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Education, individual time preferences, and asymptomatic disease detection

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ABSTRACT

Asymptomatic conditions such as hypertension are generally hard to diagnose, absent routine medical examinations. This is especially problematic in developing countries, where most citizens do not engage in routine examinations due to limited economic resources. We study the roles of education and individual time preferences in asymptomatic disease detection and management. Using discrete choice models on a sample of 4209 hypertensive Indonesian adults surveyed between November 2007 and April 2008, we find that both education and individual time preferences play important roles. However, the effects are different for people in good health than they are for people in bad health. Education does not seem to matter for disease detection when respondents are in good general health, and its effects on disease management vary largely in magnitudes between these groups. In terms of disease detection, more educated respondents have a higher probability of being diagnosed, but only conditional on being in poor general health. Time preferences, on the other hand, matter for respondents in good general health, but the effect is not significant for those in bad health. More impatient respondents that are in good health have a higher probability of being under-diagnosed because they are more likely to forgo routine physicals. The findings point to two distinct channels through which education can affect health, and suggest that different types of policies need to be implemented, in order to reach the entire population. Traditional programs that stimulate education and improve the socio-economic status of individuals in developing countries are helpful, but they do not address the whole problem. Besides its more usual positive effects, education can also negatively affect the health of asymptomatic patients, because it reflects a higher opportunity cost of engaging in preventative health screenings.

1. Introduction

A large body of literature studied the link between health and socio-economic status (SES). In most of these studies, education has been shown to be the most important determinant of health outcomes. For a comprehensive literature review on the large empirical evidence see Grossman (2000, 2006). There are however, large differences in health outcomes that cannot be accounted by differences in SES and there is no consensus regarding the mechanism through which education affects health. Some argue that education improves health production efficiency (Grossman, 1975), while others point to other unobservable variables, such as time preferences, that affect both education and health (Fuchs, 1982).

Incorporating time preferences into models of health behavior traces its roots back to the discounted utility (DU) model of Samuelson (1937) which was later shown to be supported by a set of simple axioms by Koopmans (1960). Fishburn (1970) and Fishburn and Rubinstein (1982) also provided additional, more specialized, axiomatic systems for the DU model. One particular criticism against the DU model, which assumes time preferences to be exogenous, was brought by Becker and Mulligan (1997) who argued that time preferences are actually endogenously determined by factors such as wealth, mortality, or addictions. Frederick et al. (2002) provide a comprehensive literature review of both the theoretical considerations and the empirical evidence on intertemporal choice and elicited time preferences, with a clear discussion on the limitations of the existent approaches. Attema (2012) also provides a more recent literature review, with a clear focus on the intersection between time preferences and health. We do not explicitly model time preferences in our paper, nor do we try

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to estimate new time preference parameters. Rather we use previously elicited proxies of time and risk preferences and study their effects on health, specifically on hypertension under-diagnosis.

As it relates to health, the time preferences hypothesis was clearly supported in papers such as Leigh (1983), Kenkel (1991), Farrell and Fuchs (1982), or Van Der Pol (2011), yet the causal effect of education could not be completely eliminated. This causality was proven among others by Lleras-Muney (2005), Adams (2002), and Arendt (2005). Given the body of evidence, it is likely that education does have a clear impact on health, but at the same time, individual time preferences also affect educational attainments and health. The impact of time preferences on health can be both direct and indirect (through education) and these effects should not be ignored. We also would argue that education can have an additional effect on health through the incentives that it creates in people, depending on their individual opportunity costs of being sick.

In this paper, we distinguish between two dimensions of health – health detection (prevention) and health management – and analyze the roles of education and time preferences. Most of the previous literature focused on overall health outcomes, and did not address these two separate channels. Among the few papers that tried to partially address this, Axon et al. (2009) showed that individual time preferences matter in the way people manage their diseases. More patient people checked their health status more often and engaged in health promoting activities more often. A similar correlation was found with respect to education by Goldman and Smith (2002), with more educated people better managing their disease and therefore improving more rapidly. However, the focus in both of these papers is on people with an established history of disease. There is a very limited literature that focuses on disease detection, which is a major cause of concern especially in developing countries. This is especially true for asymptomatic conditions, such as hypertension.

The World Health Organization (WHO) defines hypertension as having elevated blood pressure of 140 mm Hg systolic/90 mm Hg diastolic or greater. The most common recommendations for hypertension prevention are maintaining a normal body weight, engaging in moderate physical activity, having a diet rich in fruits, vegetables, and low-fat dairy, and limiting the consumption of alcohol, sodium, and saturated fat (Whelton et al., 2002). Severe hypertension occurs when the blood pressure climbs to 180 mm Hg systolic/110 mm Hg diastolic or higher. Severely elevated blood pressure can lead to stroke or organ damage and can be classified as hypertensive crisis or emergency, when there are clear signs or symptoms, or as severe asymptomatic hypertension, when there are no such symptoms (Kessler and Joudeh, 2010). Overall, most people with high blood pressure have no signs or symptoms, even when their blood pressure reaches dangerously high levels. This is a serious problem worldwide because patients who suffer from it, often do not manifest any symptoms and therefore seek no medical help. This is even more problematic in developing countries, where people do not engage in routine medical examinations, and asymptomatic conditions can go undetected.

Strauss et al. (2010) report figures of 49% hypertension under-diagnosis for men in China, and 42% for women. In our sample from Indonesia, about 60% of respondents are under-diagnosed, again with larger percentages for men than for women. Witoelar et al. (2012) argue that under-diagnosis is only weakly correlated with SES and this is supported by Strauss et al. (2010) who find that SES attributes such as income and education do not affect hypertension detection, but community characteristics matter. However, they do not consider the role of individual time preferences and their differential impact on healthy versus unhealthy people.

The purpose of our paper is to argue that, when it comes to asymptomatic disease detection, SES and individual time preference matter, but their effects are different for healthy versus unhealthy people. Community characteristics matter for all, as they proxy for healthcare access and lower costs of seeking healthcare, but disease detection does not only depend on available resources but also on the willingness of people to use those resources. The choice of individuals to subject themselves to medical examinations can be modeled as a discrete choice to go to the doctor or carry on their daily productive activities. We argue that education and time preferences might have different effects when it comes to this choice. We hypothesize that a generally healthy person might not seek medical care and his disease might go undetected, regardless of how educated he is, whereas a person with a poor health status might seek medical help in spite of a high time preference parameter. Education however, being correlated with earning potential, represents a measure of opportunity cost of being sick and therefore we would expect people with poor general health status to be more likely to seek medical care if they have more education. We also hypothesize similarly different effects of education and time preferences on disease management, once patients are diagnosed.

Analyzing the different effects of education and time preference parameters on health detection versus health management is extremely important from a policy standpoint. Policies geared towards improving health outcomes traditionally addressed improving educational attainments or improving access to health care. Better educating people and lowering the cost of healthcare is by all means extremely important. However, when it comes to disease detection and prevention, these traditional policies might be inadequate and not able to cope with the realities. The well documented facts regarding the high incidence of hypertension under-diagnosis in developing countries seem to support this.

Using a sample of 4209 hypertensive adults surveyed in the fourth wave of the Indonesian Family Life Survey (IFLS), we find that the probability of suffering from hypertension but being undiagnosed is affected by both education and individual time preferences. However, these effects are different when disegregating the sample. Time preference does not matter for people with poor health, while education is not a factor for people with good health. Also other factors such as income and access to healthcare have different effects for healthy and unhealthy people. Similar results were found for disease management. We conclude that, for asymptomatic disease detection, it is important that new policies are designed and implemented. Proactive door to door campaigns to check vital health statistics, or providing incentives for routine medical examinations might address this issue by targeting overall healthy people with undiagnosed asymptomatic conditions who would otherwise not visit a medical center. Educational campaigns that specifically address the benefits of routine medical examinations might also prove useful, but in the absence of further incentives it is unclear whether they could significantly reduce the number of those under-diagnosed.

2. Theoretical framework

We model the probability of being diagnosed when suffering from an asymptomatic condition as being 1 if the individual is undergoing a medical exam, or 0 otherwise. In practice, there are of course exceptions to this rule. For instance individuals might self-screen themselves for high blood pressure using personal monitoring devices and become aware of their condition without visiting a doctor. On the other hand, hypertension can be undetected during regular physical exams due to errors in measurement or faulty machines. However, the probability of these events occurring is very small overall and therefore, for the purpose of this study, we simply assume it to be zero. Hence, the base theoretical model that we will test is a discrete choice model of whether individuals choose to subject themselves to a physical exam. As is the standard in the health literature, for instance when modeling health demand functions, we assume this decision to depend on individual social and economic well-being, community infrastructure and access to healthcare, and individual time and risk preferences. Formally, we can write this discrete choice probability function as:

$$P(diagnosed|sick)_{ij} = F(SES_i, C_j, T_i, R_i)$$

where the dependent variable represents the probability of individual i living in community j undergoing a physical exam and hence being diagnosed (given the patient is actually sick). SES_i are social-economic status variables, C_j are community level variables that proxy for infrastructure and access to healthcare, T_i is the individual time preference parameter, and R_i is the individual risk preference parameter.

As is the case in the literature, we focus on Education as the most important SES indicator for health outcomes. Where our paper diverges from the existing literature is in realizing there is an additional effect of education on health, which comes from opportunity costs associated with undergoing physical exams. We claim these opportunity costs affect individuals differently, depending on their general health status. Therefore, we argue that education can actually have negative effects on health outcomes, unlike in the existent literature that only documented the positive effects of education. We do not claim that these negative effects overcome the positive effects, and therefore we agree with the larger body of literature that improvements in educational attainments improve overall health outcomes. We only claim that for the specific case of asymptomatic disease detection, improvements in education might not be sufficient to address the problem.

Our main hypothesis is that, while better educated people are overall more aware of the importance of undergoing regular medical exams, more education also means higher overall wages and hence, higher opportunity costs of undergoing these medical exams. For individuals suffering from asymptomatic conditions that are in good general health status and thus their earning potential is not affected, these negative effects from education can completely counteract the positive effects. This can be especially problematic in developing countries, where the overall levels of education are low and poverty is high. If, on the other hand, people are in poor general health status, this affects their earning potential and the opportunity cost of not undergoing a physical is hence directly correlated with education. For these individuals, the two effects are reinforcing each other and education has the usually assumed positive effect on health. According to this hypothesis, we should observe significantly smaller (possibly zero or even negative) effects of education for generally healthy people than for unhealthy people. The magnitude of this difference should depend on the overall levels of education and economic well-being, but we expect a significant difference to exist in developing countries such as Indonesia.

To test this hypothesis, we estimate two discrete choice models corresponding to the two distinct populations: individuals in good general health status vs. individuals in poor general health status. We expect to find significantly different effects of education between these two groups: education should have a clear positive effect for individuals in poor health status (and at the aggregate level), and a smaller (possibly zero or negative) effect for individuals in good health status.

Based on similar theoretical aspects, we also expect to notice group specific differences for the effects of the time preference parameter. Unlike education, impatience generally works against health in general, and this has been documented to be true at the aggregate level. This negative effect should also be true for finer dimensions of health such as undergoing regular medical exams (which is of outmost importance for detecting asymptomatic conditions). However, we argue that for people in poor health, impatience has an additional canceling effect because poor health affects present earning potential. We therefore expect a positive effect of impatience on the probability of being under-diagnosed for individuals in good health (and also at the aggregate level), and a smaller (possibly zero or negative) effect for individuals in poor health.

To our knowledge, these different effects of education and time preferences stemming from differences in opportunity costs between groups have not been studied elsewhere and we believe they are important to be understood. Formally, the reduced form equations that we will further describe in the methodology section are:

$$P(underdiagnosed|goodGHS)_{ij} = \beta_{goodGHS}EDU_i + \gamma_{goodGHS}T_i + \delta_{goodGHS}X_{ij} + \varepsilon_{ij}$$

$$P(underdiagnosed|poorGHS)_{ij} = \beta_{poorGHS}EDU_i + \gamma_{poorGHS}T_i + \delta_{poorGHS}X_{ij} + \varepsilon_{ij}$$

where the dependent variables take the value 1 for people suffering from hypertension but not being diagnosed by a doctor (conditioning on belonging to one of the two groups), EDU_i represents the education variable, T_i the time preference parameter, X_{ij} is a vector of other individual and community variables that will be detailed in the next section, and ε_{ij} is the error term representing unobservables uncorrelated with the other regressors.

3. Data and methodology

We use data from the fourth wave of the Indonesian Family Life Survey (IFLS), which was fielded between November 2007 and April 2008 by the RAND corporation in collaboration with the Center for Population and Policy Studies of the University of Gadjah Mada and Survey METER. The IFLS is a longitudinal survey which tracks down a sample representing over 80% of the Indonesian population. It surveys individual respondents and their immediate family members. The IFLS is a publicly available data set and has received IRB approval both at RAND and in Indonesia. A variety of socio-economic indicators are collected such as education, health, income, community level infrastructure, etc. There are currently four waves of the IFLS that have been fielded in 1993, 1997, 2000, and 2007. The latest wave is of particular interest to us, as it contains a module on elicited risk and time preference parameters. Risk and time preferences were elicited by subjecting respondents to a series of questions based on hypothetical lotteries. Specifically, to elicit risk preferences, the questions were formulated as:

“Suppose you are given two options of receiving income. In the first option you are guaranteed X rupiah per month. In the second option you are guaranteed Y or Z rupiah, each with equal chance. Which option would you choose?”

Respondents were faced with a sequence of such questions, where the riskiness of the next uncertain payoff depended on the respondent's previous choice. If he picked the sure amount, he would then be offered a less risky payoff on the next question. If he picked the uncertain payoff, he would then be offered a higher risk payoff on the next question. At the end of this sequence, each respondent could be classified according to his/her individual attitude towards risk. Eliciting time preferences was done in a similar fashion. Each respondent was asked a series of questions formulated as:

"Suppose you have won a prize. How will you choose to be paid?"

Respondents were then given the option between an amount to be paid today and a larger nominal amount to be paid at a later date. In order to elicit time preferences, the future payoffs were again changed in a sequence of questions, depending on respondents' previous choices. If they chose to be paid today, the future payoff on the next question would be higher; if they chose to be paid later, the future payoff on the next question would be smaller. This series of adjustments allow us to order respondents according to their individual time preferences.

There is some dispute in the literature regarding survey based methodologies versus experimental methodologies. Experiments have the advantage of ensuring incentive compatibility by offering real money payoffs, but they are often cost prohibitive and cannot be administered on a large scale. Surveys can easily achieve this large scale and elicit parameters from nationally-representative samples, but hypothetical lotteries might not be behaviorally valid (Binswanger, 1980; Holt and Laury, 2002). However, some recent evidence showed that survey-elicited risk and time preference parameters are consistent with experimentally derived parameters, and parameters derived using hypothetical lotteries were shown to be consistent with those based on real money lotteries (Dohmen et al., 2011; Hamoudi, 2006). An additional argument against elicited time and risk preferences is that monetary based time preferences might not translate very well into time preferences related to health outcomes. A paper by Chapman and Coups (1999) showed however, that monetary based time preferences are more likely to affect preventative health behavior than health based time preferences. There is no consensus in the literature regarding measuring time preferences (Chabris et al., 2007), but the IFLS method is the most widely-used.

Our sample consists of 4209 hypertensive adults (over 45 years of age in 2007), 1793 men and 2416 women. Some of these individuals were documented hypertensive patients, while others were not aware that they suffered from it at the time of the survey. As part of the survey, trained nurses measured respondents' blood pressure three different times. The first measurement was dropped because many people get nervous at first which can cause false high measurements. We then used the average of the other two measurements to construct the hypertension variable. Following WHO standards, a person is considered hypertensive if his systolic is greater than 140 or his diastolic is greater than 90. IFLS also asked respondents if they had ever been diagnosed with hypertension before. Therefore, the under-diagnosed respondents were those who were found to be hypertensive during IFLS survey measurements, but had not been previously diagnosed by doctors. Table 1 presents simple summary statistics of hypertension under-diagnosis in the IFLS sample:

The table presents a very serious issue that is prevalent in developing countries with more than half of the population being under-diagnosed. In the IFLS sample, 67% of the men and 54% of the women who were found hypertensive during the fielding of the survey had not been previously diagnosed by doctors.

Table 1
Hypertension under-diagnosis (under-diagnosed respondents out of the total hypertensive in the sample).

	Hypertensive	Under-diagnosed	Percentage of under-diagnosed
Total	4209	2513	59.71
Men	1793	1197	66.76
Women	2416	1316	54.47

Traditional health policy was formulated around improving access to healthcare, improving educational attainments, economic development, etc. However, in spite of many programs that were designed and implemented, under-diagnosis remains a problematic issue.

We argue that, while socio-economic status matters generally in a health context, for disease detection and prevention it might not be a very good predictor, and especially so in developing countries and for asymptomatic conditions such as hypertension. The role of traditional education in particular might have little to do with people deciding to routinely visit a doctor in the absence of symptoms. A large portion of hypertensive people are in good general health, with no obvious health concerns or symptoms. If this proves to be so, then different policies need to be implemented to reach these individuals. Educational programs need to specifically target the importance of routine medical exams, and even those might be insufficient if opportunity costs and time preferences are high.

To test this hypothesis, we estimate the effects of SES and individual risk and time preference parameters on the probability of being hypertensive, but under-diagnosed. Our dependent variable is a dummy equal to one for those respondents who were found to be hypertensive during the IFLS screenings, but were not previously diagnosed by a doctor. We are especially interested in the differential effects that SES and the time and risk preferences might have on people, conditional on their general health status. To this end, we estimate these effects for two separate subsamples of individuals: those in good general health and those in poor general health. Respondents were asked to evaluate their general health status (GHS) on a scale from 1 to 4. Depending on the answers provided, we split the sample in two groups: a healthy group containing respondents who characterized their general health status as being either "very healthy" or "somewhat healthy", and an unhealthy group containing respondents who claimed they were either "unhealthy" or "somewhat unhealthy". Explanatory variables include respondents' education (measured in years of formal education), respondents' age and age squared (to allow for possible non-linear effects), respondents' individual risk and time preferences, the distance from the closest health center (to proxy for the ease of access to medical care), household per capita expenditures (PCE), and a sex dummy. Per capita expenditures is used here as a proxy for household income. It has been shown in Bound and Krueger (1991) that there are systematic measurement errors in household income, and PCE has been since used as a proxy for income in many papers, as it is less prone to such measurement errors. These are all commonly used covariates for health outcomes that are used to proxy for education, economic well-being, and community infrastructure and access to healthcare. See, for instance, Grossman (2006) for a literature review that documents the role of education and Strauss et al. (2010) that document the role of community access to healthcare. We have to acknowledge the fact that both education and time preferences could be endogenous. Becker and Mulligan (1997) in particular, argued for the endogenous determination of time preferences. Definitive estimates for the partial effects of both education and time preferences are extremely hard to identify, and to our knowledge no attempt has been made so far in the literature. We also tested for multicollinearity following Belsley et al. (2005) and found no cause for concern. For the time and risk preference parameters, we follow Ng (2013) and group respondents in four distinct groups from the most patient to the most impatient, respectively from the least risk averse to the most risk averse. For all our estimations, we use a probit model and report the marginal effects of the explanatory variables.

4. Disease detection results

Table 2 contains the probit regression results for the determinants of hypertension under-diagnosis. The three separate columns represent, in order, the results for the entire sample, the results for the subsample consisting of respondents in good general health, and the results for the subsample consisting of respondents in poor general health.

We are able to confirm previous studies that showed the importance, at the aggregate level, of both SES and community level characteristics for disease diagnosis. The level of education, household economic resources, and the access to health care all matter at the aggregate level. We also confirm that individual time preferences are important for disease detection in the same way that they are important for overall health measures, and that accounting for individual time and risk preferences lowers the magnitude of the education coefficient. In a model that does not include time and risk preferences, the impact of an additional year of schooling was estimated to reduce the probability of being under-diagnosed by 0.00354, which is higher than the 0.00333 effect reported in Table 2. This is in line with Van Der Pol (2011) who reports a similar effect for overall health. This seems to support the idea that at least some of the previously documented effects of education were in fact confounded time preference effects, since time preferences affect the education decision of people. We do not find risk preferences to matter for disease detection, but we cannot argue against their importance for overall health. In spite of all the consistent results, we claim however, that the aggregate image does not tell the whole story on disease detection and prevalence of under-diagnosis, and we prove this by disaggregating the sample into generally healthy versus unhealthy respondents. What we find are different effects for healthy and for unhealthy people, which are consistent with simple economic intuition.

For individuals in good health, the education level does not matter at all, while for respondents in poor health, the time preference parameter and distance to health center do not matter. This is somehow intuitive. For people in good overall health, the decision to routinely check their health status and potentially discover asymptomatic conditions is simply a time management decision. How educated they are bares no weight, and the previously documented effects from education are simply time preference effects for these individuals in good health. They might postpone (sometimes indefinitely) their visit to a health post, depending on both their individual time preference and also on how close these health posts are, which speaks to ease of access and smaller time expenditures.

On the other hand, people who are in poor overall health will feel the need to go see a doctor, regardless of their patience or ease of access. Their poor health and the hope of finding a cure to their problems will force them to go to a health center. During these visits the medical staff will surely discover asymptomatic conditions such as hypertension. Blood pressure measurements are one of the first vital checks that every patient is subjected to once they visit a medical center. Education matters for these people, as more educated persons generally have higher opportunity costs of feeling sick and hence value their health higher, which pushes them harder to look for a cure in a doctor's office.

These different results make us conjecture that the role of education on health detection and health in general might be often misinterpreted. Many seem to believe that education affects health in the sense that more educated people live better and healthier lives because their higher education teaches them how to live better and healthier lives. Our results seem to suggest that this is not true. If this was true, we would surely find education effects for the healthy people as well. In fact, what seems to be the case is that more educated people, who generally earn higher wages and are therefore hurt more when they get sick and cannot fully perform their productive activities, respond better to finding and managing their problems, but only when these problems manifest themselves in a clear, health impairing symptom.

Note that economic resources still play important roles for everybody. People with better economic endowments are more likely to be diagnosed, but the magnitude of this effect is smaller for people in poor health. This further strengthens the idea that a poor general health status incentivizes individuals to find the resources necessary for medical visits, or have these medical visits in spite of the lack of economic resources. These results paint a profoundly sad picture that the aging population in developing countries is faced with. Because of constant economic struggles, and the huge pressure to use their time working, in order to have a chance at getting diagnosed for asymptomatic chronic conditions, individuals first need to become generally unhealthy to the point where the sheer need to get help will push them to a medical facility. Education, at least traditional education that we measure in years of schooling, does not seem to be important as long as people feel healthy. Even more so, under-diagnosis seems to be an especially problematic issue for men, who arguably are heads of household and feel even a higher pressure to worry first about time spent on economically rewarding activities rather than taking time off to routinely check their health status. Even for people in poor health, men are about 11% more likely to ignore their health and remain under-diagnosed, and that is after accounting for SES, access to healthcare, and time preferences.

Table 2
Hypertension under-diagnosis probit regression (Dependent variable: The probability of being under-diagnosed).

	Aggregate sample	Respondents in good health	Respondents in poor health
Years of Education	−0.00333*	−0.00295	−0.00867**
	(0.00188)	(0.00206)	(0.00420)
Log PCE	−0.04515***	−0.04830***	−0.03651*
	(0.01018)	(0.01151)	(0.02025)
Time Preference	0.03457***	0.02763**	0.03429
	(0.01214)	(0.01380)	(0.02379)
Risk Preference	0.00741	0.00787	0.01870
	(0.00780)	(0.00915)	(0.01424)
Distance to Health Center	0.00097**	0.00101*	0.00119
	(0.00048)	(0.00059)	(0.00084)
Female	−0.12970***	−0.12205***	−0.11808***
	(0.01549)	(0.01742)	(0.03149)
Sample Size	4209	3145	1064

The table reports marginal effects with standard errors in parentheses. Respondent's age and age squared are included in all regressions. Significance levels: *-significant at 10% level **-significant at 5% level ***-significant at 1% level.

5. Disease management

The role of education and time preferences does not stop at detecting diseases. Another important component of the individual health is disease management. Goldman and Smith (2002) documented links between education and disease management, while Axon et al. (2009) showed the importance of time preferences in the same context of disease management. To our knowledge however, there is no study that links both of these two variables with health management and distinguishing between generally healthy and less healthy individuals. Just as with disease detection, education and time preferences might have differential impacts. For instance, people who feel good might occasionally skip on their medication or routine examinations if pressed by other mundane activities. On the other hand, people who do not feel very good might pay more attention to their lifestyles and follow through with their treatment. An additional issue that separates our paper from previous research is that we focus on asymptomatic diseases which might yield different results than for diseases such as diabetes, where the symptoms can be severe enough to force people into properly managing their disease.

There are many parts to disease management: routine follow up medical exams and tests, medication protocols, changing diets and lifestyles, etc. In the case of hypertension, one of the most important and at the same time one of the easiest things to do is frequently monitoring your blood pressure. The IFLS collects information on the timing of the most recent blood pressure measurements of respondents. We construct a dummy variable that is equal to 1 if respondents checked their blood pressure at least once in the month preceding the interview. Disease management does not apply to individuals who are not aware of having any disease, so we restrict our sample to those respondents who were previously diagnosed with hypertension. Summary statistics are presented in Table 3:

Out of 1696 previously diagnosed respondents, only 406 (23.94%) routinely monitored their blood pressure during the month preceding the IFLS interview. This picture is even more troublesome than the under-diagnosis picture was. It shows that even after being diagnosed with hypertension, more than 75% of the patients do not engage in the most simple and least expensive activity that is required for properly managing their condition — frequently monitoring their blood pressure. The figures are, once again, slightly less favorable for men, although the disparity between sexes is not as pronounced as in the case of under-diagnosis.

We estimate probit models and report the marginal effects of the same set of explanatory variables on this disease management proxy. Table 4 presents the results, with the first column representing the whole sample, the second column the respondents in good general health, and the third column the respondents in poor general health.

As predicted, we do observe different effects, both in magnitude and significance for generally healthy and generally unhealthy respondents. The level of education matters for all respondents, but with different magnitudes. More specifically, for individuals in poorer general health, education has a larger impact than for individuals in good health who possess no obvious impairing symptoms. This strengthens the idea that education affects health through two distinct channels. First, education gives people a better understanding of what it means to live a healthy lifestyle and of the importance of properly managing one's disease, regardless of symptoms. This channel did not seem to be important for disease detection, but it is important for disease management. Individuals with less education might be more often tempted to skip a step in their recovery if they feel like their condition is overall good, while more educated individuals know better that some diseases are asymptomatic and they should follow through with their recovery regimen despite an overall good health status. The second channel through which education affects health, that seems to be important for both health detection and for health management, but that only works for individuals with more severe symptoms that impairs their day to day activities, is through the opportunity costs of being sick. Individuals with higher education have a higher opportunity cost of being sick and are therefore incentivized further to properly address their health and follow their recovery protocols.

In terms of individual time preferences, they only matter for the aggregate sample and for the respondents in good health. Respondents in poor health check their blood pressure often, regardless of their time preference. Their poor health pushes them to adopt good, healthy habits. Individuals in good health however, are affected by their time preference. The more impatient respondents check their blood pressure less often. This implies once again how important it is to implement programs that actively push everybody to routine blood pressure testing, designed to both detect and monitor the detected disease.

Household economic resources matter for those in good health, perhaps because wealthier people can afford to buy their own blood pressure measurement kits. There do not seem to be any significant effects for disease management caused by risk preferences, access to healthcare, or sex. However, we cannot reject possible effects of these factors for other measures of health management. As mentioned before, measuring blood pressure is only one of the many components that enter health management. Other components that enter disease prevention and recovery protocols such as following through with medication, engaging in physical exercise, maintaining a proper diet, or eliminating vice-goods consumption could be affected by risk preferences as well. Most of the lifestyle choices that contribute to a bad management of hypertension are providing some level of utility to individuals and are therefore attractive, but risky from a health perspective. Therefore, individuals with different tolerances to risk might respond differently to these types of incentives. The present paper cannot tackle these questions unfortunately due to data limitations, but we believe more research efforts should be made in this direction.

6. Policy considerations

Health has been a continuous focus of policy makers in developing countries where resources are scarce. It is hence important to understand precisely the channels and mechanisms that improve health, in order for resources to be allocated efficiently. Many developing countries allocate too much of their health budgets to

Table 3
Hypertension management (percentage of hypertensive respondents who check their blood pressure regularly).

	Hypertensive	Good management	Percentage of good management
Total	1696	406	23.94
Men	596	136	22.82
Women	1100	270	24.55

Table 4
Hypertension Management Probit Regression (Dependent Variable: The probability of engaging in good disease management).

	Aggregate sample	Respondents in good health	Respondents in poor health
Years of Education	0.00816***	0.00625**	0.01407***
	(0.00252)	(0.00281)	(0.00499)
Log PCE	0.02393*	0.03219*	0.01633
	(0.01428)	(0.01685)	(0.02567)
Time Preference	−0.3689**	−0.03214*	−0.03576
	(0.01585)	(0.01841)	(0.02893)
Risk Preference	−0.00851	−0.00545	−0.02078
	(0.01128)	(0.01404)	(0.01894)
Distance to Health Center	0.00012	0.00015	−0.00013
	(0.00078)	(0.00101)	(0.00124)
Female	0.03618	0.02359	0.04850
	(0.02279)	(0.02597)	(0.04308)
Sample Size	1696	1100	596

The table reports marginal effects with standard errors in parentheses. Respondent's age and age squared are included in all regressions. Significance levels: *-significant at 10% level **-significant at 5% level ***-significant at 1% level.

public hospitals that only address the needs of the urban elites, while impoverished villagers suffer or die from conditions that could be easily treated or prevented (Filmer et al., 2000).

It has been generally accepted in the health economics literature that, in order to improve health outcomes, efforts have to be made towards increasing the availability and quality of health services, but also towards providing the population with the right incentives to use these resources and stimulating the demand for health services. In that sense, public spending alone will not address the whole problem. Issues regarding the low utilization and the ineffectiveness of health services such as community health workers were documented by Sauerborn et al. (1989) and Berman et al. (1987). However, the low utilization of publicly provided community services was mainly attributed to quality considerations and bypassing (see Akin et al., 1995 or Akin and Hutchinson, 1999).

At the same time, some economists realized that the smaller the elasticity of demand for health services, the smaller the impact of public spending, thus advocating for demand-side mechanisms to improve the demand for services such as routine examinations (Filmer et al., 2000). This is both good news and bad news for addressing the hypertension under-diagnosis problem. The good news comes from the fact that, due to the asymptomatic nature of hypertension, patients suffering from it are likely to be extremely sensitive to price and availability of health services, and therefore public spending will have a larger impact. Papers like Cretin et al. (1990) or Gertler and Molyneaux (1996) showed that demand for health is less elastic for more serious conditions and symptoms. On the other hand however, due to the high elasticity, this population will not engage is preventative behaviors absent proper incentives to compensate for the opportunity cost of seeking these services. Our results strengthen this idea, and provide evidence that opportunity costs play important roles in both the early detection and the management of hypertension.

Indonesia has been going through a series of health reforms over the past few decades that emphasized decentralization, health promotion and prevention, quality and affordability of healthcare, social mobilization and community empowerment, etc. Daly and Fane (2002) present a comprehensive review of the economic programs implemented in Indonesia since the 1990s and find that healthcare was the most accurately targeted area. In spite of this however, hypertension under-diagnosis remains unusually high, which suggests that the current strategies are not efficient in this regard. More recent studies have been showing evidence that incentives that specifically target commitment to healthy behaviors and routine medical screenings are more effective than generic programs targeting improvements in overall SES (Thornton, 2008; Banerjee et al., 2010). Our present study brings yet another argument that better designed programs need to be implemented to specifically target the asymptomatic individuals that have a high elasticity of demand for health services. These programs, if implemented efficiently, should prove having a large impact. High elasticity of demand individuals will respond to incentives better than low elasticity individuals, and hypertension is generally cheap and easy to manage if detected in its early stages. Since developing countries like Indonesia have been going through a health transition from infectious diseases to chronic diseases during the past decades, it is likely that local governments are still too much focused on addressing infectious diseases and early mortality at the expense of detecting and preventing chronic diseases. While basic investments in community infrastructure and economic well being are the main avenues of combating infectious diseases, they prove inadequate to address one of the most important preventable contributors to disease and death in the modern world. We believe policymakers should address this growing problem by targeting the asymptomatic individuals through incentives that encourage routine physical examinations. These could include, but not limited to, focused educational programs, conditional cash transfers, or government sponsored medical home visits to screen for hypertension.

At the same time, while the direction of the effects shown by our results paints a clear picture of why current policies failed in addressing the problem, we have to acknowledge the limitation of our estimation strategy in regards to the magnitudes of these effects. We encourage future research to try to address the possible endogeneity of education and time preferences simultaneously, and possibly consider other omitted variables that could potentially be correlated with our regressors and hence bias their magnitudes.

7. Conclusions

This paper presents proof that education and individual time preferences clearly affect health through two of its most important components: health detection, and disease management. The focus is on asymptomatic chronic conditions that are pervasive in both developed and under-developed economies. In particular, we study the effects of education and individual time preferences on hypertension under-diagnosis and hypertension management in Indonesia. We find these effects to be very different, in both magnitudes and significance, for generally healthy people than they are for generally unhealthy people. Since hypertension is asymptomatic and does not cause many impairing symptoms in its early stages, many patients carry it unknowingly for years. Especially in developing countries, where people are faced with severe economic challenges, taking time to schedule a routine medical examination that could potentially identify the disease is often the last thing that a person thinks of. It is extremely discouraging that many times, in such environments, the only chance that people have to being diagnosed is to first succumb to other (symptomatic) maladies that will somehow impair their health and push them through the doors of a medical center.

We find that education and other SES, as well as individual time preferences matter for disease detection and management, but only in the aggregate sample. For respondents in good health, education is not significant for disease detection, while for respondents in bad health, time preference is not significant for both disease detection and disease management. For disease detection, the problem is even more severe for men who are heads of households and value their productive time even higher. We also point at two distinct channels through which education affects health – a direct channel where education increases respondents' awareness about health, and an indirect channel where education affects respondents' attitudes towards health only through earnings effects.

All our results point to the real cause of the severe under-diagnosis problem that persists in developing countries such as Indonesia. While economic resources and SES matter in general, they do not address the root of the problem. Traditional programs and policies targeting education and general economic help can improve the overall outcome, but will fall short for a significant portion of the population. Targeted educational programs that stress the importance of routine examinations, conditional economic incentives that pay specifically for routine testing, and active early detection programs that test people in the comfort of their own homes should prove more effective in reaching a larger population and reducing the overall level of under-diagnosis, which will undoubtedly lead to improving the overall health of the population in the long run.

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