Middle East Development Journal

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rmdj20

Chronic illnesses and labor market participation in the Arab countries: evidence from Egypt and Tunisia

Ebaidalla M. Ebaidalla & Mohammed E. Mustafa Ali

To cite this article: Ebaidalla M. Ebaidalla & Mohammed E. Mustafa Ali (2022): Chronic illnesses and labor market participation in the Arab countries: evidence from Egypt and Tunisia, Middle East Development Journal, DOI: 10.1080/17938120.2022.2143748

To link to this article: https://doi.org/10.1080/17938120.2022.2143748

Published online: 27 Nov 2022.

MIDDLE EAST DEVELOPMENT JOURNAL
https://doi.org/10.1080/17938120.2022.2143748

Chronic illnesses and labor market participation in the Arab countries: evidence from Egypt and Tunisia

Ebaidalla M. Ebaidalla[a] and Mohammed E. Mustafa Ali[b]

[a]Ibn Khaldon Center for Humanities and Social Sciences, Qatar University, Doha, Qatar; [b]Development Studies and Research Institute, University of Khartoum, Khartoum, Sudan

ABSTRACT

This paper examines the impact of chronic illnesses on labor force participation using labor market surveys data for Egypt and Tunisia. The study also investigates the reverse effect of labor force participation on the incidence of chronic diseases. We adopted the simultaneous equations modeling technique to address the potential endogeneity of chronic illnesses in the labor participation equation. The results reveal that chronically ill people are less likely to participate in the labor force in both Egypt and Tunisia. However, the sub-samples analysis indicates some variations across gender and age groups. Specifically, the effect of chronic illnesses is found to be larger and significant for the male group compared to female counterparts. Likewise, the feedback effect shows that labor force participation exerts negative impact on chronic illness, particularly for the total sample. Moreover, the impact of labor force participation on chronic diseases in elder group is larger compared to its effect in the younger group. The study recommends that policymakers in the Arab countries should endeavor to reduce chronic health conditions in order to boost labor force participation and productivity.

ARTICLE HISTORY
Received 21 February 2020
Accepted 28 October 2022

KEYWORDS
Chronic diseases; labor force participation; FIML; two-stage; Egypt; Tunisia

JEL Classifications
I12; I15; J2; J4

1. Introduction

The impact of chronic illnesses on labor force participation has been an interesting topic that gained considerable attention from policymakers and researchers. It is well known that workers with chronic illnesses generate lower income compared to healthy employees (Baanders et al., 2002; Blackaby et al., 1999). Moreover, chronic diseases affect different sides of the health equation, including chronically ill persons, families, and health care providers. On the top of that, due to the absence of financial protection schemes, chronic illnesses remain a devastating factor to productivity and economic prosperity in developing countries.

Like other countries in North Africa, Egypt and Tunisia suffer from a high prevalence of chronic illnesses (Kaneda & El-Saharty, 2017). In fact, due to the widespread unhealthy diets, obesity, smoking, and lack of consciousness regarding the importance of physical exercise, a large segment of the population in these countries suffer from chronic illnesses

CONTACT Ebaidalla Mahjoub Ebaidalla ebaidalla@qu.edu.qa

such as diabetes, hypertension, and cardiovascular (Rahim et al., 2014). The incidence of these diseases representing one of the causes of high mortality and morbidity among the population and became a significant challenge for improving healthiness in the region (Kaneda & El-Saharty, 2017). The statistics by the Global Health Estimates (2020) demonstrate that chronic diseases are responsible for 85% and 86% of the total deaths in Egypt and Tunisia, respectively. These percentages are higher than the Arab world and world' average, in which chronic illnesses contributed by 71% and 73% to total deaths, respectively.

Incidentally, Egypt and Tunisia host a large portion of informal workers (Angel-Urdinola & Tanabe, 2012), who rely primarily on physical labor and perform their work in unfavorable conditions. They mostly lack health insurance coverage that could protect them from illness and its other negative consequences such as, catastrophic health spending. The inception of sickness is likely, not only to reduce work productivity, but also to drive workers out of the labor market. The burden of chronic illnesses coupled with high unemployment rates is likely to exert a destructive impact on labor force participation in these countries. With this issue in our minds, this paper aims to answer the following questions: (1) what is the impact of chronic illnesses on labor force participation decisions? (2) Is there any feedback effect from labor force participation on participants' chronic illness status? (3) Does the impact of chronic illness on labor force engagement vary across age groups and gender?

To answer these questions, this study uses the 2012 Egyptian Labor Market Panel Survey (ELMPS, 2012) and the 2014 Tunisian Labor Market Panel Survey (TLMPS, 2014). The outcome of this study would help in designing appropriate measures to improve and reform healthcare systems in the region. The main results of this paper indicate that chronic diseases have a negative and significant effect on labor force participation in these two countries. Likewise, the results of feedback effect reveal that labor force participation exerts negative impact on chronic illness.

The rest of the paper is structured as follows. Section 2 reviews the literature on the effect of chronic illnesses on labor market participation. Section 3 discusses data and research methods. Section 4 presents some descriptive statistics on labor force participation and incidence of chronic diseases in the two countries as well as the empirical results and discussion. Section 5 ends with the conclusion and policy recommendations.

2. A brief literature review

The theoretical link between health and labor supply dates back to the 1960s with the emergence of influential works of Becker (1964, 1965), and Lancaster (1966) who argued that healthiness represents an important endowment for human capital to enhance household's production. Many scholars have claimed that healthy people are more likely to engage in work and earn higher income (Grossman, 1972; Kankeu et al., 2013; McIntyre et al., 2006). In contrast, illness pushes workers to give more value to leisure compared to work and may opt to be out of the labor market or reduce the hours of work supplied. Thus, the reduction in the stock of health increases the amount of lost time dedicated to income' generating activities because the time needed to care for one's health rises (Cai & Kalb, 2006). with this argument, some scholars view that poor health or illness does not automatically eliminate workers from participating in the labor market, advocating that chronically ill workers possibly encounter complications in joining and sustaining jobs (Baanders et al., 2002; Bradley et al., 2012).

Empirically, most of the studies indicate that the presence of good health promotes labor force participation (e.g. Bridges & Lawson, 2008; Cai & Kalb, 2006; Laplagne et al., 2007; Mete & Schultz, 2002; Pitt & Rosenzweig, 1990; Schultz & Tansel, 1997; Stern, 1989; Zhang et al., 2009). For example, Cai and Kalb (2006) examined the impact of health status on labor force participation using data obtained from the survey of Household, Income and Labor Dynamics in Australia (HILDA). Their results revealed that being with better health increases the probability of labor force participation. For the reverse effect, they found that labor force participation has a positive and significant impact on older females' health and a negative effect on younger males' health. In the same vein, Cai (2010) found a positive relationship between health and labor force participation using the first four waves of the HILDA. Similarly, Gannon (2005) studied the effect of disability on labor participation in Ireland and found that disabled men with a severe limitation are nine percentage points less likely to join labor force compared to healthy men. For the women sample, the result also indicated that the severe disability reduces the probability of labor force participation by 26% points when compared to women with no disability.

In the context of developing countries, Nwosu and Woolard (2015) investigated the impact of health status on labor force participation in South Africa. Using micro-data, they found a positive and significant association between health and labor force participation. Similarly, Bridges and Lawson (2008) examined the link between health status and labor market participation decision in Uganda using the National Household Survey (UNHS) for the years 2002–2003. They found that the health variable is highly significant and strongly linked to labor participation. Furthermore, their results showed ill health lowers the likelihood of being in the formal labor market and that the negative effect is stronger for women than for men. Mete and Schultz (2002) examined the consequences of health status on the labor force participation decision of elderly men and women in Taiwan during the period between 1989 and 1996. The results showed that an individual's health has a positive and significant impact on labor force participation.

For Egypt, Rocco et al. (2011) examined the impact of chronic diseases on three labor market outcomes namely, employment status, labor supply, and wage rates. They found that the probability of being employed is 25% points lower among people reporting chronic disease conditions (the average probability is about 50%), and that the amount of working time supplied is reduced by 22 h per week (out of 40 h). Their results also indicated that the effect of chronic diseases is larger among elderly, less educated and workers engaged in the informal sector. Moreover, the results revealed that the chronic conditions reduce the probability of employability among people with a university degree by only 10%.

The above discussion revealed a quasi-consensus that ill health in general and chronic illness, in particular, exerts a negative and significant effect on the labor supply. However, despite the vast body of literature on the relationship between health and labor force participation, most of previous studies have focused on industrial countries, with little research attention has been devoted to developing countries in general and Arab countries in particular. Moreover, the only existing study on Egypt conducted by Rocco et al. (2011) used a relatively old data from the 2002 Egypt Household Health Utilization and Expenditure Survey (EHHUES). Thus, their study mainly focused on health conditions, health care utilization, and expenditure and did not consider the labor force participation directly. Unlike the study of Rocco et al. (2011), this study examines the link between chronic illnesses and labor force participation. It also identify the possible reverse causality of labor force participation on chronic diseases in both Egypt and Tunisia. It is worth to note that, work or long working hours may negatively affect individuals' health, or individuals may use health conditions to justify their labor force status, a justification hypothesis as known in the literature (Cai, 2010). Furthermore, while most of the previous studies have mainly focused on one country, this study uses a dataset from two Arab countries (Egypt and Tunisia) for the purpose of comparison. Given that Egypt is the populist country in the region, its inclusion in the intended investigation is likely to raise the generalizability of the findings to other Arab countries.

3. Data and methodology

3.1. Data

The data for this study is mainly sourced from the 2012 round of the Egypt Labor Market Panel Survey (ELMPS 2012) and the 2014 Tunisian Labor Market Panel Survey (TLMPS 2014). The ELMPS 2012 survey comprises a sample of 12,060 households and 49,186 individuals. Whereas, the TLMPS 2014 contains 4528 households and 16,430 individuals. Both ELMPS (2012) and TLMPS (2014) include detailed information on socio-economic and labor market characteristics of households and individuals aged between 15 and 64. Specifically, the survey conveys wide range of information, including individuals' parental background, education, employment, and information on the household's assets and resources. The surveys also contain information on individual self-reported chronic diseases incidence, along with the major types of chronic diseases, such as diabetes and blood pressure.

3.2. Identification strategy and estimation technique

The problematic issue confronting this study is that chronic illness is commonly identified based on self-assessment instead of objective measures. This matter increases the likelihood of encountering an endogeneity problem, for many reasons (Anderson & Burkhauser, 1985; Baker et al., 2004; Benitez-Silva et al., 2004; Bound et al., 1999; Campolieti, 2002; Dwyer & Mitchell, 1999; Stern, 1989). First, individuals may have economic or psychological reasons to alter self-reported health to rationalize labor market decisions. Second, the participation may result in sickness for the employed people due to stress and poor working conditions (Cai & Kalb, 2006). Third, given that chronic health status is self-reported, it is likely to be affected by the measurement error (Bound et al., 1999; Kreider, 1999). In this regard, evidence brought by Kreider (1999) showed that non-working women, high school drop-outs, non-whites, and former blue-collar workers in the USA tend to over-report sicknesses, which significantly affect their labor force status. Finally, ill health may be associated with unobserved individual characteristics such as time, socio-demographic background, and risk preference that affect labor market decisions.

To overcome the probable endogeneity of both chronic illnesses and labor force participation, we follow Cai (2010), Cai and Kalb (2006), and Stern (1989) by estimating the two equations simultaneously. The first equation presents the incidence of chronic disease, while the second one depicts the labor force participation. According to previous literature (e.g. Cai, 2010; Cai & Kalb, 2006; Stern, 1989), the simultaneous equation modeling approach with two correlated equations acts as an appropriate method for estimating the impact of health on labor force participation than a single equation with health status as an exogenous explanatory variable. Thus, the first equation of chronic illnesses is specified as follows:

$$Ch^* = \gamma_1 L^* + \beta_1 X_1 + \varepsilon_{i,Ch} \tag{1}$$

where Ch^* is a latent dependent variable, represents the incidence of chronic illness, which is a function of latent labor force participation (L^*) and a vector of explanatory variables (X_1) that affect chronic disease. Finally, $\varepsilon_{i,Ch}$ is the normally distributed disturbance term.

On the other hand, the labor force participation equation is specified as follows:

$$L^* = \gamma_2 Ch^* + \beta_2 X_2 + \varepsilon_{i,L} \tag{2}$$

The latent value of being in the labor force (L^*) is a function of latent chronic illness (Ch^*) and a set of exogenous variables (X_2). The disturbance terms $\varepsilon_{i,Ch}$ and $\varepsilon_{i,L}$ are bivariate normally distributed with the following assumptions: $E(\varepsilon_{i,L}) = E(\varepsilon_{i,Ch}) = 0$, $var(\varepsilon_{i,L}) = var(\varepsilon_{i,Ch}) = 1$; $corr(\varepsilon_{i,L}, \varepsilon_{i,Ch}) = \rho$; if $\rho = 0$, it suggests that chronic diseases are exogenous. However, $\varepsilon_{i,L}$ and $\varepsilon_{i,Ch}$ are expected to be correlated because there are some unobservable variables that affect both chronic illness and labor force participation simultaneously. To examine the exogeneity of chronic illness, we test whether the correlation coefficient (ρ) is statistically different from zero. If ρ is statistically significant, it indicates the endogeneity of chronic illness. In contrast, the insignificance of ρ would suggest that estimating separate labor force and chronic illness equations might yield consistent estimates.

To satisfy the identification condition for simultaneous equation modeling, we include a different set of independent variables in the two equations. That is, while the two equations contain some identical variables, each equation includes some variables that do not appear in the other. Based on the existing literature (e.g. Cai, 2010; Cai & Kalb, 2006) a vector of individual, socio-economic, and health status characteristics are included in the two equations as explanatory variables. Specifically, the individual's characteristics include education, gender, age, age squared, and employment status. The household's characteristics include factors such as the number of children in the household, wealth quintile and level of urbanization.

It is well noted that selecting appropriate identifiers/instruments is one of the major challenges that usually faces estimating the simultaneous equations models. In our case, the surveys used in this study (i.e. ELPMS and TLMPS) do not include suitable instruments, particularly for chronic illnesses equation. Given the available data, we augmented the chronic illnesses equation by two indicators to capture the chronic health problems. The first variable is unimproved or poor sanitation. The association between sanitation and population health has been well documented in the literature, as a considerable body of empirical studies indicated that people living in poor sanitation facilities are more vulnerable to chronic diseases (Corburn & Hildebrand, 2015; Joshi et al., 2011; Gyasi et al., 2022). For example, Gyasi et al. (2022) showed that unimproved sanitation facilities like shared toilet facilities are associated with the occurrence of chronic diseases, particularly among older people. We follow the WHO/UNICEF (2010) definition, considering sanitation facility is unimproved when shared with other families or open to public use.[1] The second variable used as identifier is the unsafe water, measured by the lack of accessibility to clean water. Unhealthy water affects the health condition and the incidence of chronic illnesses, as some empirical studies (e.g. Gobalarajah et al., 2020; Jayasumana et al., 2015) indicate that unsafe water increases the incidence of Kidney disease. We used non-piped water as a cut-off for unsafe water.

Regarding the labor force participation equation, we also include two variables to ensure the identification of our structural equations. Following Cai and Kalb (2006), we used the interaction between marriage and having children under five years of age as a factor that is likely to affect labor force participation, but unlikely to affect an individual's chronic health status. The second additional variable adopted in the LFP equation is the household size. We argue that individuals living in large households are more likely to participate in labor market. The inclusion of these variables guarantees that each equation is distinguished from each other and, thus, satisfies the identification condition.

To estimate the simultaneous equations of labor force and chronic diseases, the study adopts the full information maximum likelihood (FIML) method to account for the correlation between the error terms in the two structural equations.[2] Another method is widely used in literature to estimate the health-labor force participation model is the two-stage method (2SLS) (e.g. Stern, 1989). However, although 2SLS method produces consistent estimators, it is not efficient as it does not account for the potential correlation between the error terms in the structural equations (Cai & Kalb, 2006). On the other hand, the FIML estimation method produces consistent and efficient estimators, taking into account the correlation between the two error terms in the structural model (Greene, 1993). Moreover, unlike the two-stage method that tests exogeneity partially, the FIML method test jointly the exogeneity hypothesis based on the significance of the coefficient of correlation between error terms of the two equations.

After estimating our structural model using the FIML method, we adopt the two-stage instrumental variables (IV) method for the purpose of comparison and robustness check. In the two-stage estimation, the models of chronic diseases and labor force participation are identical to equations (1) and (2), respectively. For instance, in the first stage, we use a variable that represents chronic illness as a linear function of the control and instrumental variables and then uses its predicted value in the second equation of labor force participation. Likewise, to investigate the reverse effect of labor participation on chronic illness, we follow the same procedure adopted in the labor force equation. In other words, we regress labor force participation on a vector of control and instrumental variables and then use its predictive value in the second equation of chronic illness.

To estimate the two-stage models, we use the same instrumental variables adopted in the FIML estimation method. Specifically, we instrument the chronic equation by unimproved sanitation and unsafe water, while the LFP equation is instrumented by the interaction between married and children in addition to household size. The validity of IVs must be strongly associated (i.e., $\beta_2 \neq 0$) with the endogenous variables, and exogenous in our basic model. The validity of the instrument is tested using the Cragg–Donald (Cragg & Donald, 1993) and Wald F-test for weak instruments. Moreover, the IVs should influence the outcome variables exclusively through endogenous ones, $Cov(Z_2, \varepsilon) = 0$ (i.e. exogenous) and has no independent effect on outcome variables.

Finally, we measure the size effects of chronic and labor force participation using the probability models. Size effect measures the magnitude of the effect studied or the difference between groups (Kelley & Preacher, 2012; Sullivan & Feinn, 2012), assessing the strength of the relationship between two variables. This allows us to assess how relatively chronic illnesses affect LFP and vice versa. Moreover, the coefficients generated from the binary models are not comparable across groups because unobserved variation may differ between groups (Allison, 1999; Mood, 2010).

4. Empirical results and discussion

4.1. Link between chronic illnesses and LFP: descriptive statistics

Table 1 documents the respondents' labor force status against chronic illness incidence for males and females in Egypt and Tunisia. The table reveals a significant association between male labor force participation and chronic health conditions for the male group in both countries, as indicated by Chi-square test statistics. This implies that the male respondent who participates in labor force is more likely to suffer from chronic illnesses. However, for the female respondents, while the results indicate a significant association between chronic health status and labor force participation in Egypt, in the Tunisian sample there is no significant association between these two variables. Moreover, we observe that the percentages of females suffering from chronic illnesses and simultaneously participating in LF are lower than that of the males group in Egypt and Tunisia.

In the same way, Table 2 tabulates the employment situation against chronic illnesses by age groups for both Egypt and Tunisia. The Table also provides the test results of the association between employment and chronic illnesses using the Chi-square test, for the full sample and across age groups. The Table shows a significant association between employment and chronic illnesses for the full sample (15–64 years) for both Egypt and Tunisia. However, the results reveal that the Chi statistics are not significant for all age groups, implying that employment rates do not vary between those with and without

Table 1. Labor force status and chronic diseases for male and female (%).

	Chronic illnesses					
	Yes	No	Chi statistics	Yes	No	Chi statistics
	Egypt			Tunisia		
Male (Observations)	(14,990)			(4870)		
% In labor force	73.0	79.9	51.98	51.3	72.0	104.16
% Out of labor force	27.0	20.1	(0.000)	48.7	28.0	(0.000)
Female (Observations)	(15,409)			(5701)		
% In labor force	33.4	32.6	0.493	22.7	31.7	23.17
% Out of labor force	66.6	67.4	(0.482)	77.3	68.3	(0.000)

Values in parentheses under Chi statistics are *P*-values.

Table 2. Employment status and chronic illnesses by age group (%).

	Chronic illnesses					
	Yes	No	Chi statistics	Yes	No	Chi statistics
	Egypt			Tunisia		
All age groups (15–64 years)	16,942			4660		
% Employed	96.7	92.2	62.00	96.8	88.0	26.284
% Unemployed	3.3	7.8	(0.000)	3.2	11.9	(0.000)
Age (15–29)	6521			1273		
% Employed	88.2	87.2	0.213	72.3	91.7	2.228
% Unemployed	11.8	12.8	(0.644)	27.7	8.3	(0.135)
Age (30–49)	7782			2317		
% Employed	96.1	95.4	1.059	91.0	96.0	1.516
% Unemployed	3.9	4.6	(0.303)	9.0	4.0	(0.218)
Age (50–64)	2639			1070		
% Employed	99.4	98.6	0.509	97.7	97.9	0.038
% Unemployed	0.6	1.4	(0.475)	3.3	2.1	(0.844)

Values in parentheses under Chi statistics are *P*-values.

a chronic illness for all age groups. The table also reveals that in both countries, the likelihood of chronic diseases is higher among elders.

Table 3 below presents the prevalence of chronic disease by age group and gender in Egypt and Tunisia. The reported statistics reveal that about 19.4% and 18.6% of the population aged between 14 and 65 years suffer from at least one chronic disease in Egypt and Tunisia, respectively. However, the prevalence of chronic health conditions in these countries is lower than the global and Arab region's average incidence of chronic illness.[3] Recent statistics indicated that approximately one in three of all adults worldwide suffers from chronic illnesses (Hajat & Stein, 2018). While in Arab countries, the average rate of chronic health conditions is around 45% (Hajjar et al., 2013). The low rate of chronic illnesses reported by the labor force survey for the two countries under study (i.e. Egypt and Tunisia) can be justified by the fact chronic illnesses are self-reported, hence is likely to be a victim of measurement error, as some respondents may under-report their health situation (Bound et al., 1999; Kreider, 1999). Expectedly, the table indicates that the old population is more likely to suffer more from the chronic disease compared to their young counterparts. Interestingly, the incidence of chronic illnesses is higher among females than male respondents in the two countries.

Appendix I provide definitions, means, and standards deviations of the variables used in the analysis. The Appendix shows that the average of labor force participation in Egypt is higher than Tunisia. The mean age is about 24 and 34 years for Egypt and Tunisia, respectively. This implies that Egypt hosts a large youth population compared to

Table 3. Decomposition of chronic disease for full sample, gender and age group (%).

	Egypt			Tunisia		
	Yes	No	No. observations	Yes	No	No. observations
All age groups	19.43	80.57	32,626	18.56	81.44	11,535
14–29	3.66	96.34	14,184	1.98	98.02	3484
30–49	16.01	83.99	10,927	8.04	91.96	4016
Above 50	54.18	44.82	7515	29.58	70.42	4233
Male	17.68	82.32	16,001	17.05	82.95	5302
Female	21.12	78.88	16,625	19.94	80.06	6093

Tunisia. The table also indicates that the mean and standard deviation of male, head, and married respondents in Egypt are close to those of Tunisia. This suggests relative similarities in demographic characteristics in the two countries. In addition, the average years of schooling in Egypt are relatively higher than in Tunisia. The mean household size in Egypt is higher than in Tunisia with a high standard deviation as well. These descriptive statistics represent a solid ground for comparison between the two countries regarding the impact of chronic diseases on labor force participation.

4.2. Econometric results

This sub-section presents the results of chronic illness and labor force participation equation. Sub-section 4.2.1 presents the estimation results of the FIML method, while sub-section 4.2.2 reports the results of robustness analysis using the two-stage method.

Table 4. Estimation results of full information maximum likelihood – full sample.

	Labor force participation		Chronic illness	
	Egypt	Tunisia	Egypt	Tunisia
Chronic	−0.221***	−0.165***		
	(0.0399)	(0.0310)		
Participation			−0.531***	−0.308***
			(0.0769)	(0.0822)
Age	0.0519***	0.0310***	0.0360***	0.00849***
	(0.00104)	(0.00144)	(0.00416)	(0.00311)
Age square	−0.000590***	−0.000371***	−0.000299***	−2.35e-05
	(1.14e-05)	(1.47e-05)	(4.94e-05)	(3.75e-05)
Head of household	0.110***	0.102***	0.0715***	0.0324**
	(0.00685)	(0.0124)	(0.00984)	(0.0130)
Male	0.330***	0.252***	0.153***	0.0407*
	(0.00617)	(0.0106)	(0.0267)	(0.0223)
Married	−0.0431***	−0.103***	−0.0283***	−0.0314***
	(0.00797)	(0.0122)	(0.00630)	(0.0103)
Years of schooling	0.0421***	0.000133	0.00751*	−0.00396*
	(0.00188)	(0.00245)	(0.00396)	(0.00212)
One child	−0.0741***	−0.0897***	−0.0167**	−0.0163*
	(0.00975)	(0.0193)	(0.00684)	(0.00906)
Two child	−0.0800***	−0.0590***	−0.0259***	−0.0147
	(0.0104)	(0.0212)	(0.00688)	(0.0102)
More than two child	−0.111***	−0.0732***	−0.0453***	−0.00128
	(0.0114)	(0.0239)	(0.00725)	(0.0106)
Wealth	−0.0147***	−0.0100***	0.000377	0.0101***
	(0.00206)	(0.00388)	(0.00246)	(0.00324)
Urban	−0.0726***	−0.0610***	−0.0261***	−0.000428
	(0.00529)	(0.0102)	(0.00791)	(0.00935)
Married*child	0.109***	0.159***		
	(0.0110)	(0.0190)		
Household size	0.00822***	0.00783**		
	(0.00142)	(0.00343)		
Unimproved sanitation			0.241***	0.397***
			(0.0138)	(0.0171)
Unsafe water			0.0494***	−0.0134
			(0.00853)	(0.0108)
Constant	−0.658***	−0.194***	−0.454***	−0.0594*
	(0.0181)	(0.0373)	(0.0541)	(0.0346)
Correlation ρ (prob)	7.88 (0.000)	4.26(0.000)		
Observations	33,450	12,514	33,450	12,514

***, **, * denote statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.
Standard errors in parentheses are clustered at the household level.

Finally, sub-section 4.2.3 presents the size effect of our outcome variables using the probability models.

4.2.1. The FIML results of labor force participation and chronic illness equations

Table 4 reports the estimation results of FIML estimates for chronic illness and labor force participation equation. The table shows that the correlation coefficient (ρ) is positive and statistically significant, indicating the association between error terms in the two structural equations. This result rejects the hypothesis that chronic illness is exogenous to labor force participation. Thus, we conclude that chronic illness and labor force participation variables are endogenous, constituting a suitable justification for adopting simultaneous equation models.

The estimation results of the labor force participation equation in columns 2 and 3 for Egypt and Tunisia, respectively, indicate that respondents' labor force status is significantly predicted by the presence of chronic illnesses, age, being a household head, gender, marital status, years of schooling, wealth, and residence in urban areas. Specifically, the results show that the coefficient of chronic disease is negative and statistically significant, indicating that living with chronic health conditions decreases respondents' engagement in the labor force in both countries. This finding confirms the results of previous empirical studies on the impact of health on labor force participation (e.g. Bound et al., 1999; Cai, 2010; Rocco et al., 2011; Stern, 1989).

The results also indicate that demographic characteristics have a significant impact on respondents' labor participation, since the relevant variables are significant and carry anticipated signs. For instance, the coefficient in front of the household head variable is positive and statistically significant, implying that being a household head increases respondent's likelihood to participate in labor force. Similarly, compared to single respondents, married respondents are more likely to engage in labor force. The estimation results for both countries show that labor force participation is more likely to decline with aging, which goes in line with the rise in the number of elders living with at least one chronic disease. As expected, respondents attending more years of schooling are more likely to enter labor force compared to those with less education. Moreover, the coefficient of wealth variable is negative and statistically significant in both the Egyptian and Tunisian samples.

Regarding the reverse impact of labor force participation on chronic disease, the results indicate that for both Egyptian and Tunisian models, the coefficient of labor force participation variable is negative and statistically significant; indicating that labor force participation worsens respondents' chronic disease status. This finding is consistent with the results obtained by Cai and Kalb (2006). The results also reveal some variations in the effect of explanatory variables on chronic diseases between the two countries. For example, years of schooling have a positive and significant impact on chronic illness in the Egyptian sample, while its effect is negative and significant in the Tunisian model. Moreover, the effect of wealth on chronic diseases is negative and significant in Tunisia, but insignificant in Egypt.

Secondly, to gain more insight into the nexus between chronic illness and labor force participation, the pooled sample is divided into two sub-samples according to the gender. The estimation results of the FIML model for labor force participation and chronic illness equations for both male and female sub-samples are presented in Table 5.

Table 5. Estimation results of FIML for LFP and chronic illness equation by gender.

	Labor force participation				Chronic illness			
	Egypt		Tunisia		Egypt		Tunisia	
Variables	Males	Females	Males	Females	Males	Females	Males	Females
Chronic	−0.467***	−0.0486	−0.318***	−0.0558				
	(0.0503)	(0.0602)	(0.0452)	(0.0417)				
Participation					−0.514***	−0.746***	−0.133*	−0.766*
					(0.106)	(0.209)	(0.0688)	(0.464)
Age	0.0665***	0.0357***	0.0332***	0.0246***	0.0379***	0.0375***	0.000598	0.0176
	(0.00154)	(0.00131)	(0.00234)	(0.00188)	(0.00729)	(0.00774)	(0.00336)	(0.0124)
Age square	−0.00077***	−0.00038***	−0.000427***	−0.00027***	−0.00035***	−0.00028***	5.35e-05	−0.000116
	(1.81e-05)	(1.25e-05)	(2.24e-05)	(1.95e-05)	(9.09e-05)	(8.45e-05)	(4.20e-05)	(0.000141)
Head of household	0.0428***	−0.0250*	0.0724**	−0.0187	0.0420***	0.0300*	−0.00485	0.0259
	(0.0108)	(0.0130)	(0.0314)	(0.0213)	(0.0111)	(0.0153)	(0.0222)	(0.0229)
Married	0.0739***	−0.0532***	−0.0348	−0.0838***	0.0342*	−0.0342***	0.0265	−0.0407
	(0.0137)	(0.0114)	(0.0259)	(0.0175)	(0.0201)	(0.0105)	(0.0227)	(0.0295)
Years of schooling	0.0121***	0.0708***	−0.0251***	0.0207***	−0.00402	0.0350**	−0.00361	0.00995
	(0.00215)	(0.00296)	(0.00328)	(0.00332)	(0.00298)	(0.0153)	(0.00305)	(0.0113)
One child	−0.0723***	−0.0611***	−0.123***	−0.0784***	−0.0246***	−0.0200*	−0.0146	−0.0442**
	(0.0137)	(0.0139)	(0.0288)	(0.0271)	(0.00816)	(0.0112)	(0.0115)	(0.0204)
Two child	−0.0779***	−0.0642***	−0.0729**	−0.0765**	−0.0287***	−0.0339***	−0.0274**	−0.0448**
	(0.0145)	(0.0154)	(0.0321)	(0.0320)	(0.00851)	(0.0112)	(0.0119)	(0.0196)
More than two child	−0.0962***	−0.0860***	−0.0617*	−0.0938**	−0.0323***	−0.0640***	−0.00384	−0.0399*
	(0.0153)	(0.0181)	(0.0359)	(0.0391)	(0.00975)	(0.0114)	(0.0145)	(0.0218)
Wealth	−0.0218***	−0.00937***	0.000115	−0.0196***	−0.00291	0.000706	0.0121***	0.000404
	(0.00253)	(0.00315)	(0.00555)	(0.00474)	(0.00378)	(0.00393)	(0.00387)	(0.0111)
Urban	−0.0147**	−0.138***	−0.0471***	−0.0843***	−0.000539	−0.0827***	0.00661	−0.0430
	(0.00626)	(0.00825)	(0.0142)	(0.0129)	(0.00666)	(0.0303)	(0.0101)	(0.0423)
Married*child	0.0967***	0.0699***	0.249***	0.0878***				
	(0.0164)	(0.0132)	(0.0305)	(0.0276)				
Household size	0.00164	0.00865***	0.00131	0.00521				
	(0.00144)	(0.00278)	(0.00490)	(0.00631)				
Unimproved sanitation					0.237***	0.231***	0.416***	0.381***
					(0.0227)	(0.0179)	(0.0237)	(0.0257)
Unsafe water					0.0314***	0.0698***	0.0153	0.0101
					(0.00941)	(0.0114)	(0.0149)	(0.0134)
Constant	−0.414***	−0.481***	0.231***	−0.193***	−0.283***	−0.505***	0.0362	−0.154
	(0.0290)	(0.0238)	(0.0530)	(0.0490)	(0.0526)	(0.103)	(0.0327)	(0.117)
Correlation ρ (prob)	7.74(0.000)	3.61(0.000)	3.33 (0.001)	1.68(0.094)				
Observations	16,001	16,625	5,784	6,559	16,001	16,625	5,784	6,559

***, **, * denotes statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.
Standard errors in parentheses are clustered at the household level.

The reported results show that the rho (ρ) coefficients in all models are statistically significant for both Egypt and Tunisia, implying that chronic illness is endogenous to labor participation when gender has been considered. This result confirms the analysis of full sample models in the two countries and signifies the rejection of the exogeneity hypothesis of chronic illness.

For both Egyptian and Tunisian samples, the table shows that the coefficients of chronic disease are negative and statistically significant for male models, while for female models the impact of chronic illnesses is insignificant. This result confirms the results of the full sample, conveying evidence that being male and troubled with chronic diseases decreases the probability of participating in the labor force. However, the insignificant impact of chronic diseases coefficient in the female sample suggests that being female living with chronic illness does not affect labor force participation in both Egypt and Tunisia. This outcome can be justified by the lower rate of labor force participation among women in the two countries compared to men counterparts.

In accordance with the reverse effect of labor participation on chronic illness by gender, Table 5 indicates that for both Egypt and Tunisia, the coefficients of labor participation variable are negative and statistically significant. This outcome suggests that participating in labor force reduces the likelihood of experiencing chronic illnesses. These results also support the results of the full sample.

Concerning the control variables, Table 5 indicates that most of the explanatory variables carry their expected values, confirming the results of full sample reported in Table 4. For example, while the effect of education on labor force participation is positive, its impact on chronic illness is negative and insignificant for both males and females in the two countries, ratifying the full sample results. However, wealth turns out to have different effects on respondents' labor force status when splitting pooled sample according to gender.

Finally, to understand whether the effect of chronic disease on labor force participation varies according to age group, we divided the full sample into two sub-samples: younger respondents of ages between 15 and 39 years, and elder group with ages above 39 and less than 65 years. The estimation results of FIML for the two sub-samples are presented in Table 6.

As can be read from the table, the coefficients of chronic disease variables in the models of two age categories in both Egypt and Tunisia are negative and statistically significant. This indicates that living with a chronic disease(s) lowers the probability of participating in the labor force regardless of age in both countries. This result lends support to results obtained from the pooled samples. The results of the reverse impact of labor force participation across age groups show different outcomes across countries. While the coefficient of labor force participation variable is negative and significant for those aged between 15 and 39 years, its impact is insignificant for those aged between 40 and 64 years in Egypt. This means that elder people living with chronic illnesses are not likely to be affected by labor force participation. In contrast, the participation impact of younger people (between 15 and 39 years) is not significant, while its impact is negative and significant for the elder group (between 40 and 64 years) in the Tunisian sample. This finding implies that the LFP impact on chronic illnesses varies across age groups within the two countries.

4.2.2. Results of two-stage method

For robustness check of our analysis, we re-estimate our structural model using the two-stage method. Table 7 presents the estimated coefficients of the key variables of interest using the iv-probit estimation method.[4] As outlined in the methodology, before estimating the models, we test the validity of the instruments. The results of the Cragg–Donald F-test and Wald test for all model specifications are presented in Appendix II and III. The results show that for all estimated models, the test statistic of the Cragg–Donald F-test of the first stage exceeds the usual benchmark of 10 for all labor participation and chronic illness models, rejecting the weak instrument hypothesis. The Wald test statistics for most model specifications also reject the null hypothesis that chronic disease and LFP are exogenous. Thus, we conclude that chronic illness and labor force participation variables are endogenous.

Table 7 indicates that the results of two-stage least squares are consistent with most FIML results reported in Tables 4–6. The results of the full sample in Table 7 confirm the findings reported in Table 4, as both chronic diseases and LFP coefficients are negative and statistically significant. The results of both male and female samples are also consistent with the FIML results reported in Table 5. Likewise, the coefficients of chronic illnesses and LFP for younger group (15–39) in the two countries are in line with findings of FIML. Unexpectedly, the coefficient of LFP for the elders' group (40–64) in the Egyptian model is statistically significant, contrasting the FIML results. The difference between the results of FIML and the two-stage method can be attributed to the difference in the estimation procedures between these two methods. The two-stage method depends on the predicted value for the endogenous variables generated from the first stage estimation, which replaces the original value of the endogenous variables in the second stage of the regression. Thus, the two-stage is likely to over predict the results, particularly in small samples (Cai & Kalb, 2006). This outcome indicates that the two-stage has a lower estimation efficiency compared to the FIML method (Cai & Kalb, 2006). Therefore, we conclude that the FIML estimation method is more appropriate in examining the link between chronic illnesses and labor force participation, particularly among subgroups.

4.2.3. Effect sizes of outcome variables

We estimated the probability models to understand the actual effect size of chronic illness on participation and vice versa. Table 8 presents the results of the reference probability of the outcome variables across gender and age groups by country.

For the two countries, the magnitude of chronic illnesses on labor force participation coefficients in the male sample is greater than that of the female sample. Given the negative impact of chronic diseases in male and female samples, this result indicates that male respondents living with chronic health conditions are more likely to reduce their participation in the labor force compared to their female counterparts. Expectedly, the magnitude of chronic illnesses for the elders' group (40–64) is higher than its magnitude for the younger group (15–39), for the two countries. This implies that elders with chronic illnesses are more likely to quit labor force participation. Regarding the labor force participation results, the table indicates that the effect of chronic diseases for the female subsample is greater than that of the male group. Like the chronic impact, the magnitudes

Table 6. Estimation results of FIML for LFP and chronic illness equation by age group.

	Labor force participation				Chronic illness			
	Egypt		Tunisia		Egypt		Tunisia	
Variables	Age 15–39	Age 40–64	Age 15–39	Age 40–64	Age 15–39	Age 40–64	Age 15–39	Age 40–64
Chronic	−0.359***	−0.285***	−0.531***	−0.208***				
	(0.114)	(0.0466)	(0.127)	(0.0465)				
Participation					−0.371***	4.533	−0.0650	−1.478*
					(0.0942)	(4.143)	(0.209)	(0.831)
Age	0.114***	0.135***	0.110***	0.105***	0.0368***	−0.549	0.00456	0.147
	(0.00382)	(0.0103)	(0.00720)	(0.0152)	(0.0113)	(0.522)	(0.0239)	(0.0937)
Age square	−0.0016***	−0.0013***	−0.0016***	−0.0010***	−0.00042**	0.00599	−3.30e-05	−0.00146
	(7.28e-05)	(0.000101)	(0.000134)	(0.000147)	(0.00017)	(0.00556)	(0.00036)	(0.000985)
Head of household	0.204***	0.0675***	0.300***	0.101***	0.0761***	−0.161	0.0279	0.175**
	(0.0102)	(0.0170)	(0.0234)	(0.0266)	(0.0183)	(0.230)	(0.0616)	(0.0890)
Male	0.340***	0.359***	0.233***	0.304***	0.130***	−1.867	0.00770	0.382
	(0.00853)	(0.0182)	(0.0144)	(0.0273)	(0.0335)	(1.604)	(0.0497)	(0.273)
Married	−0.0263**	0.0890***	−0.139***	0.0335	−0.0314***	−0.358	−0.0223	0.0780
	(0.0116)	(0.0178)	(0.0321)	(0.0239)	(0.00740)	(0.345)	(0.0353)	(0.0480)
Years of schooling	0.0381***	0.0328***	−0.0103***	0.00844*	0.00456	−0.185	−0.00476**	0.0121
	(0.00269)	(0.00314)	(0.00349)	(0.00446)	(0.00419)	(0.156)	(0.00230)	(0.0104)
One child	−0.0440***	0.0225	−0.0248	−0.0514	−0.00916	−0.0767	−0.0108*	−0.0311
	(0.0108)	(0.0176)	(0.0227)	(0.0376)	(0.00630)	(0.0761)	(0.00605)	(0.0318)
Two child	−0.0464***	0.0340*	−0.0303	0.0583	0.00184	−0.205	−0.0139**	0.128
	(0.0127)	(0.0184)	(0.0276)	(0.0405)	(0.00634)	(0.144)	(0.00681)	(0.0967)
More than two child	−0.0792***	0.0455**	−0.0488	0.0530	−0.00191	−0.236	0.00995	0.126
	(0.0159)	(0.0197)	(0.0341)	(0.0409)	(0.00717)	(0.168)	(0.0105)	(0.0913)
Wealth	−0.0227***	0.00838**	−0.00787	−0.0241***	−0.0083***	0.00371	0.00205	−0.0248
	(0.00260)	(0.00393)	(0.00566)	(0.00584)	(0.00284)	(0.0219)	(0.00264)	(0.0251)
Urban	−0.0549***	−0.122***	−0.0273*	−0.110***	−0.0184**	0.601	−0.000753	−0.150
	(0.00664)	(0.00977)	(0.0150)	(0.0150)	(0.00731)	(0.528)	(0.00841)	(0.0969)
Married*child	−0.0114	−0.0119	−0.00207	0.0441				
	(0.0104)	(0.0141)	(0.0391)	(0.0360)				
Household size	0.0131***	0.00524**	0.0116*	0.000597				
	(0.00264)	(0.00256)	(0.00606)	(0.00190)				
Unimproved sanitation					0.145***	0.407*	0.298***	0.372***
					(0.0202)	(0.476)	(0.0543)	(0.102)
Unsafe water					0.0281***	0.133	0.00503	0.0175
					(0.00750)	(0.0858)	(0.00914)	(0.0142)
Constant	−1.475***	−2.802***	−1.227***	−2.124***	−0.440***	11.26	−0.0113	−3.030
	(0.0522)	(0.260)	(0.0996)	(0.392)	(0.141)	(10.81)	(0.261)	(1.929)
Correlation ρ (prob)	4.68 (0.000)	−1.02(0.309)	0.56(0.596)	1.90 (0.057)				
Observations	20,850	9,215	5,866	4,708	20,850	9,215	5,866	4,708

***, **, * denotes statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.
Standard errors in parentheses are clustered at the household level.

Table 7. Two-stage estimation results (chronic and LFP coefficients).

	Egypt		Tunisia	
Sample	Chronic coefficient	LFP coefficient	Chronic coefficient	LFP coefficient
Full sample	−0.3080***	−0.4175***	−0.3577***	−0.5432***
	(0.0399)	(0.0701)	(0.047)	(0.079)
Male	−0.4173***	−0.3194***	−0.4182***	−0.4219***
	(0.0263)	(0.1146)	(0.043)	(0.011)
Female	−0.0733	−0.4901***	−0.1187	−0.520***
	(−1.01)	(0.0735)	(0.086)	(0.1056)
Age 15–39	−0.3987***	−0.5630***	−0.5837***	−0.0411
	(0.101)	(0.0696)	(0.118)	(0.102)
Age 40–64	−0.2523***	−0.6869***	−0.2707***	−0.7941***
	(0.0331)	(0.0147)	(0.050)	(0.118)

***, **, * denotes statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.
Standard errors in parentheses are clustered at the household level.

Table 8. The probability of outcome variables.

	Egypt		Tunisia	
Sample	Chronic	LFP	Chronic	LFP
Gender				
Male	0.671	0.149	0.574	0.077
Female	0.312	0.212	0.264	0.080
Age groups				
Age 15–39	0.508	0.053	0.337	0.016
Age 40–64	0.588	0.341	0.522	0.158

Reference probabilities estimated based on the IV probit estimates.

of LFP in the elders' group are higher than its impact in the younger sub-sample for both Egypt and Tunisia. Having the negative coefficients of LFP in all model specifications, this result suggests that elder respondents participating in labor force are less likely to suffer from chronic illnesses.

5. Conclusion

This study examines the nexus between chronic illnesses and labor force participation in Egypt and Tunisia. The study also investigates the reverse effects of labor force participation on respondents' chronic illness status. The study adopted the full information maximum likelihood (FIML) method to account for the endogeneity of chronic disease and labor force participation. In addition, we applied the two-stage estimation method for the purpose of robustness check.

The results indicate that the prevalence of chronic diseases exerts negative and significant impact on labor force participation in both Egypt and Tunisia. Regarding the feedback effect, the results reveal that labor force participation has a negative and significant impact on chronic illness. These outcomes vary across sub-samples of gender and age groups. Specifically, the results indicate that chronic illness has a higher effect on labor force participation in the male sample compared to the female sample. In contrast, the effect of LFP for the female groups is higher than its effect in their male counterparts. However, the effect of both chronic diseases and LFP for the elders group (40-64) is higher than their effect in the younger group of ages 15–39 years.

Undeniably, the obtained findings apply to Egypt and Tunisia and call attention to the economic burden of chronic illness in Arab countries. Thus, these countries need sound health, economic and social policy to protect workers from being victimized by chronic diseases – and to reduce the negative effects on labor productivity and economic growth. These measures may include paying extra attention to the early inspection of chronic diseases and providing healthcare to workers with chronic illnesses. In addition, investments in health education, food policies, and urban physical infrastructure are needed to support healthcare systems. Therefore, changing lifestyles and behaviors related to smoking, physical activity, and diet is crucial. Finally, achieving universal health coverage should be at the top of the development agendas in these countries.

Notes

1. According to the World Health Organization (WHO) and UNICEF, improved sanitation is defined as either a flush toilet connected to either a piped sewer system or a septic tank, a flush/pour-flush to a pit latrine, a ventilated improved pit (VIP) latrine, a pit latrine with a cover slab, and/or a composting toilet (WHO/UNICEF, 2010, p. 34). Hence, sanitation facilities are considered unimproved when shared with other families, or open to public use (WHO/UNICEF, 2010).
2. The model is estimated using the 'sem' command with mlmv option in STATA 16.
3. It is well documented that defining chronic health conditions is a controversial issue, as there is no agreement about a standard definition for chronic illness (Wolff et al., 2002; Sambamoorthi et al., 2015). Some studies define chronic illnesses by occurrence of at least one chronic disease, while others consider chronic illnesses as a case in which a person has two or more diseases. Moreover, some studies use subjective measures such as self-assessment, while others adopt objective measures. Therefore, there has been no standard measure used to compare the prevalence of chronic conditions across countries.
4. The full results of the two-stage are available upon request from the corresponding author.

Acknowledgements

Open Access funding provided by the Qatar National Library. The authors would like to thank the anonymous reviewers for their constructive comments, and Caroline Crafft for her valuable comments on the first draft.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the Economic Research Forum.

References

Allison, P. D. (1999). Comparing logit and probit coefficients across groups. *Sociological Methods & Research*, *28*(2), 186–208. https://doi.org/10.1177/0049124199028002003

Anderson, K. H., & Burkhauser, R. V. (1985). The retirement-health nexus: A new measure of an old puzzle. *Journal of Human Resources*, *20*(3), 315–330. https://doi.org/10.2307/145884

Angel-Urdinola, D. F., & Tanabe, K. (2012). *Micro-determinants of informal employment in the Middle East and North Africa region*. World Bank.

Baanders, A. N., Rijken, P. M., & Peters, L. (2002). Labor participation of the chronically ill. *The European Journal of Public Health*, *12*(2), 124–130. https://doi.org/10.1093/eurpub/12.2.124

Baker, M., Stabile, M., & Deri, C. (2004). What do self-reported, objective, measures of health measure? *Journal of Human Resources*, *39*(4), 1067–1093. https://doi.org/10.2307/3559039

Becker, G. S. (1964). *Human capital theory*. Columbia.

Becker, G. S. (1965). A theory of the allocation of time. *The Economic Journal*, *75*(299), 493–517. https://doi.org/10.2307/2228949

Benitez-Silva, H., Buchinsky, M., Man Chan, H., Cheidvasser, S., & Rust, J. (2004). How large is the bias in self-reported disability? *Journal of Applied Econometrics*, *19*(6), 649–670. https://doi.org/10.1002/jae.797

Blackaby, D., Clark, K., Drinkwater, S., Leslie, D., Murphy, P., & O'Leary, N. (1999). *Earnings and employment opportunities of disabled people*. Department for Education and Employment, Research Report No. (133).

Bound, J., Schoenbaum, M., Stinebrickner, T. R., & Waidmann, T. (1999). The dynamic effects of health on the labor force transitions of older workers. *Labor Economics*, *6*(2), 179–202. https://doi.org/10.1016/S0927-5371(99)00015-9

Bradley, C. J., Neumark, D., & Motika, M. (2012). The effects of health shocks on employment and health insurance: The role of employer-provided health insurance. *International Journal of Health Care Finance and Economics*, *12*(4), 253–267. https://doi.org/10.1007/s10754-012-9113-2

Bridges, S., & Lawson, D. (2008). *Health and labor market participation in Uganda. WIDER working paper 7/2008*. UNU-WIDER.

Cai, L. (2010). The relationship between health and labor force participation: Evidence from a panel data simultaneous equation model. *Labor Economics*, *17*(1), 77–90. https://doi.org/10.1016/j.labeco.2009.04.001

Cai, L., & Kalb, G. (2006). Health status and labor force participation: Evidence from Australia. *Health Economics*, *15*(3), 241–261. https://doi.org/10.1002/hec.1053

Campolieti, M. (2002). Disability and the labor force participation of older men in Canada. *Labor Economics*, *9*(3), 405–432. https://doi.org/10.1016/S0927-5371(02)00051-9

Corburn, J., & Hildebrand, C. (2015). Slum sanitation and the social determinants of women's health in Nairobi, Kenya. *Journal of Environmental and Public Health*, *2015*. https://doi.org/10.1155/2015/209505

Cragg, J. G., & Donald, S. G. (1993). Testing identifiability and specification in instrumental variable models. *Econometric Theory*, *9*(2), 222–240.

Dwyer, D. S., & Mitchell, O. S. (1999). Health problems as determinants of retirement: Are self-rated measures endogenous? *Journal of Health Economics*, *18*(2), 173–193. https://doi.org/10.1016/S0167-6296(98)00034-4

Gannon, B. (2005). A dynamic analysis of disability and labor force participation in Ireland 1995–2000. *Health Economics*, *14*(9), 925–938. https://doi.org/10.1002/hec.1044

Global Health Estimates. (2020). *Deaths by cause, age, sex, by country and by region, 2000–2019*. World Health Organization. https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death

Gobalarajah, K., Subramaniam, P., Jayawardena, U. A., Rasiah, G., Rajendra, S., & Prabagar, J. (2020). Impact of water quality on Chronic Kidney Disease of unknown etiology (CKDu) in Thunukkai Division in Mullaitivu District, Sri Lanka. *BMC Nephrology*, *21*(1), 1–11. https://doi.org/10.1186/s12882-020-02157-1

Greene, W. (1993). *Econometric analysis*. Macmillan.

Grossman, M. (1972). On the concept of health capital and the demand for health. *Journal of Political Economy*, *80*(2), 223–255. https://doi.org/10.1086/259880

Gyasi, R. M., Simiyu, S., & Bagayoko, M. (2022). Water, sanitation and the risk of chronic diseases in old age: Results from the Ghana WHO SAGE 2. *F1000Research*, *11*(266), 266. https://doi.org/10.12688/f1000research.75541.1

Hajat, C., & Stein, E. (2018). The global burden of multiple chronic conditions: A narrative review. *Preventive Medicine Reports*, *12*, 284–293. https://doi.org/10.1016/j.pmedr.2018.10.008

Hajjar, R. R., Atli, T., Al-Mandhari, Z., Oudrhiri, M., Balducci, L., & Silbermann, M. (2013). Prevalence of aging population in the Middle East and its implications on cancer incidence and care. *Annals of Oncology*, *24*, vii11–vii24. https://doi.org/10.1093/annonc/mdt268

Jayasumana, C., Paranagama, P., Agampodi, S., Wijewardane, C., Gunatilake, S., & Siribaddana, S. (2015). Drinking well water and occupational exposure to Herbicides is associated with chronic kidney disease, in Padavi-Sripura, Sri Lanka. *Environmental Health*, *14*(1), 1–10. https://doi.org/10.1186/1476-069X-14-6

Joshi, D., Fawcett, B., & Mannan, F. (2011). Health, hygiene and appropriate sanitation: Experiences and perceptions of the urban poor. *Environment and Urbanization*, *23*(1), 91–111. https://doi.org/10.1177/0956247811398602

Kaneda, T., & El-Saharty, S. (2017). *Curbing the noncommunicable disease epidemic in the Middle East and North Africa: Prevention among young people is the key*. Population Reference Bureau.

Kankeu, H. T., Saksena, P., Xu, K., & Evans, D. B. (2013). The financial burden from non-communicable diseases in low-and middle-income countries: A literature review. *Health Research Policy and Systems*, *11*(1), 31. https://doi.org/10.1186/1478-4505-11-31

Kelley, K., & Preacher, K. J. (2012). On effect size. *Psychological Methods*, *17*(2), 137. https://doi.org/10.1037/a0028086

Kreider, B. (1999). Latent work disability and reporting bias. *Journal of Human Resources*, *34*(4), 734–769. https://doi.org/10.2307/146415

Lancaster, K. (1966). Change and innovation in the technology of consumption. *The American Economic Review*, *56*(1/2), 14–23. https://www.jstor.org/stable/1821263

Laplagne, P., Glover, M., & Shomos, A. (2007). *Effects of health and education on labor force participation*. SSRNn no. 1018889.

McIntyre, D., Thiede, M., Dahlgren, G., & Whitehead, M. (2006). What are the economic consequences for households of illness and of paying for health care in low-and middle-income country contexts? *Social Science & Medicine*, *62*(4), 858–865. https://doi.org/10.1016/j.socscimed.2005.07.001

Mete, C., & Schultz, T. P. (2002). *Health and labor force participation of the elderly in Taiwan*. Yale University Economic Growth Center Discussion Paper, (846).

Mood, C. (2010). Logistic regression: Why we cannot do what we think we can do, and what we can do about it. *European Sociological Review*, *26*(1), 67–82. https://doi.org/10.1093/esr/jcp006

Nwosu, C. O., & Woolard, I. (2015). *Impact on health on labor force participation in South Africa*. Economic Research South Africa (ESRA) Working Paper No. 548.

Pitt, M. M., & Rosenzweig, M. R. (1990). Estimating the intrahousehold incidence of illness: Child health and gender-inequality in the allocation of time. *International Economic Review*, *31*(4), 969–989. https://doi.org/10.2307/2527025

Rahim, H. F. A., Sibai, A., Khader, Y., Hwalla, N., Fadhil, I., Alsiyabi, H., & Husseini, A. (2014). Non-communicable diseases in the Arab world. *The Lancet*, *383*(9914), 356–367. https://doi.org/10.1016/S0140-6736(13)62383-1

Rocco, L., Tanabe, K., Suhrcke, M., & Fumagalli, E. (2011). *'Chronic diseases and labor market outcomes in Egypt, world bank policy research working paper series, No. 5575*. World Bank.

Sambamoorthi, U., Tan, X., & Deb, A. (2015). Multiple chronic conditions and healthcare costs among adults. *Expert Review of Pharmacoeconomics & Outcomes Research*, *15*(5), 823–832. https://doi.org/10.1586/14737167.2015.1091730

Schultz, T. P., & Tansel, A. (1997). Wage and labor supply effects of illness in Cote d'Ivoire and Ghana: Instrumental variable estimates for days disabled. *Journal of Development Economics*, *53*(2), 251–286. https://doi.org/10.1016/S0304-3878(97)00025-4

Stern, S. (1989). Measuring the effect of disability on labor force participation. *Journal of Human Resources*, *24*(3), 361–395. https://doi.org/10.2307/145819

Sullivan, G. M., & Feinn, R. (2012). Using effect size – Or why the *P* value is not enough. *Journal of Graduate Medical Education*, *4*(3), 279–282. https://doi.org/10.4300/JGME-D-12-00156.1

Wolff, J. L., Starfield, B., & Anderson, G. (2002). Prevalence, expenditures, and complications of multiple chronic conditions in the elderly. *Archives of Internal Medicine*, *162*(20), 2269–2276. https://doi.org/10.1001/archinte.162.20.2269

World Health organization (WHO), and UNICEF. (2010). Progress on sanitation and drinking-water: 2010 update. In *Progress on sanitation and drinking-water: 2010 update* (pp. 60–60).

Zhang, X., Zhao, X., & Harris, A. (2009). Chronic diseases and labor force participation in Australia. *Journal of Health Economics*, *28*(1), 91–108. https://doi.org/10.1016/j.jhealeco.2008.08.001

Appendices

Appendix I. Descriptive statistics for the variables used in the analysis.

		Egypt		Tunisia	
Variable	Definition	Mean	Std. Dev.	Mean	Std. Dev.
Participation	1 = if individual participates in labor force (of age 15-64) and 0 = otherwise	0.519	0.499	0.453	0.497
Chronic illness	1 = if reports at least one chronic disease and 0 = otherwise	0.194	0.396	0.186	0.389
Age	Age of the respondent in completed years	26.308	19.932	34.370	22.545
Head	1 = if he/she is the head of the household and 0 = otherwise	0.245	0.430	0.275	0.446
Male	Gender of the head of household (1 = male; 0 = female)	0.498	0.500	0.480	0.500
Married	1 = if he/she is married and 0 = otherwise	0.431	0.495	0.450	0.498
Year of schooling	Year of schooling	7.421	5.303	5.845	5.113
One child	1 = if has one child and 0 = otherwise	0.204	0.403	0.171	0.376
Two child	1 = if has two child and 0 = otherwise	0.250	0.433	0.180	0.385
More than two child	1 = if has more than two child and 0 = otherwise	0.308	0.462	0.198	0.399
Wealth	Wealth quantile	2.908	1.398	2.695	1.394
Urban	1 = urban, 0 = otherwise	0.436	0.496	0.430	0.495
Married*child	Interaction between married and having child under 14 years	0.313	0.464	0.227	0.419
Household size	Number of household' members	4.979	2.203	4.463	1.732
Unimproved sanitation	1 = using shared with other families, or no facility, or open to public use; 0 = otherwise	0.047	0.201	0.046	0.209
Unsafe water	1 = using non-piped water; 0 = otherwise	0.066	0.248	0.117	0.322

Appendix II. Results of Cragg–Donald and Wald *F*-test – chronic illnesses equation.

	Egypt		Tunisia	
Sample	Cragg–Donald *F*-test	Wald test	Cragg–Donald *F*-test	Wald test
Full sample	552.72	38.45	601.62	23.26
	(0.000)	(0.000)	(0.000)	(0.000)
Male	347.32	103.82	400.16	32.40
	(0.000)	(0.000)	(0.000)	(0.000)
Female	225.35	1.13	205.41	0.54
	(0.000)	(0.287)	(0.000)	(0.461)
Age 15–39	158.74	11.01	307.26	9.78
	(0.000)	(0.000)	(0.000)	(0.001)
Age 40–64	489.38	30.13	560.65	22.69
	(0.000)	(0.000)	(0.000)	(0.000)

Values in parentheses are *P*-values.

Appendix III. Results of Cragg–Donald and Wald *F*-test – LFP equation.

	Egypt		Tunisia	
Sample	Cragg–Donald *F*-test	Wald test	Cragg–Donald *F*-test	Wald test
Full sample	68.19	23.92	18.00	0.52
	(0.000)	(0.000)	(0.000)	(0.473)

(*Continued*)

Appendix III. Continued.

	Egypt		Tunisia	
Sample	Cragg–Donald *F*-test	Wald test	Cragg–Donald *F*-test	Wald test
Male	56.22	3.71	12.20	2.35
	(0.000)	(0.054)	(0.000)	(0.124)
Female	20.44	22.76	2.38	0.101
	(0.000)	(0.000)	(0.091)	(0.909)
Age 15–39	37.66	31.68	10.87	0.18
	(0.000)	(0.000)	(0.000)	(0.692)
Age 40–64	35.11	3.30	20.43	0.53
	(0.000)	(0.69)	(0.000)	(0.466)

Values in parentheses are *P*-values