Association Between Cohabitation Status and Sleep Quality in Families of Persons With Dementia in Korea: A Cross-sectional Study

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Objectives: The aim of this study was to identify the association between cohabitation status and sleep quality in family members of people with dementia (PwDs).

Methods: Data of 190 365 participants aged ≥19 years from the 2018 Korea Community Health Survey were analyzed. Participants were categorized according to their cohabitation status with PwDs. Multiple logistic regression and ordinal logistic regression analyses were performed to evaluate the relationship between the cohabitation status of PwDs' relatives and sleep quality measured using the Pittsburgh Sleep Quality Index (PSQI) and PSQI subscales.

Results: Compared to participants without PwDs in their families, both cohabitation and non-cohabitation with PwDs were associated with poor sleep quality (cohabitation, male: odds ratio [OR],1.28; 95% confidence interval [CI], 1.08 to 1.52; female: OR, 1.40; 95% CI, 1.20 to 1.64; non-cohabitation, male: OR, 1.14; 95% CI, 1.05 to 1.24; female: OR, 1.23; 95% CI, 1.14 to 1.33). In a subgroup analysis, non-cohabiting family members showed the highest odds of experiencing poor sleep quality when the PwD lived alone (male: OR, 1.48; 95% CI, 1.14 to 1.91; female: OR, 1.58; 95% CI, 1.24 to 2.01). Cohabiting male and female participants had higher odds of poor subjective sleep quality and use of sleeping medications than non-cohabiting male and female participants, respectively.

Conclusions: The residence of PwDs and cohabitation status may contribute to poor sleep quality among PwDs' family members. The circumstances faced by cohabiting and non-cohabiting family members should be considered when evaluating sleep quality in family members of PwDs, and appropriate interventions may be needed to improve sleep quality in both cohabiting and non-cohabiting family members.

Key words: Sleep quality, Dementia, Cohabitation status, Family of a dementia patient, Residence of a dementia patient

INTRODUCTION

Approximately 50 million people have dementia worldwide, and nearly 10 million new cases occur every year [1]. As no treatment to date is available to cure dementia or to alter its progressive course, dementia is one of the representative diseases that cause disabling and burdensome health issues [2]. A loved one's diagnosis of dementia can be one of the saddest events in a person's life and comes with special challenges. Since a dementia diagnosis is confirmed well after the onset of

symptoms, the family of a person with dementia (PwD) may not be able to understand the PwD's behavior before a diagnosis is established [3]. Because PwDs experience relentless cognitive deterioration and corresponding behavioral changes, they require the support of caregivers for many hours of the day; moreover, family members may feel confused about their newfound roles as caregivers post-diagnosis. Although approximately 90% of PwDs are institutionalized before their death, approximately 84% of PwDs worldwide live at home until their family cannot care for them [4,5].

Family members of PwDs may not only experience physical burdens, but also psychological or emotional burdens such as guilt arising from the belief that it is their responsibility to care for their relative [6,7]. Thus, being a caregiver may be associated with exposure to stress, a decrease in subjective physical health and social networking, and an increased risk of depression and mortality [8-10].

Another problem of long-term care for dementia patients is sleep disturbances in their family members. Sleep disturbances are associated with a high risk of cardiovascular disease, depressive symptoms, and all-cause mortality [11,12]. A previous study reported that approximately two-thirds of caregivers for PwDs experienced sleep disturbances [13,14]; and most studies on sleep quality in family members of PwDs have focused on family caregivers living with PwDs. However, family members may feel guilty and lonely even if they do not live with a PwD [15], and strong negative and weak positive emotions can affect sleep quality in non-cohabiting family members [16].

Although the existence of dementia patients in the family may adversely affect the sleep quality of family members, no study has yet examined sleep quality according to the cohabitation status of family members of PwDs. Therefore, this study investigated the association between the cohabitation status of family members of PwDs and sleep quality based on the quantitative and subjective aspects of sleep using the Korean version of the Pittsburgh Sleep Quality Index (PSQI-K) [17].

METHODS

Study Population and Data

The study data were obtained from the Korea Community Health Survey (KCHS) in 2018. The KCHS is a nationwide survey of public health and health behaviors that has been administered by the Korea Disease Control and Prevention Agency (formerly the Korea Centers for Disease Control and Preven-

tion) since 2008. The dataset used in this study is publicly available on the KCHS's official website (https://chs.kdca.go.kr/chs/). Stratified cluster sampling methods were used to select sample areas, and systematic sampling methods were used to select sample households in the KCHS. A trained interviewer personally visited the households selected for the sample and conducted a survey with adults aged ≥19 years living within these households. The questionnaire comprised approximately 201 items in 21 areas and included questions on demographic characteristics, subjective health levels, health-related behaviors, and chronic disease history.

In total, 228 340 people participated in the 2018 KCHS. Participants who did not identify their cohabitation status with a PwD or had missing data on covariates were excluded from this study. People from single-person households whose sleep quality was unlikely to be affected by other family members and participants with dementia were also excluded. Finally, 190 365 participants were included.

Variables

The main dependent variable was sleep quality, which was measured using the PSQI-K, a tool for evaluating sleep quality and quantity during the past month. The Pittsburgh Sleep Quality Index (PSQI) is the gold standard screening tool for evaluating sleep dysfunction and has been validated in both clinical and non-clinical samples [18,19]. The PSQI-K also showed high sensitivity and specificity and was previously validated [17]. The PSQI-K comprises 18 questions using a 4-point Likert scale (0-3) that are categorized into 7 subscales for sleep and daytime functions: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medication, and daytime dysfunction. The questions on the PSQI-K and the detailed method of calculating the scores for the 7 components based on each question are presented in Supplemental Material 1. The global PSQI score is the sum of the scores for each subscale and ranges from 0 to 21. In this study, a score of ≤5 indicated good sleep quality, and a score of >5 indicated poor sleep quality [20]. Previous research validated the use of a cut-off point of 5 in the PSQI-K [21,22]. Furthermore, the internal reliability of the PSQI-K used in this study was examined using Cronbach's alpha coefficient for internal consistency. Cronbach's alpha was 0.75 for the total PSQI-K score, indicating high reliability.

The independent variable was the cohabitation status of family members of PwDs. Participants were classified into the

following 3 groups depending on whether they had a PwD in their family and whether they lived with the PwD: family members without a PwD (reference group), non-cohabiting family members of a PwD, and family members cohabiting with a PwD. Furthermore, the non-cohabiting family members were subdivided based on the residence of the PwD.

This study included demographic and socioeconomic characteristics (age, marital status, the number of family members and cohabiting generations, educational level, income level, and employment status), the number of chronic diseases (hypertension and diabetes mellitus), depressive symptoms, and health-related behaviors (smoking status, alcohol consumption, and physical activity) as covariates. Depressive symptoms were evaluated using the Patient Health Questionnaire-9 (PHQ-9), and categorized as either present (PHQ-9 score ≥ 10) or absent (PHQ-9 score <10) [23]. Participants with high physical activity levels were defined as those who walked ≥ 30 min/d for ≥ 5 d/wk.

Statistical Analysis

All analyses were conducted separately for male and female in consideration of the factors influencing sex differences in sleep quality [22,24]. We used the chi-square test to assess differences in the frequencies and proportions of categorical variables. Multiple logistic regression analysis was performed to examine the association between cohabitation status and sleep quality after adjusting for covariates. Subgroup analyses were conducted to evaluate the association of the residence of PwDs with sleep quality in their family members, and then the data were analyzed by cohabitation status using multiple logistic regression analyses. Finally, for the dependent subgroup analyses, multivariable ordinal logistic regression analysis was conducted to investigate the association between cohabitation status and the PSQI components. The response variables for dependent subgroup analyses were categorical variables that had 4 possible levels with an ordinal nature (e.g., subjective sleep quality: very good, fairly good, fairly bad, and very bad) [25]. All statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA), and a weighted logistic regression procedure was used to account for the complex and stratified sampling design of the KCHS. Two-sided p-values <0.05 were considered to indicate statistical significance.

Ethics Statement

Since the KCHS is a survey conducted by the government for the public welfare, ethics approval for the KCHS was waived by the Bioethics and Safety Act, 2015.

Table 1. General characteristics of the study subjects

Characteristics	Sleep quality							
	Male (n=89 197)				Female (n=101 168)			
	Total	Poor (PSQI>5)	Good (PSQI≤5)	p-value	Total	Poor (PSQI>5)	Good (PSQI≤5)	p-value
Total (n=190 365)	89 197	30 814 (34.5)	58 383 (65.5)		101 168	45 496 (45.0)	55 672 (55.0)	
Cohabitation status				<0.001				<0.001
Cohabiting family members of a PwD	1174	526 (44.8)	648 (55.2)		1302	736 (56.5)	566 (43.5)	
Non-cohabiting family members of a PwD	4034	1497 (37.1)	2537 (62.9)		4596	2220 (48.3)	2376 (51.7)	
Family members without a PwD	83 989	28 791 (34.3)	55 198 (65.7)		95 270	42 540 (44.7)	52 730 (55.3)	
Age (y)				<0.001				<0.001
19-29	9905	2907 (29.3)	6998 (70.7)		11 052	4099 (37.1)	6953 (62.9)	
30-39	11 557	3839 (33.2)	7718 (66.8)		13 959	5613 (40.2)	8346 (59.8)	
40-49	15 508	5174 (33.4)	10 334 (66.6)		18 178	6935 (38.2)	11 243 (61.8)	
50-59	17 534	5807 (33.1)	11 727 (66.9)		21 549	9608 (44.6)	11 941 (55.4)	
60-69	16 794	5835 (34.7)	10 959 (65.3)		18 552	9193 (49.6)	9359 (50.4)	
≥70	17 899	7252 (40.5)	10 647 (59.5)		17 878	10 048 (56.2)	7830 (43.8)	
Marital status				<0.001				<0.001
Never married	14 844	4725 (31.8)	10 119 (68.2)		12 317	4441 (36.1)	7876 (63.9)	
Divorced, widowed or separated	3398	1510 (44.4)	1888 (55.6)		12 493	6604 (52.9)	5889 (47.1)	
Married	70 955	24 579 (34.6)	46 376 (65.4)		76 358	34 451 (45.1)	41 907 (54.9)	

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Table 1. Continued from the previous page

Characteristics	Sleep quality							
	Male (n=89 197)				Female (n=101 168)			
	Total	Poor (PSQI>5)	Good (PSQI≤5)	*p*-value	Total	Poor (PSQI>5)	Good (PSQI≤5)	*p*-value
No. of family members				0.004				<0.001
2-4	81 036	28 113 (34.7)	52 923 (65.3)		90 503	41 001 (45.3)	49 502 (54.7)	
≥5	8161	2701 (33.1)	5460 (66.9)		10 665	4495 (42.1)	6170 (57.9)	
No. of cohabiting generations				<0.001				<0.001
Over two generations	6572	2218 (33.7)	4354 (66.3)		9397	4280 (45.5)	5117 (54.5)	
Two generations	46 790	15 839 (33.9)	30 951 (66.1)		54 582	23 369 (42.8)	31 213 (57.2)	
One (couple)	35 835	12 757 (35.6)	23 078 (64.4)		37 189	17 847 (48.0)	19 342 (52.0)	
Family income level				<0.001				<0.001
Very low	12 060	4997 (41.4)	7063 (58.6)		13 648	7255 (53.2)	6393 (46.8)	
Low	26 006	9599 (36.9)	16 407 (63.1)		29 420	14 506 (49.3)	14 914 (50.7)	
High	24 447	7883 (32.2)	16 564 (67.8)		27 859	11 742 (42.1)	16 117 (57.9)	
Very high	26 684	8335 (31.2)	18 349 (68.8)		30 241	11 993 (39.7)	18 248 (60.3)	
Highest level of education				<0.001				<0.001
Illiterate	3364	1513 (45.0)	1851 (55.0)		10 553	6023 (57.1)	4530 (42.9)	
Elementary school	11 363	4553 (40.1)	6810 (59.9)		16 212	8664 (53.4)	7548 (46.6)	
Middle school	9953	3797 (38.1)	6156 (61.9)		10 857	5323 (49.0)	5534 (51.0)	
High school	33 281	11 018 (33.1)	22 263 (66.9)		33 035	13 925 (42.2)	19 110 (57.8)	
College and above	31 236	9933 (31.8)	21 303 (68.2)		30 511	11 561 (37.9)	18 950 (62.1)	
Employment status				<0.001				<0.001
Unemployed	22 448	8741 (38.9)	13 707 (61.1)		46 324	22 689 (49.0)	23 635 (51.0)	
Blue-collar worker	37 603	12 827 (34.1)	24 776 (65.9)		20 460	9389 (45.9)	11 071 (54.1)	
Pink-collar worker	8948	2875 (32.1)	6073 (67.9)		15 467	6465 (41.8)	9002 (58.2)	
White-collar worker	20 198	6371 (31.5)	13 827 (68.5)		18 917	6953 (36.8)	11 964 (63.2)	
Alcohol consumption (times/wk)				<0.001				<0.001
>1	32 293	11 624 (36.0)	20 669 (64.0)		10 966	5086 (46.4)	5880 (53.6)	
0-1	37 771	12 303 (32.6)	25 468 (67.4)		51 879	22 327 (43.0)	29 552 (57.0)	
Never	19 133	6887 (36.0)	12 246 (64.0)		38 323	18 083 (47.2)	20 240 (52.8)	
Smoking status				<0.001				<0.001
Current	30 289	10 836 (35.8)	19 453 (64.2)		2474	1477 (59.7)	997 (40.3)	
Past	34 227	12 419 (36.3)	21 808 (63.7)		2050	1144 (55.8)	906 (44.2)	
Never	24 681	7559 (30.6)	17 122 (69.4)		96 644	42 875 (44.4)	53 769 (55.6)	
Physical activity				<0.001				<0.001
Low	48 500	17 371 (35.8)	31 129 (64.2)		56 457	26 180 (46.4)	30 277 (53.6)	
High	40 697	13 443 (33.0)	27 254 (67.0)		44 711	19 316 (43.2)	25 395 (56.8)	
Depressive symptoms				<0.001				<0.001
No	87 151	29 050 (33.3)	58 101 (66.7)		97 224	41 943 (43.1)	55 281 (56.9)	
Yes	2046	1764 (86.2)	282 (13.8)		3944	3553 (90.1)	391 (9.9)	
No. of chronic diseases[1]				<0.001				<0.001
≥1	28 526	10 931 (38.3)	17 595 (61.7)		28 143	14 954 (53.1)	13 189 (46.9)	
0	60 671	19 883 (32.8)	40 788 (67.2)		73 025	30 542 (41.8)	42 483 (58.2)	

Values are presented as number or number (%).
PSQI, Pittsburgh Sleep Quality Index; PwD, person with dementia.
[1]A chronic disease was defined as a diagnosis of hypertension or diabetes mellitus; The number of chronic diseases is the sum of the number of the above diagnoses.

RESULTS

The participants' general characteristics are described in Table 1. Of the 190 365 participants, 89 197 (46.9%) were male. 30 814 (34.5%) of the male participants and 45 496 (45.0%) of the female participants experienced poor sleep quality. Among the male family members of a PwD, 1174 lived with the PwD and 4034 lived separately from the PwD. Moreover, 526 (44.8%) cohabiting male family members of PwDs and 1497 (37.1%) non-cohabiting family members experienced poor sleep quality. In contrast, 736 (56.5%) of the 1302 cohabiting female family members and 2220 (48.3%) of the 4596 non-cohabiting female family members reported poor sleep quality. Table 2 outlines the general characteristics of participants with cohabitation status. Overall, family members living with PwDs were more likely to be divorced, have ≥5 family members, live with ≥2 generations, have low income, be unemployed, or have depression or chronic disease. In contrast, non-cohabiting family members of PwDs were more likely to have a higher family income and education level.

Table 3 presents the factors associated with poor sleep quality. After adjusting for covariates, cohabiting family members of PwDs were more likely to have poor sleep quality than members of families without a PwD. These results were significant in both male (odds ratio [OR],1.28; 95% confidence interval [CI], 1.08 to 1.52) and female (OR, 1.40; 95% CI, 1.20 to 1.64). Furthermore, non-cohabiting family members of PwDs also showed higher odds of poor sleep quality than family members without a PwD (male: OR, 1.14; 95% CI, 1.05 to 1.24; female: OR, 1.23; 95% CI, 1.14 to 1.33). In subgroup analyses, a very low family income level and the presence of depressive symptoms were associated with poor sleep quality in both sexes among non-cohabiting family members of PwDs. A low-level of education was associated with poor sleep quality in male participants (Supplemental Material 2). Among cohabiting family members with PwDs, an age of 50-59 years, a very low family income level, a low-level of education, and depressive symptoms were associated with poor sleep quality in both sexes. Divorced male participants were also more likely to have poor sleep quality than married male participants (Supplemental Material 3).

Figure 1 presents the analysis of sleep quality in family members of PwDs according to the PwD's residence. Among non-cohabiting relatives, the odds of having poor sleep quality significantly increased when the PwD lived alone (male: OR, 1.48; 95% CI, 1.14 to 1.91; female: OR, 1.58; 95% CI, 1.24 to 2.01) or

with other family members (male: OR, 1.16; 95% CI, 1.01 to 1.35; female: OR, 1.34; 95% CI, 1.17 to 1.54). However, when the PwD lived in a nursing facility, the sleep quality of non-cohabiting family members did not differ from that of family members without a PwD.

Figure 2 shows the results of multivariable ordinal logistic regression analysis of the association between the cohabitation status of family members of PwDs and PSQI subscales. In female participants, the presence of a PwD in the family regardless of cohabitation status was significantly associated with poor subjective sleep quality, sleep disturbances, and daytime dysfunction. In male participants, the presence of a PwD in the family regardless of cohabitation status was associated with short sleep duration, poor sleep efficiency, sleep disturbances, and daytime dysfunction. Additionally, cohabiting male participants had a higher probability of poor subjective sleep quality (OR, 1.32; 95% CI, 1.15 to 1.51) and cohabiting female participants were more likely to use sleeping medications (OR, 1.36; 95% CI, 1.06 to 1.74) and experience daytime dysfunction (OR, 1.13; 95% CI, 1.00 to 1.27) than non-cohabiting male and female relatives of PwDs.

DISCUSSION

This study revealed that family members living with PwDs had significantly higher odds of experiencing poor sleep quality, similar to the results of previous studies [13]. Among family members living with PwDs, a very low family income level and low-level of education were associated with poor sleep quality in both male and female participants. As in previous studies, people living with PwDs were more likely to have depression or chronic diseases than their counterparts [13].

In 2019, more than 16 million family members and other unpaid caregivers provided about 18.6 billion hours of care to individuals with dementia, worth nearly US$244 billion [26]. Moreover, the caregivers' burden is known to be higher in those who care for individuals with dementia than in those who care for individuals with other chronic diseases [27]. Individuals living with a PwD may face various challenges in caring for the PwD every day and may need to make care-related decisions [28]. However, caregivers are often unprepared for their roles and responsibilities, are not very familiar with treatment options, are uncertain about patient preferences, and often do not get expert support in making decisions [28,29]. In this study, a low-level of education may have been related to inexperience in

Table 2. Demographic characteristics of participants according to cohabitation status

Variables	Total	Cohabitation status			p-value
		Family members without a PwD	Non-cohabiting family members of a PwD	Cohabiting family members of a PwD	
Male (n=89 197)	89 197	83 989 (94.2)	4034 (4.5)	1174 (1.3)	
Age (y)					<0.001
19-29	9905	9224 (11.0)	590 (14.6)	91 (7.8)	
30-39	11 557	11 180 (13.3)	318 (7.9)	59 (5.0)	
40-49	15 508	14 647 (17.4)	717 (17.8)	144 (12.3)	
50-59	17 534	16 070 (19.1)	1187 (29.4)	277 (23.6)	
60-69	16 794	15 731 (18.7)	840 (20.8)	223 (19.0)	
≥70	17 899	17 137 (20.4)	382 (9.5)	380 (32.4)	
Marital status					<0.001
Never married	14 844	13 887 (16.5)	749 (18.6)	208 (17.7)	
Divorced, widowed or separated	3398	3203 (3.8)	89 (2.2)	106 (9.0)	
Married	70 955	66 899 (79.7)	3196 (79.2)	860 (73.3)	
No. of family members					<0.001
2-4	81 036	76 401 (91.0)	3678 (91.2)	957 (81.5)	
≥5	8161	7588 (9.0)	356 (8.8)	217 (18.5)	
No. of cohabiting generations					<0.001
Over two generations	6572	6050 (7.2)	201 (5.0)	321 (27.3)	
Two generations	46 790	43 864 (52.2)	2409 (59.7)	517 (44.0)	
One (couple)	35 835	34 075 (40.6)	1424 (35.3)	336 (28.6)	
Family income level					<0.001
Very low	12 060	11 431 (13.6)	378 (9.4)	251 (21.4)	
Low	26 006	24 646 (29.3)	959 (23.8)	401 (34.2)	
High	24 447	23 084 (27.5)	1099 (27.2)	264 (22.5)	
Very high	26 684	24 828 (29.6)	1598 (39.6)	258 (22.0)	
Highest level of education					<0.001
Illiterate	3364	3225 (3.8)	65 (1.6)	74 (6.3)	
Elementary school	11 363	10 841 (12.9)	318 (7.9)	204 (17.4)	
Middle school	9953	9426 (11.2)	367 (9.1)	160 (13.6)	
High school	33 281	31 125 (37.1)	1714 (42.5)	442 (37.6)	
College and above	31 236	29 372 (35.0)	1570 (38.9)	294 (25.0)	
Employment status					<0.001
Unemployed	22 448	21 113 (25.1)	870 (21.6)	465 (39.6)	
Blue-collar worker	37 603	35 479 (42.2)	1653 (41.0)	471 (40.1)	
Pink-collar worker	8948	8404 (10.0)	469 (11.6)	75 (6.4)	
White-collar worker	20 198	18 993 (22.6)	1042 (25.8)	163 (13.9)	
Alcohol consumption (times/wk)					<0.001
>1	32 293	30 404 (36.2)	1498 (37.1)	391 (33.3)	
0-1	37 771	35 487 (42.3)	1859 (46.1)	425 (36.2)	
Never	19 133	18 098 (21.5)	677 (16.8)	358 (30.5)	
Smoking status					0.134
Current	30 289	28 525 (34.0)	1386 (34.4)	378 (32.2)	
Past	34 227	32 181 (38.3)	1554 (38.5)	492 (41.9)	
Never	24 681	23 283 (27.7)	1094 (27.1)	304 (25.9)	
Physical activity					0.003
Low	48 500	45 632 (54.3)	2172 (53.8)	696 (59.3)	
High	40 697	38 357 (45.7)	1862 (46.2)	478 (40.7)	
Depressive symptoms					<0.001
No	87 151	82 096 (97.7)	3944 (97.8)	1111 (94.6)	
Yes	2046	1893 (2.3)	90 (2.2)	63 (5.4)	
No. of chronic diseases[1]					<0.001
≥1	28 526	26 877 (32.0)	1191 (29.5)	458 (39.0)	
0	60 671	57 112 (68.0)	2843 (70.5)	716 (61.0)	

Table 2. Continued from the previous page

Variables	Total	Cohabitation status			p-value
		Family members without a PwD	Non-cohabiting family members of a PwD	Cohabiting family members of a PwD	
Female (n=101 168)	101 168	95 270 (94.2)	4596 (4.5)	1302 (1.3)	
Age (y)					<0.001
19-29	11 052	10 356 (10.9)	599 (13.0)	97 (7.5)	
30-39	13 959	13 477 (14.1)	420 (9.1)	62 (4.8)	
40-49	18 178	16 902 (17.7)	1094 (23.8)	182 (14.0)	
50-59	21 549	19 846 (20.8)	1425 (31.0)	278 (21.4)	
60-69	18 552	17 569 (18.4)	752 (16.4)	231 (17.7)	
≥70	17 878	17 120 (18.0)	306 (6.7)	452 (34.7)	
Marital status					<0.001
Never married	12 317	11 497 (12.1)	670 (14.6)	150 (11.5)	
Divorced, widowed, or separated	12 493	11 892 (12.5)	344 (7.5)	257 (19.7)	
Married	76 358	71 881 (75.4)	3582 (77.9)	895 (68.7)	
No. of family members					<0.001
2-4	90 503	85 296 (89.5)	4162 (90.6)	1045 (80.3)	
≥5	10 665	9974 (10.5)	434 (9.4)	257 (19.7)	
No. of cohabiting generations					<0.001
Over two generations	9397	8762 (9.2)	247 (5.4)	388 (29.8)	
Two generations	54 582	51 201 (53.7)	2805 (61.0)	576 (44.2)	
One (couple)	37 189	35 307 (37.1)	1544 (33.6)	338 (26.0)	
Family income level					<0.001
Very low	13 648	12 927 (13.6)	438 (9.5)	283 (21.7)	
Low	29 420	27 888 (29.3)	1087 (23.7)	445 (34.2)	
High	27 859	26 264 (27.6)	1295 (28.2)	300 (23.0)	
Very high	30 241	28 191 (29.6)	1776 (38.6)	274 (21.0)	
Highest level of education					<0.001
Illiterate	10 553	10 102 (10.6)	186 (4.0)	265 (20.4)	
Elementary school	16 212	15 473 (16.2)	453 (9.9)	286 (22.0)	
Middle school	10 857	10 207 (10.7)	506 (11.0)	144 (11.1)	
High school	33 035	30 799 (32.3)	1877 (40.8)	359 (27.6)	
College and above	30 511	28 689 (30.1)	1574 (34.2)	248 (19.0)	
Employment status					<0.001
Unemployed	46 324	43 701 (45.9)	1912 (41.6)	711 (54.6)	
Blue-collar worker	20 460	19 410 (20.4)	802 (17.4)	248 (19.0)	
Pink-collar worker	15 467	14 402 (15.1)	854 (18.6)	211 (16.2)	
White-collar worker	18 917	17 757 (18.6)	1028 (22.4)	132 (10.1)	
Alcohol consumption (times/wk)					<0.001
>1	10 966	10 295 (10.8)	556 (12.1)	115 (8.8)	
0-1	51 879	48 703 (51.1)	2626 (57.1)	550 (42.2)	
Never	38 323	36 272 (38.1)	1414 (30.8)	637 (48.9)	
Smoking status					0.004
Current	2474	2334 (2.4)	120 (2.6)	20 (1.5)	
Past	2050	1913 (2.0)	94 (2.0)	43 (3.3)	
Never	96 644	91 023 (95.5)	4382 (95.3)	1239 (95.2)	
Physical activity					<0.001
Low	56 457	53 196 (55.8)	2461 (53.5)	800 (61.4)	
High	44 711	42 074 (44.2)	2135 (46.5)	502 (38.6)	
Depressive symptoms					<0.001
No	97 224	91 639 (96.2)	4404 (95.8)	1181 (90.7)	
Yes	3944	3631 (3.8)	192 (4.2)	121 (9.3)	
No. of chronic diseases[1]					<0.001
≥1	28 143	26 665 (28.0)	963 (21.0)	515 (39.6)	
0	73 025	68 605 (72.0)	3633 (79.0)	787 (60.4)	

Values are presented as number or number (%).
PwD, person with dementia.
[1]A chronic disease was defined as a diagnosis of hypertension or diabetes mellitus; The number of chronic diseases is the sum of the number of the above diagnoses.

Table 3. Factors associated with poor sleep quality

Variables	Poor sleep quality (PSQI>5)	
	Male	Female
Cohabitation status		
Cohabiting family members of a PwD	1.28 (1.08, 1.52)	1.40 (1.20, 1.64)
Non-cohabiting family members of a PwD	1.14 (1.05, 1.24)	1.23 (1.14, 1.33)
Family members without a PwD	1.00 (reference)	1.00 (reference)
Age (y)		
19-29	0.86 (0.77, 0.96)	0.82 (0.74, 0.92)
30-39	1.04 (0.95, 1.14)	0.84 (0.78, 0.93)
40-49	0.97 (0.89, 1.06)	0.77 (0.72, 0.85)
50-59	0.92 (0.85, 0.99)	0.89 (0.83, 0.96)
60-69	0.90 (0.84, 0.96)	0.94 (0.88, 1.01)
≥70	1.00 (reference)	1.00 (reference)
Marital status		
Never married	1.00 (0.93, 1.07)	0.79 (0.73, 0.85)
Divorced, widowed or separated	1.32 (1.20, 1.45)	1.03 (0.97, 1.09)
Married	1.00 (reference)	1.00 (reference)
No. of family members		
2–4	1.00 (0.93, 1.08)	1.05 (0.98, 1.13)
≥5	1.00 (reference)	1.00 (reference)
No. of cohabiting generations		
Over two generations	1.05 (0.96, 1.16)	1.04 (0.96, 1.13)
Two generations	1.12 (1.07, 1.17)	1.08 (1.03, 1.13)
One (couple)	1.00 (reference)	1.00 (reference)
Family income level		
Very low	1.21 (1.13, 1.30)	1.20 (1.12, 1.29)
Low	1.15 (1.09, 1.22)	1.14 (1.08, 1.19)
High	1.01 (0.96, 1.06)	1.01 (0.97, 1.06)
Very high	1.00 (reference)	1.00 (reference)
Highest level of education		
Illiterate	1.41 (1.25, 1.59)	1.44 (1.32, 1.58)
Elementary school	1.31 (1.21, 1.41)	1.45 (1.35, 1.57)
Middle school	1.27 (1.18, 1.36)	1.30 (1.22, 1.40)
High school	1.05 (1.00, 1.10)	1.09 (1.04, 1.14)
College and above	1.00 (reference)	1.00 (reference)
Employment status		
Unemployed	1.08 (1.01,1.15)	1.12 (1.06, 1.17)
Blue-collar worker	1.01 (0.96, 1.07)	0.99 (0.93, 1.06)
Pink-collar worker	0.97 (0.91, 1.04)	0.98 (0.92, 1.04)
White-collar worker	1.00 (reference)	1.00 (reference)
Alcohol consumption (times/wk)		
>1	1.18 (1.12, 1.25)	1.26 (1.18, 1.33)
0-1	1.05 (1.00, 1.11)	1.11 (1.07, 1.15)
Never	1.00 (reference)	1.00 (reference)
Smoking status		
Current	1.21 (1.15, 1.27)	1.52 (1.36, 1.71)
Past	1.19 (1.13, 1.25)	1.52 (1.36, 1.71)
Never	1.00 (reference)	1.00 (reference)

(*Continued to the next*)

Table 3. Continued from the previous

Variables	Poor sleep quality (PSQI>5)	
	Male	Female
Physical activity		
Low	1.10 (1.06, 1.14)	1.11 (1.07, 1.14)
High	1.00 (reference)	1.00 (reference)
Depressive symptoms		
No	0.09 (0.07, 0.10)	0.09 (0.08, 0.10)
Yes	1.00 (reference)	1.00 (reference)
No. of chronic disease[1]		
≥1	1.18 (1.13, 1.23)	1.18 (1.12, 1.23)
0	1.00 (reference)	1.00 (reference)

Values are presented as adjusted odds ratio (95% confidence interval).
PSQI, Pittsburgh Sleep Quality Index; PwD, person with dementia.
[1]A chronic disease was defined as a diagnosis of hypertension or diabetes mellitus; The number of chronic diseases is the sum of the number of the above diagnoses.

responding to unpredictable situations in caring for dementia patients, which may have been linked to poor sleep quality. Our findings demonstrated the need to develop and to apply appropriate interventions such as education for caring for dementia patients, as well as financial support, to reduce the caregiving burden on family members living with a PwD to improve their sleep quality.

Interestingly, even family members not living with a PwD were more likely to have poor sleep quality than family members without a PwD. Factors associated with poor sleep quality among the non-cohabiting group were a very low family income level and presence of depressive symptoms in both sexes and a low-level of education in male participants. These results imply that a low economic level—that is, the economic burden—in non-cohabiting family members of PwDs, as with cohabiting family members, may adversely affect sleep quality [30]. In addition, low-levels of education, which were associated with poor sleep quality in male participants, are inseparable from the economic burden. This can be explained by the traditional Korean gender role for men, who are primarily responsible for household finances [31]. Depressive symptoms were also found to be highly associated with poor sleep quality in cohabitating and non-cohabitating family members, so they are essential to consider when planning a management policy for the families of PwDs [30,31].

Furthermore, the results of subgroup analyses based on the PwDs' residence showed that non-cohabiting family members of a PwD had significantly higher odds of having poor sleep quality when the PwD lived alone or with other family mem-
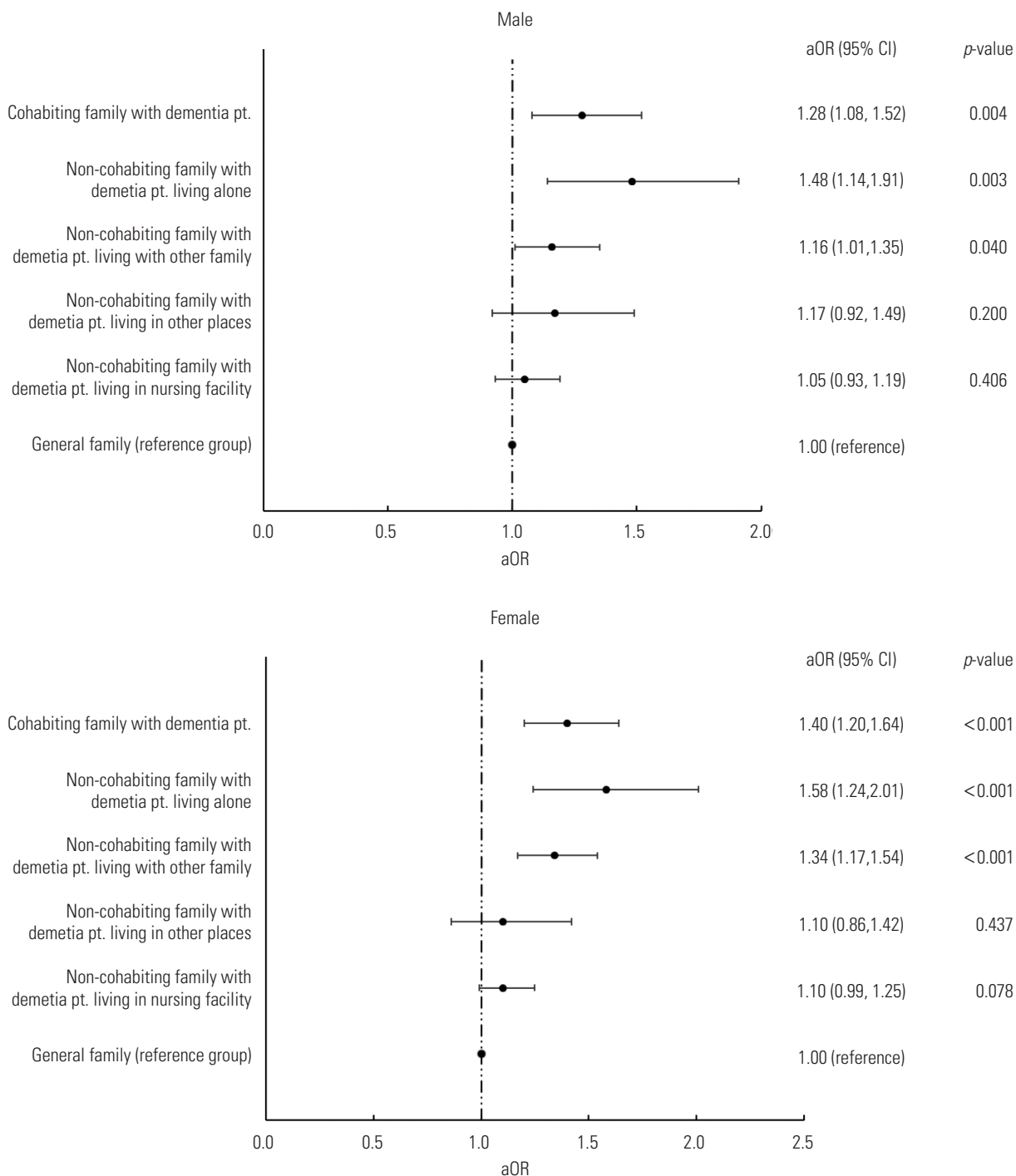
Figure 1. Association of cohabitation status and residence of a person with dementia (PwD) with sleep quality in family members (A: male B: female) of a PwD. pt., patients; aOR, adjusted odds ratio; CI, confidence interval.

bers. When the PwD lived alone, the probability of a family member experiencing poor sleep quality was the most prominent, which was presumably due to guilt and anxiety about not caring for the PwD directly [32]. Previous research reported that approximately 65% of caregivers for PwDs express feelings of guilt [33,34] and caregiving–related distress predicted sleep problems [35]. In contrast, when the PwD lived in a nursing facility, there was no significant difference in sleep quality between family members of a PwD and those without a PwD. This may be explained by the results of a previous study, which reported
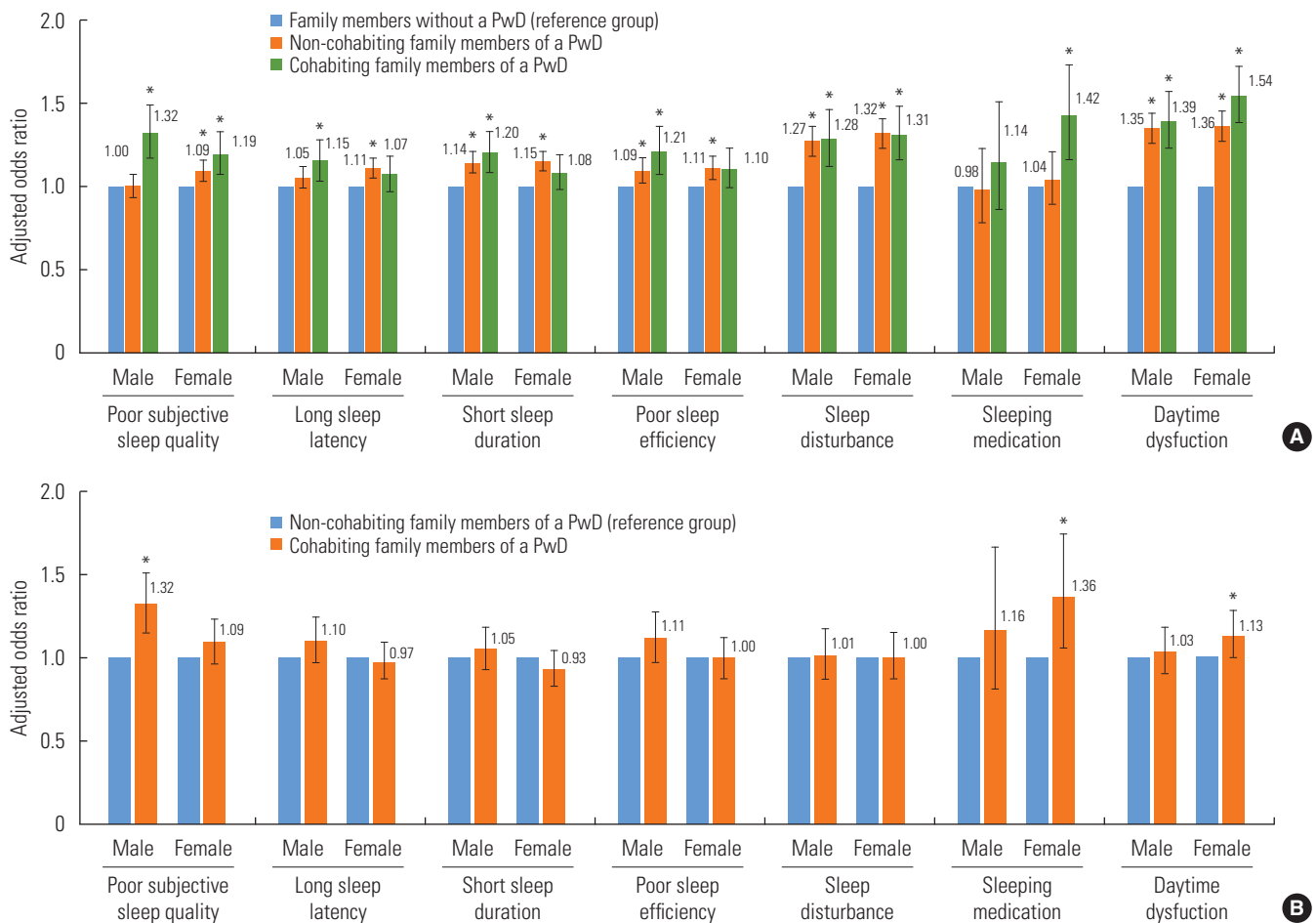
Figure 2. Association between the cohabitation status of family members of a person with dementia (PwD) and the Pittsburgh Sleep Quality Index subscales using multivariable ordinal logistic regression. (A) Family members without a PwD as the reference group. (B) Non-cohabiting family members of a PwD as the reference group. *$p<0.05$.

that family members of PwDs felt relief, but also had a troubled conscience, when placing a relative with dementia in a nursing home [36]. In other words, family members who relocated the PwD to a nursing facility showed ambivalence, and it can be assumed that this was reflected in sleep quality. These results imply that non-cohabiting family members of a PwD, especially those of a PwD who lives alone, may require appropriate interventions that consider the differences in their circumstances such as the "New Orange Plan," a comprehensive support system for PwDs via home-visit nurses in Japan [32].

Another notable finding was that cohabiting male and female relatives of a PwD had a higher probability of poor subjective sleep quality and use of sleeping medications than non-cohabiting male and female family members of a PwD, respectively. These results indicate that when investigating the cause of poor sleep quality and developing appropriate interventions

in family members of PwDs, researchers should consider the difference between male and female family members.

Our study has some limitations. First, it was not possible to identify the exact roles of the family members regarding caregiving and the burden of caregivers, since there were no survey data on caring for home-dwelling persons with dementia. The perceived health of caregivers varies depending on the level of the caregivers' burden, and this burden is not the same for all family members [37]. Therefore, the sleep quality of family members can be affected by the relationship with the PwD and the role of other family members. Second, it was not possible to consider the type and severity of dementia, because the KCHS did not contain this information. The caregiving burden and quality of life of caregivers may vary according to the type of dementia, such as frontotemporal dementia or Alzheimer's disease, as well as the severity or symptoms of dementia;

thus, further studies are needed to consider these factors [38]. Third, the duration of caregiving may affect caregivers' sleep quality, although we were unable to consider these factors in our study. Fourth, ordinal logistic regression was used to analyze the association between cohabitation status and the PSQI subscales because the items corresponding to each score were not uniform and previous studies were conducted through ordinal logistic regression [25,39], but there is a great deal of controversy about whether to use an ordinal model or a continuous model with respect to Likert-scale measurements [40]. Finally, the study's cross-sectional nature did not allow us to clearly identify the direction of the relationship between cohabitation status and sleep quality. Further longitudinal studies are required to establish a causal relationship.

Despite these limitations, our research has notable strengths. First, this study was based on nationwide representative data collected from 253 community health centers and 35 universities. Second, to the best of our knowledge, this is the first study to evaluate the association between the cohabitation status of family members of PwDs and sleep quality measured by the PSQI, a suitable tool for measuring sleep quality in the general population. Our research implies that appropriate interventions for improving sleep quality in family members of PwDs need to be developed and applied, regardless of whether family members live with a PwD.

In conclusion, our research suggests that cohabitation status, the place where the PwD lives, and financial status can all affect sleep quality. Therefore, it is necessary to understand the circumstances influencing cohabiting and non-cohabiting family members when evaluating sleep quality in family members of PwDs, and appropriate interventions may be needed to improve sleep quality in both cohabiting and non-cohabiting family members.

SUPPLEMENTAL MATERIALS

Supplemental materials are available at https://doi.org/10.3961/jpmph.21.077.

CONFLICT OF INTEREST

The authors have no conflicts of interest associated with the material presented in this paper.

AUTHOR CONTRIBUTIONS

Conceptualization: SHK, ECP. Data curation: SHK, MP, SHJ. Formal analysis: SHK. Funding acquisition: None. Methodology: SHK, ECP. Visualization: SHK, MP, SHJ. Writing – original draft: SHK. Writing – review & editing: MP, SHJ, SIJ, ECP.

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