it is shorter and simpler compared to other cognitive assessments [28]. The exam is composed of two sections: the first requiring verbal responses to questions assessing memory and attention (e.g., "What is the season?"), and the second assessing participants' abilities to name, follow instructions, and write (e.g., participants are instructed to copy a presented pattern). Scores range from 0 to 30, with scores falling between 20 and 24 indicating mild cognitive impairment, 12–20 reflecting moderate impairment, and scores < 12 indicating severe impairment.

2.3.3. PLwD Depressive Symptomology

The Patient Health Questionnaire-9 (PHQ-9), a short scale with strong reliability and diagnostic validity that is appropriate for assessing depressive symptomology in dementia populations, was utilized to assess the depressive symptoms experienced by PLwD [29,30]. The range of possible scores fell on a continuum between 0 and 27; each of the nine items on the scale was scored from 0 ("not at all") to 3 ("nearly every day"), with higher scores indicating a greater number of depressive symptoms. The PHQ-9 was interview-administered. Interviewers read each question to participants and then ensured that participants understood the question being asked. Calculated total scores falling between 5 and 9 reflected minimal depressive symptoms, 10–14 indicated minor depressive symptoms, 15–19 reflected major to moderately severe depressive symptoms, and 20 or greater indicated severe, major depressive symptoms.

2.4. Statistical Procedure

All statistical analyses were computed using the nlme package (Version 3.1.157) in R Studio Code (Version 4.2.1) [31]. Fully unconditioned models were initially fit to calculate the intraclass correlation coefficient (ICC) for each of the variables of interest. ICC values were used to determine the degree of dependence across variance levels and whether there existed sufficient levels of between-dyad (level-2) variance to suggest the violation of the assumption of independence and thus the need for the intended multilevel modeling approach [32]. Time-varying covariation models were then fit to investigate the research objective.

Equation (1) describes the first set of models, where the separate CP QoL domains (indexed by WHOQOL-BREF) served as predictors, while the symptoms experienced by PLwD (indexed by MMSE and PHQ-9) were the outcomes. Equation (2) represents the next set of models where the symptoms experienced by PLwD predicted each CP QoL domain. Each equation had continuous predictor variables and thus to make the outputs meaningful and interpretable, predictors at level-1 (reflecting within-dyad associations) were person-mean centered and predictors at level-2 (reflecting between-dyad associations) were grand-mean centered. CP_QOL and PLwD_Symptoms served as placeholders for each of the models, with the former representing CP QoL domain scores and the latter representing PLwD global cognitive functioning or depressive symptoms. Covariates included PLwD age, CP age, and time in study (in months), which are represented by PLwD_Age, CP_Age, and TIS in Equations (1) and (2).

$$\begin{aligned} \text{LEVEL-1}: \ PLwD_Symptom_{ti} &= \beta_{oi} + \beta_{1i}\,(TIS) + \beta_{2i}\,(\overline{CP_QoL}) + e_{ti} \\ \text{LEVEL-2}: \beta_{oi} &= y_{00} + y_{01}(\overline{CP_QoL}) + y_{02}(\overline{PLwD_Age}) + y_{03}(\overline{CP_Age}) + u_{oi} \\ \beta_{1i} &= y_{10} + u_{1i} \\ \beta_{2i} &= y_{20} + u_{2i} \end{aligned} \quad (1)$$

$$\begin{aligned} \text{LEVEL-1}: \ CP_QOL_{ti} &= \beta_{oi} + \beta_{1i}\,(TIS) + \beta_{2i}\,(\overline{PLwD_Symptom}) + e_{ti} \\ \text{LEVEL 2}: \beta_{oi} &= y_{00} + y_{01}(\overline{PLwD_Symptom}) + y_{02}(\overline{PLwD_Age}) + y_{03}(\overline{CP_Age}) + u_{oi} \\ \beta_{1i} &= y_{10} + u_{1i} \\ \beta_{2i} &= y_{20} + u_{2i} \end{aligned} \quad (2)$$

In Equation (1), PLwD symptoms for a dyad *i* at occasion *t* is predicted as a function of that dyad's baseline PLwD symptom score (β_{oi}), two slope parameters (β_{1i}; β_{2i}), and a within-dyad residual variance term (e_{ti}). The first slope parameter, β_{1i}, reflects the rate of change in the outcome score (PLwD symptoms) for a given dyad with each subsequent data collection session (monthly retest assessments). The other level-1 slope parameter,

β_{2i}, reflects the change in PLwD symptom scores per one-unit increase in CP QoL at time t relative to a given care partner's personal average QoL score for a given domain.

In the level-2 portion of this equation, each of the level-1 parameters become outcomes to be explained through the specification of fixed and random effects. The two key level-2 fixed effects for the current study were y_{01}, which reflects the pure between-person effect, and y_{20}, reflecting the pure within-dyad effect. The level-2 variances (u_{oi}, u_{1i}, u_{2i}) in the equation reflect the remaining between-dyad variability in PLwD symptoms to be explained.

Equation (2) is simply the inverse of Equation (1), in which CP QoL domain scores are outcomes to be predicted by PLwD symptoms. CP QoL domain scores for dyad i at occasion t are predicted as a function of that dyad's baseline CP QoL domain score (β_{oi}), the rate of change in a CP QoL domain score for a given dyad with each subsequent data collection session (β_{1i}), the rate of change in a CP QoL domain score per one-unit increase in PLwD symptoms at time t relative to that dyad's typical average (β_{2i}), and the remaining within-dyad residual variance (e_{ti}). Again, these level-1 parameters become outcomes to be estimated at level-2, with y_{01} and y_{20} being the key fixed effects of interest that reflect the coupling associations of PLwD symptoms and CP QoL domain scores between and within dyads respectively.

Restricted Maximum Likelihood (REML) was employed for each of the models in the current analyses to estimate parameters. REML utilizes all the available data from participants in the sample instead of engaging in listwise deletion and accounts for how some participants have a greater number of assessments, thus contributing more to the total amount of data. This allows REML to provide more robust parameter estimates compared to other methods, especially in the cases of smaller sample sizes [33]. The advantages yielded by REML make it an appropriate parameter estimation method to use in the context of using ViM data, given the missing data from some participants, attrition, and modest sample size associated with this project [13]. In the present study, we invoked unidirectional hypotheses and thus one-sided p-values < 0.05 were considered statistically significant. Exact p-values and 95% confidence intervals (CI) are reported to facilitate interpretation. Previous research studies have demonstrated a negative relationship between CP QoL and functional impairments experienced by individuals with PLwD [17], and depressive symptoms of PLwD as reported by CPs [18]. Moreover, there is strong evidence demonstrating that increased CP burden or distress is related to poorer QoL for CPs of individuals with chronic illness or diseases [34–36], and that CP burden and distress are increased by a wide range of symptoms experienced by their care recipient [10,37,38]. Thus, the previous literature suggests that CP QoL should be diminished with worse PLwD symptoms versus increased with fewer PLwD symptoms, thereby guiding our unidirectional hypotheses and approach.

The data were screened for missingness using Little's Missing Completely at Random (MCAR) test, in which the null hypothesis states the data are MCAR. The null was retained for the MCAR test of key study variables ($\chi^2(13) = 10.9$, $p = 0.622$).

3. Results

3.1. Sample Characteristics

The baseline sample characteristics are summarized in Table 1. WHOQOL-BREF baseline means for each QoL domain at baseline were 16.09 (range = 13–19) for environmental, 15.70 (range = 8–19) for physical, 14.64 (range = 8–18) for psychological domains, and 14.21 (range = 8–18) for social domains in the current sample. While WHOQOL-BREF scores lack defined clinical cut-offs to indicate high or low QoL, the baseline scores do reflect higher perceived QoL across the various sub-domains as they trend towards the maximum possible score of 20. The mean baseline PLwD MMSE score in the present sample was

20.61 (range = 10–29), suggesting PLwD had mild cognitive impairment; however, scores across the sample ranged from severe to normal cognitive functioning. PLwD mean PHQ-9 score at baseline was 3.17 (range = 0–14), reflecting the absence of depressive symptoms in this sample, yet scores did range from the presence of no depressive symptoms to minor depressive symptoms as defined by the DSM-V.

Table 1. Sample Characteristics at Baseline.

	Care Partners (CP) ***n* = 33**	**Care Recipients (PLwD)** ***n* = 33**
Age in years M (SD)	67.81 (10.07)	79.09 (7.95)
Sex % Women	84	55
Education, % high school or higher	100	97
Ethnicity, % Caucasian	97	100
CP, spouse *n*	16	-
CP, child *n*	6	-
CP, other family *n*	1	-
CP did not disclose *n*	10	-
PLwD Living with others, % 1 person or more	-	78
PLwD ADL, M (SD)	-	0.23 (0.77)
CP QoL envir, M (SD)	16.09 (1.72)	-
CP QoL phys, M (SD)	15.70 (2.00)	-
CP QoL soc, M (SD)	14.64 (2.15)	-
CP QoL psyc, M (SD)	14.21 (2.89)	-
PWD MMSE M, (SD)	-	20.61 (5.66)
PWD PHQ-9 M, (SD)	-	3.17 (3.45)

ADL = Activities of Daily Living Score (0–6, 0 = very independent, 6 = very dependent); QoL envir = Environmental Quality of Life; QoL phys = Physical Quality of Life; QoL soc = Social Quality of Life; QoL psyc = Psychological Quality of Life; MMSE = Mini-Mental State Examination; PHQ-9 = Patient Health Questionnaire-9.

3.2. Fully Unconditioned Models

Fully unconditioned mean models revealed that 83% of the total variability in environmental QoL, 80% in social QoL, and 70% in both psychological and physical QoL existed systematically between dyads. In regard to PLwD depressive and cognitive symptoms, 66% of the total variability in depressive symptomology and 84% of the total variability in MMSE scores were found to be systematically between dyads. Such findings confirmed the existence of variability at both level-1 and level-2 and justified the usage of the multilevel approach [32].

3.3. Coupling Associations of CP QoL and PLwD Symptoms

Although level-2 random effects were initially specified for each time-varying covariation model, level-2 random slopes for both time and the within-person coupling parameter were constrained in order to achieve model convergence. Thus, although individual differences in change and within-person coupling likely exist, this was not found empirically for the present sample. All random effects for intercepts were modeled.

Two between-dyad significant coupling associations were found. One association was between CP social QoL and PLwD MMSE scores; where CP social QoL scores were one unit greater than the sample average, there was a corresponding 0.61 increase in PLwD MMSE scores (y_{01} = 0.61, p = 0.03). The inverse was also true; where the PLwD MMSE score was one unit above the sample average, there was an associated 0.19 increase in their CP social QoL (y_{01} = 0.19, p = 0.03). The second significant between-dyad finding was the association of CP psychological QoL and PLwD MMSE scores. Specifically, a one-unit increase in CP psychological QoL relative to the sample average was associated with a 1.20-unit increase

in PLwD MMSE scores (y_{01} = 1.20, p = 0.004). This significant association was found in the inverse direction as well, in which a one-unit increase in PLwD MMSE scores relative to the sample average was associated with a 0.20 increase in CP psychological QoL scores (y_{01} = 0.20, p = 0.003). Tables 2 and 3 summarize these results, and results are illustrated in Figure 1a,b.

Table 2. Between- and within-dyad estimates of PLwD global cognitive functioning and depressive symptomology predicting CP QoL domain scores.

	Estimate	SE	*p*	Lower 95% CI	Upper 95% CI
CP-QoL Phys					
PLwD MMSE (between-dyads) (y_{01})	0.12	0.07	0.13	−0.04	0.27
PLwD MMSE (within-dyads) (y_{20})	0.02	0.09	0.82	−0.16	0.20
PLwD Mood (between-dyads) (y_{01})	0.02	0.13	0.90	−0.24	0.28
PLwD Mood (within-dyads) (y_{20})	−0.02	0.10	0.81	−0.21	0.17
CP-QoL Envir					
PLwD MMSE (between-dyads) (y_{01})	0.10	0.06	0.11	−0.03	0.23
PLwD MMSE (within-dyads) (y_{20})	0.00	0.06	0.96	−0.11	0.12
PLwD Mood (between-dyads) (y_{01})	−0.03	0.11	0.77	−0.27	0.20
PLwD Mood (within-dyads) (y_{20})	0.10	0.05	0.035 #	−0.01	0.21
CP-QoL Soc					
PLwD MMSE (between-dyads) (y_{01})	0.19	0.10	0.03 #	−0.01	0.40
PLwD MMSE (within-dyads) (y_{20})	0.05	0.10	0.57	−0.14	0.25
PLwD Mood (between-dyads) (y_{01})	0.10	0.18	0.59	−0.27	0.47
PLwD Mood (within-dyads) (y_{20})	−0.20	0.10	0.03 #	−0.40	0.01
CP-QoL Psyc					
PLwD MMSE (between-dyads) (y_{01})	0.20	0.07	0.006 **	0.06	0.34
PLwD MMSE (within-dyads) (y_{20})	−0.14	0.09	0.11	−0.32	0.03
PLwD Mood (between-dyads) (y_{01})	−0.01	0.14	0.95	−0.29	0.27
PLwD Mood (within-dyads) (y_{20})	0.02	0.09	0.83	−0.16	0.21

Note: ** $p < 0.01$, # $p < 0.05$ one-tailed.

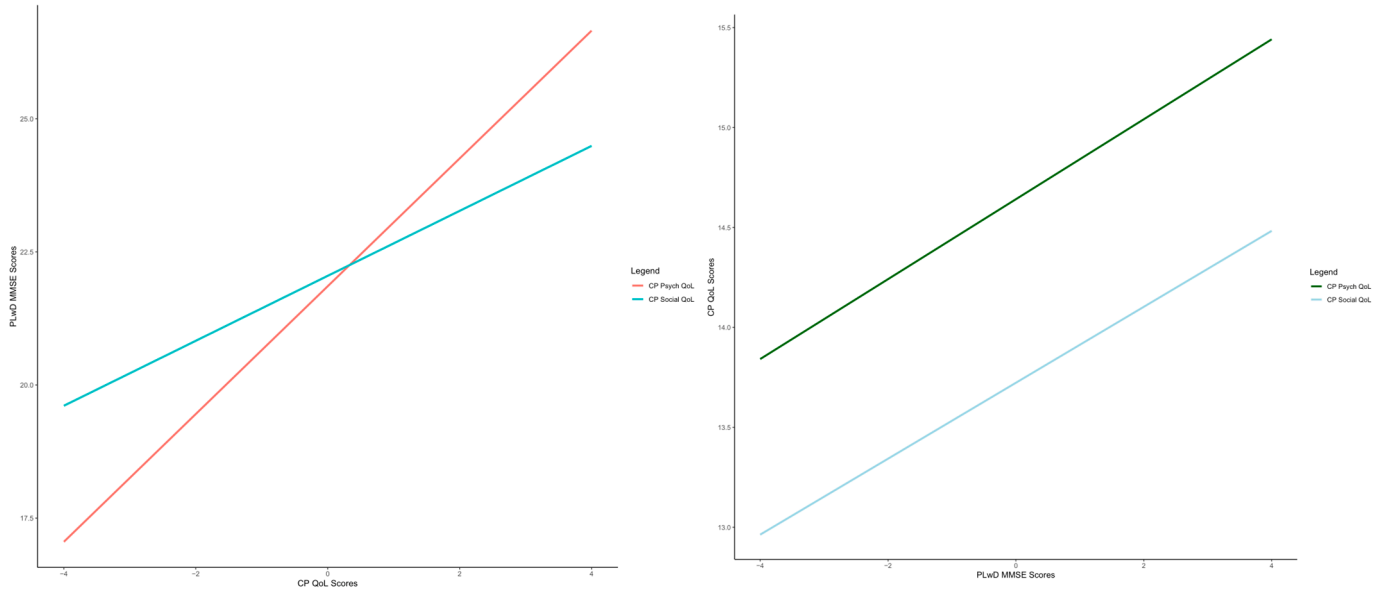
Table 3. Between- and within-dyad estimates of CP QoL domains predicting PLwD global cognitive functioning and depressive symptomology scores.

	Estimate	SE	*p*	Lower 95% CI	Upper 95% CI
PLwD MMSE					
CP Phys QoL (between-dyads) (y_{01})	0.66	0.43	0.13	−0.22	1.54
CP Phys QoL (within-dyads) (y_{20})	0.07	0.28	0.81	−0.50	0.64
CP Envir QoL (between-dyads) (y_{01})	0.80	0.49	0.09	−0.15	1.87
CP Envir QoL (within-dyads) (y_{20})	−0.01	0.44	0.98	−0.90	0.88
CP Psyc QoL (between-dyads) (y_{01})	1.20	0.39	0.004 **	0.40	2.00
CP Psyc QoL (within-dyads) (y_{20})	−0.43	0.27	0.11	−0.97	0.11
CP Soc QoL (between-dyads) (y_{01})	0.61	0.30	0.025 #	0.00	1.22
CP Soc QoL (within-dyads) (y_{20})	0.13	0.26	0.63	−0.39	0.65
PLwD Mood					
CP Phys QoL (between-dyads) (y_{01})	0.06	0.31	0.84	−0.57	0.70
CP Phys QoL (within-dyads) (y_{20})	−0.08	0.28	0.77	−0.66	0.49
CP Envir QoL (between-dyads) (y_{01})	−0.08	0.35	0.82	−0.81	0.64
CP Envir QoL (within-dyads) (y_{20})	0.85	0.45	0.035 #	−0.06	1.77

Table 3. *Cont.*

	Estimate	SE	*p*	Lower 95% CI	Upper 95% CI
CP Psyc QoL (between-dyads) (y_{01})	−0.02	0.30	0.95	−0.64	0.60
CP Psyc QoL (within-dyads) (y_{20})	0.07	0.29	0.81	−0.52	0.66
CP Soc QoL (between-dyads) (y_{01})	0.12	0.22	0.58	−0.33	0.57
CP Soc QoL (within-dyads) (y_{20})	−0.47	0.24	0.03 #	−0.97	−0.02

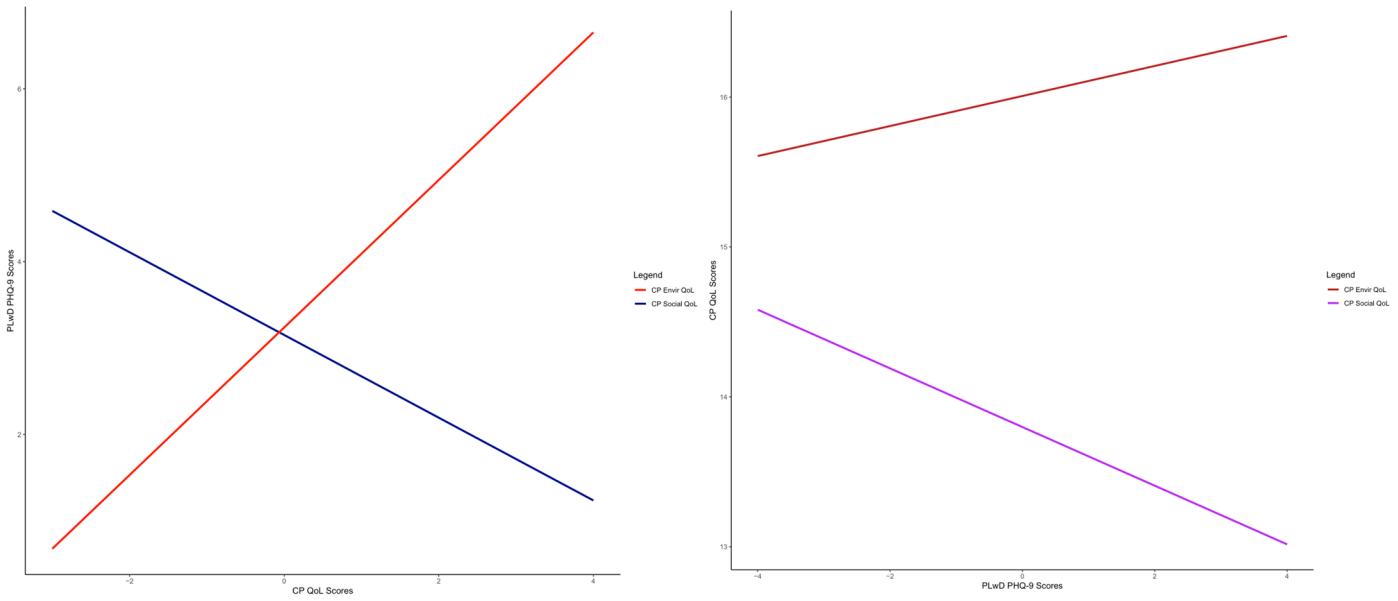
Note: ** $p < 0.01$, # $p < 0.05$ one-tailed.



(**a**) (**b**)

Figure 1. Between-dyad significant coupling associations. (**a**) Change in PLwD MMSE scores per one unit increase or decrease in CP psychological and social QoL relative to the sample average; (**b**) changes in CP psychological and social QoL scores per one unit increase or decrease PLwD MMSE relative to the sample average.

Two significant associations were found at the within-dyad level. Firstly, on occasions where CP social QoL was one unit higher relative to a CP's personal average, there was an associated 0.47 improvement in PLwD PHQ-9 scores ($y_{40} = -0.47$, $p = 0.03$). The inverse was also found to be significant, in which a one-unit increase in a PLwD's PHQ-9 score relative to their personal average was associated with a corresponding 0.20 decrease in their CP's social QoL score ($y_{40} = -0.20$, $p = 0.03$). The second significant within-dyad association was found between CP environmental QoL and PLwD PHQ-9 score. On occasions where a CP's environmental QoL score was one unit greater relative to their typical average, there was a corresponding 0.85 increase in PLwD PHQ-9 score ($y_{40} = 0.85$, $p = 0.04$). This was also true for the other direction, where a one-unit increase in PLwD PHQ-9 scores relative to their personal average was associated with a corresponding 0.10 increase in CP environmental QoL scores ($y_{40} = 0.10$, $p = 0.04$). These results are summarized in Tables 2 and 3 and illustrated in Figure 2a,b.



(**a**) (**b**)

Figure 2. Within-dyad significant coupling associations. (**a**) Change in PLwD PHQ-9 scores given a one-unit increase or decrease in CP social or environmental QoL relative to their personal average; (**b**) change in CP social and environmental QoL given a one-unit increase or decrease in PLwD PHQ-9 scores relative to their personal average.

4. Discussion

The present investigation sought to explore whether CP QoL domains systematically covary with depressive and cognitive symptoms experienced by their care recipient with dementia within and between dyads. We hypothesized that there would be an association between greater CP QoL in environmental, physical, social, and psychological domains with improved cognitive functioning and depressive symptoms, and vice versa, in their care recipient between and within dyads. Our investigation yielded significant findings ($p < 0.05$, one-tailed) that aligned with a priori hypotheses at both the between- and within-dyad levels, as well as secondary findings that contrasted with our a priori predictions for which we offer cautious interpretations. Such findings add novel contributions to the literature and provide a more nuanced understanding about the dynamic relationship between CPs and PLwD. To date, most studies in this field have been cross-sectional and between-person. The present longitudinal investigation expands the literature by highlighting the within-dyad coupling associations between CP QoL and depressive and cognitive symptoms experienced by PLwD.

4.1. Between-Dyad Findings

The present investigation found two between-dyad coupling associations. Specifically, our findings suggested that both CP psychological QoL and CP social QoL were associated with PLwD global cognitive functioning, in which greater CP psychological and social QoL scores relative to the sample average were associated with greater PLwD MMSE scores, reflecting better global cognitive functioning. Results from models also suggested that these associations were significant in the inverse direction. These findings are consistent with previous research exploring the dyadic associations of CP wellbeing and PLwD symptoms, as several studies have demonstrated that CP caregiving experiences, such as CP burnout, distress, and perceived burden, are related to the outcomes and trajectory of their care recipient with dementia [10,12,13]. What the present investigation adds to the

well-established literature includes how more global aspects of CP wellbeing, such as QoL, are also intimately related to the cognitive symptoms of their care recipient with dementia.

QoL has been associated with important health-related factors such as mortality, depression, and anxiety in older adults [39–41]. Much of the literature that has explored QoL in CPs for PLwD has sought to identify specific factors that relate to CP wellbeing and their ability to provide care [17,42,43]. Among the available literature, there are previous studies that have explored how the severity of cognitive impairment and other symptoms experienced by PLwD influence their CP's QoL [18–21]. For example, a cross-sectional study conducted by Nasrun et al. [18] demonstrated there exist strong correlations between both CP physical and social QoL and PLwD global cognitive functioning among other factors. Our results extend this research by highlighting support for longitudinal process-based change between CP psychological and social QoL and PLwD cognitive symptoms between dyads and it is, to the best of our knowledge, the first study to do so.

There are several potential reasons that these specific QoL domains were associated with PLwD cognitive symptoms. Firstly, CPs reporting greater social QoL may perceive having more support. Perceived supports are an important contributor to CP burden, which is associated with PLwD global cognitive functioning [44]. Alternatively, as dementia progresses for PLwD, CPs can experience increasing social isolation and loneliness, as well as a decreased desire or ability to socialize due to increases in care responsibilities [45]. PLwD with better global cognitive functioning may require less intensive care from their CP, resulting in CPs that do not feel as isolated or removed from their social circles and thus having higher perceived social QoL. One factor that may be contributing to the association of CP psychological QoL and PLwD global cognition could be that CPs with increased psychological QoL may have better coping skills or ability to manage care-giving-related stresses. This would have a positive influence on PLwD and reduce feelings of stress or anxiety for PLwD, which is critically important, as anxiety has been shown to exacerbate cognitive impairment for PLwD and stress has been demonstrated to accelerate Alzheimer's Disease pathology in animal studies [46,47]. Moreover, another factor that could be contributing to the relationship between CP psychological QoL and PLwD global cognition is sleep. Previous research has demonstrated that CPs of PLwD have reduced sleep quality [48,49] and that the care needs of their care recipient (such as impairments in cognitive function) [50] are key factors contributing to poorer sleep for CPs. Importantly, sleep is one factor associated with important neurobiological systems, such as the glymphatic system, that are relevant to psychiatric conditions [51]. With increasing care recipient needs, CPs of PLwD may experience poor CP sleep, leading to important changes in glymphatic system function and subsequent psychological wellbeing and QoL impacts.

Nevertheless, caution should still be exercised when interpreting these findings. An important consideration when interpreting the present results is that PLwD comprising the present sample had mild to moderate dementia diagnoses. Such stages are critical times in individuals' journey with dementia that are marked by significant change in both CPs' and PLwD's lives. Such periods are also filled with transitions in responsibilities for both parties, and it may be that CP QoL for these specific domains is particularly influenced by changes in PLwD cognition during this time. Moreover, this study invoked one-sided *p*-values. Although this approach is justified based on the clear, unidirectional a priori hypothesis based on the previous literature, it does make this test less conservative than two-sided tests.

Notably, the present results are distinct from those of the previous literature that have found that CP physical QoL is also associated with PLwD global cognition [18]. In the present study, physical wellbeing was the only QoL domain that was not associated with global cognitive functioning or depressive symptomology either between or within

dyads. Distinctions between findings may in part be due to differences in the level of PLwD global cognitive impairment and depressive symptomology or cultural differences between samples. Systematic reviews have demonstrated how the health and wellbeing of CPs for PLwD does differ across cultural and ethnic groups [52]. It is important to consider that cultural differences likely apply to the association of CP QoL and PLwD disease severity as well and it is important there are investigations into these associations across diverse groups.

4.2. Within-Dyad Findings

At the within-dyad level, both CP social and environmental QoL were found to significantly covary with PLwD depressive symptoms.

A one-unit increase in CP social QoL above one's usual level systematically covaried with lower PLwD PHQ-9 scores, and the models suggested that the inverse of this association was also found to be true. This is consistent with the a priori hypothesis, as the results indicated on occasions where CP social QoL was greater than a given CP's typical level, there was a corresponding improvement in their care recipient's depressive symptomology and vice versa. The previous literature has demonstrated that the relationship quality between CPs and PLwD is critically important for both dyad members [53,54]. Social QoL, as measured by the WHOQOL-BREF, captures individuals' satisfaction in their personal relationships, which in the context of this sample likely includes CPs' satisfaction in their relationship with their care recipient. Thus, the present findings highlighting the dynamic covariation of CP social QoL and PLwD depressive symptomology align with the literature and provide further evidence for the importance of strong, quality relationships between these two parties. Moreover, the evidence of the association between CP social QoL and PLwD depressive symptomology is especially important, as depression is a common neuropsychiatric symptom associated with dementia and a more rapid cognitive decline [55]. Managing depression and depressive symptoms in individuals with cognitive impairment is critically important for promoting optimal trajectories for individuals with dementia and is a potential target for interventions [56].

An underlying factor that may be driving this within-dyad association is a CP's perception of the availability of and satisfaction with their social support. Social QoL scores, as measured by the WHOQOL-BREF, reflect one's satisfaction with available support from friends [14]. On occasions where CPs indicate greater social QoL, they may perceive more satisfaction with their supports, leading to decreases in CP burden and overall stress, and thus, according to the well-established literature, possibly reducing the neuropsychiatric symptoms like depressive symptoms experienced by their care recipient [10]. Additionally, on days when a PLwD is experiencing greater depressive symptomology, a CP may perceive lower social QoL that is driven by feelings of disconnection from their care recipient, emotional grief, and strains in their relationship.

The second within-dyad association we observed contrasted with our predictions and is considered an exploratory finding and interpreted as such. Specifically, on occasions when CP environmental QoL was higher relative to their typical level, our models indicated that PLwD PHQ-9 scores were also higher, reflecting greater depressive symptoms. This pattern is in opposition to our a priori hypothesis and suggests that the environmental domain may be capturing contextual shifts that co-occur with periods of increased need. The WHOQOL-BREF environment domain reflects perceived satisfaction with external conditions and access to resources, including health services, transport, and financial security [14]. One plausible interpretation is increased support-seeking: periods of heightened depressive symptoms in the care recipient may necessitate the care partner accessing additional external supports to manage these symptoms. Previous qualitative work in-

dicates that CP QoL is often closely linked to the accessibility of such supports when responding to a care recipient's needs [17,57,58]. Consequently, CPs may report higher environmental QoL because access and manageability improve, even while PLwD mood is temporarily worse.

However, it is also possible that the same environmental changes that increase CP perceptions of adequacy are experienced differently by the care recipient. Empirical work emphasizes that people with dementia can be highly sensitive to changes in routine and surroundings [59,60]. Accordingly, increased service use, transportation demands, or changes to the home environment, although beneficial for CP functioning, may temporarily disrupt the PLwD's sense of stability. This interpretation is consistent with the literature on relocation stress, showing that environmental transitions for older adults are often associated with heightened anxiety and depression during adjustment periods [61]. Thus, the very act of mobilizing resources to address symptoms may inadvertently exacerbate distress, reinforcing the complex nature of the dyadic relationship [10,11,62]. Further research is needed to clarify whether these environmental shifts primarily act as a response to, or a precipitate of, depressive symptoms.

4.3. Limitations and Future Directions

This study is not without its limitations, and results should be interpreted with caution. Firstly, ViM's smaller sample size may have limited the power to detect all real effects and its generalizability. Importantly, the issue of sample size was not disregarded in either the study design or analysis procedure. The intensive repeated-measures design of ViM allowed up to four assessments per dyad, allowing sufficient modeling of change in key variables and the use of REML provided more robust parameter estimates for this smaller sample size [33]. Importantly, random slopes were constrained for models to converge for the present sample, and thus, although participants' intercepts could freely vary, their change was assumed to have the same slope. Moreover, data for this study come only from ViM participants' first season of participation, which may introduce selection bias by missing dyads that dropped out of the study in subsequent seasons. The generalizability of these findings is limited, as they do not extend to all CP-PLwD dyads due to ViM consisting mainly of white, affluent, and well-educated participants. This socioeconomically advantaged, less clinically burdened sample also had high baseline QoL and low baseline depressive symptomology, which may further limit this study's generalizability and external validity to other CP-PLwD dyads. However, given the characteristics of this sample, we likely have underestimated the true association between CP QoL and PLwD symptoms. Furthermore, the present investigation only explored global cognitive functioning, as measured by the MMSE, which restricts our ability to draw conclusions about changes in domain-specific cognitive functions. Despite these constraints, the present findings nonetheless demonstrate novel, longitudinal associations between CP QoL and symptoms experienced by PLwD that future studies can expand upon. Moreover, ViM as a social-cognitive intervention has notable strengths that should not be disregarded. Although the sample size was relatively modest, 33 PLwD and their CP participated in a 3.5-month-long choir season and provided up to four time points of assessments. Replicating and extending from ViM is something we hope future research attempts. Finally, the interpretation offered for the unexpected finding should be treated as exploratory and interpreted with caution pending replication in future studies. Future studies could also build upon the present findings by exploring the possible moderators of the observed coupling associations between CP QoL and PLwD symptoms. As discussed in previous ViM studies [13], it would be beneficial for future research studies to use more comprehensive assessments to assess cognitive functioning in PLwD. As CP wellbeing and needs are

known to differ across racial and ethnic groups [52], future research should explore how the associations of CP QoL and PLwD symptoms differ across diverse groups. Future studies could also build upon the present findings by exploring how the association between CP QoL and PLwD symptoms varies across different dyad types, such as differences between CPs who are spouses or children. Furthermore, future studies should also examine how other common symptoms experienced by PLwD relate to CP wellbeing, such as sleep disruption and anxiety, as the present investigation was specific to depressive symptoms and cognitive impairment.

5. Conclusions

Utilizing an intensive repeated-measures design and multilevel approach, this study investigated the between- and within-dyad systematic covariation of CP QoL with the dementia symptoms experienced by their care recipient, with the hypothesis that improved CP QoL would be associated with an improvement in PLwD symptoms. At the between-dyad level, models indicated both increased CP psychological and social QoL were associated with increased PLwD global cognitive functioning, while only CP social QoL was associated with improved depressive symptomology at the within-dyad level. These findings align with and add to both the previous literature about the associations between CP wellbeing and PLwD symptomology as well as previous ViM studies [13,24,25]. These findings highlight the importance of the dyadic relationship between CPs and PLwD and provide possible insights for future interventions.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Human Research Ethics Review Board at the University of Victoria (#20-0329) on 29 October 2020.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Due to the nature of this research, participants of this study did not agree for their data to be shared publicly, so supporting data is not available. For researchers interested in reproduction and extension, please contact the corresponding author for syntax availability and further information. Effort was also put towards developing legacy documents to help individuals build lifestyle/social-cognitive interventions like Voices in Motion within their own communities. Please find these resources publicly available at the Voices in Motion YouTube page, located at: https://www.youtube.com/@voicesinmotionchoirs9841 (accessed 25 January 2026). These "Train-the-trainer" resources were designed to help facilitate dementia choirs online during the COVID-19 pandemic.

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Abbreviations

The following abbreviations are used in this manuscript:

PLwD	Persons Living with Dementia
CP	Care Partner
QoL	Quality of Life
MMSE	Mini-Mental State Examination
PHQ-9	Patient Health Questionnaire-9
REML	Restricted Maximum Likelihood

References

1. Alzheimer's Disease International (ADI). World Alzheimer Report. 2015. Available online: https://www.alz.org/getmedia/4be8a3fe-b60d-4349-b167-8db03b16e272/alzheimers-facts-and-figures-2019-r.pdf (accessed on 11 December 2025).
2. Alzheimer's Association. 2019 Alzheimer's Disease Facts and Figures. *Alzheimer's Dement.* **2019**, *15*, 321–387. [CrossRef]
3. Alzheimer's Disease International (ADI). *World Alzheimer Report 2018. The State of the Art of Dementia Research: New Frontiers*; Alzheimer's Disease International (ADI): London, UK, 2018; pp. 6–7.
4. Bennett, P.N.; Wang, W.; Moore, M.; Nagle, C. Care Partner: A Concept Analysis. *Nurs. Outlook* **2017**, *65*, 184–194. [CrossRef] [PubMed]
5. Olson, D.M. Caregiver or Care-Partner. *J. Neurosci. Nurs.* **2017**, *49*, 136. [CrossRef] [PubMed]
6. Lazarus, R.S.; Folkman, S. *Stress, Appraisal, and Coping*; Springer: Berlin/Heidelberg, Germany, 1984.
7. Lazarus, R.S.; Folkman, S. *Dynamics of Stress: Physiological, Psychological and Social Perspectives*; Springer: Berlin/Heidelberg, Germany, 1986; pp. 63–80.
8. Lawton, M.P.; Moss, M.; Kleban, M.H.; Glicksman, A.; Rovine, M. A Two-Factor Model of Caregiving Appraisal and Psychological Well-Being. *J. Gerontol.* **1991**, *46*, P181–P189. [CrossRef] [PubMed]
9. Yuan, Q.; Tan, T.H.; Wang, P.; Poremski, D.; Abdin, E.; Magadi, H.; Goveas, R.; Ng, L.L.; Subramaniam, M. A Modified Transactional Model of Stress and Coping on Depressive Symptoms among Informal Caregivers of Persons with Dementia. *Sci. Rep.* **2024**, *14*, 25507. [CrossRef] [PubMed]
10. Isik, A.T.; Soysal, P.; Solmi, M.; Veronese, N. Bidirectional Relationship between Caregiver Burden and Neuropsychiatric Symptoms in Patients with Alzheimer's Disease: A Narrative Review. *Int. J. Geriatr. Psychiatry* **2019**, *34*, 1326–1334. [CrossRef] [PubMed]
11. Wennberg, A.M.; Anderson, L.R.; Cagnin, A.; Chen-Edinboro, L.P.; Pini, L. How Both Positive and Burdensome Caregiver Experiences Are Associated with Care Recipient Cognitive Performance: Evidence from the National Health and Aging Trends Study and National Study of Caregiving. *Front. Public Health* **2023**, *11*, 1130099. [CrossRef] [PubMed]
12. Black, C.M.; Ritchie, C.W.; Khandker, R.K.; Wood, R.; Jones, E.; Hu, X.; Ambegaonkar, B.M. Non-Professional Caregiver Burden Is Associated with the Severity of Patients' Cognitive Impairment. *PLoS ONE* **2018**, *13*, e0204110. [CrossRef] [PubMed]
13. Gorenko, J.; McDowell, C.; Tamburri, N.; Dujela, C.; Smith, A.P.; Sheets, D.J.; MacDonald, S.W.S. Social and Leisure Engagement Moderates the Association between Care Partner Distress and Cognitive Status of Care Recipients with Dementia. *J. Clin. Exp. Neuropsychol.* **2024**, *46*, 742–754. [CrossRef] [PubMed]
14. World Health Organization. Quality of Life Group WHOQOL-BREF: Introduction, Administration, Scoring and Generic Version of the Assessment Field Trial Version 1996. Available online: https://iris.who.int/server/api/core/bitstreams/4c40696d-8415-4141-a65f-c32041ffe6c7/content (accessed on 11 May 2026).
15. Rees, J.; O'Boyle, C.; Macdonagh, R. Quality of Life: Impact of Chronic Illness on the Partner. *J. R. Soc. Med.* **2001**, *94*, 563–566. [CrossRef] [PubMed]
16. Hazzan, A.A.; Dauenhauer, J.; Follansbee, P.; Hazzan, J.O.; Allen, K.; Omobepade, I. Family Caregiver Quality of Life and the Care Provided to Older People Living with Dementia: Qualitative Analyses of Caregiver Interviews. *BMC Geriatr.* **2022**, *22*, 86. [CrossRef] [PubMed]
17. Farina, N.; Page, T.E.; Daley, S.; Brown, A.; Bowling, A.; Basset, T.; Livingston, G.; Knapp, M.; Murray, J.; Banerjee, S. Factors Associated with the Quality of Life of Family Carers of People with Dementia: A Systematic Review. *Alzheimer's Dement.* **2017**, *13*, 572–581. [CrossRef] [PubMed]
18. Nasrun, M.W.S.; Kusumaningrum, P.; Redayani, P.; Lahino, H.L.; Mardhiyah, F.S.; Basfiansa, A.D.; Nadila, N. Relationship Between Quality of Life of People with Dementia and Their Caregivers in Indonesia. *J. Alzheimer's Dis.* **2021**, *81*, 1311–1320. [CrossRef] [PubMed]

19. Novelli, M.M.P.C.; Caramelli, P. The Influence of Neuropsychiatric and Functional Changes on Quality of Life in Alzheimer's Disease. *Dement. Neuropsychol.* **2010**, *4*, 47–53. [CrossRef] [PubMed]
20. Santos, R.L.; Sousa, M.F.B.D.; Simões-Neto, J.P.; Nogueira, M.L.; Belfort, T.T.; Torres, B.; Rosa, R.D.L.D.; Laks, J.; Dourado, M.C.N. Caregivers' Quality of Life in Mild and Moderate Dementia. *Arq. Neuropsiquiatr.* **2014**, *72*, 931–937. [CrossRef] [PubMed]
21. Takai, M.; Takahashi, M.; Iwamitsu, Y.; Oishi, S.; Miyaoka, H. Subjective Experiences of Family Caregivers of Patients with Dementia as Predictive Factors of Quality of Life. *Psychogeriatrics* **2011**, *11*, 98–104. [CrossRef] [PubMed]
22. Kowalski, K.A.; MacDonald, S.W.S.; Yeates, K.O.; Tuokko, H.A.; Rhodes, R.E. Decomposing the Within-Person and between-Person Sources of Variation in Physical Activity-Cognition Associations for Low-Active Older Adults. *Psychol. Health* **2018**, *33*, 1431–1455. [CrossRef] [PubMed]
23. Sliwinski, M.; Mogle, J. Time-Based and Process-Based Approaches to Analysis of Longitudinal Data. In *Handbook of Cognitive Aging: Interdisciplinary Perspectives*; SAGE Publications, Inc.: Thousand Oaks, CA, USA, 2008; pp. 477–491, ISBN 978-1-4129-4105-1.
24. Tamburri, N.; Trites, M.; Sheets, D.; Smith, A.; MacDonald, S. The Promise of Intergenerational Choir for Improving Psychosocial and Cognitive Health for Those with Dementia: The Voices in Motion Project. *Arbutus Rev. TAR* **2019**, *10*, 66–82. [CrossRef]
25. McDowell, C.; Tamburri, N.; Smith, A.P.; Dujela, C.; Sheets, D.J.; MacDonald, S.W.S. Exploring the Impact of Community-Based Choral Participation on Cognitive Function and Well-Being for Persons with Dementia: Evidence from the Voices in Motion Project. *Aging Ment. Health* **2023**, *27*, 930–937. [CrossRef] [PubMed]
26. Rochon, P.A.; Vozoris, N.; Gill, S.S. The Harms of Benzodiazepines for Patients with Dementia. *Can. Med. Assoc. J.* **2017**, *189*, E517–E518. [CrossRef] [PubMed]
27. American Geriatrics Society 2015 Beers Criteria Update Expert Panel. American Geriatrics Society 2015 Beers Criteria Update Expert Panel American Geriatrics Society 2015 Updated Beers Criteria for Potentially Inappropriate Medication Use in Older Adults. *J. Am. Geriatr. Soc.* **2015**, *63*, 2227–2246. [CrossRef] [PubMed]
28. Folstein, M.F.; Folstein, S.E.; McHugh, P.R. Mini-Mental State. *J. Psychiatr. Res.* **1975**, *12*, 189–198. [CrossRef] [PubMed]
29. Kroenke, K.; Spitzer, R.L.; Williams, J.B.W. The PHQ-9: Validity of a Brief Depression Severity Measure. *J. Gen. Intern. Med.* **2001**, *16*, 606–613. [CrossRef] [PubMed]
30. Saliba, D.; DiFilippo, S.; Edelen, M.O.; Kroenke, K.; Buchanan, J.; Streim, J. Testing the PHQ-9 Interview and Observational Versions (PHQ-9 OV) for MDS 3.0. *J. Am. Med. Dir. Assoc.* **2012**, *13*, 618–625. [CrossRef] [PubMed]
31. R Core Team. *A Language and Environment for Statistical Computing*; R Foundation for Statistical Computing: Vienna, Austria, 2022.
32. Peugh, J.L. A Practical Guide to Multilevel Modeling. *J. Sch. Psychol.* **2010**, *48*, 85–112. [CrossRef] [PubMed]
33. Singer, J.D.; Willett, J.B. *Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence*, 1st ed.; Oxford University Press: New York, NY, USA, 2003; ISBN 978-0-19-515296-8.
34. Martis, C.S.; Bhandary, R.P.; Chandrababu, R.; Lakshmi, R.V.; Bhandary, P.V.; Noronha, J.A.; Chakrabarty, J.; Tolson, D.; Devi, E.S. Caring Burden and Quality of Life among the Caregivers of People Living with Dementia—A Cross-Sectional Study in Udupi District of Karnataka. *Home Health Care Serv. Q.* **2024**, *43*, 191–204. [CrossRef] [PubMed]
35. Cui, P.; Yang, M.; Hu, H.; Cheng, C.; Chen, X.; Shi, J.; Li, S.; Chen, C.; Zhang, H. The Impact of Caregiver Burden on Quality of Life in Family Caregivers of Patients with Advanced Cancer: A Moderated Mediation Analysis of the Role of Psychological Distress and Family Resilience. *BMC Public Health* **2024**, *24*, 817. [CrossRef] [PubMed]
36. Liu, Z.; Heffernan, C.; Tan, J. Caregiver Burden: A Concept Analysis. *Int. J. Nurs. Sci.* **2020**, *7*, 438–445. [CrossRef] [PubMed]
37. Majer, R.; Adeyi, O.; Bagoly, Z.; Simon, V.; Csiba, L.; Kardos, L.; Hortobágyi, T.; Frecska, E. Neuropsychiatric Symptoms, Quality of Life and Caregivers' Burden in Dementia. *Open Med.* **2020**, *15*, 905–914. [CrossRef] [PubMed]
38. Tan, Y.L.; Lo, Y.K.J.; Ho, C.S.H. Psychological and Social Impacts of Frontotemporal Dementia on Caregivers and Family Members—A Systematic Review. *Gen. Hosp. Psychiatry* **2024**, *86*, 33–49. [CrossRef] [PubMed]
39. Phyo, A.Z.Z.; Freak-Poli, R.; Craig, H.; Gasevic, D.; Stocks, N.P.; Gonzalez-Chica, D.A.; Ryan, J. Quality of Life and Mortality in the General Population: A Systematic Review and Meta-Analysis. *BMC Public Health* **2020**, *20*, 1596. [CrossRef] [PubMed]
40. Sivertsen, H.; Bjørkløf, G.H.; Engedal, K.; Selbæk, G.; Helvik, A.-S. Depression and Quality of Life in Older Persons: A Review. *Dement. Geriatr. Cogn. Disord.* **2015**, *40*, 311–339. [CrossRef] [PubMed]
41. Lopez, J.; Perez-Rojo, G.; Noriega, C.; Sánchez-Cabaco, A.; Sitges, E.; Bonete, B. Quality-of-Life in Older Adults: Its Association with Emotional Distress and Psychological Wellbeing. *BMC Geriatr.* **2024**, *24*, 815. [CrossRef] [PubMed]
42. Kin, A.L.; Griffith, L.E.; Kuspinar, A.; Smith-Turchyn, J.; Richardson, J. Impact of Care–Recipient Relationship Type on Quality of Life in Caregivers of Older Adults with Dementia over Time. *Age Ageing* **2024**, *53*, afae128. [CrossRef] [PubMed]
43. Contreras, M.; Mioshi, E.; Kishita, N. Factors Predicting Quality of Life in Family Carers of People with Dementia: The Role of Psychological Inflexibility. *J. Context. Behav. Sci.* **2021**, *22*, 7–12. [CrossRef]
44. Nemcikova, M.; Katreniakova, Z.; Nagyova, I. Social Support, Positive Caregiving Experience, and Caregiver Burden in Informal Caregivers of Older Adults with Dementia. *Front. Public Health* **2023**, *11*, 1104250. [CrossRef] [PubMed]

45. Kotwal, A.A.; Allison, T.A.; Halim, M.; Garrett, S.B.; Perissinotto, C.M.; Ritchie, C.S.; Smith, A.K.; Harrison, K.L. "Relationships, Very Quickly, Turn to Nothing": Loneliness, Social Isolation, and Adaptation to Changing Social Lives Among Persons Living with Dementia and Care Partners. *Gerontologist* **2024**, *64*, gnae014. [CrossRef] [PubMed]
46. Mendez, M.F. The Relationship Between Anxiety and Alzheimer's Disease. *J. Alzheimer's Dis. Rep.* **2021**, *5*, 171–177. [CrossRef] [PubMed]
47. Justice, N.J. The Relationship between Stress and Alzheimer's Disease. *Neurobiol. Stress* **2018**, *8*, 127–133. [CrossRef] [PubMed]
48. Gao, C.; Chapagain, N.Y.; Scullin, M.K. Sleep Duration and Sleep Quality in Caregivers of Patients with Dementia: A Systematic Review and Meta-Analysis. *JAMA Netw. Open* **2019**, *2*, e199891. [CrossRef] [PubMed]
49. Mattos, M.K.; Bernacchi, V.; Shaffer, K.M.; Gallagher, V.; Seo, S.; Jepson, L.; Manning, C. Sleep and Caregiver Burden Among Caregivers of Persons Living with Dementia: A Scoping Review. *Innov. Aging* **2024**, *8*, igae005. [CrossRef] [PubMed]
50. Brewster, G.S.; Wang, D.; McPhillips, M.V.; Epps, F.; Yang, I. Correlates of Sleep Disturbance Experienced by Informal Caregivers of Persons Living with Dementia: A Systematic Review. *Clin. Gerontol.* **2024**, *47*, 380–407. [CrossRef] [PubMed]
51. Barlattani, T.; Cavatassi, A.; Bologna, A.; Socci, V.; Trebbi, E.; Malavolta, M.; Rossi, A.; Martiadis, V.; Tomasetti, C.; De Berardis, D.; et al. Glymphatic System and Psychiatric Disorders: Need for a New Paradigm? *Front. Psychiatry* **2025**, *16*, 1642605. [CrossRef] [PubMed]
52. Liu, C.; Badana, A.N.S.; Burgdorf, J.; Fabius, C.D.; Roth, D.L.; Haley, W.E. Systematic Review and Meta-Analysis of Racial and Ethnic Differences in Dementia Caregivers' Well-Being. *Gerontologist* **2021**, *61*, e228–e243. [CrossRef] [PubMed]
53. Ablitt, A.; Jones, G.V.; Muers, J. Living with Dementia: A Systematic Review of the Influence of Relationship Factors. *Aging Ment. Health* **2009**, *13*, 497–511. [CrossRef] [PubMed]
54. Martyr, A.; Nelis, S.M.; Quinn, C.; Wu, Y.-T.; Lamont, R.A.; Henderson, C.; Clarke, R.; Hindle, J.V.; Thom, J.M.; Jones, I.R.; et al. Living Well with Dementia: A Systematic Review and Correlational Meta-Analysis of Factors Associated with Quality of Life, Well-Being and Life Satisfaction in People with Dementia. *Psychol. Med.* **2018**, *48*, 2130–2139. [CrossRef] [PubMed]
55. Rapp, M.A.; Schnaider-Beeri, M.; Wysocki, M.; Guerrero-Berroa, E.; Grossman, H.T.; Heinz, A.; Haroutunian, V. Cognitive Decline in Patients with Dementia as a Function of Depression. *Am. J. Geriatr. Psychiatry* **2011**, *19*, 357–363. [CrossRef] [PubMed]
56. Pellegrino, L.D.; Peters, M.E.; Lyketsos, C.G.; Marano, C.M. Depression in Cognitive Impairment. *Curr. Psychiatry Rep.* **2013**, *15*, 384. [CrossRef] [PubMed]
57. Han, J.W.; Jeong, H.; Park, J.Y.; Kim, T.H.; Lee, D.Y.; Lee, D.W.; Ryu, S.-H.; Kim, S.-K.; Yoon, J.C.; Jhoo, J.; et al. Effects of Social Supports on Burden in Caregivers of People with Dementia. *Int. Psychogeriatr.* **2014**, *26*, 1639–1648. [CrossRef] [PubMed]
58. Johansson, M.F.; McKee, K.J.; Dahlberg, L.; Williams, C.L.; Hammar, L.M. Perceived Importance of Types and Characteristics of Support to Informal Caregivers among Spouse Caregivers of Persons with Dementia in Sweden: A Cross-Sectional Questionnaire-Based Study. *Int. J. Environ. Res. Public Health* **2024**, *21*, 1348. [CrossRef] [PubMed]
59. Cohen, S. Social Ties and Susceptibility to the Common Cold. *JAMA J. Am. Med. Assoc.* **1997**, *277*, 1940. [CrossRef]
60. Hellis, E.; Mukaetova-Ladinska, E.B. Informal Caregiving and Alzheimer's Disease: The Psychological Effect. *Medicina* **2022**, *59*, 48. [CrossRef] [PubMed]
61. Walker, C.A.; Curry, L.C.; Hogstel, M.O. Relocation Stress Syndrome in Older Adults Transitioning from Home to a Long-Term Care Facility: Myth or Reality? *J. Psychosoc. Nurs. Ment. Health Serv.* **2007**, *45*, 38–45. [CrossRef] [PubMed]
62. Brodaty, H.; Donkin, M. Family Caregivers of People with Dementia. *Dialogues Clin. Neurosci.* **2009**, *11*, 217. [CrossRef] [PubMed]

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