



Poor People and Poor Health: Examining the Mediating Effect of Unmet Healthcare Needs in Korea

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Objectives: The purpose of this study was to estimate the mediating effect of subjective unmet healthcare needs on poor health. The mediating effect of unmet needs on health outcomes was estimated.

Methods: Cross-sectional research method was used to analyze Korea Health Panel data from 2011 to 2015, investigating the mediating effect for each annual dataset and lagged dependent variables.

Results: The magnitude of the effect of low income on poor health and the mediating effect of unmet needs were estimated using age, sex, education level, employment status, healthcare insurance status, disability, and chronic disease as control variables and self-rated health as the dependent variable. The mediating effect of unmet needs due to financial reasons was between 14.7% to 32.9% of the total marginal effect, and 7.2% to 18.7% in lagged model.

Conclusions: The fixed-effect logit model demonstrated that the existence of unmet needs raised the likelihood of poor self-rated health. However, only a small proportion of the effects of low income on health was mediated by unmet needs, and the results varied annually. Further studies are necessary to search for ways to explain the varying results in the Korea Health Panel data, as well as to consider a time series analysis of the mediating effect. The results of this study present the clear implication that even though it is crucial to address the unmet needs, but it is not enough to tackle the income related health inequalities.

Key words: Unmet healthcare needs, Needs assessment, Healthcare disparities, Korea Health Panel

INTRODUCTION

Donabedian proposed a conceptual model that provide a framework for examining healthcare, defining healthcare needs as “required medical services that can appropriately prevent, alleviate, and cure the status of illness or inability

caused by some disturbance in health and well-being” [1-3]. According to this model, unmet needs for medical care refer to a situation where a lack of medical care leads to the failure of appropriate prevention, alleviation, and cure of illness or disability. Those who experience unmet needs are, by definition, likely to see deteriorating health conditions, which is supported by previous studies that demonstrated correlations between unmet needs and various proxy indicators, such as death, quality of life scale, and self-rated health [4-8].

Researchers have also explored various factors that may impact unmet needs. Assuming unmet needs as a proxy indicator of lack of access to healthcare, many previous studies found the correlation between unmet needs and low education level, low income, chronic disease, living alone, limited activities [9-12]. The factors associated with unmet needs are

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generally known to be associated with poor health, thus theoretically and empirically, unmet needs are believed to mediate or interact with the various factors that affect poor health. To sum up, unmet needs have been regarded as a proxy for healthcare accessibility that should be addressed on its own terms, but their mediating effects on poor health have rarely been studied.

The purpose of this study was to examine the mediating effect of unmet needs on poor health. In order to properly gauge the mediating effect of unmet needs, it is necessary to verify healthcare need as an independent variable and its fulfillment, followed by estimating unmet needs' mediating consequences for health. However, it was not possible to find resources with specific data on healthcare needs that may or may not be unmet. Therefore, we decided to use low income as a proxy indicator of health needs, since it is associated with higher health risk and susceptibility, poor health behavior, and a higher prevalence of diseases [13-15]. To sum up, this study investigated whether unmet healthcare needs due to financial reasons mediate poor health and if so, the magnitude of the mediating effect.

METHODS

Cross-sectional research method was used to analyze the Korea Health Panel data between 2011 and 2015, investigating the mediating effects for each annual dataset and the lagged dependent variables.

Data

The Korea Health Panel data are a reliable resource representing the status of Korea's national healthcare and medical environment that have been generated since 2008. The data include details on medical services and costs, as well as major health-related indicators. We obtained the self-rated health and unmet needs that is measured in adult population in the survey. Five years of data between 2011 and 2015 were used for analysis.

Analytical Model and Variable Measurement Methods

The analytical model was created by replacing "health need" in the Donabedian model with "low income" and the model is shown in Figure 1.

According to the Donabedian model, the mediating effect of unmet needs should be calculated by using health need events as the independent variable. However, since there is no available data on health need events, the variable was replaced by "low income," one of the major factors known to cause poor health. Low income was defined as the lowest quintile of adjusted household income, calculated by dividing monthly household income by the square root of the number of household members [16].

Unmet needs were considered as the mediator variable, defined as replies of "yes" to the survey question "Have you ever missed seeing a doctor and/or getting a medical check-up that was necessary during the last year? (Not including dental treatments and/or check-ups)". Cases where the unmet need was caused by "financial reasons (cost of treatment)" were an-

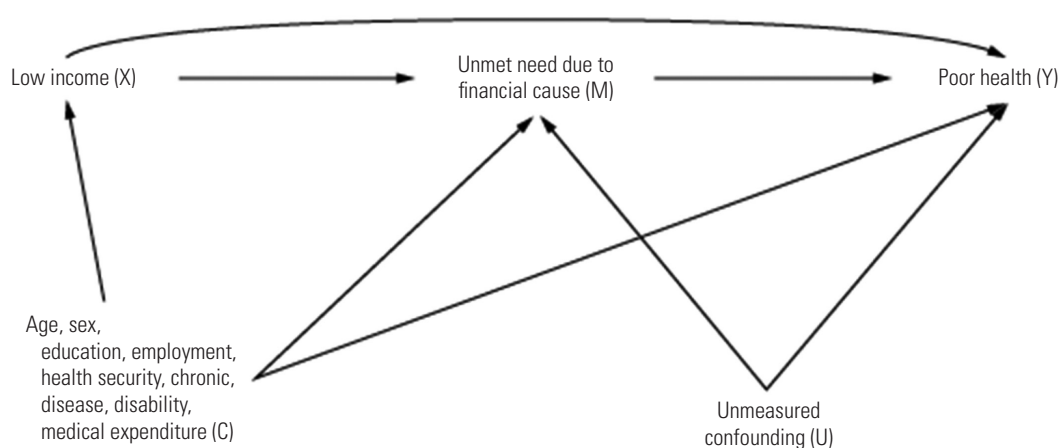


Figure 1. Analytical model for estimating the mediating effect of unmet needs. X, exposure variable; M, mediator; Y, outcome variable; C, confounding variables; U, unmeasured confounding.

alyzed separately. Replies to the question on participants' self-rated health using a 5-point Likert scale of "normal", "good", "very good", "bad", and "very bad" were dichotomized, with the first 3 scores defined as "healthy" and the last 2 as "unhealthy". Self-rated health was used as an indicator to reflect the multifaceted quality of health [17-19].

The control variables included age, sex, education level (elementary school diploma and lower, high school diploma and lower, undergraduate and higher), employment status (full-time regular employee, part-time employee, self-employed, and employer, unpaid family business, or unemployed), healthcare insurance status (National Health Insurance, Medical Aid), the presence of a disability or chronic disease, and survey year.

Subjects of the Study

The subjects of the Korea Health Panel surveys between 2011 and 2015 were adults aged 18 and older, and the composition of each panel is shown in Figure 2.

The subjects of the study were limited to adults aged 18 and older. Participants were excluded if data were missing from the additional questions that asked for variables such as self-rated health status and unmet needs; this was the case for 3.50% of the sample (2950 person-years). Responses that included the additional questions but had incomplete answers to questions related to self-rated health and unmet needs were found for 6.30% (4050 person-years) and 0.05% (33 per-

son-years) of the observation, respectively. For healthcare insurance status, only 13 person-years was either not enrolled or in delinquency, thus this data was excluded from the study. An unbalanced panel consisting of 17 761 participants (male: 8382; female: 9379) and 60 779 person-years (male: 27 542 person-years; female: 33 237 person-years) was created.

Statistical Analysis

Unmet needs were confirmed to be correlated with poor health through a fixed-effects logit model in the results of a similar previous study [20], presented in Supplementary Material 1.

Quasi-Bayesian Monte Carlo estimation was used to estimate the mediating effects of unmet needs. This method allows estimation of not only the significance of mediating effects, but also the magnitude of the average causal mediation effect [21-24]. We analyzed the Korean medical panel data cross-sectionally from 2011 to 2015 year by year. To estimate the mediation effect, a regression model with unmet needs as a dependent variable was used. The analytical model used is presented below:

$$\begin{aligned} \text{logit } P(\text{poor health} = 1 \mid \text{low income, unmet, covariates}) \\ = \theta_0 + \theta_1 \text{ low income} + \theta_2 \text{ unmet} + \theta_3 \text{ covariates} + \epsilon \end{aligned} \quad (1)$$

$$\begin{aligned} E(\text{unmet} \mid \text{low income, covariates}) \\ = \beta_0 + \beta_1 \text{ low income} + \beta_2 \text{ covariates} + \gamma \end{aligned} \quad (2)$$

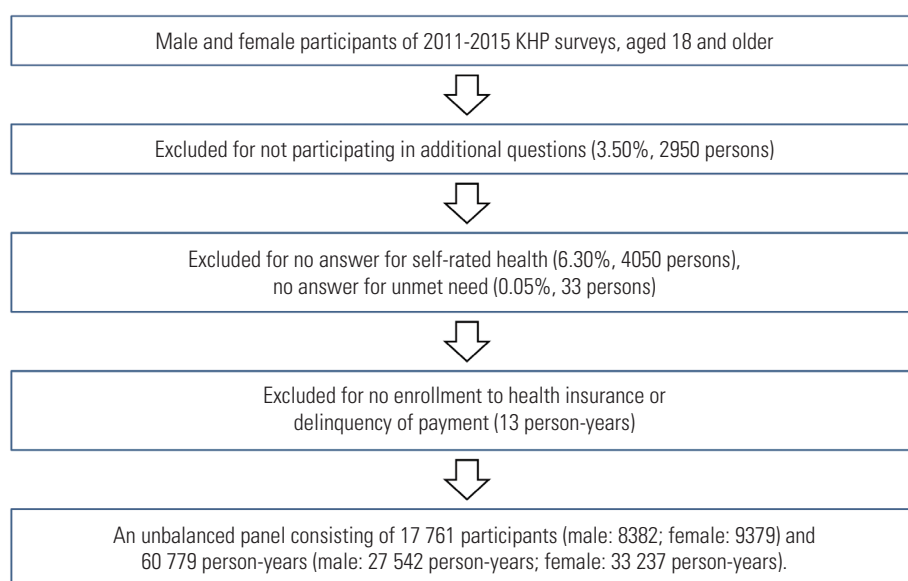


Figure 2. The composition of an unbalanced panel of subjects. KHP, Korea Health Panel.

The lagged dependent variable analysis of the effects of unmet needs in year t on health status in year $t+1$ was carried out considering the potential time lag between unmet needs and their actual effect on health. The analytical model is shown below:

$$\text{logit } P(\text{poor health}_{t+1} = 1 \mid \text{low income}_t, \text{unmet}_t, \text{covariates}_t) \\ = \theta_0 + \theta_1 \text{low income}_t + \theta_2 \text{unmet}_t + \theta_3 \text{covariates}_t + \epsilon \quad (3)$$

$$E(\text{unmet}_t \mid \text{low income}_t, \text{covariates}_t) \\ = \beta_0 + \beta_1 \text{low income}_t + \beta_2 \text{covariates}_t + \gamma \quad (4)$$

In the analysis of mediating effects, income level was considered a relatively stable variable, while unmet needs may be different each year. Therefore, the controlled direct effects and the natural direct effects were both estimated, not considering the interaction between low income and unmet needs. The total marginal effects (TMEs) of low income on poor self-

rated health, the direct effects of low income on health regardless of unmet needs, and the indirect effects of poor health mediated by unmet needs were estimated.

Stata version 15 (StataCorp., College Station, TX, USA) was used for the analyses, using the `paramed` and `medeff` commands for analyzing mediating effects.

RESULTS

Characteristics of the Subjects

The unbalanced panel included 11 760 subjects in 2011, 7697 of whom were followed up for the next 5 years without missing data. New samples were added to the panel in 2014 to fill in attrition, which contributed to some changes in the characteristics and the trends of the subjects the following years. Participants who reported their self-rated health as poor accounted for 14.6% in 2011, 16.0% in 2012, 14.8% in 2013, 16.7% in 2014, and 14.8% in 2015, respectively, demonstrat-

Table 1. General characteristics of the subjects

Characteristics	2011 (n=11 760)	2012 (n=11 026)	2013 (n=10 539)	2014 (n=14 028)	2015 (n=13 426)
Poor self-rated health	1714 (14.6)	1764 (16.0)	1559 (14.8)	2349 (16.7)	1986 (14.8)
Experienced unmet needs	1764 (15.0)	1745 (15.8)	1833 (17.4)	1816 (12.9)	1872 (13.9)
Experienced unmet needs due to financial reasons	529 (4.5)	624 (5.7)	579 (5.5)	482 (3.4)	531 (4.0)
Age (y), mean \pm SD	51.0 \pm 16.5	51.9 \pm 16.7	52.5 \pm 17.0	52.9 \pm 17.1	53.5 \pm 17.4
18-64	8856 (75.3)	8094 (73.4)	7554 (71.7)	9998 (71.3)	9402 (70.0)
\geq 65	2904 (24.7)	2932 (26.6)	2985 (28.3)	4030 (28.7)	4024 (30.0)
Sex (male)	5311 (45.2)	4978 (45.1)	4751 (45.1)	6389 (45.5)	6113 (45.5)
Education level					
Elementary school diploma and lower	2550 (21.7)	2409 (21.8)	2293 (21.8)	2933 (20.9)	2774 (20.7)
High school diploma and lower	5144 (43.7)	4777 (43.3)	4508 (42.8)	6010 (42.8)	5709 (42.5)
Undergraduate and higher	4066 (34.6)	3840 (34.8)	3738 (35.5)	5085 (36.2)	4943 (36.8)
Employment status					
Full-time, regular employee	2388 (20.3)	2192 (19.9)	2092 (19.9)	2753 (19.6)	2647 (19.7)
Part-time, temporary employee	2132 (18.1)	2124 (19.3)	1984 (18.8)	2770 (19.7)	2580 (19.2)
Self-employed, employer	1958 (16.6)	1823 (16.5)	1761 (16.7)	2320 (16.5)	2012 (15.0)
Unpaid family business	562 (4.8)	523 (4.7)	498 (4.7)	646 (4.6)	570 (4.2)
Unemployed	4720 (40.1)	4364 (39.6)	4204 (39.9)	5539 (39.5)	5617 (41.8)
Medical Aid (type 1, type 2) ¹	515 (4.4)	454 (4.1)	406 (3.9)	435 (3.1)	430 (3.2)
Prevalence of chronic disease	7280 (61.9)	6922 (62.8)	6909 (65.6)	8920 (63.6)	8591 (64.0)
Disability	777 (6.6)	742 (6.7)	687 (6.5)	901 (6.4)	855 (6.4)
Household income (adjusted for number of members, 10 000 KRW), median [IQR]	1918 [1210, 2789]	1972 [1226, 2934]	2061 [1282, 3000]	2116 [1308, 3141]	2250 [1370, 3355]

Values are presented as number (%).

SD, standard deviation; KRW, Korean won; IQR, interquartile range.

¹The Medical Aid classifies beneficiaries into two categories, type 1 and 2, on the basis of being incapable (those under 18 or over 65 years of age, or disabled) or capable of working, respectively.

ing no particular trend. The percentage of those who experienced unmet needs showed increasing trend from 2011 to 2013, then drop down from 17.4% in 2013 to 12.9% in 2014, which presumably indicate the effect of attrition and addition of new observations (Table 1).

Primary Findings

The TMEs, direct effects, and indirect effects of low income on self-rated poor health are presented as odds ratios (ORs) while the mediating effect of unmet needs was calculated as a percentage in Table 2, and the equations applied are shown

below. The reference categories were high income (quintiles 2-5) for the direct effects, no unmet need for the indirect effects, and high income and no unmet need for the TMEs.

$$OR^{TME} = OR^{NDE} \times OR^{NIE} \quad (5)$$

$$OR^{NDE} = \frac{P(\text{poor health}_{\text{low income}=1, \text{unmet}=0=1}) / P(\text{poor health}_{\text{low income}=1, \text{unmet}=0=0})}{P(\text{poor health}_{\text{low income}=0, \text{unmet}=0=1}) / P(\text{poor health}_{\text{low income}=0, \text{unmet}=0=0})} \quad (6)$$

$$OR^{NIE} = \frac{P(\text{poor health}_{\text{low income}=1, \text{unmet}=1=1}) / P(\text{poor health}_{\text{low income}=1, \text{unmet}=1=0})}{P(\text{poor health}_{\text{low income}=1, \text{unmet}=0=1}) / P(\text{poor health}_{\text{low income}=1, \text{unmet}=0=0})} \quad (7)$$

Table 2. TMEs, direct effects, and indirect effects of low income on self-rated poor health

Mediator variables	TME	NDE, CDE	NIE	% of total effect mediated
KHP 2015 (n=13 426)				
Unmet needs	1.51 (1.33, 1.70)	1.43 (1.26, 1.60)	1.06 (1.04, 1.08)	13.5
Unmet needs due to financial reasons	1.52 (1.34, 1.72)	1.44 (1.27, 1.62)	1.06 (1.04, 1.08)	18.2
KHP 2014 (n=14 028)				
Unmet needs	1.33 (1.19, 1.52)	1.23 (1.10, 1.40)	1.08 (1.06, 1.11)	30.1
Unmet needs due to financial reasons	1.31 (1.17, 1.48)	1.24 (1.10, 1.40)	1.06 (1.04, 1.09)	27.0
KHP 2013 (n=10 539)				
Unmet needs	1.33 (1.15, 1.53)	1.22 (1.06, 1.41)	1.08 (1.06, 1.11)	31.0
Unmet needs due to financial reasons	1.34 (1.16, 1.54)	1.22 (1.05, 1.40)	1.10 (1.07, 1.13)	32.9
KHP 2012 (n=11 026)				
Unmet needs	1.49 (1.32, 1.70)	1.41 (1.23, 1.61)	1.06 (1.04, 1.09)	15.8
Unmet needs due to financial reasons	1.47 (1.30, 1.68)	1.39 (1.23, 1.60)	1.06 (1.03, 1.09)	14.7
KHP 2011 (n=11 760)				
Unmet needs	1.40 (1.23, 1.60)	1.36 (1.19, 1.55)	1.03 (1.01, 1.05)	9.5
Unmet needs due to financial reasons	1.42 (1.23, 1.64)	1.34 (1.16, 1.55)	1.06 (1.03, 1.09)	19.4

Values are presented as odds ratio (95% confidence interval).

KHP, Korea Health Panel; TME, total marginal effect; NDE, natural direct effect; CDE, controlled direct effect; NIE, natural indirect effect.

Table 3. TMEs, direct effects, and indirect effects of low income on self-rated poor health in the following year

Mediator variables	TME	NDE, CDE	NIE	% of total effect mediated
KHP 2014 (n=12 495)				
Unmet needs	1.34 (1.18, 1.52)	1.28 (1.13, 1.45)	1.05 (1.03, 1.06)	16.1
Unmet needs due to financial reasons	1.32 (1.16, 1.50)	1.27 (1.12, 1.44)	1.04 (1.02, 1.06)	18.7
KHP 2013 (n=9667)				
Unmet needs	1.36 (1.18, 1.56)	1.30 (1.14, 1.49)	1.04 (1.02, 1.07)	14.4
Unmet needs due to financial reasons	1.35 (1.18, 1.55)	1.30 (1.13, 1.49)	1.04 (1.02, 1.06)	15.7
KHP 2012 (n=10 114)				
Unmet needs	1.44 (1.25, 1.66)	1.39 (1.21, 1.60)	1.04 (1.02, 1.06)	11.5
Unmet needs due to financial reasons	1.43 (1.24, 1.64)	1.38 (1.20, 1.58)	1.04 (1.02, 1.06)	14.0
KHP 2011 (n=10 742)				
Unmet needs	1.56 (1.36, 1.78)	1.52 (1.34, 1.74)	1.02 (1.00, 1.04)	4.0
Unmet needs due to financial reasons	1.55 (1.35, 1.75)	1.51 (1.31, 1.70)	1.03 (1.01, 1.05)	7.2

Values are presented as odds ratio (95% confidence interval).

KHP, Korea Health Panel; TME, total marginal effect; NDE, natural direct effect; CDE, controlled direct effect; NIE, natural indirect effect; .

The results showed that the OR of TME of low income on poor health ranged from 1.33 in 2013 to 1.51 in 2015. Of all effects, those mediated by unmet needs were the lowest at 9.5% in 2011 and the highest at 31.0% in 2013. The magnitude of the TME was not very different in unmet needs due to financial reasons. The OR of TME of low income on poor health ranged from 1.31 in 2014 to 1.52 in 2015 in model using unmet need due to financial reasons as a mediator variable. The mediating effect of unmet needs due to financial reasons was mostly higher than the mediating effect of unmet needs with every reason, with the lowest effect seen in 2012 at 14.7% and the highest in 2013 at 32.9%.

Table 3 demonstrates the results of lagged dependent variables analysis with a lag time of 1 year. The OR of TME of low income in a given year on the next year's poor health ranged from 1.34 in 2014 to 1.56 in 2011. The lowest percentage of effects mediated by unmet needs was seen in 2011 at 4.0%, and the highest in 2014 at 16.1%. The OR of TME of unmet needs due to financial reasons only range from 1.32 in 2014 to 1.55 in 2011. The lowest value of the mediating effect of unmet needs due to financial reasons was 7.2% in 2011 and the highest was 18.7% in 2014.

DISCUSSION

This study sought to understand the correlation between unmet healthcare needs and poor health, as well as to estimate the extent of the contribution of unmet needs to poor health based on the 2011-2015 Korea Health Panel data. The magnitude of the mediating effect of low income on poor health was estimated in the mediating effect analysis, and the mediating effect of unmet needs due to financial reasons accounted for 14.7%-32.9% of the TME of income. The mediating effect of unmet needs due to financial reasons in the lagged dependent variables model of the following year's health was lower, at 7.2%-18.7%. This result corresponds to the McKeown thesis [25] that one's health status is determined by various social factors more than the utilization of medical services, denying that medical intervention has the most significant impacts on health. The assumption that unmet needs have a considerable mediating effect on poor health among lower-income people turned out to be only partially true based on the results of this study. The estimated values of the mediating effect of unmet needs, in turn, suggest that 67% to 85% of poor health in lower-income individuals cannot be resolved

by simply meeting their healthcare needs.

In lagged variable model, during the analysis period, the mediating effect of unmet need due to financial reason increase from 7.2% to 18.7% while the mediating effect of unmet need due to whole reason increase from 4.0% to 16.1%. And the mediating effect of economic reason is greater than the mediating effect of the whole reason stably by years. Considering these facts, this may be related to worsening economic inequality in Korea, diminishing purchasing power for medical services among low-income group. There is also a possibility that economic recession around 2010 may have had impacts on unmet needs and poor health with a time lag [26,27]. Also, the trend of an increasing mediating effect of unmet needs for financial reasons has implication for the healthcare system, where out-of-pocket expenses account for a large portion of medical costs.

The mediating effect of unmet needs due to financial reasons accounted for 14.7%-32.9% of the TMEs of income. The effects were lower (7.2%-18.7%) in the lagged model, which is inconsistent with the proposal in previous studies that a time lag exists between the impact of low income on health status [28-30]. In other words, this result may imply that the time lag between unmet needs and the manifestation of self-rated poor health may not be as long as a year. Further studies will need to explore how long it takes for income level to affect self-rated health status and its mediated effects.

We acknowledge that this study has certain limitations. First, the issue of sequential ignorability assumption must be addressed to verify the causal relationship of the results of the mediating effect analysis. Parametric sensitivity analysis is known to be useful for this purpose [23]. However, in case where both the result variable and the mediator variable are dichotomous, we could not find currently available method to carry out a sensitivity analysis. Just as unmet needs affect poor health status, the converse may also hold; namely, poor health status may lead to increased medical needs. Studies have proven that more needs were unmet when self-rated health was consistently poor [31-34]. Future studies investigating this dynamic should be followed.

Second, attrition bias caused by follow-up loss was found during the process of compiling the panel data. The population who dropped out seemed to have distinctive characteristics, which should be reflected in the design of future studies. Nonetheless, by using an unbalanced panel for the 5-year period, this study reduced selection bias compared to previous

studies [20,35,36] that used a balanced panel that included those consistently participated in the survey over the entire study period.

Third, this study estimated the mediating effects of unmet needs on the impact of low income on health effects by using low income as the independent variable, not medical needs. This was based on the determination that low income is associated with health risks and susceptibility, poor health behaviors, and a high prevalence of diseases, meaning that it can be used as a proxy indicator for healthcare needs. Still, proximation of healthcare needs by low income brings various uncertainties that impede the estimation, insomuch as unmet need interacts with various variables in the model, which leads to the estimation of effect size that cannot be interpreted as causal inference by itself. Also, subjectively measured unmet needs used in the study may have broader meaning beside the unachieved healthcare need in clinical approach. Further research should be done to more comprehensively understand the mediating effects of unmet needs under the conceptual definition suggested in the introduction, especially on the roles that unmet needs play in the course of dealing with certain healthcare needs, and how they impact health in a qualitative way.

It is also crucial to note that the concept of unmet needs is a flexible notion with ambiguous definitions, both clinically and subjectively, although its intuitive and empirical quality is highly useful. As Levesque et al. [37] suggested in his model of patient-centered access to healthcare, healthcare needs may be unmet at any stage of the process of healthcare, ranging from perception of need to healthcare seeking, reaching, utilization, and health outcome. We must consider the qualitative dimension of unmet need as well as the traditional quantitative dimension in order to actually fulfil the need that makes people's health poor and suffer [37,38]. For example, Patients who report unmet healthcare need may seek alternative treatment such as supplementary remedies and supplementary product, including those that are not medically verified to be secure, which may deteriorate the continuity of care.

Lastly, though the result of lagged dependent variable model used in this study are not significantly different from cross-sectional studies, it has certain limitations. The results may show trends for each year, but interactions among the different independent variables, outcome variables, and parameters each year were not dealt in the analysis. While this study fails to analyze the panel data in consideration with the serial cor-

relation, several equations that can calculate mediating effects over years using changing variables over time have been recently suggested [39,40]. These methods are known for selection bias, sensitivity to confounding variables, and other disadvantages, but could enable a more comprehensive analysis of multi-year data suitable for the purposes of this study.

SUPPLEMENTARY MATERIALS

Supplementary material is available at <https://www.jpmp.org/>.

CONFLICT OF INTEREST

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

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