# Relationship between expression of gratitude by home-based care receivers and caregiver burden among family caregivers

1    **Title:** Relationship between expression of gratitude by home-based care receivers and

2    caregiver burden among family caregivers

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4    **Key words:** caregiver burden, gratitude, saying "thank you"

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6    **Short Title:** Expression of gratitude and caregiver burden

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8    **Highlight**

9    ● The frequency of gratitude expressed by a home-based care receiver was higher in the mild

10    caregiver burden group than in the severe group.

11    ● Even after adjusting for important variables, the frequency of gratitude was significantly

12    associated with caregiver burden.

13    ● In middle-aged caregivers, there was no relationship between the frequency of gratitude

14    and caregiver burden after adjusting for covariates.

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20 **Abstract**

21 **Backgrounds**

22    We focused on the frequency of "gratitude" expressed by home-based care receivers

23 towards family caregivers before they were in the condition that needed care and investigated

24 the relationship with caregiver burden.

25 **Methods**

26    This cross-sectional online survey was completed by 700 family caregivers in Japan.

27 Caregiver burden was assessed using the Zarit Burden Interview. Caregivers with a score of $\leq$

28 19 were defined as having mild caregiver burden, those with a score of 20 to 38 as having

29 moderate, and those with a score of $> 38$ as having severe. Additionally, caregivers were asked,

30 "How often did you get a 'thank you' from your care receiver before they were in a condition

31 that needed care?" Answers were scored using a 11-point Likert scale. Answers with scores 0−

32 2 were defined as low frequency of gratitude, 3−6 as middle, and 7−10 as high.

33 **Results**

34    Among all caregivers, 233 (33.3%), 229 (32.7%) and 238 (34.0%) accounted for having

35 mild, moderate and severe caregiver burden, respectively. High frequencies of gratitude of

36 48.9%, 43.7%, and 39.1%, respectively, were concluded with a significantly higher rate in the

37 mild than in the severe caregiver burden group (p = 0.03). The results of multinominal logistic

38 regression analysis, even after adjusting for several factors, show that high frequency of

39    gratitude was significantly associated with caregiver burden (p < 0.01, OR: 0.48, 95%CI: 0.28-

40    0.81).

41    **Conclusions**

42        We found the frequency of gratitude from the care receiver before they were in the

43    condition that needed care was substantially associated with caregiver burden.

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57    **Introduction**

Informal caregivers, meaning family, play a very important role in home-based care. With a rapidly increasing aging population, the number of home-based care receivers is escalating (Ministry of Health, Labor and Welfare, 2021). The family caregiver's role begins immediately from the point of the care receiver's diagnosis of disability and continues throughout the illness experience as the disease progresses (Sherman, D. W., 2019; Stajduhar, K., Funk, L., & Toye, C., 2010; Funk, L., Stajduhar, K., & Toye, C, 2010). Family caregivers need to take on a variety of roles with providing home-based care, such as bathing, dressing, feeding, toileting, housecleaning, shopping, cooking, making the medical appointments, serving as the medical interpreter, administering drugs, adjusting with external family relationships, and offering emotional and spiritual support (Sherman, D. W., 2019; Engebretson, A., Matrisian, L., & Thompson, C.,2015). Additionally, some family caregivers face financial difficulties. Many caregivers are left with no choice but to quit their jobs because of their inability to cope with the combined workload of caregiving and employment (Maresova, P., Lee, S., & Fadeyi, O., 2020). Even if they continue working, it may contribute to a high depression risk for the caregiver (Given, B., Wyatt, G., & Given, C., 2004). As a result of daily care and environmental changes, caregivers might feel physically, mentally, and economically burdened while providing home-based care.

Alleviation of caregiver burden is important to prevent negative outcomes for family caregivers. It is known that a high caregiver burden leads to various negative consequences,

77  such as psychological distress, impaired health habits, physiological responses, and psychiatric

78  and physical illness (Monin, J. K., & Schulz, R, 2009; Schulz, R., & Sherwood, P. R., 2008).

79  In addition, caregiver burden poses a high risk of mortality for caregivers themselves

80  (Christakis, N. A., & Allison, P. D., 2006).

81      Several risk factors that cause a high caregiver burden have been reported in previous studies.

82  For example, the female sex, spouse, higher frequency of care, efforts spent in caregiving and

83  lack of choice in being caregiver can lead to a high caregiver burden (Gallicchio, L., Siddiqi,

84  N., Langenberg, P., & Baumgarten, M, 2002; Beach, S. R et al., 2005; Schulz, R et al., 2012;

85  Adelman, R. D et al., 2014). Additionally, among the care receivers, situations that may be

86  associated with high care needs, such as dementia, cancer, and decreased functional status,

87  cause a high caregiver burden (Beach, S. R et al., 2005; Schulz, R et al., 2012). Based on these

88  previous findings, we need to identify the risk factors and provide social and psychological

89  support for caregivers. However, there are no well-established strategies intended for future

90  caregiver burden before care receivers are in a condition that requires care.

91      We focused on the relationships between caregivers and care receivers before they are in

92  a condition that require care. Relationships with family members have been reported to be a

93  significant aspect for well-being of individuals across the life course (Thomas, P. A., Liu, H.,

94  & Umberson, D. 2017). Generally, gratitude has traits that are characterized by habitual

95  positive well-being (Wood, A. M., Froh, J. J., & Geraghty, A. W, 2010; Tsang, J.A, 2006). In

96     addition, perceiving high levels of expression of gratitude between partners is associated with

97     greater satisfaction and commitment in the long-term (Park, Y., Impett, E. A., MacDonald, G.,

98     & Lemay, E. P, 2019). However, the effects of gratitude from care receivers to caregivers on

99     future levels of caregiver burden are still unclear in the area of home-based care. We expected

100     that a good relationship between spouses, parents, and children may have a positive impact on

101     future caregiver burden. In this study, we turned our attention to the frequency of "gratitude"

102     from care receivers to caregivers at a time before they were in a condition that required care.

103         The aim of this study was to investigate the relationship between the frequency of

104     gratitude from care receivers before they were in a situation that required care and caregiver

105     burden. We hypothesized that a high frequency of gratitude from care receivers could be

106     associated with a low caregiver burden. In addition, we examined whether the effect of

107     gratitude from care receivers on caregiver burden may vary with the caregiver's age.

108 **Methods**

109 *Participants*

110     For this study, 700 family caregivers completed an online survey from February 4 to 7,

111 2021, in Japan. The inclusion criteria included adults who were 20 to 89 years old and was

112 related to a home-based care receiver, usually the spouse or parents (including parents in-law).

113 In this study, we included family caregivers regardless of the care receiver's age, or the nature

114 and severity if their disease. This study was conducted in accordance with the guidelines

115 proposed by the Declaration of Helsinki, and the study protocol was reviewed and approved

116 by the Ethics Committee of the Faculty of Human Sciences, University of Tsukuba.

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118 *Caregiver burden measurement*

119     The caregiver burden score was assessed using the Zarit Burden Interview (ZBI) (Zarit SH,

120 Orr NK, Zarit JM, 1985), which consists of 22 items questionnaire. The caregivers were asked

121 to rate the degree of their burden on a Likert scale ranging from 0 ("never") to 4 ("always").

122 The maximum score was 88, and higher scores indicated a higher caregiver burden. Using the

123 tertile score of the ZBI, caregivers below the 1st tertile (ZBI $\leq$ 19) were defined as having mild

124 caregiver burden, those within the 1st and 3rd tertile (19 < ZBI $\leq$ 38) were defined as having

125 moderate caregiver burden, and those above the 3rd tertile (38 < ZBI) were defined as having

126 severe caregiver burden.

127

128 *Frequency of gratitude*

129     We assessed the frequency of gratitude from the care receivers before the onset of condition

130 that needed care. The caregivers were asked, "How often did you get 'thank you' from your

131 care receiver before the onset of their condition?" and answered the question using a 11-point

132 Likert scale ranging from 0 ("very infrequently") to 10 ("very frequently"). We defined

133 answers that scored 0−2 as low frequency, 3−6 as middle frequency, and 7−10 as high

134 frequency.

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136 *Demographic data in caregivers and care receivers*

137     We investigated demographic data for both caregivers and care receivers. For caregivers,

138 the following items were obtained: age, sex, body mass index (BMI), care period [year(s)],

139 time [hour(s)/day], and day [day(s)/week]. We also assessed several demographic data that

140 were obtained from the care receivers like: age, gender, BMI, relationship to caregiver, Barthel

141 Index (BI), comorbidities, long-term care insurance levels, and use of care services (e.g.,

142 visiting care and nursing, rehabilitation, day service).

143

144 *Statistical analysis*

145       The Kruskal Wallis test and chi-square test were used to compare the frequency of gratitude,

146 and the characteristics of the caregiver and the care receiver, between the mild, moderate and

147 severe caregiver burden group. We used multinominal logistic regression analyses to examine

148 the association between caregiver burden and the frequency of gratitude from care receivers.

149 In the multinominal logistic regression analysis, the three levels of frequency of gratitude were

150 used as independent variables (reference, low frequency), and caregiver burden levels were

151 used as dependent variables (reference, mild caregiver burden). Demographic details and other

152 significant variables were used as covariates to adjust for confounding factors in the

153 multinominal logistic regression models.

154       The data were analyzed using IBM SPSS Statistics for Mac, version 27.0. Inc., Tokyo,

155 Japan). A p value less than 0.05 was considered to indicate statistical significance for all

156 analyses.

157

158 **Results**

159       The caregivers' characteristics are presented in Table 1. Of the total number of caregivers,

160 233 (33.3%) were in the mild caregiver burden group, 229 (32.7%) in the moderate caregiver

161 burden group, and 238 (34.0%) in the severe caregiver burden group. Within the older and

162 middle-aged groups, the presence of mild caregiver burden was observed in 90 (38.8%) and

163 143 (30.6%) caregivers, moderate caregiver burden in 73 (31.5%) and 156 (33.3%) caregivers,

164 and severe caregiver burden in 69 (29.7%) and 169 (36.1%) caregivers, respectively. Overall,

165 significant differences between the three caregiver burden groups were identified for the times

166 and days when care was provided to care receivers ($p < 0.01$) and among caregiver burden

167 scores ($p < 0.01$). The care times for care receivers and the caregiver burden score for both

168 older and middle-aged caregiver populations were significantly different between the three

169 caregiver burden groups.

170     The characteristics of the care receivers are listed in Table 2. Among the overall care

171 receivers, significant differences between the three caregiver burden groups were observed

172 with regard to the care receiver BI points ($p < 0.01$), comorbid neurological disorders ($p < 0.01$),

173 dementia ($p < 0.01$), long-term care insurance levels ($p < 0.01$) and use of care service ($p <$

174 0.01). It was found that among care receivers who were cared for mostly by older caregivers,

175 age ($p = 0.04$), the care receiver BI points ($p < 0.01$), and long-term care insurance levels ($p <$

176 0.01) were particularly different in the three caregiver burden groups. Among care receivers

177 who were cared for by middle-aged caregivers, the proportion of females ($p = 0.02$), care

178 receiver BI points ($p < 0.01$), comorbid-dementia ($p = 0.048$), long-term care insurance levels

179 ($p < 0.01$) and use of care service ($p < 0.01$) were significantly different between the three

180 groups.

181     Figure 1 shows the relationship between the frequency of gratitude from the care receiver

182 before they were in a condition that needed care, and the caregiver burden. In the mild,

183     moderate and severe caregiver burden groups, the low frequency of gratitude was 17.2%,

184     19.2% and 28.2%, middle frequency was 33.9%, 37.1% and 32.8%, and high frequency was

185     48.9%, 43.7% and 39.1%, respectively (Figure 1A). The high frequency rate was significantly

186     higher in the mild caregiver burden group than in the severe caregiver burden group ($p = 0.03$)

187     among overall caregivers (Figure 1A). Additionally, among older caregivers, the high

188     frequency of gratitude was 63.3%, 56.2% and 37.7%, respectively, and the rate was

189     significantly higher in the mild caregiver burden group than in the severe caregiver burden

190     group ($p < 0.01$) (Figure 1B).

191         The results of the multinominal logistic regression analysis are summarized in Tables 3

192     and 4. In the crude model of the mild vs severe caregiver burden, high frequency of gratitude

193     from care receivers at a time before they were in the condition that required care was

194     significantly associated with caregiver burden ($p < 0.01$), with an odds ratio (OR) of 0.49 and

195     95% interval (95% CI) of 0.30-0.79 (Table 3). Additionally, after adjusting for full covariates

196     in Model 4, there was an association between high frequency of gratitude with caregiver burden

197     ($p < 0.01$, OR: 0.48, 95%CI: 0.28-0.81) (Table 3). We also performed a subgroup analysis

198     among the older caregivers and found that a high frequency of gratitude from care receivers

199     was significantly associated with caregiver burden in the crude model of the mild vs severe

200     caregiver burden ($p < 0.01$, OR: 0.29, 95%CI: 0.12-0.68). After adjustment in Model 4, a high

201     frequency was still significantly associated with caregiver burden ($p < 0.01$, OR: 0.25, 95%CI:

202 0.09-0.68) (Table 4A) as in the crude model. Among middle-aged caregivers, a middle

203 frequency of gratitude from care receivers was significantly associated with caregiver burden

204 in the crude model (p < 0.05, OR:0.54, 95%CI: 0.30-0.99). However, there was no association

205 between frequency of gratitude and caregiver burden after adjustment in Models 2, 3, and 4

206 (Table 4B).

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208 **Discussion**

209     In this study, we found that the frequency of gratitude from care receivers before they were

210 in a condition that required care by the caregivers was significantly higher in the mild caregiver

211 burden group than in the severe caregiver burden group. Additionally, even after adjusting for

212 some important variables, the frequency of gratitude was significantly associated with

213 caregiver burden, which supports our hypothesis. Contrastingly, there was no association

214 between the frequency of gratitude and caregiver burden in middle-aged caregivers.

215     Expression of gratitude from care receivers to caregivers may contribute to building a good

216 relationship between family, which can alleviate caregiver burden. It is known that high

217 frequency of expressing gratitude from partners or spouses can ease anxiety and increase

218 satisfaction (Park, Y., Impett, E. A., MacDonald, G., & Lemay, E. P, 2019). Additionally, a

219 prior study has found that expression of gratitude not only strengthens the relationship between

220 two individuals (grateful donor/recipient) but also that with a third party, who witnessed the

221     expression of gratitude. As per the findings, it was observed that the third parties were

222     themselves more helpful toward a person who expressed gratitude (Algoe, S. B, 2020). Thus,

223     caregivers who received high frequency of gratitude were able to understand the disabled

224     condition the care receivers were in, and likely would not feel caregiver burden more than

225     caregivers who received a low frequency of gratitude. In addition, family members might also

226     become tolerant and cooperative towards care receivers. As a result, the main caregiver's

227     caregiver burden could have been reduced.

228         However, no significant association was found between the frequency of gratitude and

229     caregiver burden in middle-aged caregivers. Although the majority of the relationship between

230     caregiver and care receiver was spouse in the older caregivers, the main relationship was parent

231     and child in the middle-aged caregivers group. Therefore, the factors that influence caregiver

232     burden may differ between older and middle-aged caregivers. Additionally, it has been reported

233     that care stress was larger for younger than older caregivers because younger caregivers may

234     have more competing roles such as work and family responsibilities (Pinquart, M, 2003). From

235     the above differences, middle-aged caregivers might not show an association between the

236     frequency of gratitude and caregiver burden unlike the older caregiver burden group.

237         The strengths and limitations of the present study are as follows: The primary strength of

238     this study is that the frequency of gratitude, which is a simple, practical, and variable indicator

239     was used. Many factors associated with caregiver burden which are invariable, have been

240     reported. Among them, the importance of expression of gratitude to partner and/or family

241     member which is variable factor was presented. The study also explored the importance of

242     family relationships in daily life before the need for care. Relationships between caregivers and

243     care receivers before they were in a condition that required care were focused on. However,

244     simultaneously, there may be a recall bias because we assessed the frequency of gratitude

245     before care needs. Additionally, there was a sampling bias because the participants in this study

246     could use Internet-connected devices and were registered with a survey company.

247         In conclusion, the frequency of gratitude from the care receivers before the onset of a

248     condition that requires care was significantly associated with caregiver burden. However, the

249     present study suggests social support and mental communication before the onset of a situation

250     that requires care is important for alleviating caregiver burden: expressing gratitude frequently

251     might contribute to good relationship between family members, and thus, help in alleviating

252     caregiver burden in the future.

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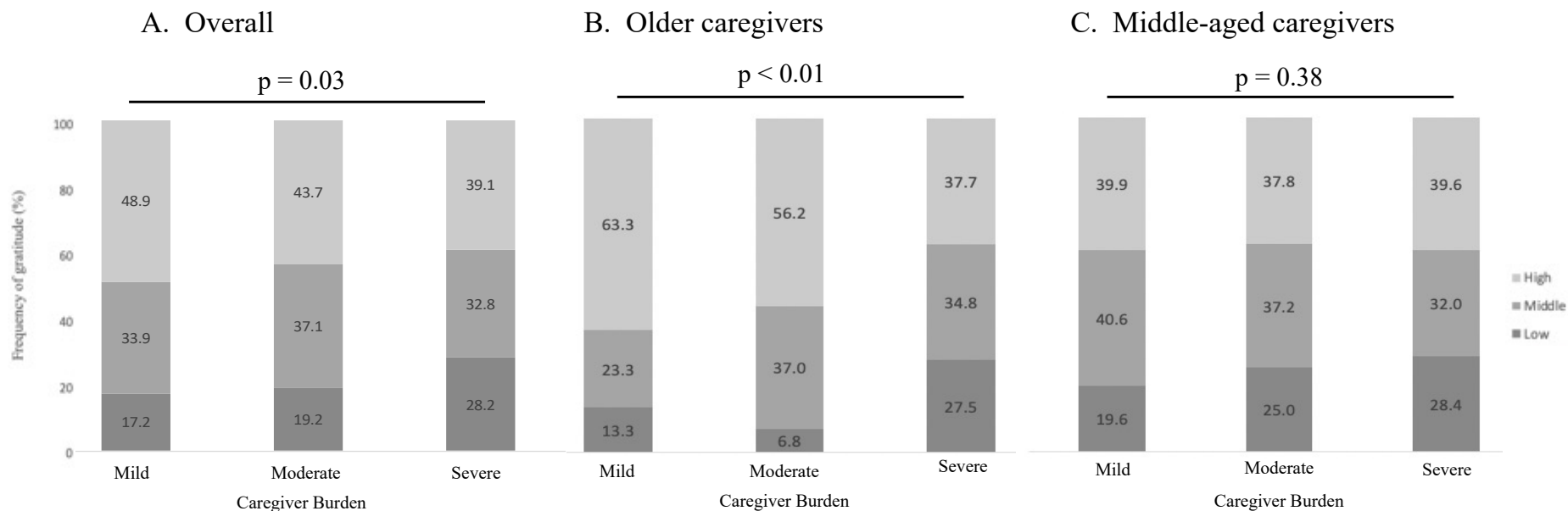
Figure 1. The relationship between frequency of gratitude from care receivers before developing a condition that required care.

The frequency of gratitude from care receivers was investigated using a 11-point Likert scale. Scores from 0−2 were defined as low frequency, 3−6 as middle frequency, and 7−10 as high frequency for caregivers. Differences in the frequency of gratitude for the mild, moderate and severe caregiver burden groups were assessed using the Chi-squared test.

Table 1. Characteristics of the caregivers

| | Overall | | | | Older caregivers | | | | Middle-aged caregivers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mild Caregiver Burden (n=233) | Moderate Caregiver Burden (n=229) | Severe Caregiver Burden (n=238) | p | Mild Caregiver Burden (n=90) | Moderate Caregiver Burden (n=73) | Severe Caregiver Burden (n=69) | p | Mild Caregiver Burden (n=143) | Moderate Caregiver Burden (n=156) | Severe Caregiver Burden (n=169) | p |
| Age (years) | 60.0 (42.0-60.0) | 57.0 (41.0-67.0) | 53.0 (41.0-66.0) | 0.06 | 70.0 (67.0-73.0) | 71.0 (67.0-73.5) | 70.0 (67.0-72.0) | 0.39 | 48.0 (39.0-57.0) | 44.0 (39.0-57.0) | 44.0 (38.0-55.5) | 0.62 |
| Female, n (%) | 113 (48.5) | 107 (46.7) | 130 (54.6) | 0.20 | 41 (45.6) | 35 (47.9) | 40 (58.0) | 0.27 | 72 (50.3) | 72 (46.2) | 90 (53.3) | 0.44 |
| Body Mass Index (kg/m$^2$) | 22.0 (19.8-24.4) | 21.9 (19.7-24.3) | 21.6 (19.7-23.6) | 0.58 | 22.2 (20.6-24.7) | 22.2 (19.7-24.9) | 21.6 (20.2-23.1) | 0.33 | 21.8 (19.5-24.3) | 21.6 (19.7-24.0) | 21.6 (19.5-24.0) | 0.96 |
| Care periods [year(s)] | 2.0 (1.0-5.0) | 3.0 (1.0-5.0) | 2.5 (1.0-5.0) | 0.07 | 3.0 (1.0-5.0) | 3.0 (2.0-5.0) | 3.0 (1.5-5.0) | 0.39 | 2.0 (1.0-4.0) | 2.0 (1.0-4.0) | 2.0 (1.0-5.0) | 0.03 |
| Care times [hour(s)/day] | 1.0 (1.0-3.0) | 3.0 (2.0-5.0) | 4.0 (2.0-7.0) | < 0.01 | 2.0 (1.0-3.0) | 3.0 (2.0-5.0) | 4.0 (2.0-8.0) | < 0.01 | 1.0 (1.0-3.0) | 3.0 (2.0-5.0) | 4.0 (2.0-7.0) | < 0.01 |
| Care days [day(s)/week] | 3.0 (1.0-7.0) | 4.0 (2.0-7.0) | 5.0 (3.0-7.0) | < 0.01 | 3.5 (1.0-7.0) | 5.0 (2.0-7.0) | 5.0 (2.0-7.0) | 0.21 | 2.0 (1.0-5.0) | 4.0 (2.0-6.0) | 5.0 (3.0-7.0) | < 0.01 |
| Caregiver burden score (points) | 7.0 (0-13.0) | 28.0 (23.0-33.0) | 47.0 (43.0-61.3) | < 0.01 | 7.5 (2.8-13.0) | 26.0 (22.0-32.0) | 47.0 (42.5-61.0) | < 0.01 | 6.0 (0-13.0) | 28.5 (23.0-33.0) | 47.0 (43.5-62.0) | < 0.01 |

All indicators are expressed in median (IQR) aside from the categorical data

Table 2. Characteristics of the care receivers

| | Overall | | | | Older caregivers | | | | Middle-aged caregivers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mild Caregiver Burden (n=233) | Moderate Caregiver Burden (n=229) | Severe Caregiver Burden (n=238) | p | Mild Caregiver Burden (n=90) | Moderate Caregiver Burden (n=73) | Severe Caregiver Burden (n=69) | p | Mild Caregiver Burden (n=143) | Moderate Caregiver Burden (n=156) | Severe Caregiver Burden (n=169) | p |
| Age (years) | 80.0 (70.0-88.0) | 80.0 (70.0-88.0) | 79.0 (69.0-87.0) | 0.27 | 81.5 (72.0-91.3) | 88.0 (77.0-94.0) | 81.0 (72.0-91.0) | 0.04 | 79.0 (68.0-86.0) | 78.0 (69.0-85.0) | 79.0 (64.5-85.0) | 0.88 |
| Female, n (%) | 151 (64.8) | 127 (55.5) | 129 (54.2) | 0.04 | 59 (65.6) | 52 (71.2) | 39 (55.6) | 0.18 | 92 (64.3) | 75 (48.1) | 90 (53.3) | 0.02 |
| Body Mass Index (kg/m$^2$) | 21.6 (19.4-23.8) | 22.2 (19.6-24.9) | 21.5 (19.0-23.8) | 0.14 | 21.6 (19.4-24.1) | 22.2 (20.0-24.6) | 21.1 (19.2-23.8) | 0.27 | 21.6 (19.2-23.8) | 22.0 (19.5-25.0) | 21.5 (19.0-23.8) | 0.40 |
| Relationship to caregiver, n (%) | | | | 0.09 | | | | 0.13 | | | | 0.17 |
| Husband | 46 (19.7) | 45 (19.7) | 52 (21.8) | | 25 (26.7) | 21 (28.8) | 29 (42.0) | | 21 (14.7) | 24 (15.4) | 23 (13.6) | |
| Wife | 54 (23.2) | 38 (16.6) | 37 (15.5) | | 32 (35.6) | 18 (24.7) | 19 (27.5) | | 22 (15.4) | 20 (12.8) | 18 (10.7) | |
| Father | 31 (13.3) | 44 (19.2) | 46 (19.3) | | 3 (3.3) | 2 (2.7) | 4 (5.8) | | 28 (19.6) | 42 (26.9) | 42 (24.9) | |
| Mother | 75 (32.2) | 70 (30.6) | 79 (33.2) | | 20 (22.2) | 24 (32.9) | 14 (20.3) | | 55 (38.5) | 46 (29.5) | 65 (38.5) | |
| Father-in-law | 6 (2.6) | 6 (2.6) | 12 (5.0) | | 3 (3.3) | 0 (0) | 0 (0) | | 3 (2.1) | 6 (3.8) | 12 (7.1) | |
| Mother-in-law | 21 (9.0) | 26 (11.4) | 12 (5.0) | | 7 (7.8) | 9 (11.0) | 3 (4.3) | | 14 (9.8) | 18 (11.5) | 9 (5.3) | |
| Barthel Index (points) | 85.0 (55.0-100) | 75.0 (55.0-90.0) | 70.0 (50.0-90.0) | < 0.01 | 85.0 (58.8-100) | 70.0 (52.5-90.0) | 70.0 (50.0-90.0) | < 0.01 | 85.0 (55.0-100) | 75.0 (55.0-90.0) | 70.0 (47.5-95.0) | < 0.01 |
| Comorbidities, n (%) | | | | | | | | | | | | |
| Cancer | 24 (10.3) | 31 (13.5) | 28 (11.8) | 0.56 | 11 (12.2) | 14 (19.2) | 7 (10.1) | 0.25 | 13 (9.1) | 17 (10.9) | 21 (12.4) | 0.64 |
| Heart failure | 26 (11.2) | 21 (9.2) | 37 (15.5) | 0.09 | 11 (12.2) | 6 (8.2) | 9 (13.0) | 0.61 | 15 (10.5) | 15 (9.6) | 28 (16.6) | 0.12 |
| Diabetes | 26 (11.2) | 35 (15.3) | 35 (14.7) | 0.38 | 10 (11.1) | 9 (12.3) | 5 (7.2) | 0.58 | 16 (11.2) | 26 (16.7) | 30 (17.8) | 0.24 |
| Liver disease | 1 (0.4) | 2 (0.9) | 4 (1.7) | 0.38 | 0 (0) | 1 (1.4) | 1 (1.4) | 0.53 | 1 (0.7) | 1 (0.6) | 3 (1.8) | 0.54 |
| Kidney disease | 7 (3.0) | 8 (3.5) | 11 (4.6) | 0.64 | 3 (3.3) | 3 (4.1) | 4 (5.8) | 0.75 | 4 (2.8) | 5 (3.2) | 7 (4.1) | 0.80 |
| Pulmonary disease | 21 (9.0) | 13 (5.7) | 24 (10.1) | 0.20 | 8 (8.9) | 2 (2.7) | 6 (8.7) | 0.24 | 13 (9.1) | 11 (7.1) | 18 (10.7) | 0.53 |
| Orthopedic disorder | 35 (15.0) | 38 (16.6) | 49 (20.6) | 0.26 | 10 (11.1) | 11 (15.1) | 11 (15.9) | 0.63 | 25 (17.5) | 27 (17.3) | 38 (22.5) | 0.41 |
| Falls and fractures | 27 (11.6) | 45 (19.7) | 38 (16.0) | 0.06 | 12 (13.3) | 15 (20.5) | 13 (18.8) | 0.44 | 15 (10.5) | 30 (19.2) | 25 (14.8) | 0.11 |
| Neurological disorder | 4 (1.7) | 11 (4.8) | 19 (8.0) | < 0.01 | 1 (1.1) | 3 (4.1) | 6 (8.7) | 0.07 | 3 (2.1) | 8 (5.1) | 13 (7.7) | 0.08 |
| Dementia | 33 (14.2) | 49 (21.4) | 63 (26.5) | < 0.01 | 12 (13.3) | 17 (23.3) | 19 (27.5) | 0.07 | 21 (14.7) | 32 (20.5) | 44 (26.0) | 0.048 |
| Stroke | 28 (12.0) | 36 (15.7) | 39 (16.4) | 0.36 | 9 (10.0) | 10 (13.7) | 10 (14.5) | 0.65 | 19 (13.3) | 26 (16.7) | 29 (17.2) | 0.61 |
| Depression | 6 (2.6) | 8 (3.5) | 10 (4.2) | 0.62 | 1 (1.1) | 4 (5.5) | 1 (1.4) | 0.17 | 5 (3.5) | 4 (2.6) | 9 (5.3) | 0.42 |
| Long-term Care Insurance levels, n (%) | | | | < 0.01 | | | | < 0.01 | | | | 0.02 |
| none | 77 (33.0) | 45 (19.7) | 57 (23.9) | | 28 (31.1) | 17 (25.3) | 15 (21.7) | | 49 (34.3) | 28 (17.9) | 42 (24.9) | |
| support care level 1 | 31 (13.3) | 21 (9.2) | 19 (8.0) | | 10 (11.1) | 3 (4.1) | 9 (13.0) | | 21 (14.7) | 18 (11.5) | 10 (5.9) | |
| support care level 2 | 28 (12.0) | 26 (11.4) | 21 (8.8) | | 17 (18.9) | 4 (5.5) | 6 (8.7) | | 11 (7.7) | 22 (14.1) | 15 (8.9) | |
| nursing care level 1 | 22 (9.4) | 35 (15.3) | 24 (10.1) | | 10 (11.1) | 12 (16.4) | 5 (7.2) | | 12 (8.4) | 23 (14.7) | 19(11.2) | |
| nursing care level 2 | 23 (9.9) | 47 (20.5) | 47 (19.7) | | 6 (6.7) | 17 (23.3) | 15 (21.7) | | 17 (11.9) | 30 (19.2) | 32 (18.9) | |
| nursing care level 3 | 27 (11.6) | 34 (14.8) | 34 (14.3) | | 12 (13.3) | 16 (21.9) | 6 (8.7) | | 15 (10.5) | 18 (11.5) | 28 (16.6) | |
| nursing care level 4 | 14 (6.0) | 11 (4.8) | 21 (8.8) | | 4 (4.4) | 3 (4.1) | 9 (13.0) | | 10 (7.0) | 8 (5.1) | 12 (7.1) | |
| nursing care level 5 | 11 (4.7) | 10 (4.4) | 15 (6.3) | | 3 (3.3) | 1 (1.4) | 4 (5.8) | | 8 (5.6) | 9 (5.8) | 11 (6.5) | |
| Use of care service, n (%) | 119 (51.1) | 170 (74.2) | 152 (63.9) | < 0.01 | 55 (61.1) | 56 (76.7) | 43 (62.3) | 0.08 | 64 (44.8) | 114 (73.1) | 109 (64.5) | < 0.01 |

All indicators are expressed in median (IQR) aside from the categorical data

Table 3. Multinominal logistic regression to determine the association between the caregiver burden and the frequency of expression of gratitude from care receivers before the onset of a situation that required care among all caregivers.

| | | Crude | | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | OR | 95%CI | OR | 95%CI | OR | 95%CI | OR | 95%CI | OR | 95%CI |
| **Caregiver burden Mild vs Moderate** | | | | | | | | | | | |
| Frequency of gratitude | Low | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. |
| | Middle | 0.98 | 0.58-1.66 | 0.98 | 0.58-1.66 | 1.03 | 0.60-1.76 | 1.07 | 0.62-1.83 | 1.02 | 0.58-1.78 |
| | High | 0.80 | 0.48-1.32 | 0.80 | 0.48-1.34 | 0.85 | 0.50-1.43 | 0.86 | 0.51-1.46 | 0.73 | 0.42-1.27 |
| **Caregiver burden Mild vs Severe** | | | | | | | | | | | |
| Frequency of gratitude | Low | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. |
| | Middle | 0.59 | 0.36-0.97 | 0.59 | 0.36-0.98 | 0.62 | 0.37-1.03 | 0.67 | 0.40-1.13 | 0.64 | 0.38-1.11 |
| | High | 0.49** | 0.30-0.79 | 0.52** | 0.32-0.84 | 0.56* | 0.34-0.91 | 0.58* | 0.35-0.97 | 0.48** | 0.28-0.81 |

$**p < 0.01$, $*p < 0.05$

OR, odds ratio; CI, confidence interval.

Model 1: Adjusted for caregiver's age, sex, and BMI

Model 2: Model 1 + adjustment for care receiver's age, sex, BMI, relationship to caregiver

Model 3: Model 2 + adjustment for the care receiver's Barthel index, comorbidities (neurological disorder, and dementia), long-term care insurance levels

Model 4: Model 3 + adjustment for care periods, care times, care days, use of care services

Table 4A. Multinominal logistic regression to determine the association between the caregiver burden and the frequency of expression of gratitude from care receivers before the onset of a situation that required care among older caregivers.

| | | Crude | | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | OR | 95%CI | OR | 95%CI | OR | 95%CI | OR | 95%CI | OR | 95%CI |
| **Caregiver burden Mild vs Moderate** | | | | | | | | | | | |
| Frequency of gratitude | Low | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. |
| | Middle | 3.09 | 0.94-10.13 | 3.22 | 0.97-10.64 | 3.32 | 0.99-11.16 | 2.97 | 0.87-10.20 | 3.33 | 0.94-11.85 |
| | High | 1.73 | 0.56-5.28 | 1.80 | 0.58-5.55 | 1.83 | 0.58-5.75 | 1.63 | 0.51-5.26 | 1.40 | 0.42-4.64 |
| **Caregiver burden Mild vs Severe** | | | | | | | | | | | |
| Frequency of gratitude | Low | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. |
| | Middle | 0.72 | 0.29-1.83 | 0.78 | 0.31-2.01 | 0.79 | 0.31-2.06 | 0.78 | 0.29-2.11 | 0.98 | 0.34-2.81 |
| | High | 0.29** | 0.12-0.68 | 0.31** | 0.13-0.75 | 0.32* | 0.13-0.77 | 0.27** | 0.11-0.70 | 0.25** | 0.09-0.68 |

**p< 0.01, *p < 0.05

OR, odds ratio; CI, confidence interval.

Model 1: Adjusted for caregiver's age, sex, and BMI

Model 2: Model 1 + adjustment for care receiver's age, sex, BMI, relationship to caregiver

Model 3: Model 2 + adjustment for the care receiver's Barthel index, comorbidities (neurological disorder, and dementia), long-term care insurance levels

Model 4: Model 3 + adjustment for care periods, care times, care days, use of care services

Table 4B. Multinominal logistic regression to determine the association between the caregiver burden and the frequency of expression of gratitude from care receivers before the onset of a situation that required care among middle-aged caregivers.

| | | Crude | | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | OR | 95%CI | OR | 95%CI | OR | 95%CI | OR | 95%CI | OR | 95%CI |
| **Caregiver burden Mild vs Moderate** | | | | | | | | | | | |
| Frequency of gratitude | Low | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. |
| | Middle | 0.72 | 0.39-1.32 | 0.72 | 0.39-1.32 | 0.77 | 0.41-1.42 | 0.80 | 0.43-1.49 | 0.70 | 0.36-1.36 |
| | High | 0.74 | 0.41-1.36 | 0.73 | 0.39-1.34 | 0.81 | 0.43-1.52 | 0.83 | 0.44-1.57 | 0.73 | 0.38-1.43 |
| **Caregiver burden Mild vs Severe** | | | | | | | | | | | |
| Frequency of gratitude | Low | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. | 1.00 | Ref. |
| | Middle | 0.54* | 0.30-0.99 | 0.54* | 0.30-0.98 | 0.56 | 0.30-1.02 | 0.62 | 0.33-1.15 | 0.53 | 0.28-1.03 |
| | High | 0.69 | 0.38-1.23 | 0.69 | 0.38-1.25 | 0.75 | 0.41-1.38 | 0.80 | 0.43-1.49 | 0.67 | 0.35-1.28 |

$**p < 0.01$, $*p < 0.05$

OR, odds ratio; CI, confidence interval.

Model 1: Adjusted for caregiver's age, sex, and BMI

Model 2: Model 1 + adjustment for care receiver's age, sex, BMI, relationship to caregiver

Model 3: Model 2 + adjustment for the care receiver's Barthel Index, comorbidities (neurological disorder, and dementia), long-term care insurance levels

Model 4: Model 3 + adjustment for care periods, care times, care days, use of care services