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RESEARCH ARTICLE

Social determinants of chronic diseases reporting among slum dwellers in Egypt

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Abstract

The high prevalence of chronic diseases in urban slums poses increasing challenges to future social and economic development for these disadvantaged areas. Assessing the health status of slum residents offers guidance for formulating appropriate policies and interventions to improve slum residents' health outcomes. This research aimed to identify the social determinants of chronic diseases reporting among slum dwellers in Egypt. A cross-sectional survey was conducted from March to December 2021 in three slum areas in Giza governorate, Egypt, including 3,500 individuals. We constructed an asset index and a welfare index to measure the economic status and living conditions of slum residents, respectively. We used these indices, along with demographic and socio-economic factors, as independent variables in the analysis. We modeled factors associated with health status using a two-level mixed logistic model to control the effects of slum areas and the potential correlation between household members. The study contributed significantly to a better understanding of the context in which slum dwellers live and the interlinkages among poor living conditions, low economic status, and health outcomes. The results showed a high rate of self-reported chronic diseases among adults aged 18 and older, reaching more than 22%, while it did not exceed 2.0% among children in the slum areas. Therefore, measuring the determinants of chronic diseases was limited to adults. The sample size was 2530 adults after excluding 970 children. The prevalence of chronic diseases among adults ranged between 16.3% in Zenin and 22.6% in Bein El Sarayat. Our findings indicated that low socio-economic status was significantly associated with reporting chronic diseases. Future policies should be dedicated to improving living conditions and providing necessary healthcare services for these vulnerable areas.

Keywords: health; self-reported chronic diseases; social determinants; slums; two-level mixed logistic model

Introduction

Over time, slums have extensively spread across developing countries and have become a distinctive feature of cities. Worldwide, the proportion of the urban population living in slum areas increased from 23%in 2014 to 24% in 2018, reaching 1 billio3n slum dwellers (UNSD, 2021). The United Nations defines slum areas as "a group of individuals that live under the same roof that lack one or more of the following conditions: access to improved water, access to improved sanitation, sufficient living space, durability of housing and secure tenure" (UN-Habitat, 2006). UNESCO defines a slum as "a contiguous settlement where the inhabitants are characterized as having inadequate housing and basic services" (Ezeh *et al.*, 2017).

A large proportion of slum residents are rural migrants, unemployed persons, illegal and legal migrants, refugees, and displaced persons (Pradhan, 2017). Although the prevailing hypothesis is that living conditions and infrastructure services in slums are poor, some slum residents have better access to water than other non-slum residents (Kanungo *et al.*, 2021; Satapathy, 2014).

Moreover, not all slum residents live in poverty (Ezeh *et al.*, 2017), and there are inequalities in healthcare utilization in favor of better-off slum residents (Kien *et al.*, 2014).

Chronic diseases have social and economic burdens that do not fall entirely on households but also affect the economy (El-Saadani *et al.*, 2021), and the situation is worse in slum areas because of the spread of chronic diseases accompanied by poor health infrastructure, lack of knowledge of risk factors, and means of prevention and treatment (Adams *et al.*, 2020; Park *et al.*, 2022). Unhealthy living conditions in slums are correlated with self-reported chronic diseases. Previous studies demonstrated that they lead to adverse health effects causing lower life expectancy through higher rates of mortality and infectious, non-communicable, and reproductive diseases (Gadallah *et al.*, 2017; Szwarcwald *et al.*, 2011).

Non-communicable chronic diseases (NCDs) including cardiovascular and chronic respiratory diseases, diabetes, and cancer are currently the leading causes of death in Egypt. The WHO (2017) estimates that NCDs are responsible for 82% of all deaths in Egypt and 67% of premature deaths. Slum health conditions in Egypt are worsening, particularly with the high prevalence of causal factors for chronic diseases such as tobacco use, malnutrition, obesity, lack of physical activity, and alcohol abuse (Gadallah *et al.*, 2017, 2018). Self-reported health outcomes of slum dwellers are often worse than those in urban areas due to the noticeable gap in the availability, accessibility, and quality of health services between urban and slum areas (Kien *et al.*, 2017; Vlahov *et al.*, 2007). Slum residents are often located away from different healthcare facilities found in cities away from slum areas. Moreover, the few public health facilities available in slum areas are usually overcrowded and mainly dedicated to family planning and child healthcare (Gadallah *et al.*, 2017).

Many studies have focused on examining the relationship between socio-economic status (SES) and health status. On the one hand, there is a well-established relationship between low SES and poor health (Ferrer and Palmer, 2004; Fritzell *et al.*, 2004; Hosseinpoor *et al.*, 2012; Martikainen *et al.*, 2004; Subramanian *et al.*, 2013; Yiengprugsawan *et al.*, 2007). Self-reported chronic diseases have been more concentrated among poor households and much more frequent among them in slums (Kien *et al.*, 2017). Underserved groups living in poor areas of low SES are more susceptible to morbidity and mortality because they are highly exposed to risk factors of chronic diseases such as smoking, obesity, and high blood pressure in addition to lacking access to healthcare for early diagnosis and timely treatment (Allen *et al.*, 2017; Di Cesare *et al.*, 2013; Stuckler *et al.*, 2012). Extensive research indicated that poor observed health outcomes in slum areas are rooted in three main characteristics: poor environmental conditions and inadequate infrastructure; limited access to preventive and treatment services due to inability to pay; and using poor quality health services that are often informal, unregulated, and unsuitable for truly meeting community health needs (Gruebner *et al.*, 2012; Harpham, 2009; Latif *et al.*, 2016a; Unger and Riley, 2007; Zulu *et al.*, 2011).

Contrary to previous perceptions, some studies have highlighted a positive association between SES and chronic diseases prevalence in low- and middle-income countries (Vellakkal *et al.*, 2015; Wang *et al.*, 2014; Williams *et al.*, 2018). SES gradient in chronic disease prevalence is related to the type of measurement. Individuals of higher SES tend to have greater knowledge about disease symptoms as well as better access to healthcare compared to poor and less-educated individuals (Hosseinpoor *et al.*, 2012). Therefore, self-reported chronic diseases are more likely to concentrate among high-SES individuals (positive SES gradients), while chronic diseases are more likely to concentrate among low-SES individuals based on criterion-based measures (negative SES gradients). The same SES gradients are confirmed in other health outcomes, for example, childhood obesity was positively correlated with income at lower development levels and negatively correlated with income at higher development levels (Broyles *et al.*, 2015).

In this context, we sought to investigate the main socio-economic factors that affect chronic diseases self-reporting among slum dwellers in Egypt. The study focused on three urban unplanned slums in Egypt, namely Bein El Sarayat, Abou Qatada, and Zenin. Our study relied on self-reported chronic diseases, so the prevalence rate of chronic diseases in the surveyed slums

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may be underestimated and far from the national figure. It is uncertain whether the well-established SES gradient exists for slum residents in Egypt, there is insufficient information on the prevalence of chronic diseases, availability of health services, and utilization rates in slums. Additionally, the true prevalence rate of chronic disease among low socio-economic groups may be underestimated due to self-reported measures of chronic diseases.

Our review of the previous literature highlighted a clear gap in the number of quantitative research studies that addressed health issues in the slums of Egypt. A few researchers have conducted health assessments of Egyptian slum residents and focused on specific elements such as child and maternal health or chronic disease occurrence. Mberu *et al.* (2016) compared the health status of slum, non-slum, urban, and rural populations in four developing countries including Egypt using demographic, urban health, and special cross-sectional slum surveys and a focus on child and maternal health; reproductive health; access to health services; and HIV/AIDS indicators. They found that children in slums had significantly worse health outcomes than those living in other residential areas, including in rural areas. Slum residents also had higher maternal health service coverage than other residential areas, were less fertile, and had higher rates of contraceptive use than residents of rural areas, but these numbers were the opposite in comparison with residents of urban areas. In another study, Gadallah *et al.* (2017) assessed the health equity in Gezerit El Warak, a slum area located in Giza governorate, Egypt, using the WHO Urban Health Equity Assessment and Response Tool. The authors found that slum residents suffered inadequate physical infrastructure and had a high prevalence of tobacco smoking, diabetes, and hypertension than reported national figures. Khalil *et al.* (2018) discussed youth access to services and infrastructure in informal settlements in greater Cairo and indicated whether the area of residence, especially slums, affected their access to these services. Gadallah *et al.* (2018) investigated the prevalence of risk factors for cardiovascular diseases among slum residents in Manshiyat Naser in Cairo and measured their association with hypertension. They found that the residents of Manshiyat Naser were more likely to have cardiovascular disease than the general Egyptian population.

Although assessing the health status of slum residents and measuring the prevalence of chronic diseases are important for designing evidence-based policies, few researchers have assessed the health status of slum residents in Egypt, and most of the available studies were descriptive. In addition, the relationship between SES and health outcomes has not been sufficiently explored in the existing slums in Egypt. In this context, we attempted with this research to fill this gap in the literature and answer a vital question for decision-makers: What are the main determinants of self-reporting chronic diseases in slum areas in Egypt?

Slums in Egypt

Developing countries lack reliable statistics for slums due to the multiplicity of definitions used to classify slum areas (Nolan, 2015), and Egypt is no exception. Egypt's Central Agency for Public Mobilization and Statistics defines slums as informal areas that were established by self-effort, whether on privately owned lands or state lands without official licenses. Informal areas in Egypt are divided into unplanned and unsafe areas. Unsafe areas refer to those prone to rockslides, torrential rains, and railway accidents (Ministry of Planning and Economic Development, 2021).

According to official 2014 statistics published by the Egyptian Cabinet's Information and Decision Support Center (IDSC), slums have expanded greatly, reaching 1,221 areas, occupying 160,800 acres, and inhabited so far by between 35 and 40 million citizens. Slums represent approximately 38% of the total urban mass in Egypt and have spread in 226 out of a total of 234 cities. The total area of unplanned slums amounts to 156,300 feddans[1], representing 97.2% of the slums' total area in Egypt. Although the total number of unsafe slums amounted to 351 areas

[1]Feddan is an Egyptian unit of area equal to 1.038 acres.

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occupying an area of 4.5 thousand acres, representing 2.8% of slum areas and including 215.4 thousand housing units nationwide in 2016 (IDSC, 2014). Many factors accelerated the growth of slums in Egypt: the imbalance between the supply of planned land for formal housing and housing demand, the inability of the private sector to remain in the housing market effectively because of unfavorable rental laws, massive population flows from the countryside to major urban cities in search of job opportunities, and absence of government oversight (Khalifa, 2011).

The Egyptian government has made a shift in tone from complete disregard and negligence towards policies aimed at identifying and upgrading slums. The government has upgraded some unplanned slum areas with new attractive buildings and integrated services. Moreover, since the launch of the UN's 2016 development agenda for 2030, Egypt has taken acceptable steps to achieve as part of its Sustainable Development Goals (SDGs) guaranteed access for all to adequate, safe, and affordable housing including basic services (Goal 11). The proportion of individuals living in households with access to basic services has increased remarkably: More than 90% have access to electricity (99.7%) and clean water (99.0%), although only two-thirds of households have access to sanitation. Nevertheless, despite efforts to achieve Goal 11 related to creating sustainable and safe cities and communities, there are noticeable variations in development within and between the regions and governorates, and slums and other less developed areas still show significant differences from urban areas (Ministry of Planning and Economic Development, 2021).

Methods

Study design and sample size

Egypt lacks periodic statistics on the size and extent of its slums; mortality and morbidity cases among slum residents are drawn primarily from governmental hospitals and vital statistics offices. Thus, financial requirements dedicated to healthcare needs are usually underestimated, and disease prevention services are inadequate (Ko *et al.*, 1999). In this context, we conducted this research with funding from Cairo University to collect information on demographic, health, and socio-economic characteristics of slum areas, hoping to guide the development of effective policies and appropriate interventions to improve health outcomes in these disadvantaged areas. The study focused on three slum areas in Giza, Egypt, called Bein El Sarayat, Abou Qatada, and Zenin. The three areas satisfy the (UN-Habitat, 2003, 2006) operational definition of slums.

The sample size was determined using the prevalence of chronic diseases and other indicators identified in the pilot survey including the unemployment rate in slum areas. We found that 17% of households have at least one member with chronic disease based on conducting a pilot study with 35 households that were not included in the study sample. Following Lwanga and Lemeshow (1991), the target sample size was 890 households based on the significance level of 0.05, relative precision/error of 0.4, sample design effect of 1.5, and after controlling for a 10% non-response rate. We increased the sample to 900 households distributed evenly over the three slums, with 300 households from each area. We randomly selected households and conducted face-to-face interviews with households. To our best knowledge, this is the first research study of these areas.

Data collection

We do not have a list of the entire target population. Since we are interested in surveying slum residents, we consulted maps of the selected slum areas and identified the main streets in each slum. We divided slums first into main streets which have roughly the same characteristics. Then we randomly selected a number of those streets and data collectors randomly selected households from the main streets and moved gradually to the small side streets until 300 households were completed in each area.

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A household is defined as a group of individuals sharing housing and food expenses for at least 6 months before the survey. The data collectors targeted the head of each household to fill out the questionnaire, but if the head was not available at the time, the interview was conducted with any adult in the household. The non-response rate ranged from 5% to 7% across all surveyed slums, and we excluded 29 households for incorrect information.

The process of conducting this community-based study in Giza took approximately 9 months from March 31 to December 31, 2021. The stages of the study included writing a conceptual framework; designing the questionnaire; conducting a pretest; finalizing the questionnaire; training data collectors; organizing and carrying out the fieldwork including supervising data collectors; arranging for incomplete questionnaires to be completed; random rechecks to verify the data validity; and coding, entry, cleaning, and analyzing the data. The analysis was carried out at the individual level by using the STATA program.

The health status of all household members was collected including self-reported chronic diseases and healthcare utilization, along with demographic and socio-economic characteristics, household property, and living conditions. The survey also requested information on health, education, security, and transportation services in the three slums and the most important problems facing their residents. We also addressed possibilities for slum residents' ethical and cooperative participation in development plans and their suggested solutions for reducing unemployment and poverty rates and improving the quality of life in slums. For more details on study design, questionnaire design, and survey administration, see Abdel-Rahman *et al.* (2022).

Statistical analysis

Differing socio-economic classifications of households helps to explain the differences in chronic disease reporting (Falkingham *et al.*, 2011; Zulu *et al.*, 2011). Variables such as educational attainment and marital status are measurable and show acceptable accuracy, but income fluctuates and is more sensitive to life-related changes. Thus, to properly measure the economic status of households, we constructed an asset index that was composed of ownership of key durable assets (TVs, computers, land and mobile phones, refrigerators, deep freezers, fans or air conditioning, a sewing machine, a dishwasher, a fully automatic washing machine or any other washing machine, water heaters, tables, beds, couches, a motorcycle, scooter, private car or van, or any other wheeled transport). Assets indices have been validated as reflecting permanent income (Ferguson *et al.*, 2003) while avoiding the endogeneity of total expenditures (O'Donnell *et al.*, 2005).

Quality of life has become a topic of sustained importance in the context of increasing morbidity prevalence and poor self-reported health outcomes in slums (Thumboo *et al.*, 2003). To reflect the living and environmental conditions of slum residents, we constructed a welfare index that comprised living conditions such as type of dwelling (apartment, entire house, one or more rooms in a condominium, or wooden or tin shack); construction materials used in dwellings, number of rooms in the house; access to utilities and infrastructure, including sanitation facilities; sources of drinking water; cooking fuel used; latrine facilities and drainage; waste disposal; street condition (paved or dirt); the area around the house (dry, standing water); health and education facilities; communications; and security. In creating this index, we attempted to capture different important components of the quality of life for residents of slums. We used principal component analysis to construct indicators and categorized households into quintiles.

A descriptive analysis was conducted to describe the socio-economic characteristics of the slum residents. Chi-squared test was used to test differences between characteristics of the study participants across slum areas. Crude and adjusted odds ratios (OR) were calculated with their corresponding 95% confidence interval (CI) to analyze study participants according to self-reporting or non-self-reporting of chronic diseases. The significance level was set to 0.05, and all variables with p-values less than 0.05 were considered significant predictors.

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Random intercept two-level logistic regression model is used to identify the factors associated with self-reporting chronic disease. The dependent variable y_{ij} denotes binary response for the ith individual in the jth household. The value of y_{ij} will be 1 if ith individual in the jth household has chronic disease and zero otherwise. We regressed the outcome variable on the demographics and socio-economic variables: At the individual level, the independent variables included sex, age, kinship ties to household head, educational attainment, marital status, and employment status. The asset index and welfare index are the most concerned independent variables at the household level besides the slum area; we also control the household size and the presence of economically active adults. The transformed probability π_{ij} for random intercept model with explanatory variables x_{Pij} can be written as: (Leyland and Groenewegen, 2020).

$$logit(\pi_{ij}) = log\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \beta_0 + \beta_1 x_{1ij} + \ldots + \beta_p x_{pij} + u_{0j}$$

Where

$i = 1, \ldots, N$ individuals and each live in one household $j = 1, \ldots, J$. There are n_j individuals from household j.

π_{ij} : The probability of a success ($y_{ij} = 1$).

β_0: Intercept

β_p : Regression coefficient associated with x_{pij}.

x_{pij}: Explanatory variables.

u_{0j} : Level two random effect for household j follow normal distribution with mean zero and variance σ^2_{u0}.

Results

Three urban slums in the Giza governorate in Egypt were selected for this study: Bein El Sarayat, Abou Qatada, and Zenin. The target sample size is 900 households distributed equally among the three slums. The total number of respondents reached 3,500. The 3,500 respondents were distributed as follows: 1,113 in Bein El Sarayat, 1,240 in Abou Qatada, and 1,147 in Zenin. Overall, our sample consisted of 51.9% men and 48.1% women, and the mean age was 30.7 ± 18.69 years. More than half of respondents were married (56.8%), about a quarter had never attended any school, and 29% had attended secondary school.

As Table 1 shows, the distributions of demographic, socio-economic, and health variables differed significantly among the three slums. The majority of respondents in the three slum areas were adults (71.7% in Bein El Sarayat, 69% in Abou Qatada, 61.5% in Zenin). While the percentage of children in Zenin was 34.6% compared to 21.6% in Bein El Sarayat. The distributions of males and females were similar in the three regions. More than half of the households in Bein El Sarayat (57.9%) consisted of three to four members, and six out of 10 households in Abou Qatada consisted of at least five members.

The three slums were characterized by high proportions of unemployed: 57.1%, 63.2%, and 54.6%, respectively, in Bein El Sarayat, Abou Qatada, and Zenin. This high unemployment was consistent with the low education levels, reflected in the fact that most respondents' highest education level attained was secondary; by sex, school non-enrollment rates were higher among females than among males. By contrast, in actual education pursued by sex, the female enrollment rate at the compulsory level was higher than enrollment among men in all three regions. However, the number of females dwindled at the secondary and university levels, and this may be due to early marriage in these poor neighborhoods where all respondents who had married before 18 years old were females.

The proportions of migrants among the respondents were 8.3%, 12.8%, and 11.9% in Bein El Sarayat, Abou Qatada, and Zenin, respectively. Over half, 56.4% of the migrants were women, and

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Table 1. Demographic, Socio-Economic, and Health Characteristics of the Total Sample ($N = 3500$)

Variable	Bein El Sarayat ($N = 1113$) *n* (%)	Abou Qatada ($N = 1240$) *n* (%)	Zenin ($N = 1147$) *n* (%)	*p*-value
Demographic characteristics				
Age				
0–17	240 (21.6)	333 (26.9)	397 (34.6)	
18–64	798 (71.7)	855 (69.0)	705 (61.5)	<0.001***
65+	75 (6.7)	52 (4.2)	45 (3.9)	
Sex				
Male	572 (51.4)	640 (51.6)	603 (52.6)	
Female	541 (48.6)	600 (48.4)	544 (47.4)	0.835
Relationship to HH				
Head of the household	300 (27.0)	300 (24.2)	300 (26.2)	
Wife or husband	220 (19.8)	206 (16.6)	228 (19.9)	
Son or daughter	551 (49.5)	656 (52.9)	586 (51.1)	<0.001***
Another kinship	42 (3.8)	78 (6.3)	33 (2.9)	
Marital status				
Less than minimum age (<15)	191 (17.2)	266 (21.5)	338 (29.5)	
Married	572 (51.4)	492 (39.7)	471 (41.1)	
Divorced/separated	32 (2.9)	41 (3.3)	22 (1.9)	
Widowed	61 (5.5)	60 (4.8)	61 (5.3)	<0.001***
Unmarried	257 (23.1)	381 (30.7)	255 (22.2)	
Place of birth				
Same area	1021 (91.7)	1081 (87.2)	1010 (88.1)	
Other (migrant)	92 (8.3)	159 (12.8)	137 (11.9)	
Household size				
1–2	80 (7.2)	84 (6.8)	92 (8.0)	0.001**
3–4	644 (57.9)	421 (34.0)	572 (49.9)	
5–6	354 (31.8)	603 (48.6)	433 (37.8)	
7+	35 (3.1)	132 (10.6)	50 (4.4)	<0.001***
Socio-economic and health characteristics				
Attended school before				
Less than minimum age (<6)	52 (4.7)	80 (6.5)	118 (10.3)	
Yes	894 (80.3)	918 (74.0)	772 (67.3)	
No	167 (15.0)	242 (19.5)	257 (22.4)	<0.001***

(*Continued*)

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Table 1. (*Continued*)

Variable	Bein El Sarayat (N = 1113) *n* (%)	Abou Qatada (N = 1240) *n* (%)	Zenin (N = 1147) *n* (%)	*p*-value
Education level[a]				
Primary school or less	178 (16.0)	223 (18.0)	167 (14.6)	
Preparatory	116 (10.4)	187 (15.1)	134 (11.7)	
Secondary	322 (28.9)	367 (29.6)	310 (27.0)	<0.001***
University or higher	278 (25.0)	133 (10.7)	161 (14.0)	
Not applicable[b]	219 (19.7)	330 (26.6)	375 (32.7)	
Employment status				
Less than minimum age (<6)	52 (4.7)	80 (6.4)	118 (10.3)	
Employed	426 (38.3)	376 (30.3)	403 (35.1)	
Unemployed	635 (57.1)	784 (63.2)	626 (54.6)	<0.001***
Economic status (asset index)				
Poorest	178 (16.0)	254 (20.5)	156 (13.6)	
Poor	244 (21.9)	290 (23.4)	174 (15.2)	
Middle	321 (28.8)	224 (18.1)	342 (29.8)	
Rich	117 (10.5)	249 (20.1)	237 (20.7)	
Richest	253 (22.7)	223 (18.0)	238 (20.7)	
Living conditions (welfare index)				<0.001***
Lowest 20%	521 (46.8)	34 (2.7)	94 (8.2)	
Lower 20%	191 (17.2)	27 (2.2)	460 (40.1)	
Middle 20%	98 (8.8)	297 (24.0)	314 (27.4)	
Higher 20%	148 (13.3)	446 (36.0)	145 (12.6)	
Highest 20%	155 (13.9)	436 (35.2)	134 (11.7)	
Self-reported chronic disease				<0.001***
Yes	202 (18.1)	165 (13.3)	128 (11.2)	
No	911 (81.9)	1075 (86.7)	1019 (88.8)	
Having disability				
Yes	25 (2.2)	30 (2.4)	22 (1.9)	
No	1088 (97.8)	1210 (97.6)	1125 (98.1)	<0.001*** 0.701

[a]The educational level is the last educational stage that the respondent attended.
[b]Not applicable includes both individuals less than 6 years old and who have not previously attended school.
***$p < 0.001$, **$p < 0.01$, *$p < 0.05$. The chi-squared test was used to test differences between proportions.

they reported that accompanying their husbands and searching for work were the main drivers of their migration. Based on the assets index, more than a third of the respondents in Bein El Sarayat and Abou Qatada lived in poor households. By contrast, 29.8% of residents in Zenin lived in the middle quintile, and 41.4% lived in better-off households. We observed significant variation across households within the same slum area based on the welfare index, which reflected living conditions and environmental characteristics. Nearly half, 46.8%, of individuals in Bein El Sarayat

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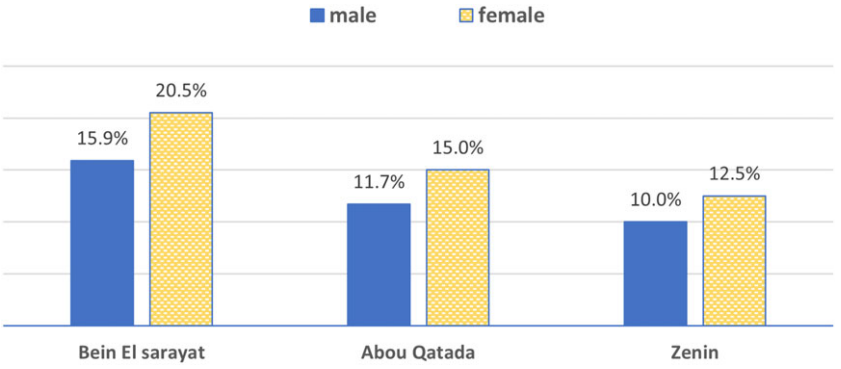

Figure 1. Chronic disease prevalence by sex and slum area.

were classified in the first quintile (the lowest 20%), and only 8% were in the third quintile; only 13.9% were classified in the fifth quintile (the highest 20%). We found contrasting results in Abou Qatada, where 36% of individuals lived in the fourth quintile and 35.2% were in the fifth quintile.

Regarding individual health status, approximately 14% of the residents of the three slums residents suffered from chronic diseases, and only 12% of them were receiving treatment. By slum area, 18.1% of Bein El Sarayat residents reported having a chronic disease, the highest prevalence of the three, followed by Abou Qatada (13.3%) and Zenin (11.2%). Almost no respondents, 98%, in Bein El Sarayat suffered from any physical or mental disability, and we found similar results in Abou Qatada and Zenin.

Chronic disease prevalence in the slum areas

The results revealed a higher prevalence of chronic diseases among females than males in the three surveyed slums, with the greatest gap in Bein El Sarayat (Fig 1). The prevalence of chronic diseases increases with age, with the highest among older adults ($\geq$ 64). More than two-thirds of older adults in Bein El Sarayat and Zenin experienced chronic diseases, and the rate was 50% in Abou Qatada. While 17.8%, 15.3%, and 12.6%, respectively, of the adults aged 18–64 years in Bein El Sarayat, Abou Qatada, and Zenin had chronic diseases. In contrast, the children showed the lowest chronic disease prevalence of no more than 2%.

We found that the higher the education level, the lower the chronic disease prevalence in Bein El Sarayat and Abou Qatada; respondents in these areas who had no more than a primary education had the highest chronic disease prevalence, that is, 27% in Bein El Sarayat and 15% in Abou Qatada (Fig 2). In both areas, the figures for a university education or higher decreased to 10.1% in Bein El Sarayat and 6.8% in Abou Qatada. The results in Zenin were contradictory: Chronic disease prevalence increased from 3% among those with primary education to 10.3% among those with secondary education and then decreased to 5% among those with university education or higher.

Self-reported chronic diseases were more prevalent among individuals in the worst-off households. As displayed in Fig 3, the prevalence of chronic diseases among individuals in the poorest and poor quintiles was significantly higher than that in the higher asset quintiles. More than one-third, 37.6%, of the poorest respondents in Bein El Sarayat reported having chronic diseases, and 10.5% of them were not receiving the required treatment.

The results showed the expected direction of the relationship between chronic disease prevalence diseases and the welfare index in Bein El Sarayat only, where respondents in the lowest welfare index quintile had the highest prevalence of chronic diseases. By contrast, in Abu Qatada and Zenin, respondents in the lowest quintile had a lower prevalence of chronic disease than those in the higher quintiles (Fig 4).

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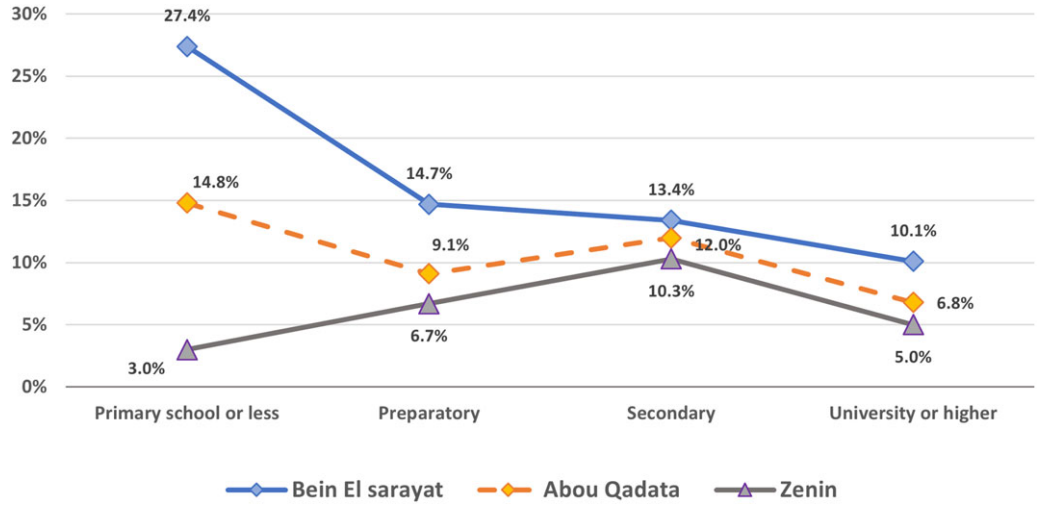

Figure 2. Chronic disease prevalence by education level and slum area.

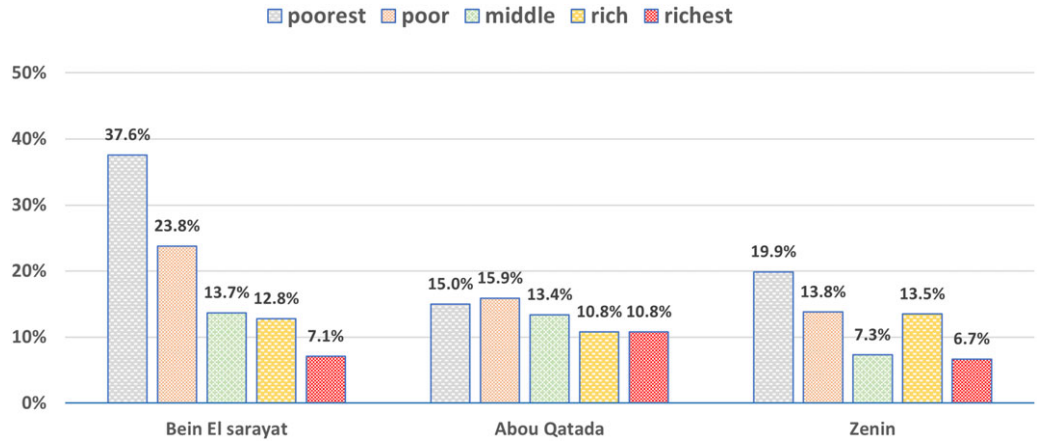

Figure 3. Chronic disease prevalence by asset index and slum area.

Respondents were asked about their most important needs in terms of health and education services, housing, utilities, transportation, communication, and security needs. The majority indicated their need for job opportunities (71.1%) and hospitals/health units (66.2%). In terms of health needs, Bein El Sarayat had the highest need for health services, and this was in line with the higher prevalence of chronic diseases there than in the other areas. Fig 5 details the residents' health needs according to the slum area, with a sizable percentage of residents in Bein El Sarayat stating a need for well-equipped public hospitals.

Most individuals who have chronic disease received health care (91%). However, 63.7% of Abou Qatada residents and 50.3% of Bein El Sarayat residents were dissatisfied with the available health services. About 90% of the residents of Bein El Sarayat were dissatisfied with the high cost of care, and 68.1% of Abou Qatada residents were dissatisfied with the inadequate health infrastructure. It is worth noting that when slum residents in each area were asked about their demands from the government and state institutions during the next 5 years to improve their living conditions, two-thirds of residents in Abou Qatada and 64% of Zenin residents stated that they were in dire need of the government's attention to hospitals and health care services.

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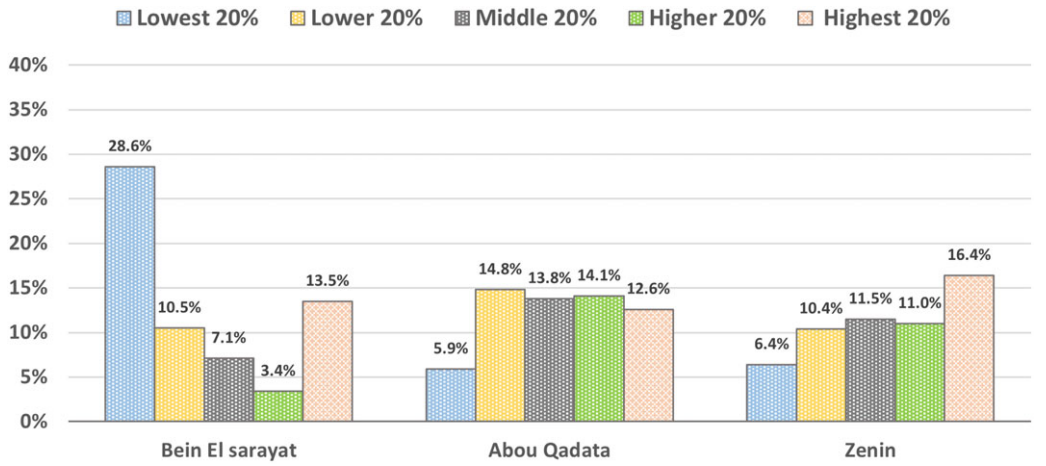

Figure 4. Chronic disease prevalence by welfare index and slum area.

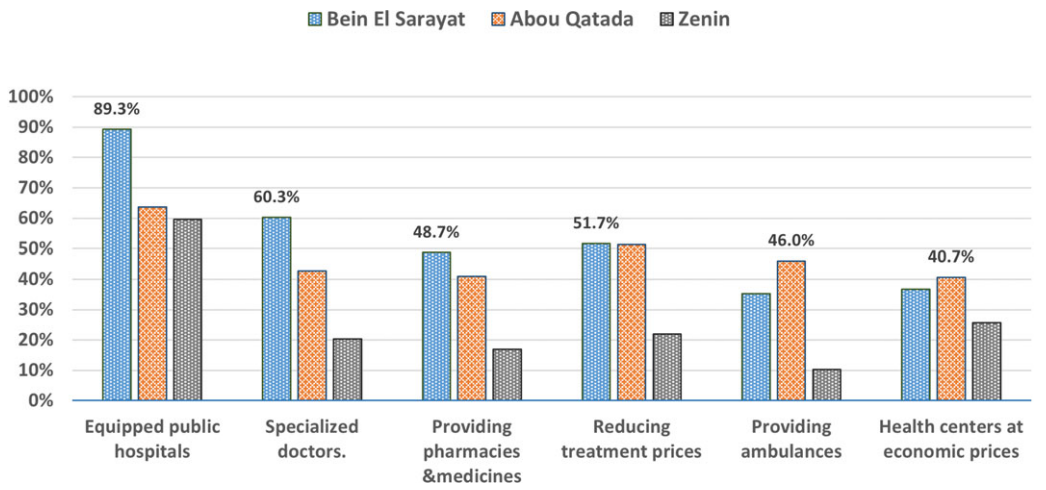

Figure 5. Health needs according to slum area.

Factors associated with chronic disease among adults in the slum areas

The results showed a high rate of self-reported chronic diseases among adults aged 18 and older, reaching more than 22%, while it did not exceed 2.0% among children in the slum areas. Therefore, measuring the determinants of chronic diseases was limited to adults. The sample size was 2530 adults after excluding 970 children. The socio-economic and demographic profile of adults aged 18+ is presented in Supplement Table (A-1). The prevalence of chronic diseases among adults in the slums ranged between 16.3% in Zenin and 22.6% in Bein El Sarayat.

Table 2 presents the unadjusted and adjusted odds ratios for a two-level mixed logistic model of self-reported chronic disease among adults in the slum areas of Giza. In the unadjusted models, almost all explanatory variables were significantly associated with self-reported chronic disease (the dependent variable). The odds of self-reported chronic disease increased slightly with age. There was also an unadjusted strong association between sex and self-reported chronic disease, where the odds decreased by 33% among males than females. There was also a negative association between reporting of chronic disease and education level: adults with no schooling (reference category) and those who completed primary education had the highest unadjusted odds of

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Table 2. Unadjusted and Adjusted Odds Ratio and Its 95% CI of Two-Level Mixed Logistic Model of Self-Reported Chronic Disease Among Adults

Fixed effect	Unadjusted OR	95% CI	Adjusted OR	95% CI
Age in years	1.11***	(1.09–1.12)	1.09***	(1.07–1.10)
Sex				
Male	0.67**	(0.54–0.84)	0.77	(0.47–1.23)
Educational level				
Primary	1.23	(0.81–1.87)	1.60	(0.98–2.62)
Preparatory	0.37***	(0.23–0.60)	0.69	(0.40–1.17)
Secondary	0.24***	(0.17–0.34)	0.86	(0.58–1.27)
University	0.09***	(0.05–0.16)	0.57*	(0.33–1.00)
Employed	0.47*	(0.37–0.59)	0.62**	(0.43–0.87)
Marital status				
Unmarried	0.03***	(0.02–0.05)	0.52^{+}	(0.26–1.04)
Married	0.21***	(0.15–0.31)	0.72	(0.43–1.20)
Relationship to HH				
Wife or husband	0.67**	(0.50–0.89)	0.78	(0.45–1.33)
Son or daughter	0.07***	(0.04–0.11)	0.89	(0.49–1.62)
Another kinship	1.59	(0.89–2.82)	1.40	(0.71–2.76)
Household size				
3–4	0.31***	(0.21–0.44)	0.80	(0.47–1.35)
5–6	0.24***	(0.16–0.35)	0.83	(0.47–1.48)
7+	0.17***	(0.08–0.35)	0.39	(0.15–1.02)
Asset index				
Poor	0.72	(0.50–1.04)	0.96	(0.58–1.58)
Middle	0.41***	(0.28–0.60)	0.48**	(0.28–0.80)
Rich	0.32***	(0.22–0.47)	0.49**	(0.28–0.83)
Richest	0.27***	(0.17–0.42)	0.43*	(0.23–0.82)
Welfare index				
Lower 20%	0.39***	(0.27–0.59)	0.48*	(0.26–0.86)
Middle 20%	0.45***	(0.30–0.66)	0.50*	(0.27–0.91)
Higher 20%	0.38***	(0.26–0.56)	0.48*	(0.26–0.89)
Highest 20%	0.45***	(0.31–0.65)	0.52*	(0.29–0.94)
Slum area				
Abou Qatada	0.71*	(0.53–0.96)	1.31	(0.77–2.20)
Zenin	0.63**	(0.48–0.87)	1.12	(0.69–1.84)
Proportion of economically active HH members aged 15–64	1.00	(1.00–1.01)	1.01*	(1.00–1.02)
Constant			0.02***	(0.01–0.08)

(*Continued*)

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Table 2. (*Continued*)

Fixed effect	Unadjusted OR	95% CI	Adjusted OR	95% CI
			Estimate (SD)	**95% CI**
Random intercept			1.25***	(0.97–1.59)

Reference categories: sex (female), educational level (no schooling), employed (no); marital status (widowed or divorced/separated); relation to HH (household head); household size (one to two); household asset index (poorest); household welfare index (lowest welfare); and slum (Bein El Sarayat).
$^{+}P < 0.1$, $^{*}P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$.

Table 3. Model Selection Criteria

	McKelvey and Zavoina's R2	σ^2_{u0}	SD	ICC	ll(model)	AIC	BIC
				HH cluster			
Two level null model	0.0	.947	.973	.223 (.044)	−1208.10	2420.19	2431.86
Two-level adjusted model	.381	1.55	1.25	.322 (.054)	−888.12	1832.23	1995.61

reporting chronic disease, whereas those with university education had the lowest. Employed adults had lower odds of chronic disease. Widowed or divorced/separated had the highest odds of chronic disease.

Additionally, being a household head increased the odds of self-reported chronic disease, whereas the odds were very low for sons/daughters in the household. The odds of self-reported chronic disease decreased as the household's economic status (wealth index) increased, and there was a negative unadjusted association between household size and chronic disease. Households of two members had the highest odds of self-reported chronic disease. Slum residents in the lowest quintile had the highest unadjusted odds of self-reported chronic disease, followed by those in the middle and highest quintiles. Residents of Bein El Sarayat had the highest odds of self-reported chronic disease followed by those in Abou Qatada.

However, in the adjusted model, the odds of self-reported chronic disease among adults did not significantly differ by sex, relationship to household head, household size, or slum area. The adjusted model revealed a significant positive association of self-reported chronic disease with age, a 9% increase in the odds of chronic disease for each extra year of age. Additionally, there was a 43% decrease in the odds of self-reported chronic disease among slum adults with a university education compared to illiterate adults. Employed slum adults had 38% lower odds of chronic disease than unemployed, and the odds of self-reported chronic disease among unmarried residents were 48% lower than that among widowed or divorced/separated persons.

As the household asset index increased, the odds of self-reported chronic disease among adults showed a decreasing trend; adults in the two highest quintiles had 51% and 57% lower odds of self-reported chronic disease than adults in the poorest quintile. The welfare index was significantly associated with self-reported chronic disease such that the odds were almost 50% lower among adults in all welfare quintiles than those in the lowest one. The odds of self-reported chronic disease among adults increased slightly with the proportion of economically active household members.

We compare the performance of the two-level null model and the adjusted model using robust accuracy metrics (the Akaike information criterion and Bayesian information criterion), which support two-level adjusted model as shown in Table 3. In the adjusted model, the variance between households (σ^2_{u0}) was approximately 1.55. The proportion of the total variance in the reporting of having a chronic disease that is attributable to the differences between households was 32%. The remaining 68% relate to differences between individuals within households that had not been accounted for by variables included in the model.

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Discussion

This study focused on quantifying the impact of demographic and socio-economic factors on reporting chronic diseases among adults in three slum areas in Giza, one of the biggest governorates in Egypt. The study supported previous studies that slum-dwellers are characterized by low SES and deteriorated living and environmental conditions. Regarding the determinants of self-reported chronic diseases, our findings are in line with the previous studies, indicating that being older adult, unemployed, uneducated, and living in a poor household increased the odds of self-reported chronic diseases (Boutayeb *et al.*, 2013; Gadallah *et al.*, 2017; Kien *et al.*, 2017; Latif *et al.*, 2016b; Zulu *et al.*, 2011). In addition, we found that unhealthy conditions significantly affected health status; slum dwellers, who exhibited worse living conditions and belonging to the lowest quintile of the welfare index, have higher odds of self-reported chronic diseases. In contrast, kinship ties with the HH, household size, and slum area did not significantly affect reporting chronic diseases.

The social determinants affect the health status of slum dwellers, such as educational level, employment status, social inclusion, safe housing, food access, and political and gender rights. Working conditions and physical characteristics such as access to safe water, sanitation, quality and affordable housing, electricity, and transport also influence slum health (World Health Organization, 2008). Some studies found significant associations between slum characteristics and environmental health issues (Corburn and Sverdlik, 2017). For example, overcrowding (two persons per room or less than 5 m^2 per person) was associated with the prevalence of influenza, TB, meningitis, skin infections, and rheumatic heart disease (Riley *et al.*, 2007). Tenure insecurity (lack of legal title deeds to house or land) was correlated with self-reported increased hypertension, diabetes, and low birth weight newborns (Gruebner *et al.*, 2012). Overcrowding, poor infrastructure, low living standards, and tenure insecurity have contributed significantly to increased exposure risks to environmental pathogens that increase communicable and non-communicable diseases (Harpham, 2009; Unger and Riley, 2007). Poor sanitation conditions and associated diseases push child mortality and morbidity rates in poor urban areas above those in rural areas (Bartlett, 2003). Poor SES and the lack of basic urban services have exacerbated the health status of slum dwellers in Kalyanpur (Latif *et al.*, 2016b).

Our study reinforces the well-established relationship between SES and health outcomes (Ferrer and Palmer, 2004; Fritzell *et al.*, 2004; Martikainen *et al.*, 2004; Yiengprugsawan *et al.*, 2007). We found that uneducated and unemployed respondents who belong to the low asset quintile were more likely to report chronic disease. Moreover, our findings pointed out that welfare and asset indices were profound predictors of self-reported chronic disease. Marital status was a significant predictor of reporting chronic disease. The same was observed for the age where increasing age correlated with a persistent increase in reporting of chronic diseases. Employment status and education level contributed significantly more than other demographic variables to self-reported chronic disease. The proportion of economically active HH members was associated significantly with reporting chronic disease. As indicated in the previous studies, the proportion of employed HH members affects the likelihood of receiving health treatment due to the internal support among household members in case of illness and incurring expenses (Buigut *et al.*, 2015). Kinship ties with the HH head did not significantly impact the reporting of chronic diseases. In sum, socio-economic variables were more powerful predictors than demographic variables in the adjusted model.

One of the most surprising findings is the lower prevalence of chronic diseases in the surveyed slums (14.1%) compared to the nationally reported rates (40%). This figure can be attributed to the fact that self-reported measures of chronic disease systemically underestimate the true prevalence rate in low- and middle-income countries. Low socio-economic groups do not have access to healthcare services, lack knowledge about disease symptoms, and neglect early detection (Vellakkal *et al.*, 2015). Additionally, the data collectors noted that some of the respondents inquired about chronic diseases and their symptoms; some were confused between chronic and

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infectious diseases; and a small proportion had been diagnosed with chronic disease by a doctor or health worker within the past 12 months. Although data collectors are well trained and define chronic diseases, this would not compensate for the medical examination for these diseases.

Our findings are consistent with the results of Kien *et al.* (2017) who found that the prevalence of chronic diseases in slum areas was significantly lower than in other areas (Kien *et al.*, 2017). Previous studies justified these results due to the low healthcare utilization rate in slum areas, which is a significant determinant of detecting chronic disease (Kien *et al.*, 2017). There is limited access to diagnostic healthcare in slum areas; official health sectors usually confront slum residents when they suffer from severe complications in the final stage of their chronic illness (Rous and Hotchkiss, 2003). Furthermore, it is highly expected among slum dwellers that the lower the economic level, the more healthcare services are avoided to escape catastrophic health payments. Food needs acquire the largest share of the household budget, for example, they account for 62% of household income in the Kalyanpur slum (Latif *et al.*, 2016b). Besides, a high proportion of older adults are unaware of their health conditions and tend to dismiss their poor health and illnesses, considering them as "old age symptoms and diseases" and usually detect their infection when fatal late complications arise.

Reducing the prevalence of chronic diseases and improving living conditions in slums are essential to undermine their overall burden and improve the well-being of slum dwellers. Therefore, effective schemes aimed at detecting and reducing chronic disease prevalence at the national level should include slum areas. Programs designed to enhance health and educational outcomes for slum residents are needed.

Among the strengths of this study, it is the first to study the profiles of slum residents in these areas and among the few studies conducted to assess the health status in the context of slum areas in Egypt. We investigated the main factors contributing to disparities in self-reported chronic diseases. Furthermore, we have depicted the economic situation of slum households and their inadequate living conditions by constructing two indices of assets and quality of life in these disadvantaged areas. In addition, the study provides salient information on the negative SES gradients in chronic disease prevalence in slum areas.

The current study is subject to some limitations. Firstly, risk factors that contribute to the prevalence of chronic diseases such as obesity, smoking, and high blood pressure were not measured in this study. Secondly, the study did not capture the full extent of the morbidity in the surveyed slums because we depended on self-reported measures of chronic diseases. Therefore, the observed prevalence rates in these slums should be considered the minimum as self-reported measures of chronic diseases are more likely to underestimate the true rate in low socio-economic groups. Thirdly, the household head provided data for other household members and may not have disclosed their health status, particularly to children. Fourthly, households' ability to finance healthcare services is missing in our analysis. Fifthly, there was no data available concerning types of chronic disease. Some types of chronic disease might be more prevalent in specific demographic and socio-economic groups than others. Therefore, disaggregating the analysis by types of chronic disease would enrich the results. Also, the small sample size of individuals with chronic disease who received healthcare in Giza slums did not enable us to investigate the demographic and socio-economic factors contributing to healthcare disparities in slums. Future studies should generally address these limitations and focus in particular on measuring the impact of health service provision and symptom-based measures on chronic disease reporting rates in slum areas and studying induced changes in the SES gradient from positive to negative in the prevalence of chronic diseases.

Conclusion

The main features of slum settlements have profound and varying effects on the health outcomes of slum dwellers. Neglecting the health status of slum dwellers and limiting access to necessary

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health services will have profound consequences and be more costly in the future due to the resulting deterioration of their health conditions. The study implemented a cross-sectional survey including 900 households distributed over three urban slums in Giza, Egypt, comprising 3,500 individuals. The research sought to assess the socio-economic and health conditions of slum dwellers and identify the health needs of slum dwellers. Our data revealed that the prevalence of chronic diseases varies across slum areas. On average, more than a quarter of all surveyed slum households are poor. About half of them belong to the lower quintiles of the welfare index. Slum dwellers need well-equipped public hospitals, specialized doctors, pharmacies and medicines, and reduced treatment prices.

The prevalence of chronic diseases in our survey is lower than our expectations which may be attributed to our focus on major chronic; most respondents are adults and lack awareness of chronic diseases and late diagnosis. The health system's failure to detect the true numbers of chronically ill patients in slums will worsen the health situation and increase health inequities in these areas, which will hinder the achievement of the Sustainable Development Goals. To protect slum dwellers from the complications of chronic diseases and ensure their access to healthcare, the government should fund health programs and formulate educational health programs to promote health awareness in these disadvantaged areas. In addition, income empowerment and other necessary policies that would reduce health disparities between slum dwellers and urban dwellers are also needed.

This study investigated the most factors associated with self-reported chronic diseases among adults in slums, focused on the social determinants, and controlled the slum characteristics and the internal connection between household members using a two-level mixed logistic model. The study contributes significantly to a better understanding of the context in which slum dwellers live and the interlinkages among poor living conditions, low economic status, and health outcomes. We found that age, education level, employment status, and marital status were significantly associated with self-reported chronic diseases among adults in slum areas. After controlling for the influence of demographic variables, significant differences in chronic disease reporting were evident across levels of assets and welfare indices. The proportion of respondents in the poorest quintile who reported having a chronic disease was higher than the highest quintile. Socio-economic variables were more powerful than demographic variables in the adjusted model. Policies should address characteristics of respondents at higher risk of having a chronic disease and remove the educational, economic, and environmental barriers that prevent slum dwellers from accessing the health services in order to achieve tangible progress in their healthy and productive lives.

List of abbreviations.

NCDs: Non-communicable diseases.
HH: Household head.
CI: Confidence interval.
OR: Odds ratio.
AIC: Akaike information criterion.
BIC: Bayesian information criterion.
ICC: Intraclass correlation.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/S0021932024000014.

Data availability statement. The datasets collected and analyzed during the study are available from the corresponding author upon reasonable request.

To view supplementary material for this article, please visit

Authors' contributions. SA contributed to the study conception and design; helped to acquire, analyze, and interpret the data; drafted the manuscript; and revised the manuscript for important intellectual content. WA helped to analyze, interpret the data, and revised the manuscript. EK and MN revised the manuscript.

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Competing interests. The author has no conflicts of interest to declare.

Ethical standard. The study was approved by the Central Agency for Public Mobilization and Statistics (CAMPAS) according to Resolution No. 783 of 2021. It is worth noting that this approval includes the official and ethical approval for data collection as CAMPAS has an ethical committee. The participants were informed of the study's objectives and data collectors informed them that participation in the study is fully voluntary, free to withdraw from the study at any time, and the data are confidential and used only for scientific research purposes. Written informed consent was obtained from all participants included in the study before the interview.

Consent for publication. Not required as the personal data gathered is anonymized (non-identifiable), and the submission does not include images that may identify the person.

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