Journal of Indonesian Economy and Business
Volume 40, Number 1, 2025, 44 – 56

DOES THE USE OF SOLID COOKING FUELS INCREASE HOUSEHOLD OUT-OF-POCKET MEDICAL EXPENSES? EVIDENCE FROM INDONESIA

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ABSTRACT

Introduction/Main Objectives: The objective of this study is to assess how the utilization of solid cooking fuels influences out-of-pocket medical expenses incurred by households in Indonesia. **Background Problems:** Solid cooking fuel use remains prevalent in Indonesia, negatively impacting the health of household members, and consequently affecting associated medical expenses as well. **Novelty:** To the best of the authors' understanding, this study is the first to explore how the use of solid cooking fuels affects the out-of-pocket medical expenses of households in Indonesia. **Research Methods:** This study employs instrumental variables to address existing endogeneity issues. **Finding/ Results:** On average, households using solid cooking fuels show a 0.0041 increased proportion of out-of-pocket medical expenses to total household expenditure compared to households using non-solid cooking fuels. **Conclusion:** The Indonesian government can reduce household medical expenses by improving the use of cleaner cooking fuels. Implementable policies include providing assistance with clean energy cooking equipment and ensuring the availability of clean energy in areas in need.

ARTICLE INFO

Article information:

Received December 20, 2023. Received in revised version July 3, 2024. Received in revised version August 26, 2024. Accepted September 18, 2024.

Keywords:

solid cooking fuels, out-of-pocket medical care expenditure, household, instrumental variables

JEL Code:

C36, I10, Q40

ISSN:

ISSN 2085-8272 (print)
ISSN 2338-5847 (online)

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https://doi.org/10.22146/jieb.v40i1.11412 https://journal.ugm.ac.id/v3/jieb

INTRODUCTION

The overall growth of the world economy has been accompanied by a gradual improvement in individual health from year to year. However, in developing countries like Indonesia, there are still many individuals with low health status. Individual health problems impact social and economic well-being (Hultin et al., 2021; Kang et al., 2021), as well as increasing the financial burden of healthcare services. The more severe the health issues, the greater the expenditure on health services. Health expenditures can be measured at both the macro and micro levels. At the macro level, various factors influence health spending, including an aging population, mortality rates, life expectancy, the cost of health services, unemployment rates, calorie consumption, and gross domestic product, among others (Nghiem et al., 2017; Raeissi et al., 2019; Samadi et al., 2013). At the micro level, household health expenditure is influenced by several factors, including the type of disease, climatic conditions, sanitation, housing conditions, and more (Olasehinde et al., 2017; Su et al., 2006).

A livable environment that meets appropriate and health-promoting standards benefits residents' health (Gascon et al., 2016). The health of every household member, including infants, depends on their living environment (Wahyuni, 2015). The emergence of environmental problems that have an impact on health has become a global concern. The decline in environmental quality is caused by a number of factors, including globalization, growth in direct investment from foreign parties, and energy use (Li et al., 2023). Energy use at both the household and non-household level greatly affects the environment,in turn affecting individual health. The cleaner the energy used, the more the environmental impact of pollution is reduced.

The choice of energy or fuel type plays a crucial role in improving environmental quality, particularly in developing countries like Indonesia. This includes the choice of cooking fuels by households. In rural areas, dirty cooking fuels dominate household energy consumption, negatively impacting environmental quality and the health of household members. In 2010, almost 3 billion people around the world, equivalent to 40 percent of the world's population, cooked using traditional biomass as their main fuel (IEA, 2010). This is of particular concern given the negative health impacts of using unclean fuels. WHO projections indicate that by 2030, more than 1.5 million deaths per year will be due to air pollution from cooking fuels, surpassing the number of deaths caused by malaria and tuberculosis combined (IEA, 2011).

Most people in developing countries still rely on unclean fuels for lighting and cooking (Pallegedara, 2020). More than half the world's population cooks using firewood, particularly in India, China, and Indonesia. Using solid fuels is inexpensive but causes harm by damaging forests, reducing air quality, and negatively affecting people's health (Jeuland, 2015). Moreover, the indoor air pollution resulting from the use of solid fuels has a more significantly harmful impact on individual health compared to outdoor air pollution (Nahar et al., 2016).

The impact of indoor air pollution from solid fuels aligns with previous research findings indicating that nearly 90 percent of daily activities take place indoors, with 70 percent of that time spent within residential houses (Klepeis et al., 2001). Reducing the use of solid cooking fuels can therefore reduce the risk of household members contracting various diseases (Oluwole, 2012). Solid fuels release numerous pollutants, including carbon monoxide (CO), carbon dioxide (CO2), sulfur dioxide (SO2), nitrogen dioxide (NO2), volatile organic

compounds (VOCs), and hydrocarbons (HC) (Koppmann et al., 2005). Indoor air quality is crucial for individuals' health, especially within their own houses. One of the primary sources of indoor air pollutants is cooking activities that predominantly rely on solid fuel (IEA, 2019).

The use of clean fuels provides many advantages over the use of solid fuels, such as saving time, better health, and less expenditure on health services, which leaves more money for food and education, for example. The use of solid cooking fuels has economic impacts on households, as members exposed to air pollution may face health issues and incur expenses for consultations or treatments. The medical expenses of households using solid fuels are almost 25 percent higher than households using LPG for cooking (Imran et al., 2020). Higher expenditure on health services will certainly interfere with other spending in the household, so households must make choices regarding what needs to be reduced or added (Pal, 2013).

As indicated above, the negative impacts of solid cooking fuels on human health contribute to medical expenses making up a higher proportion of total household expenditure (Lin et al., 2022). It follows that reducing the use of household solid cooking fuels through government programs helps reduce household medical expenses (Azorliade et al., 2022). Indeed, Imelda (2020) reports that policies that combine subsidies on the use of clean fuels with restrictions on the use of solid fuels can provide health benefits. In Indonesia, numerous studies have focused solely on analyzing the impact of choice of cooking fuel on health, including A'yun and Umaroh's (2022) research on the indoor air pollution created by cooking with solid fuels. In another example, Silwal et al. (2015) found that the use of firewood for cooking impacts respiratory health, especially in women and children. To the best of the authors' knowledge, no studies have been conducted in Indonesia to investigate the specific impact of using solid cooking fuels on household medical expenses. The aim of this study is to empirically investigate the effect of using solid cooking fuels on household medical expenses in Indonesia.

LITERATURE REVIEW

Household cooking fuels are divided into two types based on how efficiently they burn and the pollutants they generate. The first type is solid fuel, which includes firewood, briquettes, and coal. The second type is non-solid fuels like electricity, gas, and kerosene (IEA, 2010; Malakar et al., 2018). While all cooking fuels negatively affect air quality, solid fuels have a significantly more adverse impact on individual health compared to cleaner alternatives (Edwards & Langpap, 2012). The combustion of solid fuels is usually imperfect and produces various pollutants, such as particulate matter (PM), carbon monoxide (CO), carbon dioxide (CO2), sulfur dioxide (SO2), nitrogen dioxide (NO2), easily evaporated (volatile) organic compounds (VOCs), and hydrocarbons (HC). As a result, solid fuel is categorized as non-clean energy (Edwards & Langpap, 2012; Koppmann et al., 2005). However, solid cooking fuel is cheaper and easier to obtain than cleaner alternatives, especially in rural areas where household incomes are relatively low. This relationship is captured in the household energy concept, whereby household income determines the type of cooking fuel used. Thus the higher the household income, the cleaner the cooking fuel used (IEA, 2019; Van Der Kroon et al., 2013).

Household medical expenses are a proxy for household health status. Intuitively, the health status of household members will affect expenditure on household medical services. Household members who are experiencing

illness or health problems require treatment or care to meet their health needs. However, regaining health requires the household to bear the financial burden of medical services.

In line with human capital theory and Grossman's health theory, health is described as a form of consumption. This is because good health brings satisfaction through improved physical well-being. Additionally, just like any other capital good, health is viewed as an investment since increasing the number of healthy days contributes to better overall physical health, potentially leading to increased income and productivity in the future. (Grossman, 1972). Good health as a prerequisite for work and earning. Increasing the number of healthy days as a form of good individual health requires expenditure on health services that in turn directly influences total household expenditure.

This research uses the concept of out-of-pocket medical expenses. Out-of-pocket medical expenses is household expenditure for medical purposes and paid in cash with money owned by the household. Household out-of-pocket medical expenses are influenced by various factors such as socioeconomic status, clinical disease, and type of payment (Alemayehu et al., 2023). Sanjaya (2007) found that households in Indonesia predominantly use their income to cover health expenditures rather than using insurance or health cards.

Several previous studies have explored how the type of cooking fuel used can affect health in Indonesia. Using 2014 IFLS data, A'yun and Umaroh (2022) investigated how air pollution from using unclean fuel indoors can impact the health of household members. Additionally, Imelda (2020) observed that the subsidy conversion program, which encourages the shift from kerosene to LPG gas and limits the use of unclean fuel for cooking, has a positive effect on household health. This program has notably reduced infant mortality during the perinatal period, and lowered the prevalence of low birth weight.

METHOD, DATA, AND ANALYSIS

1. Data

This study uses data from the National Socioeconomic Survey (Susenas) sourced from Statistics Indonesia. This survey is conducted twice a year, in March and September. The survey provides social and economic information down to the household and individual levels covering 514 districts/cities in 34 provinces in Indonesia. Susenas data are analyzed for the period March 2018 to March 2019, to avoid the impact of the COVID-19 pandemic on household health service spending. The unit of analysis is household medical expenses, with a total sample of 323,724 households. Other data used in this study include environmental characteristics in the form of the number of health facilities, as obtained from 2018 Village Potential (Podes).

2. Method of Analysis

An empirical test is conducted to estimate the impact of the use of solid cooking fuels on household medical expenses in Indonesia. The baseline model uses Ordinary Least Squares (OLS) regression with the following equation:

$$\text{health\_exp}_{it} = \beta_0 + \beta_1 \text{solidfuel}_{it} + \beta_2 \mathbf{X}_{it} + \lambda_j + \delta_t + \varepsilon_{it} \quad (1)$$

The subscripts i, j, and t in model (1) denote the household, province, and year, respectively. health_exp_{it} is the proportion of out-of-pocket household medical expenses to total household expenditure. solidfuel_{it} is the using solid cooking fuels status of households. **X** is the control variable. β_0 is an intercept. β_1 and β_2 are

the parameters to be estimated. λ_j is the province dummy, δ_t is the year dummy, and ε_{it} is the error term.

There is a possibility of potential endogeneity in the solid cooking fuels use variable in equation (1), which would result in biased estimates (Silwal et al., 2015; Li et al., 2023). There is a potential reciprocal relationship between the use of fuel types for cooking and health service spending as a proxy for the health of household members, and also self-selection of fuel use variables (Li et al., 2023). In other words, use of solid fuels can increase spending on household health services and conversely spending on health services will affect the decision on choice of cooking fuel. The decisions of households using solid fuels are also not determined randomly,but rather are exogenous,meaning influenced by other factors. Endogeneity thus leads to biased and inconsistent parameter estimation results (Wooldridge, 2016). To overcome this endogeneity problem, this study uses instrumental variables in estimating the effect of using solid fuels on household spending on health services. The model used consists of two equations using the two-stage least squares method, as follows:

First stage:

$$\text{solidfuel}_{it} = \gamma_0 + \gamma_1 Z + \gamma_2 \mathbf{X}_{it} + \lambda_j + \delta_t + \mu_{it} \quad (2)$$

Second stage:

$$\text{health\_exp}_{it} = \beta_0 + \beta_1 \widehat{\text{solidfuel}}_{it} + \beta_2 \mathbf{X}_{it} + \lambda_j + \delta_t + \varepsilon_{it} \quad (3)$$

X is a set of control variables consisting of information on the head of the household (age, gender, education, working status), health insurance status, status in terms of receiving social assistance, number of elderly household members, number of household members aged under five, and number of health facilities. Z is the instrumental variable in the form of the proportion of households using clean cooking fuels to the total number of households in a district (population census data for 2010). The instrumental variable has no direct effect on household expenditure for health services, except indirectly through the use of cooking fuel types.

There are three assumptions applied to the instrumental variable model. First, it is an Exogenous instrument, where the instrumental variables used must be truly exogenous or random. Second, is the Exclusion restriction, where the instrument variables used do not affect the dependent variable directly, only affecting it indirectly through endogenous or first-stage variables. Third is Relevance, where the selected instrument variable must significantly affect the endogenous variable. While the gas base/agent variable may not be optimal as an instrument variable to overcome any endogeneity effect that occurs, due to the limited data available, the authors believe this instrumental variable is the best option.

The heterogeneity analysis in this study is carried out using sub-samples of Java Island and areas outside Java Island, then sub-samples of urban and rural areas. This enables a comparison of the size of the impact of solid fuel use on out-of-pocket health service spending between households in Java Island and those outside Java Island, and between urban households and households in rural areas. Robustness checks are also carried out in this study to test the consistency of the effect of using solid fuels on increasing spending on household health services. This testing is done by replacing the selected instrumental variables with different instrumental variables. This approach follows Freempong (2021), whose study uses the number of gas outlets in a district as an instrumental variable. The more gas outlets in a district, the

greater the chance for households in that district to switch from solid fuels to cleaner cooking fuels. Due to the limited data available, this study uses the proportion of villages with gas bases/agents/sellers relative to the total number of villages in a district using the 2014 Village Potential data.

RESULTS

Based on our analysis of the 2018–2019 Susenas data, among the sample of households, 22.60 percent were using solid fuels for cooking, with the balance(77.40 percent) using alternatives to solid fuels.

Table 1 shows the household sample characteristics. As can be seen, the average proportion of medical expenses relative to total household expenditure is 0.0026, or around 0.26 percent, and the use of non-solid fuels dominates. It is clear that most heads of household are male. On average, the heads of household have an education level below senior high school, and their typical employment status is employed. The average sample household tends to have health insurance, either the BPJS Contribution Assistance Program or other insurance. On average, the majority of sample households are not recipients of social assistance.

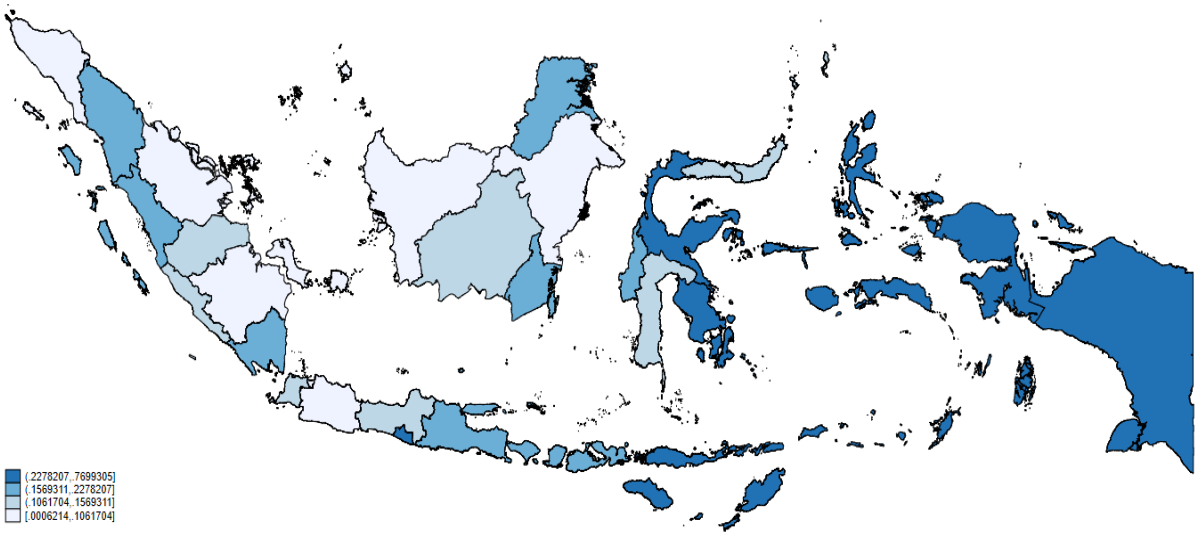
The thematic map in Figure 1 shows the distribution of households using solid cooking fuels across provinces in Indonesia. Dark blue represents provinces with the highest proportion of such households, while bright blue indicates those with the lowest proportion. The map shows that the eastern region of Indonesia has a higher proportion of households using solid cooking fuels compared to the western region. This may be due to the greater issues with distribution channels in the eastern region of Indonesia compared to the western region.

Table 1. Summary of All Variables

Variable	Observation	Mean	Standard Deviation
(1)	(2)	(3)	(4)
Out-of-Pocket Medical Expenses	323,724	0.0026	0.0103
Solid Fuel (1= Solid fuel)	323,724	0.2260	0.4182
HH Gender (1= male)	323,724	0.8498	0.3572
HH Age	323,724	49.044	13.482
HH Education (1= High school and above)	323,724	0.3509	0.4772
HH Working Status (1= Working)	323,724	0.8445	0.3623
Health Insurance (1= Have health insurance)	323,724	0.7217	0.4482
Social Assistance (1=Get Social assistance)	323,724	0.2284	0.4198
Elderly household members	323,724	0.2378	0.5140
Under five household members	323,724	0.3945	0.6022
Health facilities	323,724	472.98	382.65

Source: Susenas 2018–2019, processed

Figure1. Thematic Map of the Proportion of Households Using Solid Cooking Fuels by Province in Indonesia



Source: Susenas 2019, processed

Table 2, column (2) shows that the estimation results using OLS with no control, no provincial dummy, and no year dummy produce biased estimates. Likewise, the OLS estimation in column (3) with no control and column (4) with full control still produces biased parameter estimates because the endogeneity effect on the model has not been resolved. However, applying the instrumental variables 2-SLS method as in column (5) produces unbiased and consistent parameter estimates. Model IV shows a change in magnitude in the solid fuel usage variable, previously 0.0005 to 0.0041. It can thus be interpreted that the OLS model has a downward bias or negative bias that can be overcome with the instrumental variables 2-SLS model.

Table 2. Baseline Model Estimation Results

Variable	Dependent: Out-of-pocket medical expenses			
	OLS	OLS	OLS	IV
(1)	(2)	(3)	(4)	(5)
Solid Fuel	0.0002	0.0006***	0.0005***	0.0041***
(1= Solid Fuel)	(0.0001)	(0.0001)	(0.0001)	(0.0005)
Constant	0.0026***	0.0050***	0.0061***	0.0061***
	(0.0001)	(0.0002)	(0.0003)	(0.0003)
Control Variable	No	No	Yes	Yes
Province Dummy	No	Yes	Yes	Yes
Year Dummy	No	Yes	Yes	Yes
K-P Wald F Stat	-	-	-	340.08
R-squared	0.0001	0.0666	0.0727	-
Observation	323,724	323,724	323,724	323,724

Note: clustered standard error in parentheses.
***, **, * indicate statistical significance at 1%, 5%, and 10%.
Source: Susenas 2018-2019, processed

Before using the instrumental variable model, it is necessary to determine that the independent variables suspected to be endogenous are truly endogenous by conducting an endogeneity test. Based on the results of the endogeneity test, a p-value <0.05 is obtained, confirming that the variable—use of solid fuel—is an endogenous variable in this study. The variable—proportion of households using clean fuel to total households in one district/city—is an instrumental variable. The tendency of an area to use clean fuels will have an impact on household decisions about using clean cooking fuels as well.

The results of the Kleibergen-Paap rank Wald F statistic at the first stage show a value that is greater than the Stock-Yogo weak ID test critical values. This confirms that the instrumental variable used is strong and valid for solid fuel variables.

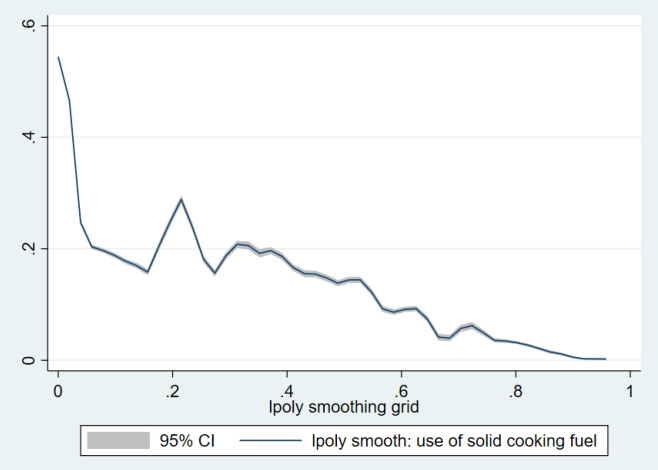
The monotonicity graph (Figure 2) shows a strong relationship between the instrumental variable, the proportion of households using clean cooking fuel, and the variable—use of solid fuels, where the higher the proportion of households using clean cooking fuel, the lower the chance of households choosing solid fuels as the main cooking fuel.

Table 3, column (3) shows the IV 2-SLS model without a control variable, and in column (4) using a control variable. On average, households using solid cooking fuels show a 0.0041 increased proportion of out-of-pocket medical expenses to total household expenditure compared to households using non-solid cooking fuels.

A heterogeneity analysis is conducted to examine the impact of using solid cooking fuel on regions within Java Island and outside Java Island, as well as urban and rural areas. The results in Table 4 show the impact of using solid cooking fuels on out-of-pocket medical expenses is higher on Java Island than in regions outside Java Island.

To test the consistency of the model, a robustness check is carried out by changing the instrumental variable to the proportion of villages that have gas bases, agents, or sellers in the district (Freempong et al., 2021). Table 5 shows that Model IV remains strong and valid. The impact estimation results for the use of solid fuel follow the same direction, albeit with a smaller magnitude. We can conclude that the use of variable solid fuel consistently raises household medical expenses, confirming the consistency and validity of this research model.

Figure 2. Monotonicity



Source: Susenas 2018-2019, processed

Table 3. Estimation Results Using Instrumental Variables

Variable	First Stage		Second Stage	
	Solid Fuel		Out-of-pocket medical expenses	
(1)	(2)	(3)	(4)	(5)
Solid Fuel			0.0038***	0.0041***
(1= Solid Fuel)			(0.0005)	(0.0005)
Clean Cooking Energy	-0.5321***	-0.4625***		
Network	(0.0280)	(0.0251)		
HH Gender		-0.0290		-0.0002***
(1= male)		(0.0028)		(0.0001)
HH Age		0.0023***		0.0000***
		(0.0001)		(0.0000)
HH Education		-0.0672***		0.0002***
(1= High school and above)		(0.0045)		(0.0001)
HH Working Status		0.0399***		-0.0012***
(1= Working)		(0.0033)		(0.0001)
Health insurance		-0.0223***		-0.0009***
(1= having health insurance)		(0.0040)		(0.0001)
Social Assistance		0.1221***		-0.0008***
(1=having Social assistance)		(0.0057)		(0.0001)
Elderly household members		0.0405***		0.0003***
		(0.0023)		(0.0001)
Under five household members		-0.0068***		0.0003***
		(0.0018)		(0.0000)
Health facilities		-0.00002		0.0000***
		(0.00001)		(0.0000)
Constant	0.2087***	0.0870***	0.0047***	0.0061***
	(0.0132)	(0.0178)	(0.0002)	(0.0003)
Province Dummy	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
K-P Wald F Stat	360.77	340.08	-	-
Observation	323,724	323,724	323,724	323,724

Note: clustered standard error in parentheses.
***, **, * indicate statistical significance at 1%, 5%, and 10%.
Source: Susenas 2018-2019, processed

Table 4. Estimation Results of the Effect of the Use of Solid Fuel on Medical Expenses by Java Island, Outside Java Island, Urban and Rural

Variable	Dependent: Out-of-pocket medical expenses			
	Java	Outside Java	Urban	Rural
(1)	(2)	(3)	(4)	(5)
Solid Fuel	0.0048***	0.0034***	0.0061***	0.0019***
1= Solid Fuel	(0.0008)	(0.0007)	(0.0012)	(0.0007)
Constant	0.0053***	0.0059***	0.0058***	0.0064***
	(0.0005)	(0.0003)	(0.0003)	(0.0003)
Control Variable	Yes	Yes	Yes	Yes
Province Dummy	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
K-P Wald F Stat	278.05	113.87	150.33	223.05
Observation	110,338	213,386	128,391	195,333

Note: clustered standard error in parentheses.
***, **, * indicate statistical significance at 1%, 5%, and 10%.
Source: Susenas 2018-2019, processed

Table 5. Estimation Results by Using Different Instrumental Variables

Variable	Dependent: Out-of-pocket medical expenses	
	IV = Clean Cooking Energy Network	IV = proportion of villages having bases/agents/gas sellers in the district
(1)	(2)	(3)
Solid Fuel	0.0041***	0.0021***
1= Solid Fuel	(0.0005)	(0.0006)
Constant	0.0061***	0.0061***
	(0.0003)	(0.0003)
Control Variable	Yes	Yes
Province Dummy	Yes	Yes
Year Dummy	Yes	Yes
K-P Wald F Stat	340.08	127.50
Observation	323,724	323,724

Note: clustered standard error in parentheses.
***, **, * indicate statistical significance at 1%, 5%, and 10%.
Source: Susenas 2018-2019, processed

DISCUSSION AND CONCLUSION

1. Discussion

This study has analyzed March 2018–March 2019 Susenas data and 2018 Village Potential data to investigate the effect of using solid cooking fuels on out-of-pocket household medical expenses using the econometric instrumental variables model with the two-stage least squares (2-SLS) method. This study focuses on household expenditure on health services in Indonesia based on a total sample of 323,724 households. Sumatera Island and Java Island show the highest average proportion of medical expenses compared to total household expenditure. As shown in the thematic map (Figure 1), the eastern region of Indonesia has a higher proportion of households using solid cooking fuels compared to the western region, possibly due to variation in reliability of their distribution channels.

The empirical findings indicate that on average, in households using solid cooking fuels the proportion of out-of-pocket medical expenses to total household expenditure is 0.0041 greater compared to households using non-solid cooking fuels. This suggests that the use of solid cooking fuels negatively impacts household members' health, leading to increased medical expenses to restore health. The result is in line with several previous studies showing that the use of solid cooking fuels can increase household medical expenses in developing countries (Azorliade et al., 2022; Lin et al., 2022; Rahut et al., 2017).

Additionally, the results also reveal that the use of solid cooking fuels has a higher impact on out-of-pocket medical expenses in the Java Island region compared to regions outside Java Island. This is possibly due to higher health costs on Java Island, where health services are more comprehensive than those in regions outside Java Island (Iqbal et al., 2017). Similar results are also observed in urban areas, where the magnitude of out-of-pocket medical expenses is higher than in rural areas. Again, compared to rural areas, urban areas offer more comprehensive health facilities and services.

2. Conclusion

The research results suggest several relevant policy implications. First, the equipment assistance program for clean cooking energy, such as gas stoves and LPG gas cylinders,

should target areas with a low proportion of clean cooking energy users, specifically the eastern region of Indonesia. In addition, the government needs to make sure that LPG gas bases, agents, and sellers are made available on a permanent basis rather than only temporarily in order to support sustained use of clean cooking energy. Furthermore, village officials should provide extensive education and promotion on the use of clean energy, including electricity and LPG gas, particularly in rural areas. This will help household members become more self-assured in the use of clean energy sources and equipment, and appreciate the health benefits of using clean energi compared to the risks associated with using solid cooking fuels.

REFERENCE

A'yun, I. Q., & Umaroh, R. (2022). Polusi udara dalam ruangan dan kondisi kesehatan: analisis rumah tangga Indonesia. *Jurnal Ekonomidan Pembangunan Indonesia*, 22(1). doi:10.21002/jepi.2022.02

Aji, B., De Allegri, M., Souares, A., & Sauerborn, R. (2013). The impact of health insurance programs on out-of-pocket expenditures in Indonesia: An increase or a decrease? *International Journal of Environmental Research and Public Health*, 10(7), 2995-3013.

Azorliade, D. A., Twerefou, D. K., & Dovie, D. B. K. (2022). The impact of household cooking fuel choice on healthcare expenditure in Ghana. *Frontiers in Environmental Science*, 10, 861204.

Badan Pusat Statistik. (2022). Statistik Kesejahteraan Rakyat 2022.

Bukari, C., Broermann, S., & Okai, D. (2021). Energy poverty and health expenditure: Evidence from Ghana. *Energy Economics*, 103, 105565.

Cesur, R., Tekin, E., & Ulker, A. (2018). Can natural gas save lives? Evidence from development of a fuel delivery system ini a developing country. *Journal of Health Economics*,59, 91-108

Ebaidalla, E. M., & Ali, M. E. M. (2019). Determinants and impact of household's out-of-pocket healthcare expenditure in Sudan: Evidence from urban and rural population. *Middle East Development Journal*, 11(2), 181-198.

Edwards, J. H. Y., & Langpap, C. (2012). Fuel choice, indoor air pollution and children's health. *Environment and Development Economics*, 17(4), 379 – 406. https://doi.org/10.1017/S1355770X12000010

Frempong, R. B., Orkoh, E., & Kofinti, R. E. (2021). Household's use of cooking gas and children's learning outcomes in rural Ghana. *Energy Economics*, 103, 105617.

Gascon, M., Triguero-Mas, M., Martínez, D., Dadvand, P., Rojas-Rueda, D., Plasència, A., & Nieuwenhuijsen, M. J. (2016). Residential green spaces and mortality: A systematic review. *Environment International*, 86, 60-67.

Grossman, M. (1972). On the concept of health capital and the demand for health. *The Journal of Political Economy*, 80(2), 223–255.

Hultin, H., Lindholm, C., & Möller, J. (2012). Is there an association between long-term sick leave and disability pension and unemployment beyond the effect of health status?– A cohort study. *PloSOne*, 7(4), e35614.

IEA. (2019). SDG7: Data and projections. International Energy Agency.

IEA (2010). World Energy Outlook. International Energy Agency.

IEA. (2011.) World Energy Outlook. International Energy Agency.

Imelda. (2020). Cooking that kills: cleaner energy access, indoor air pollution, and health. *Journal of Development Economics*, 147. https://doi.org/10.1016/j.jdeveco.2020.102548

Imran, M., & Ozcatalbas, O. (2020). Determinants of household cooking fuels and their impact on women's health in rural Pakistan. *Environmental Science and Pollution Research*, 27, 23849-23861.

Jeuland, M. A., Bhojvaid, V., Kar, A., Lewis, J. J., Patange, O., Pattanayak, S. K., ... & Ramanathan, V. (2015). Preferences for improved cook stoves: evidence from rural villages in north India. *Energy Economics*, 52, 287-298.

Kang, C., Kawamura, A., & Noguchi, H. (2021). Benefits of knowing own health status: effects of health check-ups on health behaviours and labour participation. *Applied Economics Letters*, 28(11), 926-931.

Kementerian Kesehatan RI. (2019). Laporan Nasional Riskesdas 2018.

Klepeis, N. E., Nelson, W. C., Ott, W. R., Robinson, J. P., Tsang, A. M., Switzer, P., ... & Engelmann, W. H. (2001). The National Human Activity Pattern Survey (NHAPS): a resource for assessing exposure to environmental pollutants. *Journal of exposure science & environmental epidemiology*, *11*(3), 231-252.

Koppmann, R., Von Czapiewski, K., & Reid, J. S. (2005). A review of biomass burning emissions, Part I: Gaseous emissions of carbon monoxide, methane, volatile organic compounds, and nitrogen containing compounds. *Atmospheric Chemistry and Physics Discussions*, 5(5), 10455-10516.

Legatum Institute Foundation. 2023. "The Legatum Prosperity Index 2021". https://www.prosperity.com/rankings, diakses pada 18 Februari 2023

Li, N., Zhang, G., Zhang, L., Zhou, Y., & Zhang, N. (2022). Improving rural women's health in China: Cooking with clean energy. *Environmental Science and Pollution Research*, 29(14), 20906–20920. https://doi.org/10.1007/s11356-021-17380-y

Li, W., Yu, Y., He, Q., Xu, D., Qi, Y., & Deng, X. (2023). Impact of clean energy use on the subjective health of household members: Empirical evidence from rural China. *Energy*, 263. https://doi.org/10.1016/j.energy.2022.126006

Li, X., Shen, J. J., Lu, J., Wang, Y., Sun, M., Li, C., ...& Hao, M. (2013). Household catastrophic health expenditure in eastern China: Determinants and policy implications. *BMC Health Services Research*, 13, 1-9.

Lin, B., & Wei, K. (2022). Does use of solid cooking fuels increase family medical expenses in China? International *Journal of Environmental Research and Public Health*, 19(3), 1649.

Liu, C., Liu, Z. M., Nicholas, S., & Wang, J. (2021). Trends and determinants of catastrophic health expenditure in China 2010–2018: a national panel data analysis. BMC *Health Services Research*, 21(1), 526.

Liu, J., Hou, B., Ma, X. W., & Liao, H. (2018). Solid fuel use for cooking and its health effects on the elderly in rural China. *Environmental Science and Pollution Research*, 25(4), 3669–3680. https://doi.org/10.1007/s11356-017-0720-9

Malakar, Y., Greig, C., & van de Fliert, E. (2018). Resistance in rejecting solid fuels: Beyond availability and adoption in the structural dominations of cooking practices in rural India. *Energy Research & Social Science*, 46, 225–235. https://doi.org/10.1016/J.ERSS.2018.07.025

Nahar, M., Khan, M., & Ahmad, S. (2016). Indoor Air Pollutants and Respiratory Problems among Dhaka City Dwellers. *Archives of Community Medicine and Public Health*, 032-036. doi:10.17352/2455-5479.000014

Nghiem, S. H., & Connelly, L. B. (2017). Convergence and determinants of health expenditures in OECD countries. *Health Economics Review*, 7, 1-11.

Nie, P., & Li, Q. (2022). Energy poverty and health care expenditures: evidence from the China family panel studies (No. 15479).

Institute of Labor Economics (IZA).

Olasehinde, N., & Olaniyan, O. (2017). Determinants of household health expenditure in Nigeria. *International Journal of Social Economics*, 44(12), 1694-1709.

Oluwole, O., Otaniyi, O. O.,& Ana, G.A. (2012). Indoor air pollution from biomass fuels: a major health hazard in developing countries. *Journal of Public Health*, 20(6), 565-75

Pal, R. (2013). Out-of-pocket health expenditure: Impact on the consumption of Indian households. *Oxford Development Studies*, 41(2), 258-279.

Pallegedara, A., & Mottaleb, K. A. (2021). Exploring choice and expenditure on energy for domestic works by the Sri Lankan households: implications for policy. *Energy*, 222, 119899.

Raeissi, P., Rajabi, M. R., Mousavi, A., Vahedi, S., & Khalilabad, T. H. (2019). Investigating the determinants of healthcare expenditures in different healthcare systems. *Shiraz E-Medical Journal*, 20(9).

Rahut, D. B., Ali, A., & Behera, B. (2017). Domestic use of dirty energy and its effects on human health: Empirical evidence from Bhutan. *International Journal of Sustainable Energy*, 36(10), 983-993.

Samadi, A., & Rad, E. H. (2013). Determinants of healthcare expenditure in Economic Cooperation Organization (ECO) countries: evidence from panel cointegration tests. *International Journal of Health Policy and Management*, 1(1), 63.

Sanjaya, M. R. (2007). Health cost in Indonesia: evidences from IFLS and susenas data. *Journal of Indonesian Economy and Business*, 22(1), 57-70. https://doi.org/10.22146/jieb.6465

Silwal, A. R., & McKay, A. (2015). The impact of cooking with firewood on respiratory health: evidence from Indonesia. *The Journal of Development Studies*, 51(12), 1619-1633.

Stock, J., & Yogo, M. (2005). Asymptotic distributions of instrumental variables statistics with many instruments. *Identification and inference for econometric models: essays in honor of Thomas Rothenberg*, *6*, 109-120.

Su, T. T., Pokhrel, S., Gbangou, A., & Flessa, S. (2006). Determinants of household health expenditure on Western institutional health care. *The European Journal of Health Economics*, 7, 195-203.

Twumasi, M. A., Jiang, Y., Addai, B., Asante, D., Liu, D., & Ding, Z. (2021). Determinants of household choice of cooking energy and the effect of clean cooking energy consumption on household members' health status: The case of rural Ghana. *Sustainable Production and Consumption*, 28, 484-495.

Wahyuni, H. (2015). Infant health production function: role of prenatal care. *Journal of Indonesian Economy and Business*, 30(1), 72-89. https://doi.org/10.22146/jieb.7335

Wooldridge, J. M. (2015). Introductory econometrics: a modern approach. Cengage learning.

Wu, S. (2022). Household fuel switching and the elderly's health: evidence from rural China. *Energy*, 240: 122785

Zhang, J., & Simth, K. R. (2007). Household air pollution from coal and biomass fuels in China: measurements, health impacts, and interventions. *Environmental Health Perspective*, 115(6):848-55