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The temporal impact of excessive health expenditures on suicidal ideation in heads of households

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18 **The temporal impact of excessive health expenditures on**
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22 **suicidal ideation in heads of households**
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30 9 **Jaeyong Shin^{1,2,3†}, Jae Woo Choi^{1,2†}, Sung-in Jang^{1,2,3}, Young Choi^{1,2}, Sang Gyu Lee⁴**
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4 41 **Abstract**

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6 42 **Objective** Excessive health expenditures (CHEs) are a global issue for households
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8 43 suffering from high-cost medical conditions, low incomes, and limited insurance coverage.
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10 44 After the international financial crisis of 2009, CHEs became a social problem in developed
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12 45 countries. Such economic crises might induce severe mental stress, resulting in suicide.

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15 46 **Methods** We used the Korean Welfare Panel Study (KoWePS) from 2011 to 2013 and
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17 47 selected heads of households among respondents to a questionnaire; the total number of
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19 48 analyzed samples was 4,247 out of 5,717 households in the database. To measure the impact
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21 49 of economic crises accurately, we only included households that had never experienced CHEs
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23 50 before 2011 and never missed any annual surveys during the study period. To examine the
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25 51 temporal relationship between CHEs and suicidal ideation, we conducted a logistic regression
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27 52 analysis.

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32 53 **Results** Among 4,247 heads of household, 146 (3.4%) experienced suicidal ideation
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34 54 more than once during the past year, whereas 4,101 (96.6%) did not. The heads of households
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36 55 who had poor perceived health status (odds ratio (OR)=1.89, 1.13–3.14) and the highest
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38 56 quartile group for depression score (CESD-11, OR=8.60, 4.94–14.97) were more vulnerable
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40 57 to suicidal ideation. Such ideation was influenced to a greater extent by a recent CHE
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42 58 (ORs=1.91, 1.16–3.15) than by either a remote CHE (ORs=1.37, 1.16–3.15) or CHEs in both
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44 59 2011 and 2012 (ORs=1.71, 1.56) for CHEs above 10%. Results for CHEs above 20% were
45
46 60 nearly identical to those of CHEs above 10%.

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51 61 **Conclusions** Up to our knowledge, this is the first study to determine the association
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53 62 between CHEs and suicidal ideation in Korea. At the household level, more recent and higher
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55 63 CHEs resulted in more episodes of suicidal ideation. In conclusion, it might be suggested that
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57 64 to prevent suicidal ideation and improve the mental health of individuals, recent household
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4 65 CHEs must be considered.
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10 67 **Strength and limitation of this study**
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13 68 ***Strength***
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16 ● We used the representative national data ‘Korea Welfare Panel Study(KoWePS)’
17 from the national research institute, “Korea Institute for Health and Social Affairs,
18 KIHASA”.
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24 ● We divided the occurrences of CHEs into four subgroups (none, recent, remote, and
25 both years) in an attempt to analyze temporal causality.
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29 74 ***Limitation***
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32 ● We could not determine casual relationships due to the cross-sectional nature of this
33 study.
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37 ● Because the number of suicide attempts observed during the study period was too
38 small to continue the analysis, we used suicidal ideation as a dependent variable.
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42 ● The number of cases of suicidal ideation may have been too small to determine all
43 associations.
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83 Introduction

84 Protection from excessive health expenditures (CHEs) is widely regarded as a desirable
85 objective of healthcare systems and policies. However, CHEs are not always the same as high
86 healthcare costs. For example, an expensive surgery might not be excessive if a household
87 does not bear its full cost because the service is provided free or at a subsidized price or is
88 covered by third-party insurance. On the other hand, even the small cost of common illnesses
89 can be financially disastrous for poor households with no insurance.

90 CHEs have traditionally been household issues in undeveloped countries¹⁻⁵. However, after
91 the international financial crisis of 2009, CHEs became a social problem in developed
92 countries. As these countries regard healthcare as a luxury⁶, they began to cut these benefits
93 and raise productivity in health industries⁷. The average increase in health spending across
94 Organisation for Economic Co-operation and Development (OECD) member countries was
95 only 0.2% between 2009 and 2011, compared to over 4% per annum after years of continuous
96 growth. This increase resulted in a significant increase in out-of-pocket expenses for medical
97 care and a decrease in access to the healthcare system.

98 According to OECD health data, patients pay the highest percentage of their medical fees
99 (>35%) out of pocket in the Republic of Korea⁷. The low health insurance premiums for
100 national health insurance in Korea limit the range of insurance coverage. In 2011, the national
101 health insurance rate was 5.99% of an employee's salary. Compared to the average rate of 9.5%
102 in OECD countries, this is quite low when we consider both the Korean economy and overall
103 health expenditures. The percentage of coverage paid by the government is only 44.7%,
104 which is extremely low compared to 74.4% for the average OECD country. Only three
105 countries (Mexico, Chile, and the United States) have lower coverage rates than Korea. As
106 the primary function of insurance is to protect the patient from harm in terms of health and

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4 107 economic risk, it is critical to reduce the occurrences of CHEs. According to Korean National
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6 108 Statistics, the number of households experiencing CHEs in 2010 was 618,000, or 3.9% of all
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8 109 households. This figure was only 1% in 2002 but began to increase thereafter, reaching 3.3%
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11 110 by 2006⁸.

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14 111 These data suggest that Koreans are at risk of occurrences of CHEs. Thus, they might be
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16 112 vulnerable to a decline in their economic welfare in the face of ill health, especially when
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18 113 CHEs exist.

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21 114 Additionally, the number of suicides is steeply increasing annually in Korea^{8,9}. According to
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23 115 OECD health statistics data, the age-standardized suicide mortality rate in 2011 was 33.3 per
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25 116 100,000 individuals. Among all OECD countries, this is the highest value, although the rate
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27 117 of increase in suicidal mortality remains constant. The most vulnerable age group is below 40
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29 118 years of age, presumably because of economic crises in the household.

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33 119 In this study, the compositions of health expenditures between households with and
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35 120 without CHEs were compared. In addition, the relationships between CHEs and suicidal
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37 121 ideation were assessed. Our results suggest that CHEs have an adverse effect on suicidal
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39 122 ideation.
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4 123 **Methods**
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7 124 Data from the Korean Welfare Panel Study (KoWePS: Korea Institute for Health & Social
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9 125 Affairs & Seoul National University Social Welfare Research Center, 2008) from 2011 to
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11 126 2013 were obtained for this study. The KoWePS is an on-going longitudinal study of a
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13 127 nationally representative sample of Korean households, which collects data annually. The
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15 128 constituent questionnaires in this survey consisted of a household member survey for
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17 129 household members aged 15 years and over, a household survey, and a supplementary survey
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19 130 for special topics. Face-to-face interviews were used to gain information during the first year
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21 131 of the study.
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25 132 We respect the provision of declaration of Helsinki and we obey the protocol for the
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27 133 research project, suitable for safe and ethical principles. As this study is a secondary opened
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29 134 national data for public access from Korea institute for Health and Social welfare, we do not
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31 135 need to get any individual informed consents. All patient records/information in this study
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33 136 was anonymized and de-identified prior to analysis.
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37 137 We especially focused on the economic impact to households and suggest that the most
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39 138 vulnerable family member to an economic crisis is the head of household. Indeed, we
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41 139 selected heads of households among respondents to the questionnaire. The total number of
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43 140 analyzed samples was 4,247 out of 5,717 households in the database. To measure the impact
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45 141 of economic crises accurately, we only included households that had never experienced a
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47 142 CHE before 2011 and never missed any annual surveys during the study period.
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51 143 The household questionnaire portion of the KoWePS included a set of questions that asked
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53 144 about the income of all household members. These questions addressed earned income,
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55 145 income from assets, and miscellaneous income. The present study utilized this set of income-
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4 146 related questions to create a total household income and disposable income variable. To
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6 147 obtain the number of households experiencing CHEs, we divided the total cost of health
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8 148 expenditures into disposable income for each household.
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11 149 Although a CHE was defined as an expense over 40% of disposable income by the World
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13 150 Health Organization⁴, it has been defined differently by various studies¹⁰⁻¹². To evaluate
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15 151 correlations between economic crises and health expenditures, we considered the thresholds
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17 152 of CHEs to be 10% and 20%.
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21 153 In this study, we used several covariates to control for demographic and socioeconomic
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23 154 characteristics and health status. Demographic characteristics included gender, age, marital
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25 155 status, and socioeconomic factors. Moreover, we considered temporal factors of CHEs. In
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27 156 other words, we determined when a excessive event occurred: none, remote (in 2011), recent
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29 157 (in 2012), and in both 2011 and 2012.
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33 158 To measure the level of depression, the CESD-11 scale was used, which was originally
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35 159 designed to measure depressive symptoms in the general population¹³ and has been widely
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37 160 used in community- and clinically based samples^{14,15}. For each year of the study period, the
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39 161 respondents reported symptoms experienced during the previous week using a four-point
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41 162 scale. Depression scores for each year were calculated by averaging across 11 items. Suicidal
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43 163 ideation was assessed by a questionnaire that asked about the presence of suicidal ideation
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45 164 during the past year.
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49 165 The frequency with which CHEs occurred overall, and after stratifying by household
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51 166 demographics and socioeconomic status, was determined by performing a chi-square test. To
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53 167 examine the relationship between CHEs and suicidal ideation, we conducted a logistic
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55 168 regression analysis. We used the SAS 9.3 statistical package (Cary, NC, USA) for statistical
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169 analysis.

For peer review only

170 Results

171 The general characteristics of households are shown in Table 1. A total of 4,247 households
172 were enrolled in this study. Among them, 146 heads of households (3.4%) had suicidal
173 ideation more than once during the past year, whereas 4,101 (96.6%) did not.

174 First, we performed chi-square tests for bivariate analyses (Tables 1 and 2). At the level of
175 the head of household, all dependent variables, including sex ($p<0.001$), being over 65 years
176 of age ($p=0.009$), education level ($p=0.003$), the presence of a spouse ($p<0.001$), and
177 depression ($p<0.001$) were significantly different between those who did and did not have
178 suicidal ideation. We also considered variables that reflect the overall household situation,
179 such as income level, number of family members, economically active family members,
180 presence of a disabled person in the family, and presence of a senior in the family. Among
181 these variables, there were statistically significant differences in income level ($p<0.001$),
182 number of family members ($p<0.001$), and economically active family members in the family
183 ($p<0.001$). Moreover, we investigated whether a temporal relationship between the
184 occurrence of health expenditures and suicidal ideation might exist. At different threshold
185 settings, CHEs that were 10% and 20% above disposable income were both significantly
186 different between those who did and did not have suicidal ideation. However, in both 2011
187 and 2012, CHEs over 10% had a greater impact on suicidal ideation, whereas in 2012 alone,
188 CHEs over 20% had a greater impact.

189 We carried out multivariate analysis using a logistic regression model. For CHEs above 10%
190 of disposable income, the heads of households who had poor perceived health status [odds
191 ratio (OR)=1.89, 95% CI: 1.13–3.14] and the highest quartile group for depression score
192 (CESD-11, OR=8.60, 95% CI: 4.94–14.97) were more vulnerable to suicidal ideation (Table
193 3). This ideation was influenced to a greater extent by a recent CHE than by a remote CHE or

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4 194 CHEs in both years. For CHEs above 20% of disposable income, statistical differences in
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6 195 perceived health status (OR=1.02, 95% CI: 1.01–1.04) and the highest group for depression
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8 196 score (CESD-11, OR=8.43, 95% CI: 4.84–14.68) were also present at the level of head of
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10 197 household. At this level, the impact of the lowest quartile of income was more than double
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12 198 that of the highest quartile (OR=2.07, 95% CI: 1.01–4.23). Interestingly, only the recent CHE
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14 199 (OR=2.07, 95% CI: 1.01–4.23) had a meaningful association with suicidal ideation.

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18 200 Because depression at the level of head of household had extremely high ORs in both
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20 201 threshold settings of CHEs, a subgroup analysis was performed for heads of households who
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22 202 were above average in terms of CESD-11 score (Table 4). In this subgroup analysis, the heads
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24 203 of households were more vulnerable to the high threshold of CHEs. In other words, when
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26 204 CHEs were above 20% (in 2012; OR=2.32, 95% CI: 1.40–3.87; in both 2011 and 2012;
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28 205 OR=1.82, 95% CI: 0.99–3.34) compared to 10% (in 2012; OR=1.66, 95% CI: 0.94–2.94; in
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30 206 both 2011 and 2012; OR=1.49, 95% CI: 0.86–2.57), suicidal ideation was increased (Figure
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211 Discussion

212 From this study, we observed that heads of households with poor perceived health status
213 and depressive mood who experienced CHEs reported more episodes of suicidal ideation.
214 According to measurements of the temporal influences of CHEs during 2011 and 2012, 2011
215 was associated with meaningful increases in ORs for suicidal ideation in both the above 10%
216 and 20% groups. In addition, there was a greater impact in the above 20% group than in the
217 above 10% group. We also performed a subgroup analysis for heads of households who were
218 moderately and severely depressed. Here, there were statistical trends between income level
219 and suicidal ideation, although the p-values did not indicate statistical significance. The
220 temporal relationship between CHE and suicidal ideation was stronger in the more depressed
221 groups than in the less depressed groups. Within the more depressed groups, the 20% group
222 showed a higher OR than the 10% group.

223 Globally, many politicians and public health administrators have tried to make healthcare as
224 accessible as possible^{10 11}. The problem of accessibility is likely induced by both economic
225 and spatial problems. In Korea, the amount and quality of healthcare access have improved
226 over the last 30 years by the rapid expansion of national health insurance. However, because
227 national reimbursement was low, fiscal asset quality could not be secured. In other words, the
228 out-of-pocket expenses were high regardless of insurance availability, and the range of
229 diseases covered by the insurance was limited. These problems are slow to improve because
230 medical insurance premiums are very low. In 2009, a global economic crisis hindered the
231 ability of patients to visit clinics due to high out-of-pocket expenses and low incomes. In
232 addition, patients with chronic diseases and a large economic burden suffered from
233 tremendous medical expenses.

234 In this sense, many researchers have tried to determine the causes and economic outcomes

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4 235 of CHEs rather than their effects on health. However, these kinds of economic stresses
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6 236 worsen mental health and induce depressive disorders, suicidal ideation, and numbers of
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8 237 suicide attempts^{12 13}. For example, there was a steep increase in the number of patients with
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10 238 major depressive disorder, suicidal ideation, and suicide attempts immediately after the
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12 239 international economic crisis in 2009¹⁴⁻¹⁷. The prevalence of major depressive disorder
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14 240 increased from 3.3% of the general population in 2008 to 8.2% in 2011, which is a
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16 241 statistically significant difference. In addition, suicidal ideation among men increased from
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18 242 4.4% in 2009 to 7.1% in 2011¹⁸.

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22 243 In 2008, the state of Oregon in the United States initiated a limited expansion of its
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24 244 Medicaid program for low-income adults through a lottery drawing of approximately 30,000
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26 245 names from a waiting list of almost 90,000¹⁹. Selected adults won the opportunity to apply
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28 246 for Medicaid and to enroll if they met eligibility requirements. This lottery presented an
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30 247 opportunity to study the effects of Medicaid with the use of random assignment. Five years
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32 248 after its initiation, researchers found no significant effect of Medicaid coverage on the
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34 249 prevalence or diagnosis of hypertension or high cholesterol levels or on the use of medication
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36 250 for these conditions. Medicaid coverage significantly increased the probability of a diagnosis
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38 251 of diabetes and the use of diabetes medications, but there were no significant effects on
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40 252 average glycated hemoglobin levels or on the percentage of participants with levels of 6.5%
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42 253 or higher. Interestingly, Medicaid coverage decreased the probability of a positive screening
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44 254 for depression (-9.15 percentage points; 95% confidence interval, -16.70 to -1.60; p=0.02),
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46 255 increased the use of many preventive services, and nearly eliminated excessive out-of-pocket
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48 256 medical expenditures.

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54 257 Another study that observed the association between CHEs and depression was performed
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56 258 in India²⁰. This study comprised a cross-sectional survey of 2,494 consenting women from a
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4 259 randomly selected sample of 3,000 women aged 18–50 years who lived in the catchment area
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6 260 of a primary health center in Goa, India. CHEs, defined a priori as greater than 10% of total
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8 261 household income spent out of pocket on health in the previous month, was reported by 138
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10 262 women (5.5%; CI: 4.7–6.5%); these women were more likely to report economic difficulties,
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12 263 such as having gone hungry in the past 3 months because of a lack of money (OR 1.99, CI
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14 264 1.1–3.6, $p=0.02$). Only depressive disorder was associated with significantly higher
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16 265 healthcare costs, lost time costs, and risk of CHEs (OR 2.66, CI 1.6–4.4, $p<0.001$, after
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18 266 adjustment for possible demographic confounders and other physical health problems). There
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20 267 was a linear association between psychological morbidity scores and the risk of CHEs. From
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22 268 this study, the authors concluded that if economic arguments were considered a key driver of
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24 269 global health policy, then depressive disorder should be considered a major health priority for
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26 270 women in developing countries.
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31 271 After examining these studies from the United States and India, we hypothesized that CHEs
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33 272 might increase the severity of depression and induce suicidal ideation. In addition, there are
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35 273 still many other studies investigating the association between CHEs and depression^{21 22}.
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37 274 However, no research has analyzed the direct association between CHEs and suicidal events,
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39 275 such as ideation, attempts, and mortality cases. For this reason, we expect that this study will
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41 276 stimulate additional studies on the prevention of CHE occurrences and their impact on
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43 277 suicide and mental health problems.
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47 278 There are several limitations of this study. First, we could not determine casual relationships
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49 279 due to the cross-sectional nature of this study. To overcome this weakness, we divided the
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51 280 occurrences of CHEs into four subgroups (none, recent, remote, and both years) in an attempt
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53 281 to analyze temporal causality. Second, the measured outcome was suicidal ideation, not
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55 282 suicide attempts, although there is a rough association between suicidal ideation and attempts.
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4 283 Because the number of suicide attempts observed during the study period was too small to
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6 284 continue the analysis, we used suicidal ideation as a dependent variable. Third, the number of
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8 285 cases of suicidal ideation may have been too small to determine all associations. Although we
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10 286 observed some statistical trends among independent variables for income level and temporal
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12 287 factors of CHEs, these trends did not reach statistical significance. One reason may be that
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14 288 the KoWePS study included investigations on mental health and suicide only since 2010
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16 289 despite its initiation in 2006. Hence, we could not obtain more data for analysis.
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4 296 **Conclusion**
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7 297 This is the first study to determine an association between CHEs and suicidal ideation. For
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9 298 heads of households, poor perceived health status and more severe depressed mood could
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11 299 affect suicidal ideation. For heads of households, a recent and greater CHE resulted in more
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13 300 episodes of suicidal ideation. Although this study has several limitations, a future study could
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15 301 overcome these limitations by altering the characteristics of national and panel data. We also
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17 302 plan to gather a larger number of suicide attempts and suicide mortality cases. In conclusion,
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19 303 we suggest that to prevent suicidal ideation and improve the mental health of individuals,
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21 304 recent household CHEs must be considered.
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4 316 ***Contributorship statement***
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7 we clarified that the content has not been published or submitted for publication elsewhere.
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9 We respect the provision of declaration of Helsinki and we obey the protocol for the research
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11 project, suitable for safe and ethical principles. As this study is a secondary opened national
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13 data for public access, we do not need to get any individual informed consents. All authors
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15 have contributed significantly and that all authors are in agreement with the content of the
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17 manuscript. Jaeyong Shin and Jae Woo Choi designed the study as co-first authors, Young
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19 Choi carried out the statistical analysis and wrote the paper, gave important comments for this
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21 study, Sung-in Jang and Sang Gyu Lee was responsible for the statistical design, and Eun-
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23 Cheol Park suggested the direction of this study as a corresponding author.
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31 327 ***Competing interests***
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34 328 There are no competing interests in all authors.
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43 331 There is neither private nor public funding for this study.
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49 333 ***Data sharing***
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52 334 As we used public and national open data, we are willing to sharing our data and results.
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Table 1. Bivariate analysis, based on the presence of suicidal ideation in heads of households

Variables	Absence of suicidal ideation		Presence of suicidal ideation		Total N	p-value
	n	%	n	%		
Head of household						
Sex						<0.001
Male	3040	97.6	76	2.4	3116	
Female	1061	93.8	70	6.2	1131	
Age over 65 years						0.009
<65 years	2164	97.1	64	2.9	2228	
≥65 years	1937	95.8	85	4.2	2022	
Education						0.003
Graduation from elementary school	1376	95.5	65	4.5	1441	
Graduation from middle school	545	95.4	26	4.6	571	
Graduation from high school	1198	97.3	33	2.7	1231	
Graduation from college	982	97.8	22	2.2	1004	
The presence of a spouse						<0.001
Presence	2858	97.7	66	2.3	2924	
Absence	1243	94.0	80	6.0	1323	
Perceived health status						<0.001
Excellent	2271	98.3	40	1.7	2311	
Good	912	96.7	31	3.3	943	
Poor	918	92.4	75	7.6	993	
Depressive mood status, CESD-11						<0.001
<25%	1916	99.0	19	1.0	1935	
25–50%	581	98.1	11	1.9	592	
50–75%	741	98.5	11	1.5	752	
≥75%	863	89.2	105	10.8	968	
Head of household						
Income level						<0.001
<25%	756	93.2	55	6.8	811	
25–50%	953	96.1	39	3.9	992	
50–75%	1140	97.1	34	2.9	1174	
≥75%	1252	98.6	18	1.4	1270	

Number of family members						<0.001
One	856	93.7	58	6.3	914	
Two	1233	96.5	45	3.5	1278	
Three	767	97.3	21	2.7	788	
Four or more	1245	98.3	22	1.7	1267	
Economically active family member						<0.001
None	1001	93.5	70	6.5	1071	
One	1882	97.3	52	2.7	1934	
Two or more	1218	98.1	24	1.9	1242	
Disabled person among family members						0.102
Absence	3389	96.8	113	3.2	3502	
Presence	712	95.6	33	4.4	745	
Senior person among family members						0.062
Absence	2007	97.1	60	2.9	2067	
Presence	2094	96.1	86	3.9	2180	
Total	4101	96.6	146	3.4	4247	

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Table 2. Bivariate analysis, based on the presence of suicidal ideation in heads of households and the occurrence of excessive health expenditures during the last 2 years

The occurrence of excessive health expenditure during the last 2 years	Excessive health expenditure > 10%						Excessive health expenditure > 20%					
	Absence of suicidal ideation		Presence of suicidal ideation		Total	<i>p</i> -value	Absence of suicidal ideation		Presence of suicidal ideation		Total	<i>p</i> -value
	n	%	n	%			n	%	n	%		
None	2061	98.0	43	2.0	2104	<0.001	2984	97.5	75	2.5	3059	<0.001
2011, remote	582	96.8	19	3.2	601		406	96.2	16	3.8	422	
2012, recent	632	94.8	35	5.2	667		413	92.2	35	7.8	448	
2011 and 2012	826	94.4	49	5.6	875		298	93.7	20	6.3	318	
Total	4101	96.6	146	3.4	4247		4101	96.6	146	3.4	4247	

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Table 3. Multivariate analysis, based on the presence of suicidal ideation during the past year among heads of households

Variables	Excessive health expenditure > 10%			Excessive health expenditure > 20%				
	OR	95% C.I.	<i>p</i> -value	OR	95% C.I.	<i>p</i> -value		
Head of household								
Sex								
Male	1.00	1.00	1.00	1.00	1.00	1.00		
Female	0.91	0.49	1.66	0.748	0.91	0.50	1.65	0.748
Age of head of household								
<65 years	1.00	1.00	1.00	1.00	1.00	1.00		
≥65 years	2.69	0.34	21.17	0.346	2.62	0.33	20.59	0.360
Education								
Graduation from elementary school	0.50	0.25	0.97	0.040	0.51	0.26	1.00	0.049
Graduation from middle school	0.94	0.49	1.83	0.864	0.94	0.48	1.83	0.850
Graduation from high school	0.86	0.48	1.55	0.618	0.87	0.49	1.57	0.649
Graduation from college	1.00	1.00	1.00	1.00	1.00	1.00		
The presence of a spouse								
Presence	1.00	1.00	1.00	1.00	1.00	1.00		
Absence	1.70	0.86	3.34	0.126	1.69	0.87	3.31	0.122
Perceived health status								
Excellent	1.00	1.00	1.00	1.00	1.00	1.00		
Good	1.20	0.70	2.04	0.504	1.20	0.71	2.04	0.503
Poor	1.89	1.13	3.14	0.015	1.90	1.15	3.15	0.012
Depressive mood status, CESD-11								
<25%	1.00	1.00	1.00	1.00	1.00	1.00		
25–50%	1.79	0.84	3.79	0.132	1.74	0.82	3.70	0.151
50–75%	1.29	0.60	2.76	0.521	1.26	0.59	2.71	0.553
≥75%	8.60	4.94	14.97	<.001	8.43	4.84	14.68	<0.001
Head of household								
Income Level								
<25%	2.75	1.34	5.63	0.064	2.07	1.01	4.23	0.047
25–50%	1.90	0.97	3.72	0.175	1.63	0.84	3.17	0.148
50–75%	1.70	0.92	3.16	0.187	1.56	0.84	2.88	0.159
≥75%	1.00	1.00	1.00	1.00	1.00	1.00		
Number of family members								
One	1.00	1.00	1.00	1.00	1.00	1.00		
Two	0.99	0.47	2.08	0.571	1.17	0.65	2.08	0.606
Three	0.90	0.39	2.08	0.972	1.01	0.48	2.12	0.979
Four or more	0.87	0.37	2.04	0.805	0.91	0.39	2.12	0.833
Economically active family member								
None	1.39	0.70	2.74	0.346	1.37	0.69	2.71	0.370
One	0.96	0.54	1.68	0.876	0.92	0.52	1.62	0.771
Two or more	1.00	1.00	1.00	1.00	1.00	1.00		

Disabled person among family members

Absence	1.00	1.00	1.00		1.00	1.00	1.00	
Presence	1.12	0.72	1.73	0.617	1.12	0.72	1.75	0.601

Senior person among family members

Absence	1.00	1.00	1.00		1.00	1.00	1.00	
Presence	0.16	0.02	1.21	0.075	0.16	0.02	1.24	0.080

Excessive health expenditure during the last 2 years

None	1.00	1.00	1.00		1.00	1.00	1.00	
2011, remote	1.37	0.77	2.44	0.288	1.25	0.70	2.24	0.454
2012, recent	1.91	1.16	3.15	0.012	2.29	1.45	3.64	<0.001
2011 and 2012	1.71	1.04	2.81	0.034	1.56	0.88	2.76	0.129

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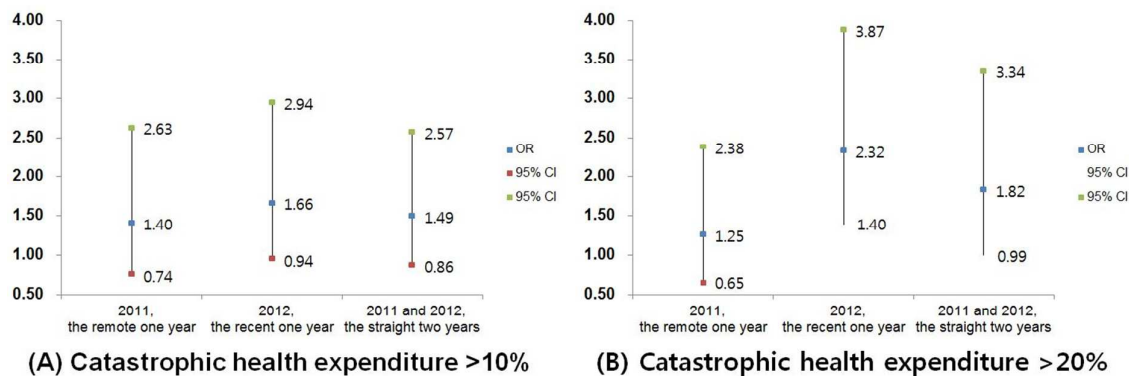
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Table 4. Multivariate analysis, based on the presence of suicidal ideation during the past year, among moderately and severely depressed heads of households

	Excessive health expenditure > 10%			Excessive health expenditure > 20%				
	OR	95% C.I.	<i>p</i> -value	OR	95% C.I.	<i>p</i> -value		
Excessive health expenditure during the last 2 years								
None	1.00	1.00	1.00	1.00	1.00	1.00		
2011, remote	1.40	0.74	2.63	0.301	1.25	0.65	2.38	0.504
2012, recent	1.66	0.94	2.94	0.083	2.32	1.40	3.87	0.001
2011 and 2012	1.49	0.86	2.57	0.156	1.82	0.99	3.34	0.054

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(A) Catastrophic health expenditure >10%

(B) Catastrophic health expenditure >20%

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468 **Figure 1.** The heads of households were more vulnerable to the high threshold of CHEs. In
 469 other words, when CHEs were above 20% (B), compared to 10% (A), suicidal ideation was
 470 increased.

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BMJ Open

The temporal association of excessive health expenditure with suicidal ideation among primary income earners: cross-sectional design using Korean Welfare Panel Survey (KoWePS)

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Keywords:	health expenditure, suicidal ideation, economic burden, household, suicide, korea

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4 41 **Abstract**

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6 42 **Objective** Excessive health expenditure (EHE) is a global issue for households
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8 43 suffering from high-cost medical conditions, low incomes, and limited insurance coverage.
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10 44 After the international financial crisis of 2008, EHE became a social problem in developed
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12 45 countries. Such economic crisis might induce severe mental stress, resulting in suicidal
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14 46 ideation.

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18 47 **Methods** We used the Korean Welfare Panel Study (KoWePS) from 2011 to 2013 and
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20 48 selected primary income earners, who were defined as practical and economic representatives
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22 49 of households; the total number of analyzed samples was 4,247 out of 5,717 households in
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24 50 the database. We only included households that had never experienced EHE before 2011. To
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26 51 examine the temporal relationship between EHE and suicidal ideation, we conducted a
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28 52 logistic regression analysis.

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32 53 **Results** Among 4,247 subjects, 146 (3.4%) experienced suicidal ideation, whereas
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34 54 4,101 (96.6%) did not. One scale of depression score (CESD-11, Odds ratio (OR)=1.28,
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36 55 Confidential Interval (CI); 1.23–1.34, $p < 0.001$) was associated with increased suicidal
37
38 56 ideation. Such ideation was influenced to a greater extent by a recent EHE above ten percent
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40 57 of disposable income (ORs=1.91, CI; 1.16–3.15, $p=0.012$) than by either a remote EHE
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42 58 (ORs=1.29, CI; 0.71–2.32) or one in both 2011 and 2012 (ORs=1.67, CI; 1.01–2.78, $p=0.048$).

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46 59 **Conclusions** In this study, more recent EHE resulted in more suicidal ideation. In
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48 60 conclusion, we suggest that recent household EHE might be considered as an important factor
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50 61 to prevent suicidal ideation and to improve the mental health of individuals.
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4 64 **Strength and limitation of this study**
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7 65 ***Strength***
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- 10 ● We used the representative national data ‘Korea Welfare Panel Study(KoWePS)’
11 from the national research institute, “Korea Institute for Health and Social Affairs,
12 KIHASA”.
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18 ● We divided the occurrences of EHE into four subgroups (none, recent, remote, and
19 both years) in an attempt to analyze temporal causality.
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22 71 ***Limitation***
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- 25 ● We could not determine casual relationships due to the cross-sectional nature of this
26 study.
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31 ● Because the number of suicide attempts observed during the study period was too
32 small to continue the analysis, we used suicidal ideation as a dependent variable.
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36 ● The number of cases of suicidal ideation may have been too small to determine all
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80 Introduction

81 Protection from excessive health expenditure (EHE) is widely regarded as a desirable
82 objective of healthcare systems and policies. However, EHE is not always the same as high
83 healthcare cost. For example, an expensive surgery might not be excessive if a household
84 does not bear its full cost because the service is provided free or at a subsidized price or is
85 covered by third-party insurance. On the other hand, even the small cost of common illnesses
86 can be financially disastrous for poor households with no insurance.

87 Although EHE is usually defined as catastrophic health expenditure (CHE), health-related
88 expenses over 40% of disposable income per annum according to the World Health
89 Organization (WHO)¹, it has often been defined differently by various studies²⁻⁴. Thus in this
90 study we defined different cut-off values to enhance the effectiveness of the study design.

91 EHE has traditionally been chronic household issues in undeveloped countries^{1 5-8}. However,
92 after the international financial crisis of 2008, EHE became a social problem even in
93 developed countries. As these countries began to see the healthcare as a luxury⁹, they started
94 to cut these benefits and raised productivity in health industries¹⁰. The average increase in
95 health spending across Organisation for Economic Co-operation and Development (OECD)
96 member countries was only 0.2% between 2009 and 2011, compared to recent drastic growth
97 in total health expenditure over 4% per annum. This increase resulted in a significant rise in
98 out-of-pocket expenses for medical care whereas a decrease in access to the healthcare
99 benefits.

100 According to OECD health data, patients pay the highest percentage of their medical fees
101 (>35%) out of pocket in the Republic of Korea¹⁰. The low health insurance premiums for
102 national health insurance in Korea limit the range of insurance coverage. In 2011, the national

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4 103 health insurance rate was 5.99% of an employee's salary. Compared to the average rate of 9.5%
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6 104 in OECD countries, this is quite low when we consider both the Korean economy and overall
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8 105 health expenditures. The percentage of coverage paid by the government is only 44.7%,
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10 106 which is extremely low compared to 74.4% for the average OECD country. Only three
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12 107 countries (Mexico, Chile, and the United States) have lower coverage rates than Korea. As
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14 108 the primary function of insurance is to protect the patient from harm in terms of health and
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16 109 economic risk, it is critical to reduce the occurrences of EHE. According to Korean National
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18 110 Statistics, the number of households experiencing EHE, more than 40% of disposable
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20 111 household income, in 2010 was 618,000, or 3.9% of all households. This figure was only 1%
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22 112 in 2002 but began to increase thereafter, reaching 3.3% by 2006¹¹.

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27 113 These data suggest that Koreans are at risk of occurrences of EHE. Thus, they might be
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29 114 vulnerable to a decline in their economic welfare in the face of ill health, especially when
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31 115 EHE exist. Additionally, the number of suicides is steeply increasing annually in Korea^{11 12}.
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33 116 According to OECD health statistics data, the age-standardized suicide mortality rate in 2011
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35 117 was 33.3 per 100,000 individuals. Among all OECD countries, this is the highest value, while
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37 118 the rate of increase in suicidal mortality remains constant. Since the financial stress might be
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39 119 an important factor in Korea, we have to put concern on the financially vulnerable groups
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41 120 such as primary income earners with EHE in household.

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45 121 For example, in 2008, the state of Oregon in the United States initiated a limited expansion
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47 122 of its Medicaid program for low-income adults¹³. Five years after its initiation, researchers
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49 123 found no significant effect of Medicaid coverage on the prevalence or diagnosis of
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51 124 hypertension or high cholesterol levels or on the use of medication for these conditions.
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53 125 However, interestingly, Medicaid coverage decreased the probability of a positive screening
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55 126 for depression (-9.15 percentage points; 95% confidence interval (CI); -16.70--1.60; $p=0.02$),
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4 127 increased the use of many preventive services, and nearly eliminated excessive out-of-pocket
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6 128 medical expenditures. This study has proven that the mental health could be improved by
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9 129 reducing the financial burden for health.

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11 130 Another study which observed the association between EHE and depression was performed
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13 131 in India¹⁴. According to this cross-sectional study in Goa, India, 138 women, whose
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15 132 households were spending more than 10% of their disposable income for medical cost, were
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17 133 more likely to report economic difficulties, such as having gone hungry in the past 3 months
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19 134 due to lack of money (OR 1.99, CI 1.10–3.62, p=0.021). In addition, depressive disorder was
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21 135 associated with significantly higher healthcare costs, lost time costs, and risk of EHE. There
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23 136 was a linear association between psychological morbidity scores and the risk of EHE. From
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25 137 this study, it could be suggested that economic arguments due to health problems were
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27 138 considered to be a key driver of mental health policy.

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32 139 Although a few studies on EHE in Korea were published in Korea^{15 16}, there were
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34 140 insignificant to prove the relationship between excessive health expenditures and mental
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36 141 health.

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40 142 In this study, the compositions of health expenditures between households with and without
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42 143 EHE were compared at first. Then we are going to focus on the analysis for the temporal
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44 144 association between EHE and suicidal ideation among the primary income earners in
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46 145 household. After the financial crisis of Korea in 1997, the primary income earners in
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48 146 households had great burden and financial responsibility to keep providing for family. For
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50 147 this reason, we would like to verify the hypothesis that the recently occurred EHE have
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52 148 greater relation to suicidal ideation rather than remote occurred EHE among those primary
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54 149 income earners and their responsibility for providing family in Asian culture.
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4 150 **Methods**

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7 151 ***Participants***

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10 152 Data from the Korean Welfare Panel Study (KoWePS: Korea Institute for Health & Social
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12 153 Affairs & Seoul National University Social Welfare Research Center, 2008) from 2011 to
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14 154 2013 were obtained for this study. The KoWePS is an on-going longitudinal study of a
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16 155 nationally representative sample of Korean households, which collects data annually. The
17
18 156 KoWePS-led survey population represents 90% of the census conducted in 2005. Statisticians
19
20 157 of this survey determined final panel households by applying ‘Stratified Double Sampling’
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22 158 model. The constituent questionnaires in this survey consisted of a household member survey
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24 159 for household members aged 15 years and over, a household survey, and a supplementary
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26 160 survey for special topics. Face-to-face interviews were used to gain information during the
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28 161 first year of the study.

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31 162 We respected the provision of declaration of Helsinki and obeyed the protocol for the
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33 163 research project, suitable for safe and ethical principles. Since this study was a secondary
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35 164 opened national data for public access from Korea institute for Health and Social welfare, we
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37 165 did not need to get any individual informed consents. All patient records/information in this
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39 166 study was anonymized and de-identified prior to analysis. In addition, we were granted the
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41 167 approval of institutional review board at the graduate school of public health in Yonsei
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43 168 university (IRB approval No.: 2-1040939-AB-N-01-2015-202).

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48 169 We especially focused on the suicidal ideation of household heads, who are defined as the
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50 170 primary income earner and practical representative in household. The study suggests that the
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52 171 most vulnerable family member to an economic crisis might be a primary income earner.
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54 172 Indeed, we selected them among respondents to the questionnaire. The total number of
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56 173 analyzed samples was 4,247 out of 5,717 households from the database. In Korea, there were
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4 174 total 17,339,422 households enrolled in governmental system in 2010. We only included
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6 175 households those had never experienced EHE before 2011 and never missed any annual
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8 176 surveys during the study period.
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14 178 ***The characteristics of individuals as primary income earners***
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17 179 In this study, we used several covariates to control for demographic and socioeconomic
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19 180 characteristics of individual levels. Demographic characteristics such as sex, age, educational
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21 181 level, presence of a spouse, perceived health status, regular medication more than three
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23 182 months, and depressive mood status were included. Since the official retiring age is sixty-five
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25 183 years old in Korea, we divided the age groups into one under sixty-five and another on sixty-
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27 184 five and over. Four education categories including degree from elementary, middle, high
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29 185 school, and college and above were self-reported by participants. In terms of the presence of
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31 186 a spouse, interviewers reported whether the subjects were in social marital status with
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33 187 someone else. We divided perceived health status with three categories into good, normal,
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35 188 and bad, while the original survey questionnaire used scale with five degrees including
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37 189 excellent, good, normal, bad, and very bad. The question of self-rated health is as follow; “In
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39 190 your opinion, How do you evaluate your own general health status during the last one year?”.
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41 191 In terms of regular medication, interviewers asked whether the subjects were taking any
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43 192 medication regularly more than last three months or not. This was used as an indicator to
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45 193 determine presence of any kind of chronic diseases.
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54 195 ***The characteristics of households***
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57 196 The household questionnaire portion of the KoWePS included a set of questions that asked
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4 197 about the income of all household members. These questions addressed earned income,
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6 198 income from assets, and miscellaneous income. The present study utilized this set of income-
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8 199 related questions to create a total household income and disposable income variable. To
9
10 200 obtain the number of households experiencing EHE, we divided the total cost of health
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12 201 expenditures into disposable income for each household. Moreover, we considered temporal
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14 202 factors of EHE. In other words, we determined when an excessive event occurred: none,
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16 203 remote (in 2011), recent (in 2012), and in both 2011 and 2012.
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20 204 We also considered other covariates of households such as number of family members,
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22 205 economically active family members, disabled members, and members over sixty five years
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24 206 old. In terms of economically active family members, it was defined as someone who worked
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26 207 regularly and earned salaries during last one year. Disabled were those officially diagnosed
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28 208 by doctors using the standard of national guideline for disabled.
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35 210 *Measuring depressive symptoms and suicidal ideation*

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38 211 To measure the level of depression, the Center for Epidemiologic Studies Depression scale
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40 212 (CES-D) was used, which was originally designed to measure depressive symptoms in the
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42 213 general population¹⁷ and has been widely used in community- and clinically based samples¹⁸
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44 214 ¹⁹. For each year of the study period, the respondents reported symptoms experienced during
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46 215 the previous week using a four-point scale. Depression scores for each year were calculated
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48 216 by totaling across 11 items.
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51 217 Suicidal ideation was assessed by a questionnaire regarding the occurrence of suicidal
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53 218 ideation during the past year as follows; “Have you ever had any serious suicidal ideation in
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55 219 the past year as of today?”
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4 220 *Statistical analysis*
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7 221 The frequency, with which EHE occurred overall, and after stratifying by household
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9 222 demographic and socioeconomic status, was determined by performing a chi-square test. To
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11 223 examine the relationship between EHE and suicidal ideation, we conducted a logistic
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13 224 regression analysis.
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16 225 At the level of the primary income earners, all dependent variables regarding characteristics
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18 226 of individuals were used in analysis. We also considered variables that reflect the overall
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20 227 household situation, such as income level, number of family members, economically active
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22 228 family members, disabled members, and members over sixty five years old.
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26 229 Moreover, we investigated whether there is a temporal relationship between the occurrence
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28 230 of healthcare expenditures and suicidal ideation. The EHE over 10% of disposable income,
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30 231 which is the standard threshold from the Ministry of Health and Welfare, South Korea, was
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32 232 significantly different between those who did and did not have suicidal ideation. To examine
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34 233 the increased relationship between EHE and suicidal ideation, we also performed another
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36 234 analysis using various cut-off values as 20% and 40% for EHE, the latter being the standard
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38 235 of WHO.
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42 236 In logistic regression analysis, we only included the variables of individual level in Model 1.
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44 237 Furthermore, we expanded to use variables both individual and household levels in Model 2.
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46 238 When p-value was less than 0.05, we defined the statistical result as significance. We used the
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48 239 SAS 9.3 statistical package (Cary, NC, USA) for statistical analysis.
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240 Results

241 The general characteristics of primary income earners and households are shown in Table 1.
242 A total of 4,247 households are enrolled in this study. Among them, 146 heads of households
243 (3.4%) reported suicidal ideation once or more during the past year, whereas 4,101 (96.6%)
244 did not. A total number of 76 men (52.1%) and 70 women (47.9%) had suicidal ideation
245 among primary income earners. Moreover, the lowest educated subjects with elementary
246 level of education 65 subjects (44.5%) had higher proportion among the group with suicidal
247 ideation. The average sum of CESD-11 among the subjects with suicidal ideation is 23.15,
248 while the average score among the others is only 18.81. Only five subjects attempted suicide
249 among all primary income earners.

250 Threshold of the EHE of 10% and 40% above disposable income are significantly different
251 for those who did and did not have suicidal ideation (Table 2). Among 875 subjects whose
252 households suffered from EHE over 10% during the last two consecutive years, 49 persons
253 (5.6%) experience suicidal ideation. In 62 subjects with EHE above 40% during the last two
254 consecutive years, eight persons (12.9%) reported suicidal ideation, indicating greater
255 association with suicidal ideation.

256 We carried out multivariate analysis using a logistic regression model, based on the
257 threshold of EHE above 10% of disposable income (Table 3). In model 1, the primary income
258 earners who had poor perceived health status (odds ratio (OR)=1.78, 95% CI: 1.03–3.08) and
259 a higher depression score (CESD-11, OR=1.29, 95% CI: 1.24–1.35) are more vulnerable to
260 suicidal ideation. In model 2, a higher depressive score (CESD-11, OR=1.28, 95% CI: 1.23–
261 1.34) is associated with the presence of suicidal ideation. In both model 1 and 2, EHE
262 occurred in the recent year of 2012 (Model 1; OR=2.03, 95% CI: 1.23–3.35 / Model 2;
263 OR=1.91, 95% CI: 1.16–3.15) and for both consecutive years in 2011 and 2012 (Model 1;

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4 264 OR=1.83, 95% CI: 1.12–2.98 / Model 2; OR=1.67, 95% CI: 1.01–2.78) have statistically
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6 265 significant ORs for suicidal ideation. Moreover, the suicidal ideation is influenced to a greater
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8 266 extent by a recent EHE than by a remote EHE or EHE in both years. To compare the fitness
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10 267 between the models, we used $-2\log L$ methods. Through this measurement, it seems that the
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12 268 model 2 is more suitable for suicidal ideation because the number of $-2\log L$ is less than that
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14 269 of model 1.

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18 270 As the official cut-off value in our study is 10%, we performed other values as threshold.
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20 271 The primary income earners are more vulnerable to the high threshold of EHE. When EHE is
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22 272 above 20%, compared to 10%, the odds ratio for suicidal ideation with the EHE in recent one
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24 273 year is increased. (Figure 1)

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28 274 For EHE above 40% of disposable income in the Supplementary table 1, the consecutive
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30 275 two years with EHE is statistical meaningful to the increased odds ratio for suicidal ideation
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32 276 (Model 2; OR=2.67, 95% CI: 1.10–6.46).

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35 277 Since the heads of households with depressive symptoms may have more correlation with
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37 278 suicidal ideation, a subgroup analysis was performed for the primary income earners whose
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39 279 sum of CESD-11 score were sixteen or more (Table 4). The sum of CESD-11 score over
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41 280 sixteen indicates potential risk for major depressive disorder (MDD). In this subgroup
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43 281 analysis, the primary income earners were more vulnerable to the higher EHE. In other words,
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45 282 when EHE were above 20% (in 2012; OR=2.46, 95% CI: 1.57–3.85 / in both 2011 and 2012;
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47 283 OR=1.89, 95% CI: 1.08–3.31) compared to 10% (in 2012; OR=1.98, 95% CI: 1.21–3.22 / in
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49 284 both 2011 and 2012; OR=1.86, 95% CI: 1.15–3.02), suicidal ideation was increased.

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4 286 **Discussion**

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6 287 According to measurements of the temporal association with EHE during 2011 and 2012,
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8 288 the recent one year in 2012 was associated with meaningful increases in ORs for suicidal
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10 289 ideation with the EHE above 10%. We also performed a subgroup analysis for primary
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12 290 income earners with potential risk to MDD. The temporal relationship between EHE and
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14 291 suicidal ideation is stronger in this potentially depressed group than in the others. Within this
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16 292 group, the subjects with the EHE over 20% showed a higher OR than one of the EHE over
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18 293 10%. Interestingly, in the EHE over 40%, the recent 2012 one year is not statically associated
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20 294 with suicidal ideation. However, the two consecutive two years with EHE is highly associated
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22 295 with suicidal ideation. Since the number of households with EHE over 40 % is only 197
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24 296 (4.4%), the odds ratio of the recent one year in 2012 might not show statistically increased
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26 297 OR for suicidal ideation. In spite of this limited condition, the consecutive occurrence of EHE
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28 298 have strong statically association with suicidal ideation. Thus we need to focus on the
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30 299 households with EHE in a long term through appropriate intervention based on social
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32 300 consensus.
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38 301 Globally, many politicians and public health administrators have tried to make healthcare as
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40 302 accessible as possible^{2,3}. The problem of accessibility is likely induced by both economic and
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42 303 spatial problems. In Korea, the amount and quality of healthcare access have improved over
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44 304 the last 30 years by through rapid expansion of national health insurance. However, because
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46 305 national reimbursement was low, fiscal asset quality in healthcare system could not be
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48 306 secured. Although this problem was improving gradually, a global economic crisis in 2008
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50 307 hindered the ability of patients to visit clinics because of decreased incomes and heavy out-
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52 308 of-pocket expenses, especially for the low SES class with chronic and severe diseases with
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54 309 the tremendous medical expenses²⁰. In this sense, many researchers have tried to determine
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56 310 the causes and economic outcomes of EHE rather than their effects on health. However, these
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4 311 kinds of economic stresses worsen mental health and induce depressive disorders, suicidal
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6 312 ideation, and numbers of suicide attempts^{4 17}. For example, there was a steep increase in the
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8 313 number of patients with MDD, suicidal ideation, and suicide attempts immediately after the
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10 314 international economic crisis in 2008^{18 19 21}. The prevalence of MDD increased from 3.3% of
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12 315 the general population in 2008 to 8.2% in 2011, which is a statistically significant difference.
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15 316 In addition, suicidal ideation among men increased from 4.4% in 2008 to 7.1% in 2011²².

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18 317 Just as the same as these previous studies on this topic, our result also mentioned the strong
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20 318 association between financial burden of health and suicidal ideation. However, there were
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22 319 several limitations of this study.

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25 320 First, we could not determine casual relationship due to the cross-sectional nature of this
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27 321 study. To overcome this weakness, we divided the occurrences of EHE into four subgroups
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29 322 (none, recent, remote, and both years) in an attempt to analyze temporal causality.

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33 323 Second, we used the suicidal ideation as a dependent variable, not suicidal attempt.
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35 324 Because the number of suicide attempts observed during the study period was minimal to
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37 325 conduct the analysis, we used suicidal ideation. Although a small portion of general
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39 326 population with suicidal ideation eventually tried suicide attempts, suicidal ideation is still
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41 327 one of the powerful indicators to predict suicide attempt. According to one study in Korea, 84%
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43 328 of subjects with suicide attempt had previous suicidal ideation in the last two year²³.
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45 329 Moreover, ‘someone talking or writing about death, dying, or suicide’ is well established
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47 330 consensus warning sign for suicide²⁴. Thus, even suicidal ideation is regarded as important
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49 331 dependent variable for preventing the progress to suicidal attempt and suicide.

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54 332 Third, the number of cases of suicidal ideation may have been too small to determine all
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56 333 associations. Although we observed some statistical trends among independent variables for
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4 334 income level and temporal factors of EHEs, these trends did not reach statistical significance.
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6 335 One reason may be that the KoWePS study included investigations on mental health and
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8 336 suicide only since 2011 regardless of its initiation in 2006. Hence, we could not obtain more
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10 337 data for analysis.

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14 338 Fourth, we excluded other family members except for the primary income earner in
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16 339 households. This panel survey tried to include as many family members as possible; surveys
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18 340 were mainly answered by heads of household who are practical and economic representatives
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20 341 of households. In addition, since family members under nineteen years old did not answer the
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22 342 CESD-11 scale, we could not adjust the depressive symptoms, which is one of the most
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24 343 important factors to suicidal ideation. In this regard, we only included the primary income
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26 344 earners as study population.

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30 345 Fifth, we did not know what kinds of diagnosis categories, including mental and physical
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32 346 illness, were most significant to the occurrence of EHE. Although few researchers studied the
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34 347 attributable medical conditions, the range of them were so wide, defined as chronic diseases
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36 348 or disabled. For example, Choi et al. analyzed that cancer patients with unstable economic
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38 349 status were more vulnerable to EHE than those with stable economic conditions¹⁶. In addition,
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40 350 they studied that family members with chronic diseases or disabilities were powerful
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42 351 attributable factors to EHE on household²⁵. However, none of them tried to figure out the
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44 352 most important kinds of disease categories. In this sense, another further study is needed to
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46 353 investigate the disease specific targeted to policy on EHE.

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51 354 Despite of such limitations, we still believe that this study still deserves to be published for
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53 355 several reasons.

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56 356 First, this study used national opened data representing the Republic of Korea. Through this
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4 357 well-designed panel survey, this study had high external validity and is able to be expanded in
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6 358 the future. Furthermore, this national data could be compared to ones in other countries such
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8 359 as Japan and Scandinavian countries¹⁰, those had reduced the suicidal mortality rates
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10 360 dramatically.

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13 361 Second, this is the first study on the relationship between EHE and suicidal ideation in
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15 362 Korea up to our knowledge. Thus, it could draw attentions of other researchers and policy
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17 363 makers to the economic burden for health as an attributable factor to suicidal ideation.

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20 364 Third, it is able to minimize the health disparity in society through the subsidies to EHE.
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22 365 Because EHE hinders the access to healthcare system, solving this problem could improve
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24 366 the basic human right for health and overall quality of public health. Korea already started
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26 367 to public subsidies for EHE last year, further studies would possibly figure out the effect of
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28 368 the support for EHE in the near future.

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31 369 To put all things together, we still need to perform further investigation. As we are going to
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33 370 accumulating these Korean Data and following the trend of policy implication, we will report
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35 371 the effect of the policy for EHE apparently.

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41 42 43 373 **Conclusion**

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46 374 This is the first study to examine an association between EHE and suicidal ideation among
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48 375 primary income earners. For them, more severe depressive mood is associated with suicidal
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50 376 ideation. Furthermore, recently occurred and greater EHE might increase suicidal ideation.
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52 377 Although this study has several limitations, a future study could overcome these limitations
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54 378 by altering the characteristics of national and panel data. We also plan to gather a larger
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56 379 number of suicide attempts and suicide mortality cases. In conclusion, we suggest that in
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4 380 order to prevent suicidal ideation and to improve the mental health of individuals especially
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6 381 for primary income earners in households, recent household EHE might be considered.
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12 383 ***Contributorship statement***
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15 384 We clarified that the content has not been published or submitted for publication elsewhere.
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17 385 We respect the provision of declaration of Helsinki and we obey the protocol for the research
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19 386 project, suitable for safe and ethical principles. As this study is a secondary opened national
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21 387 data for public access, we do not need to get any individual informed consents. All authors
22
23 388 have contributed significantly and that all authors are in agreement with the content of the
24
25 389 manuscript. Jaeyong Shin and Jae Woo Choi designed the study as co-first authors and wrote
26
27 390 the paper, Young Choi and Tae Hwan Ihm carried out the statistical analysis and gave
28
29 391 important comments for this study, Sung-in Jang and Sang Gyu Lee was responsible for the
30
31 392 statistical design, and Eun-Cheol Park suggested the direction of this study as a
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33 393 corresponding author.
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38 394 ***Competing interests***
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40
41 395 There are no competing interests in all authors.
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46
47 397 There is neither private nor public funding for this study.
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50 398 ***Data sharing***
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53 399 As we used public and national open data, we are willing to sharing our data and results.
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Table 1. Demographic characteristics among subjects, based on the presence of suicidal ideation in heads of households

Variables	Absence of suicidal ideation		Presence of suicidal ideation		Total n	p-value
	n	%	n	%		
Level of individual primary income earner						
Sex						<0.001
Male	3040	74.1	76	52.1	3116	
Female	1061	25.9	70	47.9	1131	
Age, over 65 years						0.009
≥65 years	1937	47.2	85	58.2	2022	
Education						0.003
Graduation from elementary school	1376	33.6	65	44.5	1441	
Graduation from middle school	545	13.3	26	17.8	571	
Graduation from high school	1198	29.2	33	22.6	1231	
Graduation from college	982	23.9	22	15.1	1004	
The presence of a spouse						<0.001
Presence	2858	69.7	66	45.2	2924	
Perceived health status						<0.001
Excellent	2271	55.4	40	27.4	2311	
Good	912	22.2	31	21.2	943	
Poor	918	22.4	75	51.4	993	
Regular medication more than three months^f						<0.001
Presence	2492	60.8	117	80.1	2609	
Depressive mood	Mean	SD	Mean	SD	Mean	<0.001
Sum of CESD-11 ^g	18.808	2.9	23.151	4.3	18.953	
Level of household						
Income level						<0.001
<25% (lowest)	756	18.4	55	37.7	811	
25–50%	953	23.2	39	26.7	992	
50–75%	1140	27.8	34	23.3	1174	
≥75% (highest)	1252	30.5	18	12.3	1270	
Number of family members						<0.001
One	856	20.9	58	39.7	914	
Two	1233	30.1	45	30.8	1278	
Three	767	18.7	21	14.4	788	
Four or more	1245	30.4	22	15.1	1267	
Economically active family member*						<0.001
None	1001	24.4	70	47.9	1071	
One	1882	45.9	52	35.6	1934	
Two or more	1218	29.7	24	16.4	1242	
Disabled person among family members**						0.102
Presence	712	17.4	33	22.6	745	
Aged over 65, among family members						0.062
Presence	2094	51.1	86	58.9	2180	
Total	4101	96.6	146	3.4	4247	

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4 476 ¶ “Regular medication more than three months” indicated the presence of on-going chronic
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6 477 diseases. † “CESD-11” means “Center for Epidemiological Studies Depression Scale”. *The
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8 478 variable of “Economically active family members” is defined as someone who worked
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10 479 regularly and got salary during last one year. **Disabled person means persons, who are
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12 480 officially qualified by doctors using the standard of national guideline for disabled.
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Table 2. Bivariate analysis, based on the presence of suicidal ideation in heads of households and the occurrence of excessive health expenditures during the last 2 years

The occurrence of excessive health expenditure during the last 2 years	Excessive health expenditure > 10%*						Excessive health expenditure > 40%**					
	Absence of suicidal ideation		Presence of suicidal ideation		Total	<i>p</i> -value	Absence of suicidal ideation		Presence of suicidal ideation		Total	<i>p</i> -value
	n	%	n	%			n	%	n	%		
None	2061	98.0	43	2.0	2104	<0.001	3683	97.0	115	3.0	3798	<0.001
2011, remote	582	96.8	19	3.2	601		180	94.7	10	5.3	190	
2012, recent	632	94.8	35	5.2	667		184	93.4	13	6.6	197	
2011 and 2012	826	94.4	49	5.6	875		54	87.1	8	12.9	62	
Total	4101	96.6	146	3.4	4247		4101	96.6	146	3.4	4247	

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486 The threshold of 10%* as excessive health expenditure (EHE) is the standard from
 487 the Ministry of Health and Welfares in Korea, while the one of 40%** is from the WHO. As
 488 WHO recommended to use flexible threshold according to cultural and national background
 489 differently, we did further statistical analysis using 10% in paper, although we also performed
 490 another statistical analysis in supplementary materials.

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Table 3. Multivariate analysis, based on the presence of suicidal ideation during the past year among heads of households with the threshold of excessive health expenditure as ten percent from total expenditure in household.

Variables	Model 1 (-2logL=1056.60)			Model 2 (-2logL=1032.57)		
	OR	95% C.I.	p-value	OR	95% C.I.	p-value
Excessive health expenditure* during the last 2 years						
None	1.00			1.00		
2011, remote	1.32	0.74 2.36	0.347	1.29	0.71 2.32	0.405
2012, recent	2.03	1.23 3.35	0.006	1.91	1.16 3.15	0.012
2011 and 2012	1.83	1.12 2.98	0.016	1.67	1.01 2.78	0.048
Level of individual primary income earner						
Sex						
Male	1.00			1.00		
Female	0.94	0.51 1.71	0.832	0.83	0.45 1.54	0.559
Age, over 65						
<65 years	1.00	1.00 1.00		1.00	1.00 1.00	
≥65 years	0.57	0.36 0.91	0.018	2.52	0.32 20.13	0.384
Education						
Degree from elementary school	0.60	0.31 1.15	0.124	0.53	0.27 1.06	0.073
Degree from middle school	1.03	0.54 1.98	0.930	0.96	0.49 1.89	0.899
Degree from high school	0.90	0.50 1.60	0.713	0.85	0.47 1.54	0.596
Degree from college	1.00	1.00 1.00		1.00	1.00 1.00	
The presence of a spouse						
Presence	1.00	1.00 1.00		1.00	1.00 1.00	
Absence	0.54	0.30 0.96	0.035	0.54	0.28 1.06	0.072
Perceived health status						
Excellent	1.00	1.00 1.00		1.00	1.00 1.00	
Good	1.30	0.74 2.26	0.363	1.20	0.69 2.11	0.520
Poor	1.78	1.03 3.08	0.041	1.61	0.92 2.82	0.093
Depressive mood						
Sum of CESD-11 ^f	1.29	1.24 1.35	<.001	1.28	1.23 1.34	<.001
^fRegular medication more than three months						
Absence	1.00			1.00		
Presence	1.22	0.71 2.10	0.473	1.22	0.70 2.11	0.481
Level of household						
Income Level						
<25% (Lowest)				2.01	0.97 4.15	0.059
25–50%				1.58	0.81 3.10	0.181
50–75%				1.60	0.86 2.96	0.139
≥75% (Highest)				1.00	1.00 1.00	
Number of family members						
One				1.00	1.00 1.00	
Two				1.14	0.63 2.06	0.666
Three				1.06	0.50 2.25	0.888
Four or more				0.86	0.37 2.01	0.735
Economically active family member*						
None				1.29	0.65 2.58	0.465
One				0.87	0.49 1.54	0.642
Two or more				1.00	1.00 1.00	
Disabled person among family members**						
Absence				1.00	1.00 1.00	
Presence				1.12	0.71 1.75	0.626
Aged over 65, among family members						
Absence				1.00	1.00 1.00	
Presence				0.16	0.02 1.24	0.079

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4 505 ¶ “Regular medication more than three months” indicated the presence of on-going chronic
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6 506 diseases. † “CESD-11” means “Center for Epidemiological Studies Depression Scale”. *The
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8 507 variable of “Economically active family members” is defined as someone who worked
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10 508 regularly and got salary during last one year. **Disabled person means persons, who are
11 509 officially qualified by doctors using the standard of national guideline for disabled.

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532 **Table 4.** The adjusted odds ratios for suicidal ideation among the subjects, whose CESD-11
 533 score are sixteen or over, according to the various settings of thresholds of excessive health
 534 expenditure.

	EHE > 10%			EHE > 20%				
	OR	95% C.I.	p-value	OR	95% C.I.	p-value		
Excessive health expenditure during the last two years								
None	1.00			1.00				
2011, remote	1.28	0.72	2.28	0.397	1.19	0.66	2.13	0.571
2012, recent	1.98	1.21	3.22	0.006	2.46	1.57	3.85	<0.001
2011 & 2012	1.86	1.15	3.02	0.012	1.89	1.08	3.31	0.026

535 We all adjusted the individual and household characteristics including sex, age, education,
 536 the presence of spouse, perceived health status, regular medication, income level, number of
 537 family members, the number of economically active family members, the presence of
 538 disabled in family, and the presence of aged over 65 in family.

539 “CESD-11” means “Center for Epidemiological Studies Depression Scale”

540 “EHE” is the excessive health expenditure, which is the proportion of health cost among
 541 disposable income of household.

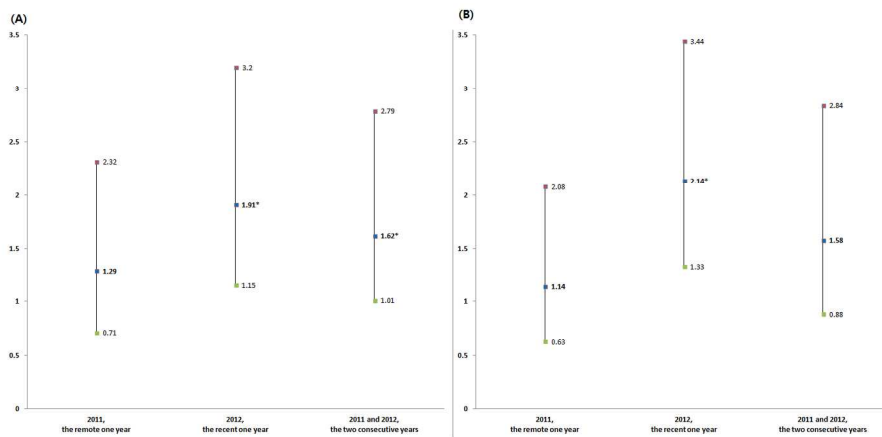
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4 545 **Figure 1.** The primary income earners were more vulnerable to the high threshold of EHE. In
5 546 other words, when EHE were above 20% (B), compared to 10% (A), the odds ratio for
6 547 suicidal ideation with the EHE in recent one year was increased. * p -value <0.05
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Supplementary table 1. Multivariate analysis, based on the presence of suicidal ideation during the past year among heads of households with the threshold of excessive health expenditure as ten percent from total expenditure in household as 40%

	Model 1 (-2logL= 1051.1)			Model 2 (-2logL= 1035.3)			Model 2 among depressive subjects					
	OR	95% C.I.	<i>p</i> -value	OR	95% C.I.	<i>p</i> -value	OR	95% C.I.	<i>p</i> -value			
Excessive health expenditure during the last 2 years												
None	1.00			1.00			1.00					
2011, remote	1.22	0.60	2.51	0.583	1.11	0.53	2.30	0.785	1.20	0.59	2.46	0.616
2012, recent	1.32	0.68	2.55	0.415	1.20	0.62	2.35	0.587	1.61	0.86	3.02	0.138
2011 and 2012	2.91	1.24	6.86	0.014	2.67	1.10	6.46	0.030	2.96	1.28	6.85	0.011

When we set the cut-off value as 40%, the EHE during the two consecutive years only have statistically meaningful increased odds ratios both in model 1 and 2. This might be due to the limited number of households, those spending more than 40% of disposable income as EHE.

Depressive subjects mean the primary income earners who reported depressive scales of sixteen or over, which is the cut-off value for potential major depressive disorder.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	The temporal association of excessive health expenditure with suicidal ideation among primary income earners: cross-sectional design using Korean Welfare Panel Survey (KoWePS) Excessive health expenditure (EHE) is a global issue for households suffering from high-cost medical conditions, low incomes, and limited insurance coverage. After the international financial crisis of 2008, EHE became a social problem in developed countries. Such economic crisis might induce severe mental stress, resulting in suicidal ideation.
Introduction		
Background/rationale	2	Excessive health expenditure (EHE) is a global issue for households suffering from high-cost medical conditions, low incomes, and limited insurance coverage. After the international financial crisis of 2008, EHE became a social problem in developed countries. Such economic crisis might induce severe mental stress, resulting in suicidal ideation.
Objectives	3	To figure out whether recent occurred EHE is more associated with suicidal ideation
Methods		
Study design	4	Cross-sectional study design
Setting	5	the Korean Welfare Panel Study (KoWePS) from 2011 to 2013
Participants	6	<i>Cross-sectional study</i> — the Korean Welfare Panel Study (KoWePS) from 2011 to 2013. The total number of analyzed samples was 4,247 out of 5,717 households in the database. We only included households that had never experienced EHE before 2011 <i>Case-control study</i> — Among 4,247 subjects, 146 (3.4%) experienced suicidal ideation, whereas 4,101 (96.6%) did not.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy (e) we also performed another analysis using various cut-off values as 20% and 40% for EHE, the latter being the standard of WHO

Continued on next page

Results

Participants	13*	<p>(a) Among 4,247 subjects, 146 (3.4%) experienced suicidal ideation, whereas 4,101 (96.6%) did not. One scale of depression score (CESD-11, Odds ratio (OR)=1.28, Confidential Interval (CI); 1.23–1.34, $p < 0.001$) was associated with increased suicidal ideation. Such ideation was influenced to a greater extent by a recent EHE above ten percent of disposable income (ORs=1.91, CI; 1.16–3.15, $p=0.012$) than by either a remote EHE (ORs=1.29, CI; 0.71–2.32) or one in both 2011 and 2012 (ORs=1.67, CI; 1.01-2.78, $p=0.048$).</p> <p>(b) The total number of analyzed samples was 4,247 out of 5,717 households in the database. We only included households that had never experienced EHE before 2011</p>
Descriptive data	14*	<p>(a) The general characteristics of primary income earners and households are shown in Table 1. A total of 4,247 households are enrolled in this study. Among them, 146 heads of households (3.4%) reported suicidal ideation once or more during the past year, whereas 4,101 (96.6%) did not. A total number of 76 men (52.1%) and 70 women (47.9%) had suicidal ideation among primary income earners. Moreover, the lowest educated subjects with elementary level of education 65 subjects (44.5%) had higher proportion among the group with suicidal ideation. The average sum of CESD-11 among the subjects with suicidal ideation is 23.15, while the average score among the others is only 18.81. Only five subjects attempted suicide among all primary income earners.</p> <p>(b) None of them were missed, because all of them completed surveys.</p> <p><i>Cross-sectional study</i>— A total number of 76 men (52.1%) and 70 women (47.9%) had suicidal ideation among primary income earners. Moreover, the lowest educated subjects with elementary level of education 65 subjects (44.5%) had higher proportion among the group with suicidal ideation. The average sum of CESD-11 among the subjects with suicidal ideation is 23.15, while the average score among the others is only 18.81. Only five subjects attempted suicide among all primary income earners.</p>
Main results	16	<p>(a) Among 4,247 subjects, 146 (3.4%) experienced suicidal ideation, whereas 4,101 (96.6%) did not. One scale of depression score (CESD-11, Odds ratio (OR)=1.28, Confidential Interval (CI); 1.23–1.34, $p < 0.001$) was associated with increased suicidal ideation. Such ideation was influenced to a greater extent by a recent EHE above ten percent of disposable income (ORs=1.91, CI; 1.16–3.15, $p=0.012$) than by either a remote EHE (ORs=1.29, CI; 0.71–2.32) or one in both 2011 and 2012 (ORs=1.67, CI; 1.01-2.78, $p=0.048$).</p> <p>(b) Based on a depressive scale of CESD, we defined the cut-off value as sixteen for potential major depressive disorder.</p>
Other analyses	17	<p>As the official cut-off value in our study is 10%, we performed other values as threshold. The primary income earners are more vulnerable to the high threshold of EHE. When EHE is above 20%, compared to 10%, the odds ratio for suicidal ideation with the EHE in recent one year is increased. (Figure 1)</p> <p>For EHE above 40% of disposable income in the Supplementary table 1, the consecutive two years with EHE is statistically meaningful to the increased odds ratio for suicidal ideation (Model 2; OR=2.67, 95% CI: 1.10–6.46).</p> <p>Since the heads of households with depressive symptoms may have more correlation with suicidal ideation, a subgroup analysis was performed for the primary income earners whose sum of CESD-11 score were sixteen or more (Table 4). The sum of CESD-11 score over sixteen indicates potential risk for major depressive disorder (MDD). In this subgroup analysis, the primary income earners were more vulnerable to the higher EHE. In other words, when EHE were above 20% (in 2012; OR=2.46, 95% CI: 1.57–3.85 / in both 2011 and 2012; OR=1.89, 95% CI: 1.08–3.31) compared to 10% (in 2012; OR=1.98, 95% CI: 1.21–3.22 / in</p>

both 2011 and 2012; OR=1.86, 95% CI: 1.15–3.02), suicidal ideation was increased.

Discussion

Key results	18	According to measurements of the temporal association with EHE during 2011 and 2012, the recent one year in 2012 was associated with meaningful increases in ORs for suicidal ideation with the EHE above 10%.
Limitations	19	<p>First, we could not determine casual relationship due to the cross-sectional nature of this study. To overcome this weakness, we divided the occurrences of EHE into four subgroups (none, recent, remote, and both years) in an attempt to analyze temporal causality.</p> <p>Second, we used the suicidal ideation as a dependent variable, not suicidal attempt. Because the number of suicide attempts observed during the study period was minimal to conduct the analysis, we used suicidal ideation. Although a small portion of general population with suicidal ideation eventually tried suicide attempts, suicidal ideation is still one of the powerful indicators to predict suicide attempt. According to one study in Korea, 84% of subjects with suicide attempt had previous suicidal ideation in the last two year²³. Moreover, ‘someone talking or writing about death, dying, or suicide’ is well established consensus warning sign for suicide²⁴. Thus, even suicidal ideation is regarded as important dependent variable for preventing the progress to suicidal attempt and suicide.</p> <p>Third, the number of cases of suicidal ideation may have been too small to determine all associations. Although we observed some statistical trends among independent variables for income level and temporal factors of EHEs, these trends did not reach statistical significance. One reason may be that the KoWePS study included investigations on mental health and suicide only since 2011 regardless of its initiation in 2006. Hence, we could not obtain more data for analysis.</p> <p>Fourth, we excluded other family members except for the primary income earner in households. This panel survey tried to include as many family members as possible; surveys were mainly answered by heads of household who are practical and economic representatives of households. In addition, since family members under nineteen years old did not answer the CESD-11 scale, we could not adjust the depressive symptoms, which is one of the most important factors to suicidal ideation. In this regard, we only included the primary income earners as study population.</p> <p>Fifth, we did not know what kinds of diagnosis categories, including mental and physical illness, were most significant to the occurrence of EHE. Although few researchers studied the attributable medical conditions, the range of them were so wide, defined as chronic diseases or disabled. For example, Choi et al. analyzed that cancer patients with unstable economic status were more vulnerable to EHE than those with stable economic conditions¹⁶. In addition, they studied that family members with chronic diseases or disabilities were powerful attributable factors to EHE on household²⁵. However, none of them tried to figure out the most important kinds of disease categories. In this sense, another further study is needed to investigate the disease specific targeted to policy on EHE.</p>
Interpretation	20	This is the first study to examine an association between EHE and suicidal ideation among primary income earners. For them, more severe depressive mood is associated with suicidal ideation. Furthermore, recently occurred and greater EHE might increase suicidal ideation. Although this study has several limitations, a future study could overcome these limitations by altering the characteristics of national and panel data. We also plan to gather a larger number of suicide attempts and suicide mortality cases. In conclusion, we suggest that in order to prevent suicidal ideation and to improve the mental health of individuals especially for primary income earners in households, recent household EHE might be considered
Generalisability	21	As the national stratified data was used, the external validity of the study is quite high.

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2 However, there are some limitations in the study, we need to do further investigation to prove
3 the hypothesis more clearly.
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Other information

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6 Funding 22 No funding source regarding this study
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9 *Give information separately for cases and controls in case-control studies and, if applicable, for exposed and
10 unexposed groups in cohort and cross-sectional studies.
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12 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and
13 published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely
14 available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at
15 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is
16 available at www.strobe-statement.org.
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BMJ Open

The temporal association of excessive health expenditure with suicidal ideation among primary income earners: cross-sectional design using Korean Welfare Panel Survey (KoWePS)

Journal:	<i>BMJ Open</i>
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Primary Subject Heading:	Public health
Secondary Subject Heading:	Health policy, Mental health, Public health
Keywords:	health expenditure, suicidal ideation, economic burden, household, suicide, korea

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30 9 **Jaeyong Shin^{1,2,3+}, Jae Woo Choi^{1,2+}, Sung-in Jang^{1,2,3}, Young Choi^{1,2}, Sang Gyu Lee⁴,**
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33 10 **Tae Hwan Ihm⁵, and Eun-Cheol Park^{2,3*}**
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10 21 **Keywords:** Excessive health expenditure, suicidal ideation, suicide, depression, economic
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4 41 **Abstract**

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6 42 **Objective** Excessive health expenditure (EHE) is a global issue for households
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8 43 suffering from high-cost medical conditions, low incomes, and limited insurance coverage.
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10 44 After the international financial crisis of 2008, EHE became a social problem in developed
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12 45 countries. Such economic crisis might induce severe mental stress, resulting in suicidal
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14 46 ideation.

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18 47 **Methods** We used the Korean Welfare Panel Study (KoWePS) from 2011 to 2013 and
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20 48 selected primary income earners, who were defined as practical and economic representatives
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22 49 of households; the total number of analyzed samples was 4,247 out of 5,717 households in
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24 50 the database. We only included households that had never experienced EHE before 2011. To
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26 51 examine the temporal relationship between EHE and suicidal ideation, we conducted a
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28 52 logistic regression analysis.

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32 53 **Results** Among 4,247 subjects, 146 (3.4%) experienced suicidal ideation, whereas
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34 54 4,101 (96.6%) did not. One scale of depression score (Odds ratio (OR)=1.28, Confidential
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36 55 Interval (CI); 1.23–1.34, $p < 0.001$) was associated with increased suicidal ideation. Such
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38 56 ideation was influenced to a greater extent by a recent EHE above ten percent of disposable
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40 57 income (ORs=1.91, CI; 1.16–3.15, $p=0.012$) than by either a remote EHE (ORs=1.29, CI;
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42 58 0.71–2.32) or one in both 2011 and 2012 (ORs=1.67, CI; 1.01–2.78, $p=0.048$).

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46 59 **Conclusions** In this study, more recent EHE resulted in more suicidal ideation. In
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48 60 conclusion, we suggest that recent household EHE might be considered as an important factor
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50 61 to prevent suicidal ideation and to improve the mental health of individuals.
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4 64 **Strengths and limitations of this study**
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7 65 ***Strength***
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- 10 ● We used the representative national data ‘Korea Welfare Panel Study(KoWePS)’
11 from the national research institute, “Korea Institute for Health and Social Affairs,
12 KIHASA”.
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18 ● We divided the occurrences of EHE into four subgroups (none, recent, remote, and
19 both years) in an attempt to analyze temporal causality.
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22 71 ***Limitation***
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- 25 ● We could not determine casual relationships due to the cross-sectional nature of this
26 study.
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31 ● Because the number of suicide attempts observed during the study period was too
32 small to continue the analysis, we used suicidal ideation as a dependent variable.
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36 ● The number of cases of suicidal ideation may have been too small to determine all
37 associations.
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80 Introduction

81 According to OECD health statistics data, the age-standardized suicide mortality rate in
82 2011 was 33.3 per 100,000 individuals^{1 2}. Among all OECD countries, this is the highest
83 value, while the rate of increase in suicidal mortality remains constant. Since financial stress
84 might be an important factor in Korea, we have to put concern on the financially vulnerable
85 groups such as primary income earners with excessive health expenditure (EHE) in
86 household.

87 Protection from EHE is widely regarded as a desirable objective of healthcare systems and
88 policies³⁻⁷. However, EHE is not always the same as high healthcare cost. For example, an
89 expensive surgery might not be excessive if a household does not bear its full cost because
90 the service is provided free or at a subsidized price or is covered by third-party insurance. On
91 the other hand, even the small cost of common illnesses can be financially disastrous for poor
92 households with no insurance.

93 Although EHE is usually defined as catastrophic health expenditure (CHE), health-related
94 expenses over 40% of disposable income per annum according to the World Health
95 Organization (WHO)³, it has often been defined differently by various studies⁸⁻¹⁰. Thus in this
96 study we defined different cut-off values as ten, twenty, and forty percents to enhance the
97 effectiveness of the study design.

98 According to OECD health data, patients pay the highest percentage of their medical fees
99 (>35%) out of pocket in the Republic of Korea¹¹. As the primary function of insurance is to
100 protect the patient from harm in terms of health and economic risk, it is critical to reduce the
101 occurrences of EHE. According to Korean National Statistics, the number of households
102 experiencing EHE, more than 40% of disposable household income, in 2010 was 618,000, or

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4 103 3.9% of all households. This figure was only 1% in 2002 but began to increase thereafter,
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6 104 reaching 3.3% by 2006¹. These data suggest that Koreans are at risk of occurrences of EHE.
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8 105 Thus, they might be vulnerable to a decline in their economic welfare in the face of ill health,
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10 106 especially when EHE exist.

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13 107 For example, in 2008, the state of Oregon in the United States initiated a limited expansion
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15 108 of its Medicaid program for low-income adults¹². Medicaid coverage decreased the
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17 109 probability of a positive screening for depression (-9.15 percentage points; 95% confidence
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19 110 interval (CI); -16.70--1.60; $p=0.02$), increased the use of many preventive services, and
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21 111 nearly eliminated excessive out-of-pocket medical expenditures. This study showed that
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23 112 mental health could be improved by reducing the financial burden for health.

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26 113 Another study which observed the association between EHE and depression was performed
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28 114 in India¹³. According to this cross-sectional study in Goa, India, depressive disorder was
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30 115 associated with significantly higher healthcare costs, lost time costs, and risk of EHE. There
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32 116 was a linear association between psychological morbidity scores and the risk of EHE. From
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34 117 this study, it could be suggested that economic arguments due to health problems were
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36 118 considered to be a key driver of mental health policy.

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39 119 Although few studies on EHE in Korea were published in Korea^{14 15}, there were no
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41 120 appropriate study design to examine the association between excessive health expenditures
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43 121 and mental health.

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46 122 The aims of this study were to (1) compare health expenditures between households with
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48 123 and without EHEs (2) examine the temporal association between EHEs and suicidal ideation
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50 124 among the primary income earners in household, (3) test whether recent EHEs have a greater
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52 125 impact on suicidal ideation than more remote EHEs.
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4 126 **Methods**

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7 127 ***Participants***

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10 128 Data from the Korean Welfare Panel Study (KoWePS: Korea Institute for Health & Social
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12 129 Affairs & Seoul National University Social Welfare Research Center, 2008) from 2011 to
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14 130 2013 were obtained for this study. The KoWePS is an on-going longitudinal study of a
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16 131 nationally representative sample of Korean households, which collects data annually. The
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18 132 KoWePS-led survey population represents 90% of the census conducted in 2005. Statisticians
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20 133 of this survey determined final panel households by applying ‘Stratified Double Sampling’
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22 134 model. The constituent questionnaires in this survey consisted of a household member survey
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24 135 for household members aged 15 years and over, a household survey, and a supplementary
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26 136 survey for special topics. Face-to-face interviews were used to gain information during the
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28 137 first year of the study.

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31 138 This study respected the provisions of the Declaration of Helsinki for ethical medical
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33 139 research. Since this study used secondary data from the Korea Institute for Health and Social
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35 140 Welfare, we did not need to obtain individual informed consent. All patient
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37 141 records/information in this study were anonymized and de-identified prior to analysis. In
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39 142 addition, we were granted the approval of institutional review board at the graduate school of
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41 143 public health in Yonsei university (IRB approval No.: 2-1040939-AB-N-01-2015-202).

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44 144 We especially focused on the suicidal ideation of household heads, who are defined as the
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46 145 primary income earner and practical representative of the household. The study suggests that
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48 146 the most vulnerable family member to an economic crisis might be a primary income earner.
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50 147 Hence, primary income earners were selected for the questionnaire. The total number of
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52 148 analyzed samples was 4,247 out of 5,717 households from the database. In Korea, there were
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54 149 total 17,339,422 households enrolled in governmental system in 2010. We only included
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4 150 households those had never experienced EHE before 2011 and never missed any annual
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6 151 surveys during the study period.
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11 12 153 *Covariates of individual and household characteristics* 13

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15 154 In this study, we used several covariates to control for demographic and socioeconomic
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17 155 characteristics of individual levels. Demographic characteristics such as sex, age, educational
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19 156 level, marital status, perceived health status, regular medication more than three months, and
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21 157 depressive mood status were included. Since the official age of retirement in Korea is sixty-
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23 158 five, we divided the age groups into one under sixty-five and another on sixty-five and over.
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25 159 Four education categories including degree from elementary, middle, high school, and college
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27 160 and above were self-reported by participants. We divided perceived health status with three
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29 161 categories into good, normal, and bad, while the original survey questionnaire used scale with
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31 162 five degrees including excellent, good, normal, bad, and very bad. The question of self-rated
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33 163 health is as follow; “How would you rate your general health during the last year?”. In terms
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35 164 of regular medication, interviewers asked whether the subjects were taking any medication
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37 165 regularly more than last three months or not. This was used as an indicator to determine
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39 166 presence of any kind of chronic diseases.
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45 167 We also considered other covariates of households such as number of family members,
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47 168 economically active family members, disabled members, and members over sixty-five years
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49 169 old. An economically active member was defined as someone who worked regularly and
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51 170 earned a salary during last one year. Disabled were those officially diagnosed by doctors
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53 171 using the standard of national guideline for disabled.
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4 173 ***Excessive health expenditure as an interesting variable***
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7 174 We defined EHE as the health expenditure over 10% of disposable income, which is the
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9 175 standard threshold from the Ministry of Health and Welfare, South Korea. Furthermore, to
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11 176 examine the increased relationship between EHE and suicidal ideation, we also performed
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13 177 another analysis using various cut-off values as 20% and 40% for EHE, the latter being the
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15 178 standard of the WHO.
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19 179 The household questionnaire portion of the KoWePS included a set of questions that asked
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21 180 about the income of all household members. These questions addressed earned income,
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23 181 income from assets, and miscellaneous income. The present study utilized this set of income-
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25 182 related questions to create total household income and disposable income variable. To obtain
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27 183 the number of households experiencing EHE, we divided the total cost of health expenditures
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29 184 into disposable income for each household. Moreover, we considered temporal factors of
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31 185 EHE. In other words, we determined when an excessive event occurred: none, remote (in
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33 186 2011), recent (in 2012), and in both 2011 and 2012.
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40 188 ***Measuring depressive symptoms and suicidal ideation***
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43 189 To measure the level of depression, the Center for Epidemiologic Studies Depression scale
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45 190 (CES-D) was used, which was originally designed to measure depressive symptoms in the
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47 191 general population¹⁶ and has been widely used in community- and clinically based samples¹⁷
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49 192 ¹⁸. For each year of the study period, the respondents reported symptoms experienced during
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51 193 the previous week using a four-point scale. Depression scores for each year were calculated
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53 194 by totaling across 11 items.
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57 195 Suicidal ideation was assessed by a questionnaire regarding the occurrence of suicidal
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4 196 ideation during the past year as follows; “Have you seriously considered suicide at any time
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6 197 in the past year?”.
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11 199 ***Statistical analysis***
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14 200 The frequency of EHE for samples stratified by demographic and socioeconomic status was
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16 201 determined by performing a chi-square test. To examine the relationship between EHE and
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18 202 suicidal ideation, we conducted a logistic regression analysis.
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22 203 In logistic regression analysis, Model 1 includes individual level variables. Furthermore,
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24 204 variables in Model 2 are extended to both individual and household levels. When p-value was
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26 205 less than 0.05, we defined the statistical result as significant. We used the SAS 9.3 statistical
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28 206 package (Cary, NC, USA) for statistical analysis.
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4 207 **Results**
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7 208 The general characteristics of primary income earners and households are shown in Table 1.
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9 209 A total of 4,247 households are enrolled in this study. Among them, 146 heads of households
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11 210 (3.4%) reported suicidal ideation once or more during the past year, whereas 4,101 (96.6%)
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13 211 did not. A total number of 76 men (52.1%) and 70 women (47.9%) had suicidal ideation
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15 212 among primary income earners. Moreover, the lowest educated subjects with elementary
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17 213 level of education 65 subjects (44.5%) had higher proportion among the group with suicidal
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19 214 ideation.
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23 215 Threshold of EHE of 10% and 40% above disposable income are significantly different for
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25 216 those who did and did not have suicidal ideation (Table 2). Among 875 subjects whose
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27 217 households suffered from EHE over 10% during the last two consecutive years, 49 persons
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29 218 (5.6%) experienced suicidal ideation. In 62 subjects with EHE above 40% during the last two
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31 219 consecutive years, eight persons (12.9%) reported suicidal ideation.
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35 220 We carried out multivariate analysis using a logistic regression model, based on the
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37 221 threshold of EHE above 10% of disposable income (Table 3). In Model 1, the primary
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39 222 income earners who had poor perceived health status (odds ratio (OR)=1.78, 95% CI: 1.03–
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41 223 3.08) and a higher depression score (CESD-11, OR=1.29, 95% CI: 1.24–1.35) are more
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43 224 vulnerable to suicidal ideation. In Model 2, a higher depressive score (CESD-11, OR=1.28,
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45 225 95% CI: 1.23–1.34) is associated with the presence of suicidal ideation. In both Model 1 and
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47 226 2, EHE occurred in the recent year of 2012 (Model 1; OR=2.03, 95% CI: 1.23–3.35 / Model
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49 227 2; OR=1.91, 95% CI: 1.16–3.15) and for both consecutive years in 2011 and 2012 (Model 1;
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51 228 OR=1.83, 95% CI: 1.12–2.98 / Model 2; OR=1.67, 95% CI: 1.01–2.78) have statistically
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53 229 significant ORs for suicidal ideation. Moreover, the suicidal ideation is influenced to a greater
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55 230 extent by a recent EHE than by a remote EHE or EHE in both years. To compare the fitness
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4 231 between the models, we used $-2\log L$ methods. Through this measurement, it seems that
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6 232 Model 2 is more suitable for suicidal ideation because it has a lower $-2\log L$ than Model 1
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9 233 Although the official cut-off value in our study is 10%, we also tested with other values as
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11 234 cut-off thresholds. These results showed that primary income earners are more vulnerable to
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13 235 the high threshold of EHE. When EHE is above 20%, compared to 10%, the odds ratios of
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15 236 suicidal ideation associated with EHE was increased in recent year (Figure 1).
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19 237 For EHE above 40% of disposable income, the consecutive two years with EHE is
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21 238 statistically significantly correlated with a higher rate of suicidal ideation. (Model 2;
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23 239 OR=2.67, 95% CI: 1.10–6.46) (Supplementary Table 1).
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26 240 Since the heads of households with depressive symptoms may have more correlation with
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28 241 suicidal ideation, a subgroup analysis was performed for the primary income earners whose
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30 242 sum of CESD-11 score were sixteen or more (Table 4). A sum of CESD-11 score over sixteen
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32 243 indicates potential risk for major depressive disorder (MDD). In this subgroup analysis, the
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34 244 primary income earners were more vulnerable to the higher EHE. In other words, when EHE
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36 245 was above 20% (in 2012; OR=2.46, 95% CI: 1.57–3.85 / in both 2011 and 2012; OR=1.89,
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38 246 95% CI: 1.08–3.31) compared to 10% (in 2012; OR=1.98, 95% CI: 1.21–3.22 / in both 2011
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40 247 and 2012; OR=1.86, 95% CI: 1.15–3.02), suicidal ideation was increased.
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45 248 According to subgroup analysis by sex in 2012, women primary income earners with recent
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47 249 EHEs are more vulnerable to suicidal ideation (EHE > 10%; OR=2.71, 95% CI: 1.25-5.86 /
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49 250 EHE > 20%; OR=2.66, 95% CI: 1.37–5.15) than the reference group without any EHE
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51 251 history (Supplementary Table 2). Although men do not have statistically meaningful odds
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53 252 ratios, the men subjects with EHE above ten and twenty percent above in recent one year had
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55 253 higher values for suicidal ideation than the reference group without any EHE history during
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254 the last two years.

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For peer review only

256 Discussion

257 According to measurements of the temporal association with EHE during 2011 and 2012,
258 the recent one year in 2012 had meaningful increases in ORs for suicidal ideation among
259 those with EHE above 10%. We also performed a subgroup analysis for primary income
260 earners with potential risk of MDD. The temporal relationship between EHE and suicidal
261 ideation is stronger in this potentially depressed group than in the others. Within this group,
262 the subjects with EHE over 20% showed a higher OR than one of EHE over 10%.
263 Interestingly, in EHE over 40%, the recent 2012 one year is not statically associated with
264 suicidal ideation. However, the two consecutive two years with EHE is highly associated with
265 suicidal ideation. Since the number of households with EHE over 40% is only 197 (4.4%),
266 the odds ratio of the recent one year in 2012 might not show statistically increased OR for
267 suicidal ideation. In spite of this limited condition, the consecutive occurrence of EHE have
268 strong statically association with suicidal ideation. Thus we need to focus on the households
269 with EHE in a long term through appropriate intervention based on social consensus.

270 In addition, when the primary income earners are women in households, EHE is more
271 associated with suicidal ideation. Even though we need some further investigation to reveal
272 exact mechanism of gender difference, we suggest that the job insecurity of women and
273 surplus financial stress to caregiving might induce more suicidal ideation compared to men.
274 According to the study in France, the people with unstable and unfavorable employment
275 characteristics are disproportionately likely to be suicidal ideation¹⁹. In another similar study
276 in Japan²⁰, women workers without stress reduction techniques were found to be at
277 significantly higher risk for suicidal ideation. In this sense, it is needed that we need to
278 initiate more careful financial support to the households with women primary income earners
279 to prevent worsening their mental health.

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4 280 Globally, many politicians and public health administrators have tried to make healthcare as
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6 281 accessible as possible^{8 9}. The problem of accessibility is likely induced by both economic and
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8 282 spatial problems. In Korea, the amount and quality of healthcare access have improved over
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10 283 the last 30 years by through rapid expansion of national health insurance. However, because
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12 284 national reimbursement was low, fiscal asset security in healthcare system could not be
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14 285 sustainable. Although this problem was improving gradually, a global economic crisis in 2008
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16 286 hindered the ability of patients to visit clinics because of decreased incomes and heavy out-
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18 287 of-pocket expenses, especially for the low SES class with chronic and severe diseases with
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20 288 the tremendous medical expenses²¹. In this sense, many researchers have tried to determine
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22 289 the causes and economic outcomes of EHE rather than their effects on health. However, these
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24 290 kinds of economic stresses worsen mental health and induce depressive disorders, suicidal
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26 291 ideation, and numbers of suicide attempts^{10 16}. For example, there was a steep increase in the
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28 292 number of patients with MDD, suicidal ideation, and suicide attempts immediately after the
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30 293 international economic crisis in 2008^{17 18 22}. The prevalence of MDD increased from 3.3% of
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32 294 the general population in 2008 to 8.2% in 2011, which is a statistically significant difference.
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34 295 In addition, suicidal ideation among men increased from 4.4% in 2008 to 7.1% in 2011²³.

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37 296 Just as the same as these previous studies on this topic, our result also mentioned the strong
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39 297 association between financial burden of health and suicidal ideation. However, there were
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41 298 several limitations of this study.

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47 299 First, we could not determine casual relationship due to the cross-sectional nature of this
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49 300 study. To overcome this weakness, we divided the occurrences of EHE into four subgroups
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51 301 (none, recent, remote, and both years) in an attempt to analyze temporal causality. Second,
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53 302 we used the suicidal ideation as a dependent variable, not suicide attempt because of the
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55 303 limited subjects. However, suicidal ideation is still one of the powerful indicators to predict
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4 304 suicide attempts²⁴. According to one study in Korea, 84% of who attempted suicide had
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6 305 previously seriously considered suicide within the last two years²⁵. Thus, even suicidal
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8 306 ideation is regarded as important dependent variable for preventing the progress to suicidal
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10 307 attempt and suicide. Third, the number of cases of suicidal ideation may have been too small
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12 308 to determine all associations. Although we observed some statistical trends among
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14 309 independent variables for income level and temporal factors of EHEs, these trends did not
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16 310 reach statistical significance. One reason may be that the KoWePS study included
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18 311 investigations on mental health and suicide only since 2011 regardless of its initiation in 2006.
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20 312 Hence, we could not obtain more data for analysis. Fourth, we excluded other family
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22 313 members except for the primary income earner in households. Since family members under
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24 314 nineteen years old did not answer the CESD-11 scale, we could not adjust the depressive
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26 315 symptoms, which is one of the most important factors to suicidal ideation. Fifth, we did not
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28 316 know what kinds of diagnosis categories, including mental and physical illness, were most
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30 317 significant to the occurrence of EHE. Although few researchers studied the attributable
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32 318 medical conditions^{15 26}, the range of them were so wide, defined as chronic diseases or
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34 319 disabled. In this sense, another further study is needed to investigate the disease specific
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36 320 targeted to policy on EHE.

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42 321 Despite of such limitations, this study has several strengths as follow.

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45 322 First, this study used national opened data representing the Republic of Korea. Through this
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47 323 well-designed panel survey, this study had high external validity and is able to be expanded in
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49 324 the future. Furthermore, this national data could be compared to ones in other countries such
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51 325 as Japan and Scandinavian countries¹¹, those had reduced the suicidal mortality rates
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53 326 dramatically. Second, this is the first study on the relationship between EHE and suicidal
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55 327 ideation in Korea to our knowledge. Thus, it could draw attentions of other researchers and
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4 328 policy makers to the economic burden for health as an attributable factor to suicidal ideation.
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7 329 Third, it is able to minimize the health disparity in society through the subsidies to EHE.
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9 330 Because EHE hinders the access to healthcare system, solving this problem could improve
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11 331 the basic human right for health and overall quality of public health. Korea already started
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13 332 to Provide subsidies for families with EHE in 2014, future studies could investigate the
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15 333 impact this support has had.
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18 334 To put all things together, we still need to perform further investigation using a longitudinal
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20 335 study design with a larger populations. Thorough accumulating these Korean Data and
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22 336 following the trend of policy implication, we will report the effect of the policy for EHE
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24 337 apparently. However, we possibly mention that EHE could be considered as an important
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26 338 factor for aggravating mental illness through this study. Furthermore, it could surge that we
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28 339 need to take more consider newly occurring EHEs to protect vulnerable primary income
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30 340 earners such as women.
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38 342 **Conclusion**

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41 343 This is the first study to examine an association between EHE and suicidal ideation among
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43 344 primary income earners. For this group, more severe depressive mood is associated with
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45 345 suicidal ideation. Furthermore, recently occurred and greater EHE might increase suicidal
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47 346 ideation, especially for women. In conclusion, we suggest that in order to prevent suicidal
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49 347 ideation and to improve the mental health of individuals, especially for primary income
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51 348 earners in households, recent household EHE might be considered as an important factor.
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53 349 Furthermore, we hope that health policy makers also take these results into account the
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55 350 national financial support program for EHEs in Korea and develop immediate intervention
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4 351 after the onset of EHEs.
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10 353 ***Contributorship statement***
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13 354 We clarified that the content has not been published or submitted for publication elsewhere.
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15 355 We respect the provision of declaration of Helsinki and we obey the protocol for the research
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17 356 project, suitable for safe and ethical principles. As this study is a secondary opened national
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19 357 data for public access, we do not need to get any individual informed consents. All authors
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21 358 have contributed significantly and that all authors are in agreement with the content of the
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23 359 manuscript. Jaeyong Shin and Jae Woo Choi designed the study as co-first authors and wrote
24

25 360 the paper, Young Choi and Tae Hwan Ihm carried out the statistical analysis and gave
26

27 361 important comments for this study, Sung-in Jang and Sang Gyu Lee was responsible for the
28

29 362 statistical design, and Eun-Cheol Park suggested the direction of this study as a
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31 363 corresponding author.
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4 372 ***Competing interests***
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7 373 There are no competing interests in all authors.
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12

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14
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16 376 ***Data sharing***
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19 377 As we used public and national open data, we are willing to sharing our data and results. It
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21 378 is available on 'www.koweps.re.kr'.
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24 379 ***Acknowledgement***
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27 380 Biosciencewriters has checked and corrected the English in our manuscript.
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Table 1. Demographic characteristics among subjects, based on the presence of suicidal ideation in heads of households

Variables	Absence of suicidal ideation		Presence of suicidal ideation		Total		p-value
	n	%	n	%	n	%	
Primary income earner characteristics							
Sex							<0.001
Male	3040	74.1	76	52.1	3116	73.4	
Female	1061	25.9	70	47.9	1131	26.6	
Age, over 65 years							0.009
≥65 years	1937	47.2	85	58.2	2022	47.6	
Education							0.003
Graduation from elementary school	1376	33.6	65	44.5	1441	33.9	
Graduation from middle school	545	13.3	26	17.8	571	13.4	
Graduation from high school	1198	29.2	33	22.6	1231	29.0	
Graduation from college	982	23.9	22	15.1	1004	23.6	
The presence of a spouse							<0.001
Presence	2858	69.7	66	45.2	2924	68.8	
Perceived health status							<0.001
Excellent	2271	55.4	40	27.4	2311	54.4	
Good	912	22.2	31	21.2	943	22.2	
Poor	918	22.4	75	51.4	993	23.4	
Regular medication more than three months[†]							<0.001
Presence	2492	60.8	117	80.1	2609	61.4	
Depressive mood	Mean	SD	Mean	SD	Mean		<0.001
Sum of CESD-11 [‡]	18.808	2.9	23.151	4.3	18.953		
Household characteristics							
Income level							<0.001
<25% (lowest)	756	18.4	55	37.7	811	19.1	
25–50%	953	23.2	39	26.7	992	23.4	
50–75%	1140	27.8	34	23.3	1174	27.6	
≥75% (highest)	1252	30.5	18	12.3	1270	29.9	
Number of family members							<0.001
One	856	20.9	58	39.7	914	21.5	
Two	1233	30.1	45	30.8	1278	30.1	
Three	767	18.7	21	14.4	788	18.6	
Four or more	1245	30.4	22	15.1	1267	29.8	
Economically active family member*							<0.001
None	1001	24.4	70	47.9	1071	25.2	
One	1882	45.9	52	35.6	1934	45.5	
Two or more	1218	29.7	24	16.4	1242	29.2	
Disabled person among family members**							
Presence	712	17.4	33	22.6	745	17.5	
Aged over 65, among family members							0.062
Presence	2094	51.1	86	58.9	2180	51.3	
Total	4101	96.6	146	3.4	4247	100.0	

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4 458 ¶ “Regular medication more than three months” indicated the presence of on-going chronic
5 459 diseases. † “CESD-11” means “Center for Epidemiological Studies Depression Scale”. *The
6 460 variable of “Economically active family members” is defined as someone who worked
7 461 regularly and got salary during last one year. **Disabled person means persons, who are
8 462 officially qualified by doctors using the standard of national guideline for disabled.
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Table 2. Bivariate analysis, based on the presence of suicidal ideation in heads of households and the occurrence of excessive health expenditures during the last 2 years

The occurrence of excessive health expenditure during the last 2 years	Excessive health expenditure > 10%*						Excessive health expenditure > 40%**					
	Absence of suicidal ideation		Presence of suicidal ideation		Total	<i>p</i> -value	Absence of suicidal ideation		Presence of suicidal ideation		Total	<i>p</i> -value
	n	%	n	%			n	%	n	%		
None	2061	98.0	43	2.0	2104	<0.001	3683	97.0	115	3.0	3798	<0.001
2011, remote	582	96.8	19	3.2	601		180	94.7	10	5.3	190	
2012, recent	632	94.8	35	5.2	667		184	93.4	13	6.6	197	
2011 and 2012	826	94.4	49	5.6	875		54	87.1	8	12.9	62	
Total	4101	96.6	146	3.4	4247		4101	96.6	146	3.4	4247	

The threshold of 10%* as excessive health expenditure (EHE) is the standard from the Ministry of Health and Welfares in Korea, while the one of 40%** is from the WHO. As WHO recommended to use flexible threshold according to cultural and national background differently, we did further statistical analysis using 10% in paper, although we also performed another statistical analysis in supplementary materials.

Table 3. Multivariate analysis, based on the presence of suicidal ideation during the past year among heads of households with the threshold of excessive health expenditure as ten percent from total expenditure in household.

Variables	Model 1 (-2logL=1056.60)				Model 2 (-2logL=1032.57)			
	OR	95% C.I.		p-value	OR	95% C.I.		p-value
Excessive health expenditure* during the last 2 years								
None	1.00				1.00			
2011, remote	1.32	0.74	2.36	0.347	1.29	0.71	2.32	0.405
2012, recent	2.03	1.23	3.35	0.006	1.91	1.16	3.15	0.012
2011 and 2012	1.83	1.12	2.98	0.016	1.67	1.01	2.78	0.048
Level of individual primary income earner								
Sex								
Male	1.00				1.00			
Female	0.94	0.51	1.71	0.832	0.83	0.45	1.54	0.559
Age, over 65								
<65 years	1.00	1.00	1.00		1.00	1.00	1.00	
≥65 years	0.57	0.36	0.91	0.018	2.52	0.32	20.13	0.384
Education								
Degree from elementary school	0.60	0.31	1.15	0.124	0.53	0.27	1.06	0.073
Degree from middle school	1.03	0.54	1.98	0.930	0.96	0.49	1.89	0.899
Degree from high school	0.90	0.50	1.60	0.713	0.85	0.47	1.54	0.596
Degree from college	1.00	1.00	1.00		1.00	1.00	1.00	
The presence of a spouse								
Presence	1.00	1.00	1.00		1.00	1.00	1.00	
Absence	0.54	0.30	0.96	0.035	0.54	0.28	1.06	0.072
Perceived health status								
Excellent	1.00	1.00	1.00		1.00	1.00	1.00	
Good	1.30	0.74	2.26	0.363	1.20	0.69	2.11	0.520
Poor	1.78	1.03	3.08	0.041	1.61	0.92	2.82	0.093
Depressive mood								
Sum of CESD-11 ^f	1.29	1.24	1.35	<.001	1.28	1.23	1.34	<.001
Regular medication more than three months								
Absence	1.00				1.00			
Presence	1.22	0.71	2.10	0.473	1.22	0.70	2.11	0.481
Level of household								
Income Level								
<25% (Lowest)					2.01	0.97	4.15	0.059
25–50%					1.58	0.81	3.10	0.181
50–75%					1.60	0.86	2.96	0.139
≥75% (Highest)					1.00	1.00	1.00	
Number of family members								
One					1.00	1.00	1.00	
Two					1.14	0.63	2.06	0.666
Three					1.06	0.50	2.25	0.888
Four or more					0.86	0.37	2.01	0.735
Economically active family member*								
None					1.29	0.65	2.58	0.465
One					0.87	0.49	1.54	0.642
Two or more					1.00	1.00	1.00	
Disabled person among family members**								
Absence					1.00	1.00	1.00	
Presence					1.12	0.71	1.75	0.626
Aged over 65, among family members								
Absence					1.00	1.00	1.00	

Presence 0.16 0.02 1.24 0.079

487 ¶ “Regular medication more than three months” indicated the presence of on-going chronic
488 diseases. † “CESD-11” means “Center for Epidemiological Studies Depression Scale”. *The
489 variable of “Economically active family members” is defined as someone who worked
490 regularly and got salary during last one year. **Disabled person means persons, who are
491 officially qualified by doctors using the standard of national guideline for disabled.

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514 **Table 4.** The adjusted odds ratios for suicidal ideation among the subjects, whose CESD-11
 515 score are sixteen or over, according to the various settings of thresholds of excessive health
 516 expenditure.

	EHE > 10%			EHE > 20%				
	OR	95% C.I.	p-value	OR	95% C.I.	p-value		
Excessive health expenditure during the last two years								
None	1.00			1.00				
2011, remote	1.28	0.72	2.28	0.397	1.19	0.66	2.13	0.571
2012, recent	1.98	1.21	3.22	0.006	2.46	1.57	3.85	<0.001
2011 & 2012	1.86	1.15	3.02	0.012	1.89	1.08	3.31	0.026

517 We all adjusted the individual and household characteristics including sex, age, education,
 518 the presence of spouse, perceived health status, regular medication, income level, number of
 519 family members, the number of economically active family members, the presence of
 520 disabled in family, and the presence of aged over 65 in family.

521 “CESD-11” means “Center for Epidemiological Studies Depression Scale”

522 “EHE” is the excessive health expenditure, which is the proportion of health cost among
 523 disposable income of household.

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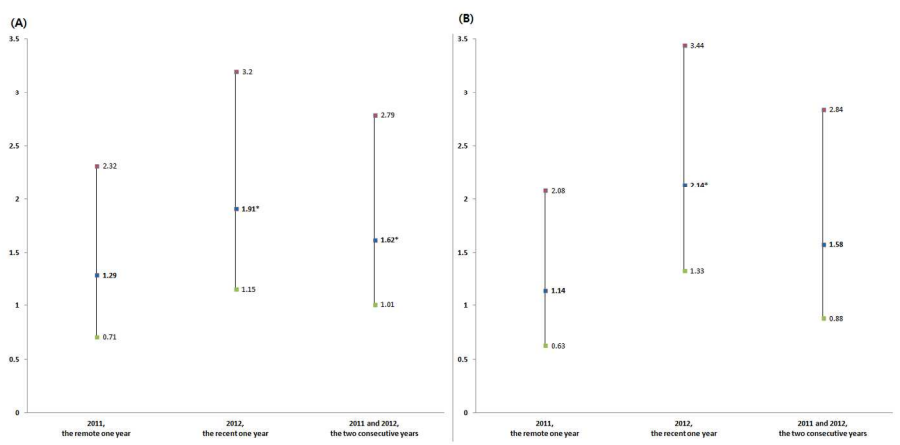
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4 527 **Figure 1.** The primary income earners were more vulnerable to the high threshold of EHE. In
5 528 other words, when EHE were above 20% (B), compared to 10% (A), the odds ratio for
6 529 suicidal ideation with EHE in recent one year was increased. **p*-value <0.05
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Supplementary table 1. Multivariate analysis, based on the presence of suicidal ideation during the past year among heads of households with the threshold of excessive health expenditure as forty percent from total expenditure in household.

	Model 1 (-2logL= 1051.1)			Model 2 (-2logL= 1035.3)			Model 2 among depressive subjects					
	OR	95% C.I.	<i>p</i> -value	OR	95% C.I.	<i>p</i> -value	OR	95% C.I.	<i>p</i> -value			
Excessive health expenditure during the last 2 years												
None	1.00			1.00			1.00					
2011, remote	1.22	0.60	2.51	0.583	1.11	0.53	2.30	0.785	1.20	0.59	2.46	0.616
2012, recent	1.32	0.68	2.55	0.415	1.20	0.62	2.35	0.587	1.61	0.86	3.02	0.138
2011 and 2012	2.91	1.24	6.86	0.014	2.67	1.10	6.46	0.030	2.96	1.28	6.85	0.011

When we set the cut-off value as 40%, the EHE during the two consecutive years only have statistically meaningful increased odds ratios both in model 1 and 2. This might be due to the limited number of households, those spending more than 40% of disposable income as EHE.

Depressive subjects mean the primary income earners who reported depressive scales of sixteen or over, which is the cut-off value for potential major depressive disorder.

Supplementary table 2. Subgroup analysis by sex and various thresholds of EHEs.

Excessive health expenditure during the last two years	Excessive health expenditure >10%			Excessive health expenditure >20%			Excessive health expenditure >40%					
	OR	95% C.I.	<i>p</i> -value	OR	95% C.I.	<i>p</i> -value	OR	95% C.I.	<i>p</i> -value			
Men												
None	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
2011, the remote one year	1.28	0.58	2.83	0.546	1.15	0.49	2.72	0.753	0.73	0.22	2.43	0.611
2012, the recent one year	1.37	0.66	2.87	0.398	1.74	0.86	3.51	0.124	0.96	0.37	2.53	0.934
2011 and 2012, the straight two years	1.55	0.75	3.20	0.240	1.12	0.48	2.65	0.793	1.56	0.42	5.79	0.508
Women												
None	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
2011, the remote one year	1.31	0.53	3.28	0.558	1.01	0.42	2.41	0.983	1.26	0.48	3.32	0.644
2012, the recent one year	2.71	1.25	5.86	0.011	2.66	1.37	5.15	0.004	1.40	0.54	3.64	0.486
2011 and 2012, the straight two years	1.75	0.82	3.76	0.149	2.19	0.95	5.07	0.067	4.73	1.21	18.46	0.025

According to the results, women are more vulnerable to suicidal ideation by EHEs than men. Although men do not have statistically meaningful odds ratio, the EHE with recent one year had higher values for suicidal ideation than the reference group without any EHE history during the last two years.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	The temporal association of excessive health expenditure with suicidal ideation among primary income earners: cross-sectional design using Korean Welfare Panel Survey (KoWePS) Excessive health expenditure (EHE) is a global issue for households suffering from high-cost medical conditions, low incomes, and limited insurance coverage. After the international financial crisis of 2008, EHE became a social problem in developed countries. Such economic crisis might induce severe mental stress, resulting in suicidal ideation.
Introduction		
Background/rationale	2	Excessive health expenditure (EHE) is a global issue for households suffering from high-cost medical conditions, low incomes, and limited insurance coverage. After the international financial crisis of 2008, EHE became a social problem in developed countries. Such economic crisis might induce severe mental stress, resulting in suicidal ideation.
Objectives	3	To figure out whether recent occurred EHE is more associated with suicidal ideation
Methods		
Study design	4	Cross-sectional study design
Setting	5	the Korean Welfare Panel Study (KoWePS) from 2011 to 2013
Participants	6	<i>Cross-sectional study</i> — the Korean Welfare Panel Study (KoWePS) from 2011 to 2013. The total number of analyzed samples was 4,247 out of 5,717 households in the database. We only included households that had never experienced EHE before 2011 <i>Case-control study</i> — Among 4,247 subjects, 146 (3.4%) experienced suicidal ideation, whereas 4,101 (96.6%) did not.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy (e) we also performed another analysis using various cut-off values as 20% and 40% for EHE, the latter being the standard of WHO

Continued on next page

Results

Participants	13*	<p>(a) Among 4,247 subjects, 146 (3.4%) experienced suicidal ideation, whereas 4,101 (96.6%) did not. One scale of depression score (CESD-11, Odds ratio (OR)=1.28, Confidential Interval (CI); 1.23–1.34, $p < 0.001$) was associated with increased suicidal ideation. Such ideation was influenced to a greater extent by a recent EHE above ten percent of disposable income (ORs=1.91, CI; 1.16–3.15, $p=0.012$) than by either a remote EHE (ORs=1.29, CI; 0.71–2.32) or one in both 2011 and 2012 (ORs=1.67, CI; 1.01-2.78, $p=0.048$).</p> <p>(b) The total number of analyzed samples was 4,247 out of 5,717 households in the database. We only included households that had never experienced EHE before 2011</p>
Descriptive data	14*	<p>(a) The general characteristics of primary income earners and households are shown in Table 1. A total of 4,247 households are enrolled in this study. Among them, 146 heads of households (3.4%) reported suicidal ideation once or more during the past year, whereas 4,101 (96.6%) did not. A total number of 76 men (52.1%) and 70 women (47.9%) had suicidal ideation among primary income earners. Moreover, the lowest educated subjects with elementary level of education 65 subjects (44.5%) had higher proportion among the group with suicidal ideation. The average sum of CESD-11 among the subjects with suicidal ideation is 23.15, while the average score among the others is only 18.81. Only five subjects attempted suicide among all primary income earners.</p> <p>(b) None of them were missed, because all of them completed surveys.</p> <p><i>Cross-sectional study</i>— A total number of 76 men (52.1%) and 70 women (47.9%) had suicidal ideation among primary income earners. Moreover, the lowest educated subjects with elementary level of education 65 subjects (44.5%) had higher proportion among the group with suicidal ideation. The average sum of CESD-11 among the subjects with suicidal ideation is 23.15, while the average score among the others is only 18.81. Only five subjects attempted suicide among all primary income earners.</p>
Main results	16	<p>(a) Among 4,247 subjects, 146 (3.4%) experienced suicidal ideation, whereas 4,101 (96.6%) did not. One scale of depression score (CESD-11, Odds ratio (OR)=1.28, Confidential Interval (CI); 1.23–1.34, $p < 0.001$) was associated with increased suicidal ideation. Such ideation was influenced to a greater extent by a recent EHE above ten percent of disposable income (ORs=1.91, CI; 1.16–3.15, $p=0.012$) than by either a remote EHE (ORs=1.29, CI; 0.71–2.32) or one in both 2011 and 2012 (ORs=1.67, CI; 1.01-2.78, $p=0.048$).</p> <p>(b) Based on a depressive scale of CESD, we defined the cut-off value as sixteen for potential major depressive disorder.</p>
Other analyses	17	<p>As the official cut-off value in our study is 10%, we performed other values as threshold. The primary income earners are more vulnerable to the high threshold of EHE. When EHE is above 20%, compared to 10%, the odds ratio for suicidal ideation with the EHE in recent one year is increased. (Figure 1)</p> <p>For EHE above 40% of disposable income in the Supplementary table 1, the consecutive two years with EHE is statistically meaningful to the increased odds ratio for suicidal ideation (Model 2; OR=2.67, 95% CI: 1.10–6.46).</p> <p>Since the heads of households with depressive symptoms may have more correlation with suicidal ideation, a subgroup analysis was performed for the primary income earners whose sum of CESD-11 score were sixteen or more (Table 4). The sum of CESD-11 score over sixteen indicates potential risk for major depressive disorder (MDD). In this subgroup analysis, the primary income earners were more vulnerable to the higher EHE. In other words, when EHE were above 20% (in 2012; OR=2.46, 95% CI: 1.57–3.85 / in both 2011 and 2012; OR=1.89, 95% CI: 1.08–3.31) compared to 10% (in 2012; OR=1.98, 95% CI: 1.21–3.22 / in</p>

both 2011 and 2012; OR=1.86, 95% CI: 1.15–3.02), suicidal ideation was increased.

Discussion

Key results	18	According to measurements of the temporal association with EHE during 2011 and 2012, the recent one year in 2012 was associated with meaningful increases in ORs for suicidal ideation with the EHE above 10%.
Limitations	19	<p>First, we could not determine casual relationship due to the cross-sectional nature of this study. To overcome this weakness, we divided the occurrences of EHE into four subgroups (none, recent, remote, and both years) in an attempt to analyze temporal causality.</p> <p>Second, we used the suicidal ideation as a dependent variable, not suicidal attempt. Because the number of suicide attempts observed during the study period was minimal to conduct the analysis, we used suicidal ideation. Although a small portion of general population with suicidal ideation eventually tried suicide attempts, suicidal ideation is still one of the powerful indicators to predict suicide attempt. According to one study in Korea, 84% of subjects with suicide attempt had previous suicidal ideation in the last two year²³. Moreover, ‘someone talking or writing about death, dying, or suicide’ is well established consensus warning sign for suicide²⁴. Thus, even suicidal ideation is regarded as important dependent variable for preventing the progress to suicidal attempt and suicide.</p> <p>Third, the number of cases of suicidal ideation may have been too small to determine all associations. Although we observed some statistical trends among independent variables for income level and temporal factors of EHEs, these trends did not reach statistical significance. One reason may be that the KoWePS study included investigations on mental health and suicide only since 2011 regardless of its initiation in 2006. Hence, we could not obtain more data for analysis.</p> <p>Fourth, we excluded other family members except for the primary income earner in households. This panel survey tried to include as many family members as possible; surveys were mainly answered by heads of household who are practical and economic representatives of households. In addition, since family members under nineteen years old did not answer the CESD-11 scale, we could not adjust the depressive symptoms, which is one of the most important factors to suicidal ideation. In this regard, we only included the primary income earners as study population.</p> <p>Fifth, we did not know what kinds of diagnosis categories, including mental and physical illness, were most significant to the occurrence of EHE. Although few researchers studied the attributable medical conditions, the range of them were so wide, defined as chronic diseases or disabled. For example, Choi et al. analyzed that cancer patients with unstable economic status were more vulnerable to EHE than those with stable economic conditions¹⁶. In addition, they studied that family members with chronic diseases or disabilities were powerful attributable factors to EHE on household²⁵. However, none of them tried to figure out the most important kinds of disease categories. In this sense, another further study is needed to investigate the disease specific targeted to policy on EHE.</p>
Interpretation	20	This is the first study to examine an association between EHE and suicidal ideation among primary income earners. For them, more severe depressive mood is associated with suicidal ideation. Furthermore, recently occurred and greater EHE might increase suicidal ideation. Although this study has several limitations, a future study could overcome these limitations by altering the characteristics of national and panel data. We also plan to gather a larger number of suicide attempts and suicide mortality cases. In conclusion, we suggest that in order to prevent suicidal ideation and to improve the mental health of individuals especially for primary income earners in households, recent household EHE might be considered
Generalisability	21	As the national stratified data was used, the external validity of the study is quite high.

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2 However, there are some limitations in the study, we need to do further investigation to prove
3 the hypothesis more clearly.
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Other information

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6 Funding 22 No funding source regarding this study
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9 *Give information separately for cases and controls in case-control studies and, if applicable, for exposed and
10 unexposed groups in cohort and cross-sectional studies.
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12 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and
13 published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely
14 available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at
15 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is
16 available at www.strobe-statement.org.
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