

Data Analysis on Medical Service Utilization and Out-of-pocket Spending among Near-poor National Health Insurance Members in South Korea

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Research

Keywords: medical utilization, out-of-pocket spending, catastrophic health expenditure, poverty, relative poverty

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1 *Data analysis on medical service utilization and out-of-pocket spending*
2 *among near-poor National Health insurance members in South Korea*

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27 **Abstract**

28 **Background:** The near poor, a low income population which is excluded from the Republic
29 of Korea's Medical Aid (MA) program, experiences insufficient use of medical services and
30 high out-of-pocket (OOP) spending due to insufficient coverage by the country's National
31 Health Insurance (NHI). This study aims to examine medical utilization, OOP spending, and
32 occurrence of catastrophic health expenditures (CHE) among the near poor compared to MA
33 beneficiaries and other NHI members.

34 **Methods:** A cross-sectional study was conducted drawing upon a nationally representative
35 dataset based on the 2018 Korea Welfare Panel Study (KOWEPS). We classified people into
36 MA beneficiaries, the near-poor population below 50% of the median income threshold, and
37 other NHI members above the 50% median income threshold. Using propensity score
38 matching between MA beneficiaries and the near poor and between the near-poor group and
39 the group of those above the poverty line, this study examined medical utilization, OOP
40 spending, and the occurrence of CHE among the study groups.

41 **Results:** The findings suggest that MA beneficiaries make greater use of outpatient services
42 compared to the near poor, but other uses of medical services were not significantly different
43 among the study groups. However, OOP spending and occurrence of CHE were significantly
44 higher in the near-poor group compared to the other two groups.

45 **Conclusion:** We found that the near-poor group was the most vulnerable group in these terms
46 among the Korean population. Health policy needs to take into account the vulnerability of
47 the near-poor population.

48 **Keywords:** medical utilization, out-of-pocket spending, catastrophic health expenditure,
49 poverty, relative poverty

50 **Background**

51 Universal health coverage aims to provide financial protection from catastrophic
52 health expenditures (CHE) and subsequent impoverishment due to health care costs and also
53 to allow access to essential health services [1]. The South Korean health care system includes
54 the National Health Insurance (NHI) and Medical Aid (MA) programs, both aimed at providing
55 protection from CHE and ensuring access to essential health services.

56 Although South Korea achieved a degree of UHC with the establishment of NHI in
57 1989, the program has been criticized for insufficient benefit coverage. For example, computed
58 tomography (CT) was not covered until 1995, magnetic resonance imaging (MRI) was
59 excluded from the benefits until 2005, and overall coverage reached only 62.7% in 2017, below
60 the Organization for Economic Cooperation and Development (OECD) average of 73% [2, 3].
61 The original form of MA was initiated in 1997 as a part of the South Korean social welfare
62 program known as the National Basic Livelihood Security System. It was re-envisioned as the
63 MA program in 2001. MA is a public aid program that guarantees access to necessary health
64 services to low-income populations incapable of maintaining their daily lives or who are having
65 difficulty with living costs. It is comparable to the Medicaid program in the US [1]. MA
66 beneficiaries are composed of Type I and Type II recipients based on their level of inability or
67 incapacitation [4]. Type I beneficiaries are exempted from out-of-pocket (OOP) payment for
68 any medical utilization while Type II beneficiaries are assigned minimum copayment rates of
69 up to 15% [1]. Approximately 3% of the overall population qualified for MA in 2017 [4].

70 The near poor are defined under the National Basic Living Security Act as those who
71 are not eligible for public aid programs but who have equivalized disposable household
72 incomes less than 50% of median ordinary income [5]. The OECD defines relative poverty
73 using the same definition [6]. Because South Korea's entitlement criteria for MA is less than
74 40% of median ordinary income and several exceptions exist, South Korea's relative poverty

75 rate based on a threshold of below 50% median ordinary income was 17.5% in 2017, but only
76 3% of the total population was eligible for MA in that year [7]. The remaining group is enlisted
77 only in NHI, and because of its insufficient coverage, the majority of the low-income
78 population remains in a blind spot within the health care system. With the low coverage
79 provided by South Korea's health insurance, high OOP spending is blamed for the occurrence
80 of unmet needs among the near poor caught in a blind spot in the health care system [8].
81 Excessive OOP spending among patients with low solvency can result in excessive medical
82 expenses, leaving these populations vulnerable to CHE and impoverishment due to healthcare
83 expenditures. Because of this under-insuring taking place within NHI, it cannot function
84 properly as a primary social safety net protecting citizens from financial crises caused by illness
85 [9, 10]. The relatively poor health resulting from their sociodemographic condition means that
86 the near-poor population tends to experience greater medical needs. Due to low coverage under
87 NHI, however, the near poor often cannot use the medical services that they require [11].

88 Extensive research has been performed on health care utilization and OOP spending
89 among the low-income population in South Korea. Many studies have compared OOP spending
90 and medical utilization among MA beneficiaries and NHI members [12, 13, 14]. The studies
91 reviewed here show that MA beneficiaries tend to use more medical services but experience
92 less OOP spending compared to NHI members. For instance, Kim (2015)[12] found that the
93 number of outpatient visits was 1.431 times higher, and the hospitalized days per year was
94 1.604 times higher among MA beneficiaries compared to NHI members. However, studies
95 examining health utilization and OOP spending among the near poor are limited. Lee (2016)[8]
96 compared OOP spending and medical utilization among MA beneficiaries and NHI members
97 by using propensity score matching, and because equalized disposable household income
98 was included in the matching variables, the study population extracted from NHI members had
99 similar characteristics to those defining the near-poor group. Lee (2016)[8] found that a person

100 enrolled in MA had less OOP spending for hospitalization and outpatient visits and their
101 number of days of hospitalization was greater compared to NHI members. A study which
102 compared MA benefits and Medicaid among low income populations found that the near poor
103 in South Korea had similar sociodemographic characteristics with MA beneficiaries [5]. Choi
104 (2015)[15] found that poor people not enrolled in MA had significantly lower medical
105 utilization compared to MA beneficiaries, and greater healthcare costs as well. However, these
106 studies have only compared the near poor with MA beneficiaries and do not include the
107 population above the threshold of 50% of median income, or they did not divide the low-
108 income groups according to specific criteria to separate the near poor out of the low-income
109 population. Because of the existence of supportive programs for CHE and aid for OOP
110 spending among the near-poor population and because the near poor have distinctive socio-
111 demographic conditions compared to other NHI members above the 50% income threshold,
112 there is a need to distinguish the near-poor population from other NHI members and compare
113 them to examine the different socio-demographic and policy contexts they inhabit. In addition,
114 studies using propensity score matching or defining the near poor have relied only on income
115 to distinguish the near poor from other NHI members. The reasons for poor people being
116 excluded from MA include not only the income threshold, but other reasons as well [7]. For
117 instance, those whose obligatory provider exceeds certain criteria are excluded from MA
118 enrollment.

119 Therefore, this study examines general characteristics by dividing total respondents by
120 equivalized disposable household income of 50%, and then separates the near-poor population
121 from the low-income population according to specific criteria which will be discussed later. In
122 addition, we analyzed medical utilization and OOP spending among three separate groups.

123
124 **Material and methods**

125

126 **Data source**

127 We collected individual data from the 14th Korea Welfare Panel Study (2019) database,
128 which is conducted by Seoul National University (SNU) and the KIHASA. The Korea Welfare
129 Panel Study was designed to provide a probability sample of South Korea's population. The
130 study subjects were selected to compare low-income and general families by collecting half of
131 the samples from low-income households [16]. Data collected from February 18 through May
132 21, 2019 were used for this study. The period of the survey was January 1 through December
133 31, 2018 for flow data and December 31, 2018 for stock data.

134 Among the total of 14,418 individuals and 6,331 households initially selected for this
135 study, 3,183 individuals were excluded due to being a minor under the age of 18, missing health
136 care program type information, being beneficiaries of free medical treatment for reasons of
137 national merit, and as individuals above the poverty line but still beneficiaries of MA.
138 Eventually, 11,235 individuals were selected as subjects of this study

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140 **Variable definition**

141 *Defining the Study Group*

142 The study population was categorized into three groups: MA beneficiaries, the near
143 poor, and those above the poverty line. The poverty line was defined as 50% of median income
144 by the number of household members in 2018. Near poor was defined as the population who
145 are below the poverty line and enrolled in NHI, or who were subject to national basic living
146 security aid in 2018 but not enlisted in MA because the obligatory provider's income or
147 property exceeded criteria or for a failure to pay the NHI contribution for more than six months
148 and thus being excluded from NHI benefits. NHI members not grouped as near poor were

149 placed in the above-poverty-line group. The entire population enlisted as MA beneficiaries
150 were grouped as MA beneficiaries.

151

152 *Selection and definition of explanatory variables*

153 We examined two types of medical utilization for 2018: outpatient services and
154 inpatient services. Inpatient services were examined in terms of three variables: hospital visits,
155 hospitalized days, and hospitalized days per visit. For OOP spending, the Korea Welfare
156 Panel Study includes all OOP spending, including hospital costs, dental costs, Korean
157 traditional medicine costs, and drug costs. CHEs are defined as annual OOP spending
158 exceeding a specified fraction of annual income, which is distinct from high health costs
159 defined simply as those exceeding a determined amount [17, 18]. The specified fraction
160 threshold varies between 10% to 40%; for this study, 20% and 40% were used as a threshold.

161 Sex, age, marital status, education, employment, income, self-reported health status,
162 chronic disease states, private insurance coverage status, depression, and other disorders were
163 set as predisposing factors affecting medical utilization and OOP spending. Educational
164 achievement was grouped into no completion, below high school diploma, high school diploma,
165 and above high school diploma. Employment was grouped into temporary employee; employer,
166 self-employed, or unpaid family worker; unemployed or economically inactive; and permanent
167 employee. Income was defined as equivalized disposable personal income by adding gross
168 income and non-consumption expenditures to calculate household disposable income and
169 dividing household disposable income by the square root of the number of household members.
170 Self-reported health status was measured with "very healthy," "healthy," "moderate" deemed
171 healthy and "not very healthy" and "unhealthy" as bad health. Private insurance coverage status
172 was measured by whether the respondent has at least one type of private insurance. Depression
173 status was measured on the CESD-11 scale. Depression status was defined as the sum of

174 CESD-11 questionnaires (0 - 33 points) multiplied by 20/11 being greater than or equal to 16
175 [19]. Respondents were grouped as having another disorder if any type of mental, kidney, heart,
176 respiratory, liver, physical, speech, facial nerve, brain lesion, visual disturbance, hearing
177 impairment, mental retardation, or intestinal disorder was present.

178

179 **Statistical analyses**

180 We examined the effect of MA and poverty on health utilization and OOP spending.
181 Because the decision to use medical services and incur OOP spending is not random given that
182 an individual's health status, occupational status, and various other factors influence it, we
183 applied the model by Rubin (1974)[20]. Following his notation we observed $Y = \alpha + \beta \cdot X +$
184 $\delta \cdot T + \epsilon$, where T is a 0 to 1 indicator of whether an individual is assigned to the treatment
185 (MA beneficiary or below poverty line) or control group, X is the observable factors, Y is the
186 outcome (medical utilization, OOP spending, or occurrence of CHEs), and ϵ is unobservable
187 but influences Y. If we simply compare the realized outcomes, for instance, based on the
188 average treatment effect on the treated (ATT), that is $E(Y_1|T = 1) - E(Y_1|T = 0)$, selection
189 bias will occur due to the non-randomness of factors that influence the decision [21]. However,
190 if the assignment of treatment is random for individuals with similar values of observable
191 covariates, the ATT can be identified.

192 We used propensity score matching to estimate treatment's effects in an unbiased
193 manner by accounting for possible covariates that predict receiving treatment [22]. To conduct
194 matching between the MA and near-poor groups, a propensity score was derived by applying
195 a probit model, setting policy variables as to whether the individual is an MA beneficiary, and
196 other covariates were adjusted between the control and case group. Sex, age, marital status,
197 education, employment, income, self-reported health status, chronic disease states, private

198 insurance coverage status, depression, and other disorders were set as covariates.

199 Propensity score for respondent i is the conditional probability of assignment to the
200 treatment condition, as follows.

$$\begin{aligned} 201 \quad \Pr(T_i = \text{medical aid, poverty line}) &= \frac{e^{X\beta}}{1 + e^{X\beta}}, \\ 202 \quad \text{where } \ln\left(\frac{p}{1-p}\right) &= \beta_0 + \beta_1 X_1 + \cdots + \beta_k X_k \\ 203 \end{aligned}$$

204 Estimated propensity scores were used to match MA beneficiaries and the near-poor
205 group. Given that an increasing number of controls matched to each case resulted in improved
206 efficiency, but efficiency is minor when one-to-M matching exceeds $M=5$, we applied one-to-
207 four nearest neighbor matching with replacement and 0.01 caliper width [23]. After matching
208 was completed, a t-test was applied to verify whether the covariates' distribution was the same
209 between the groups.

210 To conduct matching between the near-poor and above-poverty line groups, the
211 unmatched near-poor groups with MA beneficiaries were excluded. The rest of the near-poor
212 sample was matched with the above-poverty line group, setting policy variables as whether or
213 not the individual is below the poverty line. The same procedure was conducted to derive the
214 propensity score and matching between the near-poor and above-poverty-line groups.

215 After matching was completed, regression was applied to check each policy variable's
216 effect on medical utilization and OOP spending. We assumed that the outpatient and inpatient
217 medical usage in this analysis follows a Poisson basic model [24]. For medical utilization,
218 there are three fundamental statistical properties: 1) To be non-negative; 2) to have no non-
219 trivial fraction of zero outcomes; 3) to follow a positively skewed distribution of non-zero
220 realization [25]. To accommodate these unique count data structures, a zero-inflated Poisson

221 (ZIP) model was used to model hospital visits, hospitalized days, and hospitalized days per
 222 visit. For outpatient use, we applied a negative binomial model.

223 Let x_i be the vector for the covariates with μ_i the expected number of occurrences
 224 where x_i is the vector independent variable and β the vector of parameters to be estimated.

$$225 \quad \mu_i = \exp(\beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \dots + \beta_k x_{ki}) = \exp(x'_i \beta) > 0$$

226 The ZIP model first models the probability of observing zeroes using logistic
 227 regression, and then uses a Poisson regression to model the non-zero count data while
 228 accounting for the excess zeroes. The ZIP model can be presented as y_i , which represents the
 229 count of the hospital visits, hospitalized days, and hospitalized days per visit for the i th person
 230 and π as the probability of a case in which the count is zero and $1 - \pi$ is the probability of a
 231 case in which the count is not zero. Therefore, the probability distribution of y_i can be written
 232 as follows:

$$233 \quad \Pr(y_i = j) = \begin{cases} \pi_i + (1 - \pi_i) \exp(-\mu_i) & \text{if } j = 0 \\ (1 - \pi_i) \frac{\mu_i^{y_i} \exp(-\mu_i)}{y_i!} & \text{if } j > 0 \end{cases}$$

234 The negative binomial model can be written as below, where y_i presents the
 235 count of the dependent variable outpatient use for the i th person and $\alpha = \frac{1}{v}$, where v is
 236 the scale parameter of the gamma noise variable, and the negative binomial regression
 237 model can be shown as follows:

$$238 \quad \Pr(Y = y_i | \mu_i, \alpha) = \frac{\Gamma(y_i + \alpha^{-1})}{\Gamma(\alpha^{-1}) \Gamma(y_i + 1)} \left(\frac{1}{1 + \alpha \mu_i} \right)^{\alpha^{-1}} \left(\frac{\alpha \mu_i}{1 + \alpha \mu_i} \right)^{y_i}$$

239 Because the OOP spending data is skewed to the right and was not normally distributed,

240 log-link Generalized Linear Model(GLM) was applied to model OOP spending [26]. The
241 gamma distribution is undefined for values of '0', an offset of 0.00001 was added to each OOP
242 spending value in consideration of the users who had no OOP spending, and results were
243 interpreted with exponentiated coefficients [27].

244 The occurrence of CHEs was modeled by applying binomial logistic regression to
245 estimate each group's risk ratio and risk difference. All statistical analyses were performed
246 using Stata ver. 16 (StataCorp, College Station, Texas, USA). This study protocol was
247 approved by the Institutional Review Board of Seoul National University (IRB No. E2010/001-
248 004).

249

250 **Results**

251

252 **Demographic characteristics**

253 Various demographic and socio-economic characteristics, health status, and
254 occupation status among three study groups are compared (Table 1). MA beneficiaries and the
255 near-poor group were found to show similar health and socio-economic status. However, the
256 near-poor group tends to be more economically active than the MA beneficiaries. The above-
257 poverty-line group was found to have better health and socioeconomic status and was more
258 economically active.

259 **(Table 1 here)**

260

261 **Matching quality**

262 Overall descriptive statistics for all covariates were compared among the three study

263 groups. Before matching, almost all covariates are statistically different between the groups at
264 the 5% significance level. After matching, there are no significant differences in all covariates
265 among the groups. A matched sample of 507 MA beneficiaries and 915 individuals from the
266 near-poor group was generated and used in the subsequent analysis. For the near-poor and
267 above-poverty line group, five of the 915 in the matched sample for the MA and near-poor
268 groups were excluded because common support was not achieved. A matched sample of 910
269 from the near-poor group and 1,482 from the above-poverty-line group were generated and
270 used in the subsequent analysis.

271

272

(Table 2 here)

273

274 **Differences in health utilization and OOP spending among Medical Aid beneficiaries and**
275 **the near-poor group**

276 The MA beneficiaries group was found to use 35% more outpatient services than the
277 near-poor group ($p < 0.001$; $\exp(0.30)=1.35$). The two groups showed no significant difference
278 in hospital visit frequency and hospitalized days per visit. The MA group showed a
279 significantly lower number of expected hospitalized days than the near-poor group. The
280 expected number of hospitalized days for the MA group was estimated to be 31% smaller than
281 the near-poor group ($p < 0.1$; $\exp(-0.36)=0.69$). The other three occupation groups were found
282 to use significantly less use outpatient services and hospital visits than permanent employees
283 at the at least 10% significance level. Private insurance subscription had a negative effect on
284 hospital days and hospital days per visit based on Poisson estimation ($p < 0.05$) (Table 3).

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(Table 3 here)

OOP spending and CHE occurrence were compared among the near poor and MA beneficiaries. MA beneficiaries showed 73.6% lower OOP spending and less chance of CHE experience for both the 20% and 40% thresholds compared to the near-poor group ($p < 0.001$) (Table 4). Permanent job status was found to show a lower chance of occurrence of CHE than the other occupational statuses, with the exception of unemployed or economically inactive (at least 10% significance level). People with private insurance responded as spending 41.9% more on OOP spending ($p < 0.05$), but had no significant effect on occurrence of CHE.

(Table 4 here)

Differences in medical utilization and OOP spending among the near-poor and above-poverty-line groups

There was no significant difference in medical utilization except hospitalized days and hospitalized days per visit between the near-poor and above-poverty-line groups. For hospitalized days, the higher use of hospitalized days was conditional on being a hospital user, as Poisson and logit estimates were both positive ($p < 0.1$). The near-poor group had a 23% greater chance of no hospital visits ($p < 0.1$; $\exp(0.21)=1.23$). Occupation status was not a significant factor influencing medical utilization. Private insurance subscription was found to be negatively associated with the chance of no hospital visits, higher number of hospital visits, and hospitalized days at the at least 10% significance level.

(Table 5 here)

311 The near-poor group was more likely to experience CHE but less OOP spending
312 compared to the above-poverty-line group (Table 6). Respondents with a permanent job had
313 less chance of experiencing CHEs at the 40% threshold compared to any other occupational
314 status, except unemployed or economically inactive.

315

316

(Table 6 here)

317

318 **Discussion**

319 We found that the near-poor group was the most vulnerable group among the Korean
320 population. There were no significant differences in medical utilization between the near-poor
321 and above-poverty-line group except hospital days after controlling for potential bias and
322 between the near-poor group and MA beneficiaries except outpatient use. In addition, the near-
323 poor group was found to make more OOP spending by 73.55% than did MA beneficiaries and
324 to have significantly higher chance of experiencing CHE at both the 40% and 20% thresholds
325 compared to the two other groups after equivalized disposable personal income was adjusted.
326 These results demonstrate that the near-poor group could be the most vulnerable population
327 based on medical service utilization and OOP spending. This assumption is in agreement with
328 the results reported by several other studies. MA beneficiaries were found to use more inpatient
329 and outpatient services, incurred less OOP spending, and had a lower chance of experiencing
330 CHEs compared to NHI members [8, 28]. A study which defined the near poor as people not
331 enrolled in MA with income less than 120% of the minimum cost of living found that MA
332 beneficiaries experienced significantly higher health care utilization in terms of both outpatient
333 visits and inpatient visits, and lower health care costs and proportion of OOP spendings to
334 income compared to the poor not enrolled in MA [15]. However, contrary to previous findings,
335 our study shows that the difference in medical utilization only applies to outpatient visits

336 among MA beneficiaries and the near poor. This might demonstrate the effect of recent policy
337 changes. CHE support for the population below 50% of the median income, which matches the
338 defined near-poor population in this study, was implemented for severe diseases in 2013 and
339 expanded to all diseases in 2018 [29]. Furthermore, the current administration implemented an
340 NHI coverage expansion in 2017 by alleviating uncovered services and restricting the OOP
341 spending threshold to 10% of annual income for the bottom 50% income group [30]. Because
342 previous research was based on data from before 2016, the findings do not reflect these recently
343 implemented policies affecting the medical utilization of the near poor. Further study is needed
344 to examine the effects of this recent policy change on medical utilization among the near poor.
345 Also, compared to outpatient services, inpatient services rely more on the decision of health
346 experts than the patient's discretion [31, 32]. Hospitalization and length of stay is affected more
347 by health experts, commonly physicians, so factors of individual patients may not affect
348 inpatient service to a great degree.

349 The presence of chronic disease was significantly associated with greater numbers of
350 outpatient and inpatient visits among the three study groups, but were not related to OOP
351 spendings and CHEs beyond the case of the CHE threshold of 20% among NHI members.
352 Chronic disease has been confirmed in several studies as a significant factor in determining
353 outpatient service use, such as the number of outpatient visits [33]. Because the average age of
354 our study population is high, the presence of chronic disease likely influences higher inpatient
355 use due to a lack of proper self-management [34, 35]. Additional focus is required on chronic
356 disease prevention by empowering the population through strengthening education. Self-
357 management programs must be supported in order to mitigate hospitalization due to chronic
358 disease. Also, perceived negative health status was associated with a higher volume of
359 outpatient and inpatient use. Perceived negative health status can lead to poor physical health
360 and greater social isolation [36]. Thus, self-evaluated health status must be considered in the

361 development of health promotion programs among both MA beneficiaries NHI members.

362 In the comparison of hospitalized days and private health insurance subscription
363 among the near-poor and above-poverty-line groups, the conflict result of Poisson and logit
364 estimators may reflect the difference characteristics of subgroups among the near poor and
365 subscribers to private health insurance [24]. For hospitalized days, it may indicate a subgroup
366 among the near poor which may have both a higher number of hospitalized days overall and a
367 greater probability of no hospital visits. This might indicate the possibility of preventable
368 hospitalization due to a lack of hospital visits. Because of the socio-economic status of the
369 near-poor, it can be presumed that they felt a significant financial burden from hospital visits
370 [37]. Insufficient hospital visits could result in deterioration of health and eventually
371 hospitalization and longer length of stays. For private health insurance subscription, it might
372 indicate that the subgroup of subscribers may have a lower number of hospital visits overall
373 but less probability of no hospital visits.

374 South Korea has constantly implemented expansions of NHI coverage and pursued the
375 reduction of copayments and support programs for CHEs among the near-poor population to
376 ensure proper health care use and to prevent impoverishment by health care costs. Despite these
377 efforts, several studies, including ours, have demonstrated that the near-poor population still
378 remains unprotected from the occurrence of CHEs. Moreover, previous studies have found that
379 the near-poor population is reported to experience higher unmet needs compared to MA
380 beneficiaries [13. 38]. An expansion of MA could be considered an alternative for alleviating
381 this burden and ensuring essential health services among the near-poor. Lee (2020)[14] found
382 that people who shifted from NHI to MA increased their number of outpatient visits without
383 increasing OOP spending. A more focused policy regarding populations in a blind spot within
384 the health care system, including on perceived health status and chronic disease, is required to
385 ensure essential health services for the near-poor group.

386 Our study has certain limitations and strengths. Our findings may not be generalizable
387 to other countries with different medical utilization and OOP spending programs. This study
388 conducted a cross-sectional analysis including 516 MA beneficiaries, 915 among the near-
389 poor, and 1,492 in the above-poverty-line group after matching, which could be an insufficient
390 sample size for analysis using several independent variables. Second, we could not resolve the
391 issue of supply-induced demand or demand-induced demand among MA beneficiaries. Third,
392 although we used propensity score matching to adjust the potential bias, we could not examine
393 several factors that may influence medical utilization and OOP spendings due to a lack of data.
394 Finally, given the limits of the data, we could not identify the use of uncovered medical services
395 because medical services were not categorized as covered or uncovered services. Because
396 several high-quality medical services offered in South Korea are uncovered by either MA or
397 NHI, we cannot verify the quality of medical service that respondents used. Future research
398 should examine various factors that may influence medical utilization and OOP spendings,
399 including variables such as unmet need, health service quality, and service accessibility related
400 factors.

401 The strengths of this study include its analysis of socio-economic and health-related
402 factors and the use of several statistical methods to accommodate the unique characteristics of
403 outcome variables and minimize potential bias. In addition we examined the medical utilization
404 and OOP spendings of an above-poverty-line group not included in previous studies [39].

405

406 **Conclusions**

407 This study found that the near-poor population showed no significant difference in
408 medical utilization compared to the MA and above-poverty-line groups, but that they incurred
409 greater OOP spending and were exposed to a higher chance of experiencing CHEs. This result
410 indicates that the near-poor group is the most vulnerable within South Korea's population.

411 Health policy needs to take into account this vulnerability of the near-poor population and
412 several factors, such as chronic disease and perceived health status, that significantly influence
413 medial use and cost in order to ensure essential services and provide protection from
414 impoverishment by health care costs.

415

416 **List of abbreviations**

417 Medical Aid (MA), out-of-pocket (OOP), National Health Insurance(NHI), Korea
418 Welfare Panel Study (KOWEPS), catastrophic health expenditure (CHE), World Health
419 Organization (WHO), computed tomography (CT), magnetic resonance imaging (MRI),
420 Organization for Economic Cooperation and Development (OECD), Health Insurance Review
421 & Assessment Service (HIRA), Korea Institute for Health and Social Affairs (KIHASA), Seoul
422 National University (SNU), Center for Epidemiological Studies-Depression (CESD), average
423 treatment effect on the treated (ATT), zero-inflated Poisson (ZIP), Generalized Linear Model
424 (GLM),

425

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429

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432

433 **Availability of data and materials**

434 The dataset analyzed during the current study are available in the Korea Welfare Panel Study,
435 [<https://www.koweps.re.kr/>]

436

437 **Ethics approval and consent to participate**

438 This study protocol was approved by the Institutional Review Board of Seoul National
439 University (IRB No. E2010/001-004).

440

441 **Competing interests**

442 The author declares that he has no competing interests.

443

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