

# BMJ Open Effects of number and gender of offspring on quality of life among older adults: evidence from the Korean Longitudinal Study of Aging, 2006–2012

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## ABSTRACT

**Objectives:** We examined correlations between number and gender of offspring and health-related quality of life (HRQoL) and quality of life (QoL) in older adults.

**Setting:** We used data from the 2006–2012 data sets of the Korean Longitudinal Study of Aging.

**Participants:** There were 10 242, 8680, 7907 and 7480 participants in 2006, 2008, 2010 and 2012, respectively.

**Interventions:** Number and gender of offspring.

**Primary and secondary outcome measures:** We measured participants' QoL and HRQoL using a visual analogue scale developed by the Korea Labour Institute and which is similar to the EQ-VAS, a European measure.

**Results:** We estimated the HRQoL and QoL of individuals with offspring. Estimates for the HRQoL and QoL of parents with no offspring were –7.762 and –9.384, respectively (both  $p < 0.0001$ ) versus parents with two offspring. For parents with five or more offspring, the estimates for the HRQoL and QoL were –1.529 and 0.885, respectively ( $p < 0.001$  and  $p < 0.017$ , respectively) compared with parents with two offspring. For fathers with no offspring compared with fathers with two offspring, the estimates for the HRQoL and QoL were –6.143 and –7.492, respectively (both  $p < 0.0001$ ).

**Conclusions:** These results suggest that number of offspring is associated with both HRQoL and QoL. Those with no offspring showed the lowest HRQoL and QoL. Although having five or more children had positive associations with QoL, it had negative associations with HRQoL. Public health services for those with poor quality of life should provide effective support programmes and services based on these findings.

## INTRODUCTION

Although the Korean population has been increasing steadily, reaching 47.99 million in 2010, the fertility rate between 2005 and 2010

## Strengths and limitations of this study

- This study used nationwide longitudinal survey data of community-dwelling adults; the large population sample size was representative of the overall population, so these results can be generalised to the population of adults  $\geq 45$  years of age in South Korea.
- Respondent reports are subjective and imperfect measures, potentially affected by perception bias and adaptation of resources.
- We recognise that the estimates may have understated the potential associations for all of the outcomes because we used a short follow-up period in our analysis.
- Twins or triplets might have been present in the population, but we did not examine composition of offspring because of insufficient sample sizes, nor could we determine whether adults with no offspring were childless as a result of infertility.
- We used longitudinal data for our estimates, but the results possibly reflected reverse causality and bidirectional relationships when the associations between number of offspring and quality of life were assessed.

was the lowest in the world. The number of live births declined from 1 006 654 in 1970 to a low of 435 031 in 2005, then slightly increased to 470 171 in 2010.<sup>1</sup> In June 2006, the Presidential Committee on the Aging Society and Population Policy introduced a basic plan for a low-fertility and aging society. The first basic plan (2006–2010) aimed to foster environments favouring child-rearing and to establish a base for improving quality of life in an aging society. The second basic plan (2011–2015) aimed to steadily increase fertility to previous rates, and to consolidate social supports for the elderly. The third plan (2016–2020) aims to raise the fertility rate to the average level in OECD countries, and to encourage society to adapt for an aging population.<sup>1</sup>

Another problem is the rapid increase in the elderly population. Populations worldwide have been rapidly aging since 2000, and particularly in South Korea. The proportion of the population considered to be aged increased from 3.8% in 1980 to 11% in 2010. Estimates indicate that the proportion of older adults will increase geometrically, to 24.3% in 2030 and 37.4% in 2050.<sup>2</sup> Accordingly, the requirements of this population have become an important public health issue.

The increase in life expectancy may be an indicator of the quality of the state welfare systems in South Korea. However, a *longer* lifespan does not always indicate *quality* survival for older adults. Thus, because of this increased longevity and life expectancy, quality of life (QoL) has become an important issue in the public health sector.<sup>3</sup>

According to the WHO Quality of Life Group, 'Quality of life is the individual's perception of their position in life in the context of the culture and the value systems in which they live in relation to their goals, expectations, standards, and concerns. It is a broad concept affected in a complex way in which the person's physical health, psychological state, level of independence, and social relationships are salient features of their environment'.<sup>4</sup>

Health, functional status, social support (especially the support of family and friends) and social relationships are among the main issues that affect the QoL of older adults.<sup>5</sup> Robinson and Molzahn<sup>6</sup> stated that personal relationships and health status are the most important factors that explain differences in the QoL of older people. Social support and variables pertaining to social networks (family, children and friends) are also important factors related to the QoL of older adults. For the subscales of sensory abilities and death-and-dying, older adults with offspring have higher mean QoL variable scores than adults without offspring. Notwithstanding the arguments for and against having children and the effects on mental health, many studies have shown that offspring make important contributions to the social network of aging parents.<sup>7</sup> Offspring can provide social support and care to prevent loneliness in old age. Loneliness was a significant factor for older people living alone with lower QoL.<sup>8</sup> An extensive literature has noted the adverse impact of loneliness upon physical and psychological health, which may eventually impair QoL.<sup>9–10</sup> Having offspring also causes parents to feel grateful and gives meaning to their life, which may positively affect mental health.<sup>11</sup>

QoL is used to describe the general well-being of a population, which is a subjective and complex concept.<sup>12</sup> Health-related quality of life (HRQoL) indicates how an individual physically feels about him/herself, and the extent to which they are capable of fulfilling their daily responsibilities and achieving their aims. In the psychological sense, HRQoL assesses the ability to feel and express emotions such as anger, resentment, fear and happiness.<sup>13</sup> Thus, the concept of HRQoL is often used to measure the effect of illness on

QoL.<sup>14</sup> The objective of our study was to investigate whether offspring reduce or increase HRQoL and QoL.

## METHODS

### Study sample and design

Data were from the 2006–2012 data sets of the Korean Longitudinal Study of Aging (KLoSA), a nationwide survey of community-dwelling adults aged  $\geq 45$  years. A multistage stratified cluster sampling design was used for the KLoSA study, and data collection was repeated every even-numbered year. The information was collected by the Korea Labour Institute and consisted of the basic data needed to devise and implement effective social and economic policies to address emerging trends related to population aging.

The original KLoSA study population consisted of South Korean adults aged  $\geq 45$  years who lived in 15 large administrative areas (Seoul, Incheon, Kyunggi, Kangwon, Busan, Ulsan, Kyungnam, Daegu, Kyungbuk, Kwangju, Chonbuk, Chunnam, Daejeon, Chungbuk and Chungnam). KLoSA maintains a national public database (<http://www.kli.re.kr/klosa/en/about/introduce.jsp>).<sup>15</sup>

Our study used samples from the first- to fourth-wave KLoSA data sets. In the first baseline survey in 2006, 10 254 individuals in 6171 households (1.7 individuals per household) were interviewed using a computer-assisted personal interviewing method. The second survey, in 2008, followed up 8688 subjects, representing 86.6% of the original panel. The third survey, in 2010, followed up 7920 subjects, representing 80.3% of the original panel. The fourth survey, in 2012, followed up 7486 subjects, representing 76.2% of the original panel.

We excluded 12 of the 2006 survey participants as they lacked information (5 had missing data on education, 3 on income, 2 on smoking status and 2 on chronic disease). We excluded 8 subjects with missing information in 2008 (5 lacked data on QoL, 2 on education and 1 on smoking status), 13 subjects with missing information in 2010 (10 lacked data on QoL, 1 on education and 2 on chronic disease), and 6 subjects with missing information in 2012 (1 lacked data on education, 1 on smoking status and 4 on chronic disease).

### Offspring-related independent variables

The number of offspring and composition of offspring were the independent variables of interest. The average age of offspring was divided into four categories: Q1 ( $\leq 27.5$  years), Q2 (27.6–36.0 years), Q3 (36.1–44.0 years) and Q4 ( $\geq 44.0$  years).

### Control variables

We divided the population into seven age groups at 5-year intervals:  $\leq 49$ , 50–54, 55–59, 60–64, 65–69, 70–74 and  $\geq 75$  years. Education status was divided into five categories: no schooling, elementary school, middle school, high school and college or above. Income status was divided into two categories: Yes or No. The frequency of

visiting friends was divided into five categories: every day, 1–2 times per week, 1–2 times per month, 3–6 times per year, and never. Economic activity status was divided into two categories: employed and unemployed. Self-rated health characteristics were also included as covariates in our analyses. In response to the question: ‘Have you felt sadness or despair that hindered everyday life consistently for 2 weeks or more during the last year?’, depressive symptoms were subcategorised as ‘yes’ or ‘no’. Smoking status and alcohol use were divided into three categories: yes, former user or no.

## Dependent variables

### HRQoL

HRQoL was measured as a response to the simple question:<sup>16 17</sup> ‘How do you usually perceive your health-related quality of life?’. Although the measure was developed by the Korea Labour Institute, it is similar to EQ-VAS, which also consists of only one question: ‘How do you usually perceive your health-related quality of life?’. The scale ranges from 0 (worst health state) to 100 (best health state) points.

### Overall subjective QoL

Subjective QoL was measured with a simple question: ‘How is your overall quality of life?’ and was a proxy indicator of the current health status of respondents indicated on a vertical visual analogue scale from zero to 100, marked in tens. The endpoints were labelled ‘best imaginable overall state’ and ‘worst imaginable overall state’, ranging from 0 (worst overall state) to 100 (best overall state).

## Analytical approach and statistics

Analysis of variance and mixed modelling were used to investigate the effects of offspring on quality of life (HRQoL, QoL) among older adults. For all analyses, a *p* value  $\leq 0.05$  (two-tailed test) was considered statistically significant. All analyses were performed using SAS software V.9.2 (SAS Institute, Cary, North Carolina, USA).

### Mixed-effects model (SAS Proc Mixed)

A mixed model was used to handle unbalanced data with correlated outcomes and missing data. In all mixed models, only the intercept was allowed to vary between subjects, and the regression slopes were assumed to be fixed effects; random intercept models were applied to the data. The random intercept variance is reported as  $\sigma^2$ .<sup>18</sup>

The outcome in mixed models was QoL as a continuous variable. Covariates of interest from all subjects were added to the model to determine their effects on the probability of reporting changed QoL. To determine whether the probability of changed QoL varied over time, we included time (year) in the model as a categorical covariate; the regression coefficient was used to estimate both the change in probability of altered QoL and independent variables annually.<sup>18</sup>

## RESULTS

Table 1 presents the general characteristics at baseline of the covariates included in the study and of additional variables of interest (eg, marital status and average number of offspring). Data from 10 242 individuals were included at baseline.

For the number of offspring at baseline, the weighted mean for the QoL and HRQoL of those with no offspring was 46.0 and 46.4, respectively (father mean: 46.5 and 48.6; mother mean: 45.5 and 43.4; table 1). The weighted mean for the QoL and HRQoL of those with one offspring was 60.4 and 58.9, respectively (father mean: 61.3 and 61.6; mother mean: 59.6 and 56.5). The weighted mean for the QoL and HRQoL of those with five or more offspring was 58.5 and 47.1, respectively (father mean: 60.4 and 52.8; mother mean: 57.5 and 44.3; table 1).

Tables 2 and 3 and figures 1 and 2 show the estimates derived using a mixed-effects model. Table 2 presents the results for the adjusted effects of number of offspring on HRQoL and QoL. For those with no offspring, the estimates for HRQoL and QoL were  $-7.762$  and  $-9.384$ , respectively (SE: 0.679 and 0.606; both  $p < 0.0001$ ) compared with those with two offspring. For those with five or more offspring, the estimates for HRQoL and QoL were  $-1.529$  and  $0.885$ , respectively (SE: 0.414 and 0.369;  $p < 0.001$  and  $p < 0.017$ ) compared with those with two offspring. For fathers with five or more offspring compared with fathers with two offspring, the estimates for HRQoL and QoL were  $-6.143$  and  $-7.492$  (SE: 0.949 and 0.829; both  $p < 0.0001$ ), respectively. For fathers with five or more offspring, the estimates for HRQoL and QoL were  $-0.400$  and  $1.304$ , respectively. For mothers with no offspring, the estimates for HRQoL and QoL were  $-8.372$  and  $-8.998$ , respectively (SE: 1.031 and 0.934; both  $p < 0.0001$ ) compared with mothers with two offspring. For mothers with five or more offspring, the estimates for HRQoL and QoL were  $-1.897$  and  $0.797$ , respectively (SE: 0.516 and 0.467;  $p < 0.001$  and  $p < 0.090$ ) compared with mothers with two offspring.

Tables 4 and 5 present results for the adjusted effect of the composition of offspring on HRQoL and QoL. For those with no boys and no girls (no offspring), the estimates for HRQoL and QoL were  $-7.943$  and  $-9.377$ , respectively (SE: 0.697 and 0.621; both  $p < 0.0001$ ) compared with those with one boy and one girl. For those with two or more boys and two or more girls, the estimates for HRQoL and QoL were  $1.537$  and  $-0.058$ , respectively (SE: 0.422 and 0.377;  $p < 0.001$  and  $p < 0.878$ ) compared with those with one boy and one girl.

For fathers with no boys and no girls, the estimates for HRQoL and QoL were  $-6.410$  and  $-7.356$ , respectively (SE: 0.975 and 0.852; both  $p < 0.0001$ ) compared with fathers with one boy and one girl. For fathers with two or more boys and two or more girls, the estimates for HRQoL and QoL were  $-1.575$  and  $0.405$ , respectively (SE: 0.689 and 0.602;  $p = 0.024$  and  $p = 0.502$ ) compared with fathers with one boy and one girl.

**Table 1** General characteristics at baseline (2006)

	Total						Father						Mother					
	N	Weighted %	QoL (mean)	p Value	HRQoL (mean)	p Value	N	Weighted %	QoL (mean)	p Value	HRQoL (mean)	p Value	N	Weighted %	QoL (mean)	p Value	HRQoL (mean)	p Value
Age (years)				<0.0001		<0.0001				<0.0001		<0.0001				<0.0001		<0.0001
≤49	1480	9.6	65.8		64.5		529	32.6	65.1		65.5		951	67.4	66.4		63.5	
50–54	1173	8.3	64.2		62.7		533	44.3	65.3		65.1		640	55.7	63.0		60.2	
55–59	1508	10.8	62.4		59.2		675	43.4	63.1		62.3		833	56.6	61.7		56.3	
60–64	1383	13.2	62.6		56.5		633	48.4	64.2		61.0		750	51.6	61.2		52.1	
65–69	1407	13.5	58.5		50.7		643	49.2	61.5		56.3		764	50.9	56.3		46.5	
70–74	1505	20.4	56.8		48.2		668	50.7	58.1		53.2		837	49.3	55.7		44.3	
≥75	1786	24.2	54.4		43.7		776	50.4	56.0		47.0		1010	49.7	53.7		42.1	
Gender				<0.0001		<0.0001	NA											
Male (father)	4457	47.1	63.2		61.3													
Female (mother)	5785	53.0	60.8		54.2													
Education				<0.0001		<0.0001				<0.0001		<0.0001				<0.0001		<0.0001
Elementary school or less	4826	39.9	55.9		48.3		1420	30.0	56.3		51.7		3406	70.0	55.8		46.8	
Middle school	1654	16.8	61.9		58.6		762	47.9	60.7		58.4		892	52.1	63.1		58.7	
High school	2706	30.8	66.1		64.1		1497	57.0	65.2		64.6		1209	43.0	67.3		63.5	
College or above	1056	12.5	71.0		69.4		778	75.7	70.5		69.5		278	24.3	72.6		69.0	
Marital status				<0.0001		<0.0001				<0.0001		<0.0001				<0.0001		<0.0001
Married	7959	81.0	64.4		60.2		4090	53.4	64.8		62.5		3869	46.7	63.9		57.6	
Single (including separated, divorced)	2283	19.0	51.6		46.1		367	20.2	45.6		47.4		1916	79.8	53.1		45.8	
Income				<0.0001		<0.0001				<0.0001		<0.0001				0.6383		<0.0001
Yes	1983	23.6	65.6		66.0		1334	71.0	66.8		67.7		649	29.0	62.6		61.8	
No	8259	76.4	60.8		54.9		3123	39.7	61.3		57.7		5136	60.4	60.5		53.1	
Economic activity				<0.0001		<0.0001				<0.0001		<0.0001				0.0005		<0.0001
Yes	3880	45.6	65.9		65.0		2490	67.6	66.9		67.0		1390	32.4	63.7		60.6	
No	6362	54.4	58.7		51.3		1967	29.8	56.4		50.3		4395	70.2	59.7		51.7	
Number of visits with friends				<0.0001		<0.0001				<0.0001		<0.0001				<0.0001		<0.0001
Never	1222	12.1	53.9		49.9		546	48.8	53.7		51.7		676	51.2	54.1		48.2	
3–6 times a year	603	6.1	58.6		55.8		281	49.9	60.0		58.5		322	50.1	57.1		53.1	
1–2 times a month	1828	18.9	61.6		58.9		941	55.8	62.9		62.5		887	44.2	60.0		54.3	
1–2 times a week	3283	32.1	63.7		59.3		1406	46.8	65.6		62.9		1877	53.2	62.0		56.2	
Every day	3306	30.8	64.2		58.1		1283	40.7	66.0		63.4		2023	59.3	62.9		54.5	
Smoking status				<0.0001		<0.0001				<0.0001		<0.0001				<0.0001		0.0005
Never	7291	68.7	62.5		56.7		1733	25.7	65.9		62.9		5558	74.3	61.3		54.6	
Former smoker	978	9.3	62.4		57.6		942	97.0	62.7		58.3		36	3.0	51.2		33.3	
Smoker	1973	22.1	60.1		60.0		1782	92.6	61.2		61.2		191	7.4	47.4		45.5	
Alcohol use				<0.0001		<0.0001				<0.0001		<0.0001				0.0004		<0.0001
Yes	3883	42.5	63.7		62.1		2811	74.4	64.0		63.4		1072	25.7	62.9		58.1	
Former user	689	6.1	55.3		47.5		552	79.3	56.5		49.6		137	20.7	50.7		39.5	
No	5670	51.3	61.3		55.0		1094	20.6	64.0		60.1		4576	79.4	60.6		53.6	
Depressive symptoms				<0.0001		<0.0001				<0.0001		<0.0001				<0.0001		<0.0001
Yes	1225	10.9	48.3		39.6		363	32.3	46.7		41.7		862	67.8	49.0		38.7	
No	9017	89.1	63.6		59.7		4094	48.9	64.6		62.8		4923	51.2	62.7		56.7	

Continued



Table 1 Continued

	Total					Father					Mother							
	N	Weighted %	QoL (mean)	p Value	HRQoL (mean)	p Value	N	Weighted %	QoL (mean)	p Value	HRQoL (mean)	p Value	N	Weighted %	QoL (mean)	p Value	HRQoL (mean)	p Value
Number of chronic diseases				<0.0001		<0.0001				0.0033		<0.0001				<0.0001		<0.0001
0	5376	57.7	64.8		64.3		2568	51.3	65.1		66.3		2808	48.7	64.5		62.1	
1	2962	26.5	60.2		52.9		1217	43.5	62.0		57.3		1745	56.5	58.8		49.5	
≥2	1904	15.8	54.4		40.7		672	37.4	56.4		43.7		1232	62.6	53.2		38.8	
Number of offspring			<0.0001		<0.0001				<0.0001		<0.0001				<0.0001		<0.0001	
0	319	3.6	46.0		46.4		154	57.4	46.5		48.6		165	42.6	45.2		43.4	
1	794	8.8	60.4		58.9		336	48.2	61.3		61.6		458	51.9	59.6		56.5	
2	3509	40.5	64.8		62.5		1691	52.8	65.5		65.0		1818	47.2	64.0		59.7	
3	2540	23.4	63.5		58.5		1130	46.1	65.0		61.8		1410	53.9	62.2		55.7	
4	1458	11.6	58.6		51.4		578	39.0	60.4		55.3		880	61.1	57.5		48.9	
≥5	1622	12.1	58.5		47.1		568	33.6	60.4		52.8		1054	66.4	57.5		44.3	
Composition of offspring				0.0441		0.1313				0.0316		0.0275				0.6297		0.4036
0 Boy and 0 girl	319	3.6	46.0		46.4		154	57.4	46.5		48.6		165	42.6	45.2		43.4	
0 Boy and 1 girl	291	3.1	60.2		58.0		128	48.2	62.6		62.6		163	51.8	58.0		53.7	
1 Boy and 0 girl	503	5.7	60.5		59.5		208	48.1	60.6		61.1		295	51.9	60.5		58.0	
0 Boy and ≥2 girls	707	7.8	64.0		60.3		332	51.5	65.9		62.8		375	48.5	62.0		57.5	
1 Boy and 1 girl	1837	21.3	64.5		62.9		889	52.9	64.8		65.7		948	47.1	64.2		59.8	
≥2 Boys and 0 girl	1640	17.3	64.3		60.4		759	50.2	65.5		63.2		881	49.9	63.0		57.6	
≥2 Boys and 1 girl	1519	12.7	61.0		54.6		626	41.5	63.1		58.5		893	58.5	59.5		51.9	
1 Boy and ≥2 girls	1710	15.5	63.4		57.8		723	44.3	65.1		62.4		987	55.7	62.1		54.1	
≥2 Boys and ≥2 girls	1716	12.9	58.1		47.8		638	35.7	59.4		52.2		1078	64.3	57.3		45.4	
Number of boys in family				0.0345		<0.0001				0.2908		0.0003				0.0096		0.0068
0	1317	14.5	58.8		56.4		614	52.3	60.0		58.9		703	47.8	57.4		53.6	
1	4050	42.6	63.6		60.6		1820	49.1	64.4		64.0		2230	50.9	62.8		57.3	
≥2	4875	43.0	61.4		54.9		2023	43.2	63.3		59.1		2852	56.8	60.0		51.7	
Number of girls in family				0.0147		<0.0001				0.2067		0.6872				0.0972		0.0856
0	2462	26.6	61.0		58.3		1121	50.7	61.6		60.5		1341	49.3	60.4		56.0	
1	3647	37.1	62.9		59.7		1643	48.6	64.1		63.3		2004	51.4	61.8		56.2	
≥2	4133	36.3	61.6		54.8		1693	42.8	63.6		59.5		2440	57.2	60.2		51.3	
Average age of offspring (years)				<0.0001		<0.0001				<0.0001		<0.0001						<0.0001
Q1 (≤27.5)	3487	45.0	64.2		63.0		1805	57.1	64.3		64.2		1682	42.9	64.1		61.4	
Q2 (27.6–36.0)	2637	25.3	63.1		58.8		1216	46.0	64.4		61.8		1421	54.0	62.0		56.3	
Q3 (36.1–44.0)	2246	17.2	58.4		50.3		904	37.8	59.7		54.6		1342	62.3	57.5		47.8	
Q4 (≥44.1)	1872	12.5	56.6		44.9		532	25.8	58.0		49.1		1340	74.2	56.2		43.5	
Total	10 242	100.0	62.0		57.5		4457	47.1	63.2		61.3		5785	53.0	60.8		54.2	

HRQoL, health-related quality of life; QoL, quality of life.

**Table 2** Adjusted effect of number of offspring on HRQoL according to parent

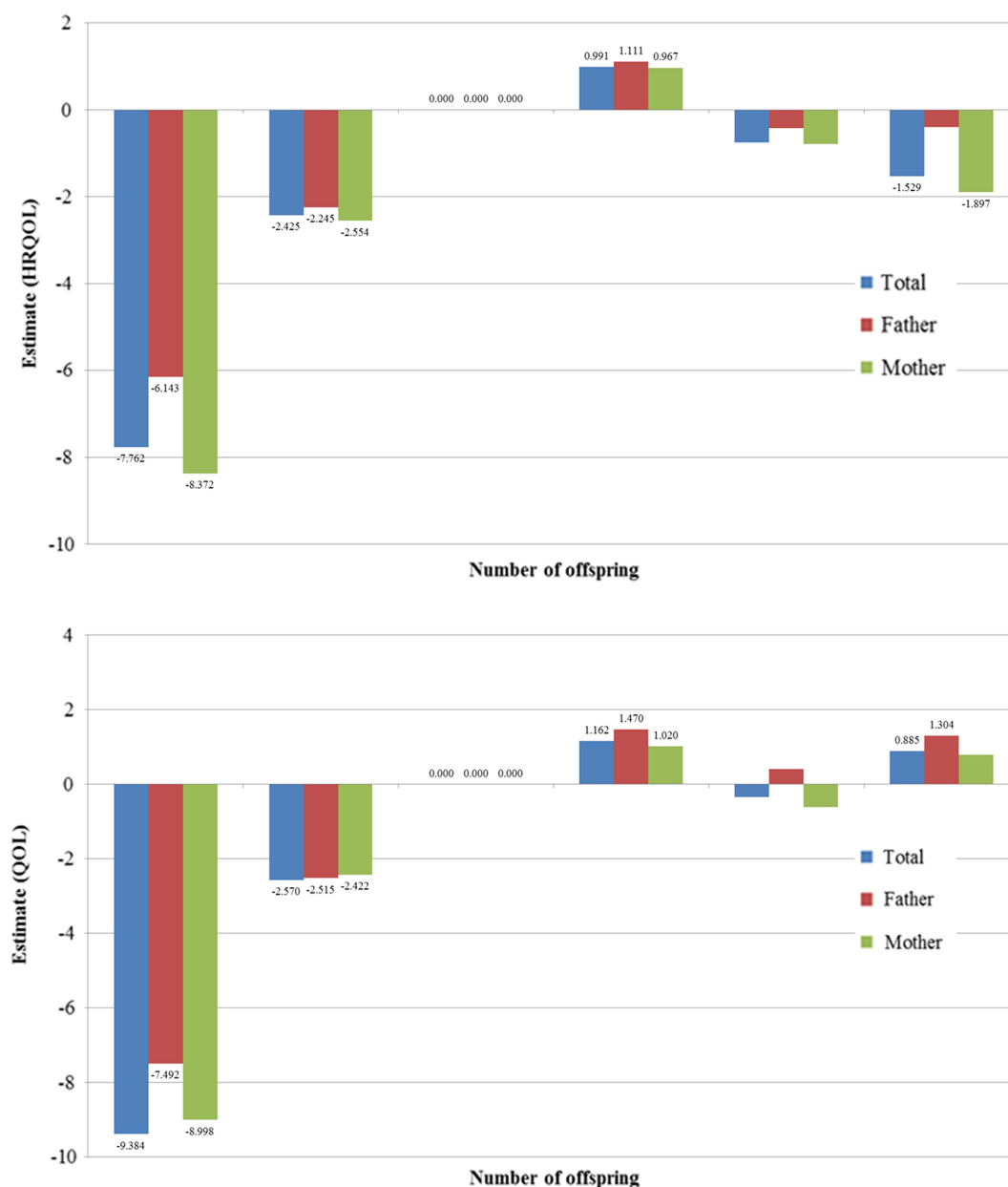
	Total			Father			Mother		
	Estimate	SE	p Value	Estimate	SE	p Value	Estimate	SE	p Value
Number of offspring									
0	-7.762	0.679	<0.0001	-6.143	0.949	<0.0001	-8.372	1.031	<0.0001
1	-2.425	0.398	<0.0001	-2.245	0.589	0.000	-2.554	0.543	<0.0001
2	Ref.			Ref.			Ref.		
3	0.991	0.279	0.000	1.111	0.412	0.008	0.967	0.382	0.012
4	-0.744	0.379	0.051	-0.418	0.605	0.491	-0.785	0.488	0.109
≥5	-1.529	0.414	0.000	-0.400	0.700	0.569	-1.897	0.516	0.000
Average age of offspring (years)									
Q1 (≤27.5)	-1.333	0.677	0.049	-2.467	1.097	0.025	-1.283	0.907	0.158
Q2 (27.6–36.0)	-0.271	0.576	0.638	-1.081	0.977	0.269	-1.297	0.757	0.087
Q3 (36.1–44.0)	0.123	0.465	0.793	-0.123	0.821	0.881	-0.527	0.593	0.374
Q4 (≥44.1)	Ref.			Ref.			Ref.		
Age (years)									
≤49	Ref.			Ref.			Ref.		
50–54	0.172	0.426	0.687	0.006	0.621	0.993	0.745	0.597	0.212
55–59	-0.537	0.500	0.283	-0.385	0.705	0.585	0.118	0.741	0.874
60–64	-1.612	0.559	0.004	-1.129	0.815	0.166	-1.425	0.815	0.081
65–69	-2.771	0.629	<0.0001	-1.055	0.921	0.252	-4.164	0.909	<0.0001
70–74	-4.546	0.711	<0.0001	-3.596	1.062	0.001	-5.740	1.009	<0.0001
≥75	-6.028	0.782	<0.0001	-6.268	1.250	<0.0001	-7.011	1.069	<0.0001
Gender									
Male (father)	0.479	0.326	0.142	NA			NA		
Female (mother)	Ref.								
Education									
Elementary school or less	-11.304	0.397	<0.0001	-9.976	0.517	0.000	-13.314	0.689	<0.0001
Middle school	-6.683	0.405	<0.0001	-6.399	0.528	0.001	-8.271	0.705	<0.0001
High school	-3.879	0.361	<0.0001	-4.015	0.445	0.003	-5.078	0.670	0.000
College or above	Ref.			Ref.			Ref.		
Marital status									
Married	2.615	0.296	<0.0001	4.332	0.595	<0.0001	1.460	0.350	<0.0001
Single (including separated, divorced)	Ref.			Ref.			Ref.		
Income									
Yes	1.871	0.278	<0.0001	2.493	0.364	<0.0001	1.178	0.442	0.008
No	Ref.			Ref.			Ref.		
Economic activity									
Yes	4.876	0.261	<0.0001	7.007	0.400	<0.0001	3.300	0.356	<0.0001
No	Ref.			Ref.			Ref.		
Number of visits with friends									
Never	-11.696	0.418	<0.0001	-12.802	0.637	<0.0001	-10.127	0.558	<0.0001
3–6 times a year	-5.672	0.420	<0.0001	-5.831	0.635	<0.0001	-5.447	0.560	<0.0001
1–2 times a month	-3.538	0.303	<0.0001	-3.485	0.446	<0.0001	-3.694	0.420	<0.0001
1–2 times a week	-2.609	0.263	<0.0001	-3.035	0.416	<0.0001	-2.319	0.337	<0.0001
Every day	Ref.			Ref.			Ref.		
Smoking status									
Never	2.259	0.334	<0.0001	1.664	0.385	<0.0001	4.339	0.840	<0.0001
Former smoker	1.592	0.377	<0.0001	1.551	0.407	0.000	-0.292	1.471	0.843
Smoker	Ref.			Ref.			Ref.		
Alcohol use									
Yes	1.904	0.267	<0.0001	1.674	0.413	<0.0001	2.084	0.361	<0.0001
Former user	-3.505	0.382	<0.0001	-3.529	0.534	<0.0001	-3.380	0.619	<0.0001
No	Ref.			Ref.			Ref.		
Depressive symptoms									
Yes	-13.504	0.404	<0.0001	-13.378	0.708	<0.0001	-13.206	0.487	<0.0001
No	Ref.			Ref.			Ref.		
Number of chronic diseases									
0	12.557	0.518	<0.0001	12.626	0.836	<0.0001	12.118	0.657	<0.0001
1	7.116	0.548	<0.0001	7.569	0.890	<0.0001	6.591	0.690	<0.0001
≥2	Ref.			Ref.			Ref.		
Year									
2006	-3.963	0.335	<0.0001	-4.284	0.499	<0.0001	-3.473	0.452	<0.0001
2008	-4.275	0.327	<0.0001	-4.540	0.490	<0.0001	-3.829	0.440	<0.0001
2010	-4.523	0.315	<0.0001	-4.733	0.471	<0.0001	-4.119	0.425	<0.0001
2012	Ref.			Ref.			Ref.		

HRQoL, health-related quality of life; Ref., reference.

**Table 3** Adjusted effect of number of offspring on QoL according to parent

	Total			Father			Mother		
	Estimate	SE	p Value	Estimate	SE	p Value	Estimate	SE	p Value
Number of offspring									
0	-9.384	0.606	<0.0001	-7.492	0.829	<0.0001	-8.998	0.934	<0.0001
1	-2.570	0.355	<0.0001	-2.515	0.515	<0.0001	-2.422	0.492	<0.0001
2	Ref.			Ref.			Ref.		
3	1.162	0.249	<0.0001	1.470	0.360	<0.0001	1.020	0.346	0.004
4	-0.339	0.338	0.316	0.404	0.528	0.446	-0.611	0.442	0.168
≥5	0.885	0.369	0.017	1.304	0.612	0.035	0.797	0.467	0.090
Average age of offspring (years)									
Q1 (≤27.5)	-4.221	0.604	<0.0001	-4.847	0.958	<0.0001	-4.473	0.822	<0.0001
Q2 (27.6–36.0)	-2.427	0.514	<0.0001	-2.827	0.854	0.001	-2.949	0.686	<0.0001
Q3 (36.1–44.0)	-1.895	0.415	<0.0001	-2.012	0.717	0.005	-1.814	0.538	0.001
Q4 (≥44.1)	Ref.			Ref.			Ref.		
Age (years)									
≤49	Ref.			Ref.			Ref.		
50–54	-0.383	0.380	0.314	-0.670	0.543	0.217	-0.077	0.541	0.887
55–59	-0.006	0.446	0.989	-0.151	0.616	0.806	-0.005	0.671	0.994
60–64	-0.529	0.499	0.289	-0.539	0.712	0.449	-0.933	0.739	0.206
65–69	-1.508	0.561	0.007	-0.910	0.805	0.258	-2.876	0.823	0.001
70–74	-3.509	0.634	<0.0001	-3.794	0.928	<0.0001	-4.213	0.914	<0.0001
≥75	-4.518	0.698	<0.0001	-5.692	1.092	<0.0001	-5.202	0.968	<0.0001
Gender									
Male (father)	-0.044	0.291	0.880	NA			NA		
Female (mother)	Ref.								
Education									
Elementary school or less	-10.518	0.354	<0.0001	-9.596	0.452	0.000	-11.638	0.624	<0.0001
Middle school	-6.714	0.362	<0.0001	-6.580	0.462	0.001	-7.228	0.639	<0.0001
High school	-3.891	0.322	<0.0001	-3.959	0.389	0.002	-4.407	0.607	0.000
College or above	Ref.			Ref.			Ref.		
Marital status									
Married	0.089	0.248	0.718	0.983	0.318	0.002	-1.249	0.400	0.002
Single (including separated, divorced)	Ref.			Ref.			Ref.		
Income									
Yes	5.149	0.264	<0.0001	9.107	0.520	<0.0001	3.625	0.317	<0.0001
No	Ref.			Ref.			Ref.		
Economic activity									
Yes	2.949	0.233	<0.0001	4.687	0.350	<0.0001	1.503	0.323	<0.0001
No	Ref.			Ref.			Ref.		
Number of visits with friends									
Never	-11.104	0.373	<0.0001	-11.997	0.556	<0.0001	-9.578	0.505	<0.0001
3–6 times a year	-5.126	0.375	<0.0001	-5.246	0.555	<0.0001	-4.901	0.507	<0.0001
1–2 times a month	-3.924	0.271	<0.0001	-3.770	0.390	<0.0001	-4.120	0.380	<0.0001
1–2 times a week	-2.644	0.234	<0.0001	-2.547	0.363	<0.0001	-2.757	0.305	<0.0001
Every day	Ref.			Ref.			Ref.		
Smoking status									
Never	3.988	0.298	<0.0001	3.349	0.336	<0.0001	6.662	0.761	<0.0001
Former smoker	3.142	0.336	<0.0001	2.972	0.356	<0.0001	3.185	1.333	0.018
Smoker	Ref.			Ref.			Ref.		
Alcohol use									
Yes	0.746	0.238	0.002	0.070	0.360	0.845	1.332	0.327	<0.0001
Former user	-2.202	0.341	<0.0001	-2.296	0.466	<0.0001	-2.038	0.561	0.000
No	Ref.			Ref.			Ref.		
Depressive symptoms									
Yes	-11.078	0.360	<0.0001	-10.222	0.618	<0.0001	-11.179	0.441	<0.0001
No	Ref.			Ref.			Ref.		
Number of chronic diseases									
0	4.211	0.462	<0.0001	3.918	0.730	<0.0001	4.379	0.595	<0.0001
1	2.581	0.489	<0.0001	2.803	0.778	0.000	2.457	0.625	<0.0001
≥2	Ref.			Ref.			Ref.		
Year									
2006	-3.798	0.299	<0.0001	-3.127	0.436	<0.0001	-4.103	0.410	<0.0001
2008	-2.769	0.292	<0.0001	-2.320	0.428	<0.0001	-2.891	0.398	<0.0001
2010	-3.100	0.281	<0.0001	-2.806	0.411	<0.0001	-3.135	0.385	<0.0001
2012	Ref.			Ref.			Ref.		

QoL, quality of life; Ref., reference.



**Figure 1** Adjusted effects of number of offspring on health-related quality of life (HRQoL) and QoL, by parent. Adjusted for average age of offspring, age, gender, education, marital status, income, economic activity, number of visits with friends, smoking status, alcohol use, depressive symptoms, number of chronic diseases and year.

For mothers with no boys and no girls, the estimates for HRQoL and QoL were  $-8.392$  and  $-9.108$ , respectively (SE: 1.054 and 0.955; both  $p < 0.0001$ ) compared with fathers with one boy and one girl. For fathers with two or more boys and two or more girls, the estimates for HRQoL and QoL were  $-1.249$  and  $-0.152$ , respectively (SE: 0.541 and 0.490;  $p = 0.024$  and  $p = 0.502$ ) compared with mothers with one boy and one girl.

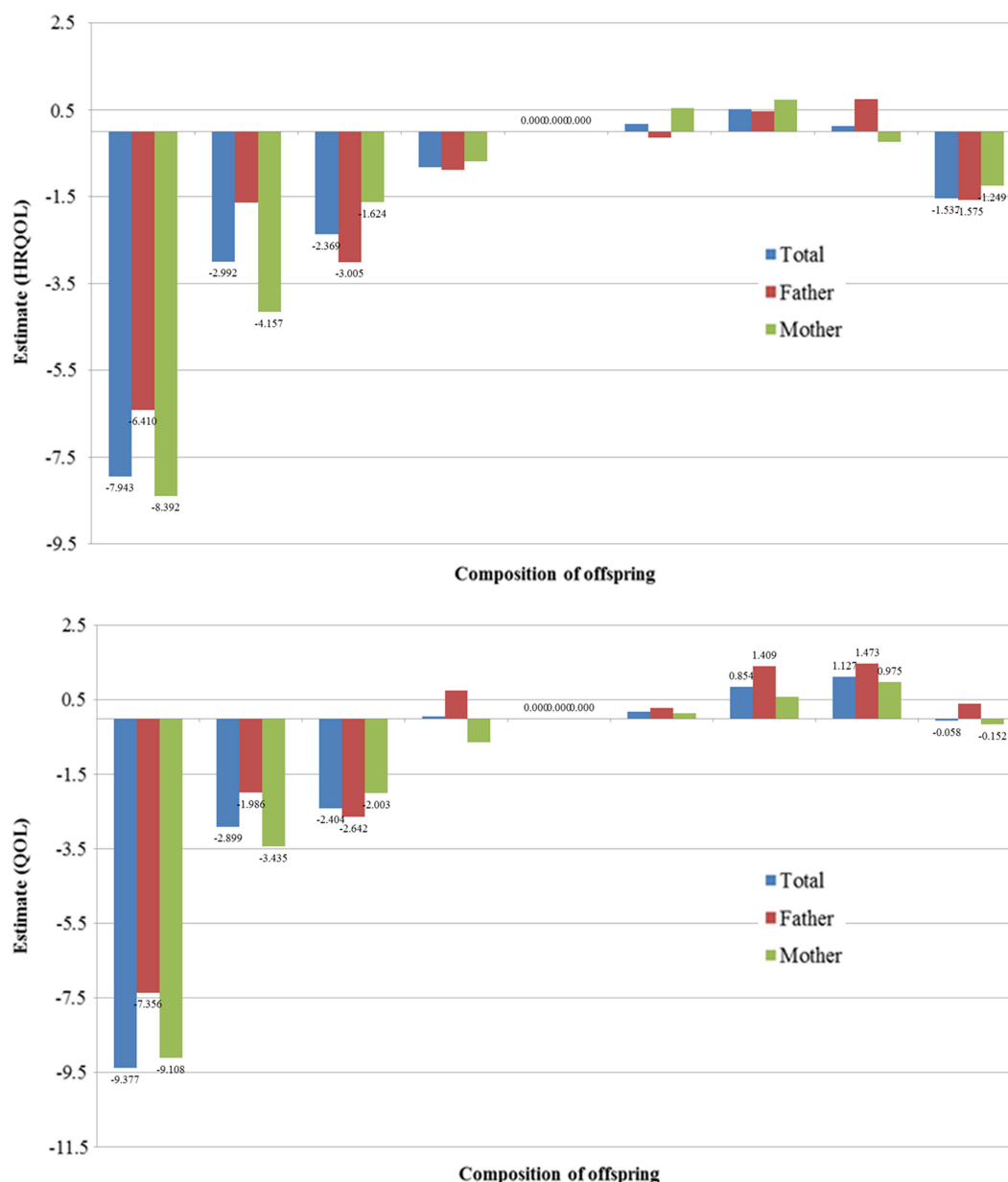
## DISCUSSION

Our primary purpose in this study was to investigate the effect of number of offspring on HRQoL and QoL in a longitudinal model. We also sought to investigate any association between composition of offspring and

HRQoL and QoL. We used a nationally representative sample of older adults ( $\geq 45$  years of age) in South Korea.

Overall, for number of offspring, the HRQoL and QoL estimates varied more for mothers than for fathers (tables 2 and 3). There was a similar tendency for composition of offspring (tables 4 and 5). Although having more offspring tended to reduce HRQoL compared with QoL, both HRQoL and QoL were decreased for those with no offspring. Additionally, the decrease in HRQoL was less than the decrease in QoL for fathers and mothers. Although the trends were similar for mothers and fathers, the deterioration in HRQoL and QoL was greater for mothers than for fathers. Tables 4 and 5 show that the effects of the composition of





**Figure 2** Adjusted effects of composition of offspring on health-related quality of life (HRQoL) and QoL, by parent. Adjusted for average age of offspring, age, gender, education, marital status, income, economic activity, number of visits with friends, smoking status, alcohol use, depressive symptoms, number of chronic diseases and year.

offspring on parents' HRQoL and QoL were inconsistent, but having more offspring tended to result in a greater deterioration in HRQoL (estimate:  $-1.537$ ;  $p < 0.001$ ) compared with QoL (estimate:  $-0.058$ ;  $p = 0.878$ ).

These associations were independent of offspring-related variables (average age of offspring), sociodemographic variables (age, gender, education, marital status, numbers of visits with friends, income, and economic activity status), health risk behaviour variables (smoking status and alcohol consumption), health status (depression symptoms and number of chronic diseases) and year.

Well-being, such as eudaemonic well-being, is a concept that goes beyond subjective happiness and is

not simply defined in terms of living well. Rather, the concept implies objective indicators of one's wellness and suggests human flourishing. Rogers<sup>19</sup> argued that the eudaemonic position of well-being is the extent to which a person is fully functioning, rather than simply feeling pleasant. The eudaemonic paradigm defines well-being in terms of values and purposes in life and/or potential achieving, with respect to a higher order of the self (ie, realisation of true self, positive relationships, human strengths and virtues), which reflect psychological well-being.<sup>20</sup> Such themes have gained increasing appreciation in the aging-related literature.<sup>20</sup>

A recent study<sup>21</sup> indicated that  $\sim 20\%$  of Korean older adults experience depression that interferes with

**Table 4** Adjusted effect of composition of offspring on HRQoL

	Total			Father			Mother		
	Estimate	SE	p Value	Estimate	SE	p Value	Estimate	SE	p Value
Composition of offspring									
0 Boy and 0 girl	−7.943	0.697	<0.0001	−6.410	0.975	<0.0001	−8.392	1.054	<0.0001
0 Boy and 1 girl	−2.992	0.650	<0.0001	−1.640	0.974	0.095	−4.157	0.873	<0.0001
1 Boy and 0 girl	−2.369	0.504	<0.0001	−3.005	0.740	<0.0001	−1.624	0.691	0.020
0 Boy and ≥2 girls	−0.824	0.435	0.059	−0.884	0.624	0.159	−0.685	0.609	0.263
1 Boy and 1 girl	Ref.			Ref.			Ref.		
≥2 Boys and 0 girl	0.173	0.337	0.607	−0.142	0.484	0.770	0.539	0.471	0.253
≥2 Boys and 1 girl	0.512	0.389	0.189	0.470	0.594	0.430	0.734	0.519	0.159
1 Boy and ≥2 girls	0.131	0.354	0.712	0.744	0.524	0.158	−0.238	0.481	0.622
≥2 Boys and ≥2 girls	−1.537	0.422	0.000	−1.575	0.689	0.024	−1.249	0.541	0.022
Average age of offspring (years)									
Q1 (≤27.5)	−1.172	0.680	0.085	−2.567	1.100	0.020	−1.083	0.911	0.235
Q2 (27.6–36.0)	−0.111	0.577	0.848	−1.154	0.977	0.238	−1.099	0.759	0.148
Q3 (36.1–44.0)	0.202	0.466	0.664	−0.165	0.820	0.840	−0.459	0.594	0.440
Q4 (≥44.1)	Ref.			Ref.			Ref.		
Age (years)									
≤49	Ref.			Ref.			Ref.		
50–54	0.158	0.426	0.711	−0.035	0.621	0.955	0.727	0.597	0.224
55–59	−0.527	0.501	0.293	−0.449	0.707	0.525	0.129	0.742	0.862
60–64	−1.566	0.560	0.005	−1.147	0.817	0.160	−1.384	0.815	0.090
65–69	−2.757	0.629	<0.0001	−1.059	0.923	0.251	−4.243	0.908	<0.0001
70–74	−4.632	0.709	<0.0001	−3.613	1.061	0.001	−5.994	1.005	<0.0001
≥75	−6.194	0.779	<0.0001	−6.236	1.245	<0.0001	−7.396	1.063	<0.0001
Gender									
Male (father)	0.513	0.326	0.116	NA			NA		
Female (mother)	Ref.								
Education									
Elementary school or less	−11.356	0.396	<0.0001	−9.956	0.517	0.000	−13.431	0.689	<0.0001
Middle school	−6.735	0.406	<0.0001	−6.431	0.529	0.001	−8.370	0.706	<0.0001
High school	−3.885	0.361	<0.0001	−4.002	0.445	0.003	−5.136	0.670	0.000
College or above	Ref.			Ref.			Ref.		
Marital status									
Married	2.647	0.296	<0.0001	4.384	0.595	<0.0001	1.476	0.350	<0.0001
Single (including separated, divorced)	Ref.			Ref.			Ref.		
Previous year income									
Yes	1.896	0.278	<0.0001	2.493	0.364	<0.0001	1.208	0.442	0.006
No	Ref.			Ref.			Ref.		
Economic activity									
Yes	4.820	0.261	<0.0001	6.993	0.400	<0.0001	3.233	0.356	<0.0001
No	Ref.			Ref.			Ref.		
Number of visits with friends									
Never	−11.684	0.418	<0.0001	−12.780	0.637	<0.0001	−10.093	0.558	<0.0001
3–6 times a year	−5.641	0.420	<0.0001	−5.845	0.635	<0.0001	−5.406	0.560	<0.0001
1–2 times a month	−3.553	0.304	<0.0001	−3.516	0.446	<0.0001	−3.698	0.420	<0.0001
1–2 times a week	−2.616	0.263	<0.0001	−3.068	0.416	<0.0001	−2.307	0.337	<0.0001
Every day	Ref.			Ref.			Ref.		
Smoking status									
Never	2.282	0.334	<0.0001	1.655	0.385	<0.0001	4.332	0.841	<0.0001
Former smoker	1.612	0.377	<0.0001	1.523	0.408	0.000	−0.225	1.472	0.879
Smoker	Ref.			Ref.			Ref.		
Alcohol use									
Yes	1.885	0.267	<0.0001	1.636	0.413	<0.0001	2.040	0.361	<0.0001
Former user	−3.510	0.383	<0.0001	−3.576	0.534	<0.0001	−3.367	0.620	<0.0001
No	Ref.			Ref.			Ref.		
Depressive symptoms									
Yes	−13.491	0.404	<0.0001	−13.388	0.708	<0.0001	−13.181	0.487	<0.0001
No	Ref.			Ref.			Ref.		
Number of chronic diseases									
0	12.578	0.518	<0.0001	12.573	0.836	<0.0001	12.171	0.657	<0.0001
1	7.151	0.548	<0.0001	7.535	0.891	<0.0001	6.649	0.690	<0.0001
≥2	Ref.			Ref.			Ref.		
Year									
2006	−3.912	0.334	<0.0001	−4.280	0.499	<0.0001	−3.381	0.452	<0.0001
2008	−4.243	0.327	<0.0001	−4.530	0.490	<0.0001	−3.769	0.440	<0.0001
2010	−4.506	0.316	<0.0001	−4.718	0.471	<0.0001	−4.088	0.425	<0.0001
2012	Ref.			Ref.			Ref.		

HRQoL, health-related quality of life; Ref., reference.

**Table 5** Adjusted effect of number of offspring on QoL according to parent

	Total			Father			Mother		
	Estimate	SE	p Value	Estimate	SE	p Value	Estimate	SE	p Value
Composition of offspring									
0 Boy and 0 girl	-9.377	0.621	<0.0001	-7.356	0.852	<0.0001	-9.108	0.955	<0.0001
0 Boy and 1 girl	-2.899	0.579	<0.0001	-1.986	0.851	0.021	-3.435	0.790	<0.0001
1 Boy and 0 girl	-2.404	0.450	<0.0001	-2.642	0.647	<0.0001	-2.003	0.626	0.002
0 Boy and ≥2 girls	0.059	0.388	0.880	0.749	0.545	0.172	-0.639	0.552	0.248
1 Boy and 1 girl	Ref.			Ref.			Ref.		
≥2 Boys and 0 girl	0.188	0.301	0.532	0.287	0.423	0.499	0.151	0.426	0.723
≥2 Boys and 1 girl	0.854	0.347	0.015	1.409	0.519	0.008	0.580	0.470	0.218
1 Boy and ≥2 girls	1.127	0.315	0.000	1.473	0.458	0.002	0.975	0.436	0.027
≥2 Boys and ≥2 girls	-0.058	0.377	0.878	0.405	0.602	0.502	-0.152	0.490	0.757
Average age of offspring (years)									
Q1 (≤27.5)	-4.292	0.606	<0.0001	-5.075	0.961	<0.0001	-4.468	0.825	<0.0001
Q2 (27.6–36.0)	-2.500	0.515	<0.0001	-3.009	0.854	0.000	-2.963	0.688	<0.0001
Q3 (36.1–44.0)	-1.950	0.415	<0.0001	-2.104	0.717	0.003	-1.857	0.538	0.001
Q4 (≥44.1)	Ref.			Ref.			Ref.		
Age (years)									
≤49	Ref.			Ref.			Ref.		
50–54	-0.386	0.380	0.310	-0.685	0.543	0.207	-0.067	0.541	0.902
55–59	-0.003	0.447	0.995	-0.177	0.617	0.774	0.002	0.672	0.997
60–64	-0.515	0.499	0.303	-0.543	0.714	0.447	-0.925	0.739	0.211
65–69	-1.476	0.561	0.009	-0.916	0.807	0.256	-2.835	0.822	0.001
70–74	-3.468	0.633	<0.0001	-3.779	0.927	<0.0001	-4.160	0.910	<0.0001
≥75	-4.386	0.695	<0.0001	-5.601	1.088	<0.0001	-5.053	0.962	<0.0001
Gender									
Male (father)	-0.045	0.291	0.877	NA			NA		
Female (mother)	Ref.								
Education									
Elementary school or less	-10.516	0.354	<0.0001	-9.563	0.452	0.000	-11.701	0.624	<0.0001
Middle school	-6.758	0.362	<0.0001	-6.589	0.462	0.001	-7.343	0.640	<0.0001
High school	-3.910	0.322	<0.0001	-3.974	0.389	0.002	-4.455	0.607	0.000
College or above	Ref.			Ref.			Ref.		
Marital status									
Married	5.170	0.264	<0.0001	9.135	0.520	<0.0001	3.638	0.317	<0.0001
Single (including separated, divorced)	Ref.			Ref.			Ref.		
Previous year income									
Yes	0.092	0.248	0.711	0.985	0.318	0.002	-1.270	0.400	0.002
No	Ref.			Ref.			Ref.		
Economic activity									
Yes	2.954	0.233	<0.0001	4.710	0.350	<0.0001	1.511	0.323	<0.0001
No	Ref.			Ref.			Ref.		
Number of visits with friends									
Never	-11.091	0.373	<0.0001	-11.978	0.557	<0.0001	-9.569	0.506	<0.0001
3–6 times a year	-5.100	0.375	<0.0001	-5.237	0.555	<0.0001	-4.884	0.507	<0.0001
1–2 times a month	-3.937	0.271	<0.0001	-3.786	0.390	<0.0001	-4.142	0.380	<0.0001
1–2 times a week	-2.655	0.234	<0.0001	-2.574	0.363	<0.0001	-2.760	0.305	<0.0001
Every day	Ref.			Ref.			Ref.		
Smoking status									
Never	3.990	0.298	<0.0001	3.345	0.336	<0.0001	6.707	0.762	<0.0001
Former smoker	3.140	0.336	<0.0001	2.971	0.357	<0.0001	3.309	1.333	0.014
Smoker	Ref.			Ref.			Ref.		
Alcohol use									
Yes	0.738	0.239	0.002	0.033	0.361	0.926	1.355	0.327	<0.0001
Former user	-2.209	0.341	<0.0001	-2.319	0.467	<0.0001	-2.012	0.561	0.000
No	Ref.			Ref.			Ref.		
Depressive symptoms									
Yes	-11.104	0.360	<0.0001	-10.257	0.618	<0.0001	-11.184	0.441	<0.0001
No	Ref.			Ref.			Ref.		

Continued

Table 5 Continued

	Total			Father			Mother		
	Estimate	SE	p Value	Estimate	SE	p Value	Estimate	SE	p Value
Number of chronic diseases									
0	4.205	0.462	<0.0001	3.903	0.730	<0.0001	4.376	0.595	<0.0001
1	2.582	0.489	<0.0001	2.780	0.778	0.000	2.474	0.625	<0.0001
≥2	Ref.			Ref.			Ref.		
Year									
2006	−3.821	0.298	<0.0001	−3.166	0.436	<0.0001	−4.117	0.409	<0.0001
2008	−2.785	0.292	<0.0001	−2.347	0.428	<0.0001	−2.897	0.398	<0.0001
2010	−3.105	0.282	<0.0001	−2.815	0.412	<0.0001	−3.131	0.385	<0.0001
2012	Ref.			Ref.			Ref.		

QoL, quality of life; Ref., reference.

their daily lives and continues for >2 weeks. Depression in old age threatens mental and physical health, and leads to a deterioration in QoL.<sup>22</sup> Older adults in Korea who live alone are at risk of negative effects on their mental health; 15% use alcohol and 60% of these have an alcohol use problem. Moreover, their level of suicidal ideation is higher than that of the general population.<sup>23</sup>

Living with family and having children could increase the QoL of older adults by providing social and psychological support. Using a meta-analysis approach,<sup>5</sup> Pinquart and Sorensen examined 286 studies and found that there were positive relationships between the social status of elderly people, social relationships, competence and well-being. Chappell<sup>24</sup> reported that social support and health contribute significantly to the variance in subjective QoL characteristics. Family cohesion and adaptability are also positively correlated with quality of life, and adaptability is also correlated with social support from the family. Such results are consistent with previous findings on the association between cohesion or adaptability and adjustment to serious illness.<sup>25 26</sup>

The term 'QoL' is used to describe the general well-being of populations and is employed in the international development, health and political domains. It should not be confused with the concept of 'standard of living', which is based primarily on income. Standard indicators of QoL include wealth and employment, and also the built environment, physical and mental health, education, recreation and leisure time, and social belonging variables.<sup>3</sup> Health status is an important factor that directly affects QoL. However, HRQoL includes the individual's perception of his/her health status, and activity in physical, social and psychological terms.

Our previous studies<sup>17</sup> revealed that there is a significant relationship between offspring and QoL characteristics. The present study indicates that offspring have statistically significant effects on HRQoL and QoL. For both of these indicators, there were differences between disease states and average total life quality scores.

This study has several strengths and limitations. A strength was that the survey participants were representative of the overall population. A large population sample

size was used to estimate the effects, so the results can be generalised to the population of older adults aged ≥45 years in South Korea. Nevertheless, possible sample biases could have been present in the study. First, respondents' reports were subjective and imperfect measures, potentially affected by perception bias and adaptation of resources. Second, because personality characteristics are likely to be associated with HRQoL and QoL characteristics, failure to include them in the statistical models may have resulted in exaggeration of the associations of interest. Third, in addition to the potential biases discussed above that were likely to inflate the associations between offspring and at least some of the health variables, we recognise that the estimates may have understated the potential associations for all of the outcomes because we used a short follow-up period in our analysis. Fourth, twins or triplets might have been present in the population, but we did not examine the composition of offspring because of insufficient sample sizes. Fifth, we used longitudinal data for our estimates, but the results possibly reflected reverse causality and bidirectional relationships when the associations between number of offspring and quality of life were assessed. Sixth, some recent investigations have focused on the QoL characteristics of infertile patients.<sup>27 28</sup> A study of the psychosocial burden of infertility treatment revealed that there is a decline in mental health and social support and an increase in physical and social stress in those who continue to experience involuntary childlessness after 1 year of treatment.<sup>29</sup> However, we could not determine whether adults with no offspring were childless as a result of infertility.

## Conclusions

We provided additional evidence that supports the effects of offspring-related variables on HRQoL and QoL. Having a larger number of offspring appeared to reduce HRQoL more than QoL. However, parents with no offspring seemed to experience greater deterioration in QoL than HRQoL. Additionally, QoL in older people was affected by several variables (eg, age, educational level, marital status, income, economic activity, smoking status, alcohol use, depression symptoms, chronic

disease, average number of offspring with whom they lived, and whether they had offspring). Thus, individuals in South Korea with poor quality of life need active support and effective programmes and services.

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