



An evolution of socioeconomic inequalities in self-rated health in Korea: Evidence from Korea National Health and Nutrition Examination Survey (KNHANES) 1998–2018

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ABSTRACT

Reducing socioeconomic inequalities in health has become an important health policy agenda. This study aimed to measure socioeconomic inequalities in health in Korea over the past two decades and identify the contributing factors to the observed inequalities. Data from the Korea National Health and Nutrition Examination Survey (KNHANES) from 1998 to 2016/2018 were utilized. The concentration index (CI) was calculated to measure health inequalities, and decomposition analysis was applied to identify and quantify the contributing factors to the observed inequalities in health. The results indicated that health inequalities exist, suggesting that poor health was consistently more concentrated among Korean adults with lower income (1998: -0.154 ; 2016/2018: -0.152). Gender-stratified analyses also showed that poor health was more concentrated in lower income women and men, with the degree of inequalities slightly more pronounced among women. The decomposition approach revealed that income and educational attainment were the largest contributors to the observed health inequalities as higher income and education associated with better self-rated health. These findings suggest the importance of considering socioeconomic determinants, such as income and education, in efforts to tackling health inequalities, particularly considering that self-rated health is a predictor of future mortality and morbidity. Furthermore, it is essential to implement more egalitarian social, labour market, and health policies in order to eliminate the existing socioeconomic inequalities in health in Korea.

1. Introduction

As unprecedented social and health inequalities are defining issues in public health, alleviating health inequalities has become a major policy agenda in most countries (Townsend et al., 2020). An individual's socioeconomic status, including income and education, and occupation, contribute to one's health. In particular, individuals with lower income, lack of educational attainment, and low occupational status tend to have worse health status in comparison to their privileged counterparts (Braveman et al., 2011; Kivimäki et al., 2020). Meanwhile, it has also been suggested that an individual's health condition contributes to their socioeconomic positions (Choi et al., 2019; Manor et al., 2003). Individuals with worse health conditions tend to limit their participation in economic activities and other social engagements, causing social and economic resource constraints that ultimately contribute to existing

health inequalities (Arcaya et al., 2015). This vicious circle between health and socioeconomic status (SES) amplifies existing health inequalities (Sohn et al., 2022). Considering this interconnection, policies to tackle and mitigate unjust and unfair socioeconomic inequalities in health are necessary, both within and outside the healthcare system (Kim, 2016). Overall, it is important to note that health inequalities are a consequence of inequalities in the social determinants of health, including material circumstances, the social environment, and psychological factors. There are in turn influenced by social position and context, and shaped by a range of factors, such as education, income and race/ethnicity (Arcaya et al., 2015).

Attention to social policies as essential approaches to diminish health inequalities has steadily increased since the Declaration of Alma-Ata in 1978 (Lawn et al., 2008). After the final reports from the World Health Organization Commission on Social Determinants of Health in 2008,

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social policies to address social determinants of health have been seriously called for as one of the key principles of health inequalities related to socioeconomic position (Ruckert & Labonté, 2017). In addition, a growing body of studies has emphasized the importance of a wide range of determinants of health, suggesting the need for various policies to reduce the observed health inequalities (Adler et al., 2016; Bambra et al., 2010; WHO, 2008). Despite the imperative of addressing socioeconomic inequalities in health, many policies tend to perceive health inequalities as innate rather than structural problems, inadvertently overlooking the broader social determinants of health at the macro level (Garzón-Orjuela et al., 2020; Khang & Lee, 2012; Pons-Vigués et al., 2014).

South Korea is not an exception. For instance, the National Health Plan, the Korean government's strategy for health policy that outlines objectives and initiatives to improve public health, prioritizes the enhancement of health equity as its primary goal and advocates for a policy approach grounded in the social determinants of health (Oh, 2021). However, the scope and action plan of Korea's health policies and programs as outlined in the plan, predominantly focus on individual health behaviours (Khang & Lee, 2012), and this point is still valid. Accompanying the growing interest on health inequalities in Korea, an increasing number of studies highlight the existence of significant disparities by SES. Individuals with lower income and education levels experience shorter life expectancies, higher risk of chronic diseases and cancer, and limited access to high-quality healthcare services, including preventive screening services, despite the Korea's universal healthcare system (Khang et al., 2019; Kim et al., 2018). To address these deepening health inequalities, there is a need for a better understanding of the underlying factors and effective policy strategies at the upstream level (National Academies of Sciences & Medicine, 2017). Yet, current research predominantly focuses on documenting the observed disparities and describing downstream risk factors, leading to a failure in implementing social and health policies aimed at tackling the root causes (Collyer & Smith, 2020; Khang & Lee, 2012), rather than translating findings into actionable health and social policies (Koh et al., 2010; Regidor, 2004).

It is also suggested that monitoring the magnitude of health inequalities and exploring the underlying determinants of changes in these inequalities are necessary to address the current research gap and promote successful health equitable policies (Kelly-Irving et al., 2023; Khang & Lee, 2012). In response, a limited number of Korean studies have attempted to assess health inequalities, suggesting that these disparities have persisted over time in Korea (Chang et al., 2019; Khang et al., 2004, 2008; Kim & Khang, 2020; Lee et al., 2020). However, the results from these existing studies may fail to elaborate on the mechanism of the existing inequalities and to evaluate the impact of relevant policies on the magnitude of health inequalities (Khang & Lee, 2012).

Recent studies have highlighted the significant impact of macro socioeconomic events such as economic crises on health inequalities revealing a pronounced deterioration, especially among Korean women (Kim et al., 2011; Lee et al., 2020; Min, 2014). Following the 1997 economic crisis in Korea, labour market flexibilization strategies were introduced, leading to increased labour market participation among women with higher education, particularly in professional roles and within large firms (Kim et al., 2019; Kim & Hong, 2009). Conversely, these strategies have resulted in heightened employment precariousness and lower earnings in the female labour market, especially for those with lower education (Bae, 2009). In 2023, 45.5% among working women are in precarious employment whereas 29.8% of their counterpart are (Statistics Korea, 2023). It is plausible that education-related inequalities in health among Korean women have been exacerbated since 1997. However, this has not been comprehensively examined in the existing literature.

In response to the increasing focus on health inequalities in Korea and the gaps identified in previous research, our study aimed to measure socioeconomic inequalities in self-rated health among Korean adults

over the past 30 years and to identify and quantify the factors contributing to these inequalities in self-rated health. Furthermore, we aimed to investigate the variation in observed inequalities and their contributing factors by gender. This comprehensive approach provided a deeper understanding of the dynamics of health inequalities in Korea, suggesting the development of more effective policy interventions.

2. Material and methods

Data from the Korea National Health and Nutrition Examination Survey (KNHANES) from wave 1 (1998) to 7 (2016–2018) were analyzed for calculating the trends of the health inequalities, and wave 1 and 7 for identifying the factors contributing to the inequalities and its changes. The KNHANES is a nationally representative survey for examining the health and nutritional statuses of Koreans and monitoring health-related risk factors as well as the prevalence of noncommunicable disease (Kweon et al., 2014). KNHANES is comprised of noninstitutionalized Koreans living in Korea who are sampled based on a multi-stage clustered probability design. The KNHANES survey collects a wide range of information including sociodemographic status, health behaviours, quality of life, healthcare utilization, and health examination results. In this study, we included respondents over the age of 18 who participated in KNHANES health examination (see Table 1).

2.1. Variables

2.1.1. Individual's health

Individual's health was measured by a self-reported assessment from KNHANES. Individuals were asked to evaluate their own health and the original responses were "Very good, good, fair, poor and very poor". For this study, we reclassified the original responses into 2 categories – Good (including very good, good, fair), and poor (including poor and very poor). Previous studies using nationally collected dataset employed the same classification for self-rated health (Hwang, Guilcher, et al., 2017; Hwang & Kim, 2022).

2.1.2. Socioeconomic status

Our main interest of SES was income. Equivalized annual household income, calculated based on self-reported annual household by the square root of the number of household members, was used to assess the degree of inequality in health among Korean adults over the past decades.

2.1.3. Other variables for decomposition analysis

Socio-demographic variables were included for our decomposition analysis based on various determinants of health from previous studies (Marmot & Bell, 2019; Palmer et al., 2019). These included gender, age, marital status, educational and income levels, employment status, and resident regions.

2.2. Statistical analyses

To measure the socioeconomic inequalities in self-rated health, the Concentration Index (CI) was calculated for each wave of the KNHANES. The CI is a widely used measure in health economics and population health research to quantify the degree of socioeconomic inequalities in health (Kakwani et al., 1997; Wagstaff et al., 2007). After obtaining the CIs, decomposition of the CI was applied to quantify the sociodemographic factors contributing to observed inequalities and their changes in contributions to sociodemographic factors of Korean's self-rated health between wave 1 (1998) and wave 7 (2016/2018).

2.2.1. Concentration index

The CI is defined as twice the area between the 45-degree line (also called the line of equality) and a concentration curve, where the individuals are placed by income levels, and the cumulative ranking of

Table 1
Descriptive characteristics of the study population from the Korea National Health and Nutrition Examination Survey (KNHANES).

Variables		1998 n (%)	2001 n (%)	2005 n (%)	2007–2009 n (%)	2010–2012 n (%)	2013–2015 n (%)	2016–2018 n (%)
Gender	Male	4180 (46.5)	12,034 (47.1)	11,256 (46.4)	7035 (42.3)	7448 (42.3)	6454 (42.2)	7616 (43.5)
	Female	4811 (53.5)	13,515 (52.9)	13,017 (53.6)	9588 (57.7)	10,172 (57.7)	8847 (57.8)	9894 (56.5)
Age	19–34	3048 (33.9)	8537 (33.4)	6998 (28.8)	3687 (22.2)	3439 (19.5)	3055 (20.0)	3270 (18.7)
	35–49	2928 (32.6)	8953 (35.1)	8336 (34.3)	5180 (31.2)	5013 (28.5)	4084 (26.7)	4824 (27.6)
	50–64	1971 (21.9)	5000 (19.6)	5384 (22.2)	4101 (24.7)	4954 (28.1)	4365 (28.5)	4938 (28.2)
	65+	1044 (11.6)	3054 (12.0)	3554 (14.6)	3655 (22.0)	4214 (23.9)	3797 (24.8)	4478 (25.6)
Education level	Elementary school or less	2527 (28.1)	5496 (21.5)	5627 (23.2)	4784 (28.8)	4539 (25.8)	3654 (23.9)	3636 (20.7)
	Junior high school	1242 (13.8)	3067 (12.0)	2644 (10.9)	1860 (11.2)	1923 (10.9)	1629 (10.7)	1774 (10.1)
	High school	3185 (35.4)	9370 (36.7)	9582 (39.5)	5738 (34.5)	5862 (33.3)	5182 (33.9)	5596 (32.0)
	College or more	2037 (22.7)	7616 (29.8)	6420 (26.5)	4241 (25.5)	5296 (30.1)	4836 (31.6)	6504 (37.1)
Income	Q1	1933 (21.5)	5949 (23.3)	4894 (20.2)	3551 (21.4)	3461 (19.6)	2960 (19.4)	3374 (19.3)
	Q2	2099 (23.4)	6344 (24.8)	6086 (25.1)	4150 (25.0)	4530 (25.7)	3878 (25.3)	4240 (24.2)
	Q3	2566 (28.5)	6472 (25.3)	6738 (27.8)	4436 (26.7)	4793 (27.2)	4165 (27.2)	4801 (27.4)
	Q4	2393 (26.6)	6784 (26.6)	6555 (27.0)	4486 (26.7)	4836 (27.5)	4298 (28.1)	5095 (29.1)
Employment status	Regular employment	1337 (14.9)	4502 (17.2)	4561 (18.8)	3034 (18.3)	3657 (20.8)	3366 (22.0)	4369 (25.0)
	Irregular employment	1354 (15.1)	4111 (16.1)	3442 (14.2)	2075 (12.5)	2139 (12.1)	1937 (12.7)	2250 (12.9)
	Non-working	2841 (31.6)	6424 (25.1)	6509 (26.8)	4602 (27.7)	4590 (26.1)	3604 (23.6)	4021 (23.0)
	Unemployment	3459 (38.5)	10,512 (41.1)	9761 (40.2)	6912 (41.6)	7234 (41.1)	6394 (41.8)	6870 (39.2)
Marital status	Married or partnered	6495 (72.2)	17,819 (69.7)	16,552 (68.2)	11,963 (72.0)	13,015 (73.9)	10,744 (70.2)	12,119 (69.2)
	Singled, divorced, or widowed	2496 (27.8)	7730 (30.3)	7721 (31.8)	4660 (28.0)	4605 (26.1)	4557 (29.8)	5391 (30.8)
Region	Seoul-metro regions	5450 (60.6)	13,940 (54.6)	13,503 (55.6)	9643 (58.0)	9104 (51.7)	7660 (50.1)	8843 (50.5)
	Non-metro regions	3541 (39.4)	11,609 (45.4)	10,770 (44.4)	6980 (42.0)	8516 (48.3)	7641 (49.9)	8667 (49.5)
Self-rated Health	Good	6903 (76.8)	21,179 (82.9)	19,231 (79.2)	12,537 (75.4)	14,159 (80.4)	12,338 (80.6)	14,042 (80.2)
	Bad	2088 (23.2)	4370 (17.1)	5042 (20.8)	4086 (24.6)	3461 (19.6)	2963 (19.4)	3468 (19.8)
Total		8991	25,549	24,273	16,623	17,620	15,301	17,510

each individual is plotted against the cumulative share of health outcomes. The CI is typically bound between -1 to $+1$, and if there is no inequality, the index has a value of Zero. A positive CI value indicates good health is more concentrated in higher income group, which can be defined “pro-rich” direction (i.e., positive CI), whereas a negative value indicates bad health is more concentrated in lower income group called “pro-poor” direction (i.e., negative CI). The greater value of the CI means a greater degree of concentration in a negative or positive direction. The CI was calculated using the following Equation:

$$C = \frac{2 * cov(y_i * r_i)}{\mu}$$

where y is the health variable, r is the fractional rank in the income distribution, and μ is the mean of the health variable. It has been discussed that applying the CI method for dichotomized outcome variables has limitations, as the CI is bound differently according to different mean values of the outcome variable (Wagstaff, 2011). In order to rectify this issue, the Erreygers correction was applied (Erreygers, 2009). The CI can be modified by multiplying $4\mu/(b - a)$, where a is a

lower bound and b is an upper bound of the binary outcome because the CI needs to reveal the same magnitude of inequality when calculated on the basis of both health and ill health variables.

2.2.2. Decomposition of the CI

After obtaining the CI, we applied decomposition methods, as proposed by Wagstaff et al. to assess the contributing factors to the observed inequalities (Wagstaff et al., 2003). The basic idea of decomposing the CI is quantifying each contribution of factors to the observed CI as a sum of the contribution from each factor and residuals is the overall CI. The decomposition analyses were calculated by the following equation:

$$C_{total} = \sum_k \left(\frac{\beta_k \bar{x}_k}{\mu} \right) C_k + \frac{CG_k}{\mu}$$

Where the index K refers to the regressor included in the underlying equation, β_k is the coefficient for each health determinant, \bar{x}_k is the mean of each regressor, C_k is the CI for each individual regressor, and μ is the mean of the health variable under consideration. CG_e is the generalized C for the residual from the underlying regression. To assess the

contributing factors to the CI, two steps were followed. First, absolute contribution of each factor was calculated. This was done by multiplying its outcome elasticity, represented as $(\frac{\beta_i \bar{x}_i}{\mu})$, by the CI for each factor.

Next, the percentage contribution of each factor was determined by dividing its absolute contribution by the CI of the outcome variable. A positive contribution of the factor suggests that if this factor were distributed more evenly across income group, the observed inequalities could be reduced by $x\%$.

All analyses were conducted using STATA v. 15 (StataCorp, College Station, TX, USA), and the survey weights provided by KNHANES were applied to all analyses.

3. Results

A description of the study population is presented in Table 1. The descriptive statistics showed that better self-rated health decreased from 23.2% to 19.8% over the 20-year period considered. The results from descriptive analysis also showed gender variation in self-rated health. As presented in Table 2, the rate of poor health slightly decreased for both women and men. Meanwhile, women have consistently reported higher rate of poor health than men over the same period.

Fig. 1 illustrated the income-related health inequalities among Korean adults and by gender as measured by CIs. The results revealed that poor health was consistently more concentrated among the individuals with lower income throughout the observed period (1998: -0.154; 2001: -0.230; 2005: -0.239; 2007/2009: -0.163; 2010/2012: -0.147; 2013/2015: -0.0145; 2016/2018: -0.152). Despite some fluctuations, these trends remained relatively stable over time, with slight increases in the magnitude of CIs in 2007–2009 and 2016–2018 compared to 1998. Gender-stratified analysis revealed that the magnitudes of health inequalities have remained constant, showing “pro-poor” direction (i.e., negative CI) over the years, indicating that poor health was more concentrated among both women and men with lower income groups. Specifically, the CI values for women decreased from -0.174 in 1998 to -0.201 in 2007–2009, suggesting a deepening of health inequalities among women. In addition, to account for relative inequality, an Absolute Concentration Index (ACI) was calculated by multiplying the CI by the mean level of health for a sensitivity analysis. The trends of inequalities observed with the ACI were not significantly different from those obtained using the Erreygers correction. However, there was a noted decrease in the degree of inequalities over the observed period (see Appendix 1).

Table 3 showed the contributions of each socio-demographic factor to the observed inequalities in health among Korean adults. A positive (negative) elasticity indicates that an increase in socio-demographic variables is associated with an increased (decreased) probability of

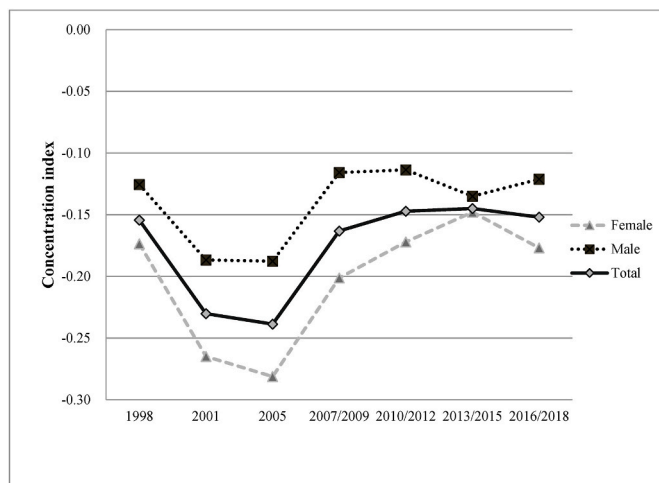


Fig. 1. Concentration Index for poor self-rated health among Korean adults, Korea National Health and Nutrition Examination Survey (KNHANES), 1998–2016/2018 *The Concentration Index presented in this figure was adjusted using the Erreygers correction.

poor health. The CI for each variable represents whether the factor is more concentrated among higher or lower income groups. The positive contribution of each variable to the observed inequalities reveals that the income distribution of each factor and the association between each factor and self-rated health lead to increased probability of being poor health among higher income groups. In essence, a positive contribution from a specific variable indicates that the observed inequality could be reduced by a certain percentage if the factor were distributed equally across different income groups or if the factor was not associated with poor health.

In 1998, the largest contribution to the pro-poor inequality came from income (39.5%), in particular the higher income groups including Q3 and Q4. Higher educational attainment, such as completion of high school and college or more, was the second-largest contributor to the existing health inequalities among Korean adults. The contributions from income and educational levels remained the major factors driving the existing health inequality in 2016–2018, but the magnitudes of their contribution had increased.

Table 4 and Table 5 presented the results of decomposition analyses for Korean women and men, respectively. For women, the highest income and educational attainment accounted for the largest fractions of health inequalities, and the contributions from income and education to the pro-poor inequalities notably increased in 2016–2018. If there was no contribution from education and income, the degree of health inequality would have been approximately 51.9% and 36.7% smaller (closer to zero) in 2016–2018. In the case of men, the contribution from income in 2016–2018 almost doubled compared to the one in 1998, yet the degree of health inequality did not significantly change. In the meantime, education emerged as the second largest contributor to the existing pro-poor health inequality.

4. Discussion

The findings of this study pointed out persistent health inequalities among Korean adults over the past few decades and quantified the contribution of each socioeconomic determinant to the observed inequalities using the CI and CI decomposition. The findings suggest that there have been no notable changes in the magnitude and “pro-poor” direction (i.e., negative CI) of health inequalities over the past 20 years in Korea, showing that poor self-rated health was predominantly concentrated among individuals with lower income groups. While socioeconomic inequalities in health have become entrenched, the

Table 2

A total sample and rates of poor self-rated health among Korean adults from the Korea National Health and Nutrition Examination Survey (KNHANES).

Survey year	Women		Men		Total	
	n	Poor self-rated health (%)	n	Poor self-rated health (%)	Total	Poor self-rated health (%)
1998	4811	28.6	4180	17.0	8991	23.2
2001	13,515	19.7	12,043	14.2	25,549	17.1
2005	13,017	24.5	11,256	16.4	24,273	20.8
2007/2009	9588	28.4	7035	19.3	16,623	24.6
2010/2012	10,172	22.5	7448	15.8	17,620	19.6
2013/2015	8847	22.0	6454	15.7	15,301	19.4
2016/2018	9894	22.1	7616	16.8	17,510	19.8

Table 3

Decomposition of socioeconomic inequalities in health among Korean adults from the Korea National Health and Nutrition Examination Survey (KNHANES) 1998 and 2016/2018.

Variables	1998					2016/2018				
	Elasticity	CI	AbsoluteContribution	Sum	Contribution (%)	Elasticity	CI	AbsoluteContribution	Sum	Contribution (%)
Gender										
Female	0.127	-0.032	-0.004		2.7	0.029	-0.057	-0.002		1.1
Age										
35-49	0.066	0.152	0.010	-0.010	6.8	0.010	0.188	0.002	-0.005	3.2
50-64	0.103	-0.121	-0.013			0.043	0.059	0.003		
65+	0.051	-0.155	-0.008			0.029	-0.318	-0.009		
Education level										
Junior high school	-0.026	-0.053	0.001	-0.059	38.3	-0.010	-0.080	0.001	-0.073	47.7
High school	-0.170	0.094	-0.016			-0.122	0.010	-0.001		
College or more	-0.159	0.281	-0.045			-0.197	0.366	-0.072		
Income										
Q2	-0.029	-0.318	0.009	-0.061	39.5	-0.063	-0.386	0.024	-0.072	47.6
Q3	-0.081	0.155	-0.013			-0.087	0.098	-0.009		
Q4	-0.075	0.761	-0.057			-0.108	0.815	-0.088		
Employment status										
Irregular employment	0.015	0.073	0.001	-0.013	8.2	-0.003	0.011	0.000	-0.010	6.8
Non-working	-0.001	-0.151	0.000			-0.017	-0.092	0.002		
Unemployment	0.076	-0.183	-0.014			0.051	-0.233	-0.012		
Marital status										
Singled, divorced, or widowed	-0.009	-0.113	0.001	-0.6		0.038	-0.207	-0.008		5.2
Region										
Non-metro regions	-0.007	0.176	-0.001		0.8	-0.031	0.157	-0.005		3.2
Sum			-0.148					-0.174		
Residual (Total C-Sum)			-0.007					0.022		
Total CI for poor health			-0.154					-0.152		

Table 4

Decomposition of socioeconomic inequalities in health among Korean women from the Korea National Health and Nutrition Examination Survey (KNHANES) 1998 and 2016/2018.

Variables	1998					2016/2018				
	Elasticity	CI	AbsoluteContribution	Sum	Contribution (%)	Elasticity	CI	AbsoluteContribution	Sum	Contribution (%)
Age										
35-49	0.087	0.150	0.013	-0.017	9.9	0.003	0.217	0.001	-0.013	7.1
50-64	0.122	-0.158	-0.019			0.036	0.041	0.002		
65+	0.067	-0.165	-0.011			0.039	-0.379	-0.015		
Education level										
Junior high school	-0.053	-0.026	0.001	-0.064	36.8	-0.013	-0.070	0.001	-0.092	51.9
High school	-0.182	0.174	-0.032			-0.140	0.080	-0.011		
College or more	-0.143	0.234	-0.034			-0.213	0.384	-0.082		
Income										
Q2	-0.045	-0.300	0.014	-0.067	38.5	-0.061	-0.357	0.022	-0.065	36.7
Q3	-0.108	0.172	-0.019			-0.073	0.136	-0.010		
Q4	-0.083	0.751	-0.062			-0.096	0.799	-0.077		
Employment status										
Irregular employment	0.004	0.072	0.000	-0.008	4.5	-0.018	0.011	0.000	-0.013	7.2
Non-working	-0.008	-0.162	0.001			-0.005	-0.105	0.001		
Unemployment	0.106	-0.088	-0.009			0.069	-0.188	-0.013		
Marital status										
Singled, divorced, or widowed	-0.012	-0.151	0.002	-1.0		0.028	-0.258	-0.007		4.1
Region										
Non-metro regions	-0.019	0.181	-0.004		2.0	-0.023	0.176	-0.004		2.3
Sum			-0.157					-0.193		
Residual (Total C-Sum)			-0.016					0.017		
Total CI for Poor health			-0.174					-0.177		

Table 5

Decomposition of socioeconomic inequalities in health among Korean men from the Korea National Health and Nutrition Examination Survey (KNHANES) 1998 and 2016/2018.

Variables	1998					2016/2018				
	Elasticity	CI	AbsoluteContribution	Sum	Contribution (%)	Elasticity	CI	AbsoluteContribution	Sum	Contribution (%)
Age										
35-49	0.041	0.152	0.006	-0.005	3.8	0.019	0.156	0.003	0.001	-1.2
50-64	0.080	-0.078	-0.006			0.051	0.081	0.004		
65+	0.034	-0.142	-0.005			0.022	-0.252	-0.006		
Education level										
Junior high school	0.000	-0.083	0.000	-0.052	41.0	-0.004	-0.089	0.000	-0.050	40.9
High school	-0.147	-0.003	0.000			-0.090	-0.065	0.006		
College or more	-0.159	0.327	-0.052			-0.165	0.339	-0.056		
Income										
Q2	-0.011	-0.338	0.004	-0.056	44.5	-0.063	-0.413	0.026	-0.079	65.2
Q3	-0.052	0.136	-0.007			-0.101	0.055	-0.006		
Q4	-0.068	0.772	-0.053			-0.120	0.828	-0.010		
Employment status										
Irregular employment	0.021	0.073	0.002	-0.009	6.8	0.010	0.017	0.000	-0.004	3.4
Non-working	0.002	-0.153	0.000			-0.029	-0.102	0.003		
Unemployment	0.036	-0.268	-0.010			0.028	-0.253	-0.007		
Marital status										
Singled, divorced, or widowed	-0.012	-0.066	0.001	-0.6		0.043	-0.155	-0.007		5.5
Region										
Non-metro regions	0.006	0.160	0.001	-0.7		-0.039	0.139	-0.005		4.4
Sum			-0.119					-0.143		
Residual (Total C-Sum)			-0.007					0.022		
Total CI for Poor health			-0.126					-0.121		

contributions of income and education have increased over the given periods. Furthermore, our gender-stratified results highlighted different dynamics of health inequalities between women and men. The contributions of income for men, and education for women have nearly doubled over the past 20 years.

Our findings suggest that there are relatively small but persistent health inequalities in Korea over two decades. The values of the CIs were similar with the results from previous studies highlighting the resolution of health inequalities in Germany (0.11 in 1998, -0.12 in 2001, -0.13 in 2005, and -0.18 in 2008) (Siegel et al., 2014) and Ireland (-0.28 in 2008 and -0.17 in 2013) (Mazeikaite et al., 2019) where countries with universal healthcare system. Korea has accomplished universal health coverage (UHC) through the national health insurance (NIH) system, which aims to address health inequalities by reducing financial hardship for healthcare services (Lee et al., 2021). Despite the achievement of UHC, there is a considerable scope of non-insured healthcare services and higher levels of out-of-pocket (OOP) expenditures compared to other OECD countries as repeatedly reported (Lee & Shaw, 2014; Sohn et al., 2022). In this sense, the persistence of the observed inequalities may imply that the current healthcare system, an indicator of healthcare accessibility, contributes to reducing health inequalities at some extent but not completely. It is plausible that limited benefit coverage and higher OOP could be attributed to the observed persistence of socioeconomic inequalities in self-rated health and may imply that socioeconomic inequalities in health cannot be attenuated solely by the healthcare system itself. More generous income security policies, as a growing body of studies suggested, needs to be considered accompanied with improvement of the NHI in order to alleviate the existing health inequalities (Diderichsen et al., 2012; Macinko et al., 2004).

In addition, we observed that the CI decreased in 2001 and 2005 but remained unchanged in 2008. This indicates that health inequalities do not follow simple, linear trends but rather exhibit fluctuations influenced by various events such as economic crisis (Atkinson, 1997;

Bacigalupe & Escolar-Pujolar, 2014). The variances in health inequalities in Korea could potentially be explained by income inequalities driven by economic fluctuations. The decreased CI in 2001 and 2005 can be attributed to two significant economic crises: the 1997-98 Korean Financial Crisis and the 2002-03 credit card crisis, along with austerity measures implemented in response to these crises (Moon et al., 2019). Previous studies have suggested that these crises, along with the accompanying austerity measures, led to increased income inequalities (Kim & Han, 2007; Park & Kim, 2013), which, in turn, could contribute to the exacerbation of health inequalities (Bacigalupe & Escolar-Pujolar, 2014). In contrast, the 2008 Great Recession did not lead to deeper income inequalities in Korea (Jeong et al., 2017). Consequently, health inequalities did not intensify but remained stable during the period.

The results of our decomposition analyses confirmed that income and educational levels were considerable factors contributing to the observed health inequalities over a 20-year period. Income and education are fundamental resources that can influence health outcomes (Herd et al., 2007). For instance, higher income level increase accessibility to high-quality healthcare services, nutritious food, adequate housing, and other materials essential for promoting health outcomes. Similarly, education enhances individuals' abilities to recognize and effectively manage their health (Sharma, 2021). Our findings are in line with evidence from other countries, highlighting the positive impacts of education and income on self-rated health (Gunasekara et al., 2012; Miething & Åberg Yngwe, 2014; Vonneilich et al., 2020). An increasing body of evidence shows the important role of income and education in health among Korean population. Studies have reported that the individuals with higher income and educational attainment consistently reported better health outcomes compared to their counterparts (Hwang & Shon, 2014; Khang & Kim, 2005). A recent Korean study further highlighted the existence of education-related inequalities in health among working-aged Korean women and men, with observed inequalities even surpassing those found in Japan (Kino et al., 2020). In

light of these findings, it is imperative that social policies, such as those related to education and income security should be integrated into health policies to alleviate the existing income- and educational-related inequalities in health.

Furthermore, our findings provide additional evidence regarding the gender differences in the major contributions to the observed inequality. Specifically, we found that contributions from income have notably increased between 1998 and 2016/2018, particularly among Korean men, with their contribution nearly doubling during this period. The underlying reasons for income being the primary factor driving these inequalities among men remain unclear. However, one plausible explanation is the growing income-driven polarization, which may have a more pronounced impact on men because of their substantial involvement in the labour market and their traditional role as the primary source of household income in Korean society (Kim et al., 2022). The increase in relative deprivation could further accentuate the men's vulnerability to income inequalities, particularly those with lower incomes. In fact, our results demonstrate that the CI for household income has increased, indicating income inequalities have widened in the given period. This finding underscores the significance of income inequalities in affecting the health of Korean men.

Meanwhile, it has been observed that education has a significant contribution to the observed inequalities in health among Korean women. Education serves as a crucial pathway and form of human capital for health, exerting a more substantial effect on women's well-being and health compared to men's (Ross et al., 2012). The polarization of women's job and employment conditions, combined with labour market flexibilization and the increase in women's educational attainment due to meritocratic education policies, could lead to wage inequalities. Such institutional interactions threaten to further widen education-related and health inequalities. To effectively address these observed inequalities among Korean women, it is essential to devise and implement comprehensive education and labour market policies that tackle the root causes of education-related inequalities. The adoption of such policies could significantly eliminate health inequalities among Korean women, paving the way toward a more equitable society.

In the realm of health inequality research, some studies have traditionally focused on measuring disparities between two groups, often relying on central tendency metrics such as mean to gauge the distribution of health conditions (Hwang et al., 2017b). While informative, this approach falls short in capturing the full extent of existing inequalities across the entire distribution. To address this limitation, our study adopted the CI, an advanced measure that enables a more detailed assessment of the magnitude of health inequalities. Furthermore, by decomposing the CI, we identified the contributions of key factors to the observed inequality. This methodological advancement offered a more nuanced understanding of health inequalities, providing valuable insights for the development of social and health policies aimed at reducing these inequalities. Despite these contributions, it is important to acknowledge some limitations. The CI is a descriptive approach that does not establish direct causation between income or other socioeconomic factor and self-rated health. Instead, it offers insight into the extent of the association between income and health by comparing with the poor and the rich. Moreover, the decomposition approach does not establish any causal pathway between socioeconomic factors and health. It rather reveals additional factors that are correlated with the existing

relationship between income and health. In addition, the decomposition used in this study only explains the degree of variation in health, as it is one-dimensional, focusing solely on health without considering the covariance between health and rank (Wagstaff et al., 2007). With respect to the KNHANES, it is worth noting that self-reported data from the KNHANE may be subject to recall bias and response bias, which could have impacted our results (Rosenman et al., 2011).

5. Conclusions

This study presents compelling evidence of entrenched income-related inequalities in self-rated health in Korea over two decades. The findings highlight the significant contribution of income and education to the observed health inequalities. In particular, individuals with higher incomes and better education levels showed a higher likelihood of reporting better health compared to those with lower socioeconomic status. Given that self-rated health is a predictor of future mortality and morbidity, addressing observed health inequalities is crucial. Furthermore, it is imperative to implement more egalitarian social, labour market, and health policies in order to eliminate the existing socioeconomic inequalities in health. By focusing on the relationship between income/education and health, policymakers can gain a deeper understanding and develop effective interventions to alleviate persistent health inequalities among Korean adults.

Ethics approval and consent to participate

Ethical review and approval were waived for this study as KNHANES is publicly available datasets. KNHANES I, IV and VII were collected with the approval of Research Ethics Review Committee of the Korea Disease Control and Prevention Agency (KCDA) under the following reference numbers:2007-02CON-04-P; 2008-04EXP-01-C; 2009-01CON-03-2C; 2018-01-03-P-A.

Declaration of interest statement

The authors declare no competing interests.

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CRedit authorship contribution statement

Daseul Moon: Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Roman Pabayo:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Jongnam Hwang:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Conceptualization.

Data availability

The datasets used in this study are publicly available in Korea National Health and Nutritional Examination Survey (KNHANES) data archives: https://knhanes.kdca.go.kr/knhanes/sub03/sub03_02_05.do

Appendix

Appendix 1

Absolute Concentration Index (ACI) for poor self-rated health among Korean adults, Korea National Health and Nutrition Examination Survey (KNHANES), 1998–2016/2018

Year	Total	Women	Men
1998	-0.0358	-0.0496	-0.0214
2001	-0.0394	-0.0522	-0.0265
2005	-0.0496	-0.0689	-0.0310
2007/2009	-0.0401	-0.0574	-0.0223
2010/2012	-0.0289	-0.0387	-0.0180
2013/2015	-0.0283	-0.0328	-0.0214
2016/2018	-0.0303	-0.0393	-0.0206

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