Are Informal Older Workers Utilizing Less Healthcare Services? Evidence from the Longitudinal Ageing Study in India, Wave-1

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Abstract

India's informal sector employs many workers without social security benefits, such as pension support and health insurance. Many older workers continue to work in this sector beyond the retirement age (60+years) due to financial and health needs. Given the vulnerable position of informal older workers in terms of their social and economic stature, as well as the increasing burden of non-communicable diseases, it becomes important to study healthcare utilization. The present research aims to investigate variations in healthcare visits by type of work in India for older workers. The first wave of LASI (2017-18) data has been used in this study. The overall healthcare visits, consisting of inpatient and outpatient care, are considered as the outcome variable for the analysis. Zero-inflated Poisson regression is applied to study the relationship between type of work and healthcare visits while controlling for other covariates. The results of zero-inflated Poisson regression shows that informal workers have fewer healthcare visits than formal workers ($P<0.01$). However, the relationship between type of work and healthcare visits is influenced by health conditions, including chronic health conditions (CHC), depression as well as both CHC and depression. Informal workers with depression visit 0.892 times less ($P<0.05$) than formal workers with depression. Informal workers with CHC and depression visit 0.847 times less ($P<0.0001$) than formal workers with CHC and depression. The present study underscores the importance of proper economic support and healthcare provision to financially encourage older workers belonging to poor social-economic status to seek for healthcare services.

Keywords Informal older workers · Healthcare utilization · Chronic Health Conditions (CHC) · Depression · Zero-inflated poisson regression · India

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Introduction

Globally, the phenomenon of population ageing, experienced by countries with declining fertility rates along with improving longevity, has resulted in a stark increase in the share of the older population (Agrawal & Keshri, 2014; Jeyashree et al., 2018; Pandey et al., 2017). It is likely that the older population aged 60 years and above will reach 2 billion by 2050 (World Health Organization, 2018). Consequently, low- and middle-income countries will witness a whopping 80% of older people in the next two decades (World Health Organization, 2018). This is evident in developing nations such as India, China, and Brazil where the proportion of the older population is on the rise due to factors like decreasing fertility rates, increasing lifespan, and large age groups transitioning into old age (UNITED NATIONS, 2017). Apparently, the United Nations (2017) report suggests that around 60% of the total share of older population are residing in developing countries (UNITED NATIONS, 2017). However, unlike developed countries, the pension support or retirement programs are less prevailing in developing countries. In these countries, only one-fifth of the older population avail pension related benefits and the rest of the older population heavily depends on family support (ILO, 2017). This leads to a significant proportion of older people in the workforce, which is larger as compared to developed countries (Adhikari et al., 2011; Dantas et al., 2017; Dhar, 2014; Liu & Lou, 2016; Rajan, 2010; Reddy, 2016; United Nations, 2015).

The rising concern of older population has become an imminent phenomenon in India. Presently, older people in India accounts for 8.6% (104 million in 2011) of the total population (Census of India, 2011; Mini & Thankappan, 2017). Estimates suggest that, by 2050, India will be the home of around 319 million people aged 60 years and above (United Nations, 2019), and will soon have to face a huge public health related concern (Anand, 2016) as ageing is associated with increased risk of chronic health conditions (Chowdhury et al., 2018; Dey et al., 2012; Ingle & Nath, 2008; Mini & Thankappan, 2017; Puri & Singh, 2022). Non-communicable diseases (NCDs) which are common among older population play a major role in escalating the risk of death and disability worldwide (Joshi et al., 2013). Likewise, in India more than half of the older population experiences NCDs, and one-fourth of them are affected by multimorbidity (Agrawal & Keshri, 2014; Talukdar, 2017). By 2030, nearly 45% of the health burden will be concentrated among older people (Pradhan et al., 2017; World Health Organization, 2010). In addition, research also indicates that isolation and loneliness can lead to stress and depression among the older people, which is increasingly becoming a public health concern (Ansari et al., 2022; Courtin & Knapp, 2017; Muhammad & Maurya, 2022; Singh & Misra, 2009). Therefore, the health needs of the older population aged 60 years and above are quite different than other age groups (Anand, 2016).

The rapid growth of the older population in India (India, 2014) has presented new challenges to the country's healthcare system, particularly in providing specialized care for NCDs, mental health issues, and palliative treatments (Jeyashree et al., 2018). Further, the epidemiological shift towards NCDs has triggered the demand for inpatient as well as outpatient healthcare services in India (Dandona et al., 2017; Rahaman et al., 2022). A study using national survey data on healthcare utilization

of older people in India showed a 21% increase in inpatient care from 1995 to 96 to 2014 (Pandey et al., 2017). Besides, the hospitalization rates are 3.6 times higher among older people seeking treatment for NCDs than those in younger age groups (Pandey et al., 2017). Predominantly, older people suffering from chronic ailments have considerable levels of inpatient and outpatient care (Bose & Banerjee, 2019; Peltzer et al., 2014), although the frequency of outpatient care services are higher compared to inpatient care services (IIPS. et al., 2020; Rahaman et al., 2022).

Public healthcare facilities are the backbone of healthcare system in India, aiming to provide equitable and affordable access to health care services, but suffers from inadequate infrastructure, long waiting time, paucity of health workforce, poorly equipped health units and lack of patient's satisfaction (Brinda et al., 2015; Dey et al., 2012; Srivastava & Gill, 2020). Further, the healthcare utilization in India is pro-rich in nature, with comparatively lower utilization rates for older females, poor and rural residents (Agrawal & Keshri, 2014; Banerjee, 2021; Bose & Banerjee, 2019; Jeyashree et al., 2018; Joe et al., 2015; Kundu et al., 2022; Pandey et al., 2017, 2018). Similarly, the use of healthcare services among the older population is concentrated among the wealthiest and most educated, contributing significantly to the overall inequality in healthcare utilization (Agrawal & Keshri, 2014; Joe et al., 2015). More-over, the use of private healthcare services is quite common among all wealth quintiles except the lowest group (Anand, 2016; Bose & Banerjee, 2019; Jeyashree et al., 2018; Pandey et al., 2017; Peltzer et al., 2014). Nevertheless, it is socio-economically disadvantaged groups where the requirement of proper treatment is crucial, but they tend to use fewer healthcare services (Brinda et al., 2015, 2016; Srivastava & Gill, 2020).

In India, most of the older population. are often not covered under financial protection such as adequate pension and any other form of social security schemes (Agrawal & Mishra, 2021; India, 2014; Jeyashree et al., 2018; Sahoo et al., 2021). Accordingly, several social security programs, poverty alleviation programs, and social welfare policies were introduced for the older population in India. These include the National Policy on Older Persons, National Policy for Senior Citizens, National Social Assistance Program, National Program for Healthcare of the Elderly, Mahatma Gandhi National Rural Employment Guarantee Scheme, and Indira Gandhi National Old Age Pension Scheme. However, these programs have failed to provide enough financial support to older people, especially those from below poverty line (BPL) and working in informal sector (Bharati & Singh, 2013; Dhillon & Ladusingh, 2013; Gokhale, 2003). Likewise, the Rashtriya Swasthya Bima Yojana (RSBY) was launched with the aim to offer health insurance coverage for workers in unorganized sectors. However, it failed to achieve its goal as it was unable to capture tribal blocks, BPL families, and impoverished sections of the society (Ghosh, 2014; Narayana, 2010; Sun, 2011). To address the issues and concerns of the previous programs, the Government of India launched the Ayushman Bharat Program (ABP) in 2018. ABP provides financial health assistance to 500 million vulnerable Indian population (Angell et al., 2019). Agrawal and Mishra (2021) mentioned that, like any other program, ABP is also suffering from supply and demand gap as majority of the older people are less educated and unaware of such programs and policies. According to Sahoo et al. (2021), the existing public health infrastructure is inadequate to manage the escalat-

ing health demands of an increasingly aging population. This is primarily due to the absence of comprehensive social security measures at a national level, which compels older individuals to depend excessively on the public healthcare sector, thereby over-burdening it significantly. Inefficient public health services, unregulated systems, lack of financial resources, and growing private health sector make older population reluctant to opt for healthcare services utilization despite of their dire needs (Anand, 2016; Brinda et al., 2015, 2016; Joe et al., 2015; Sahoo et al., 2021; Srivastava & Gill, 2020). To cope-up with financial insecurity and rising healthcare needs, older population either have to depend on their children or to work after the retirement age (Chowdhury et al., 2023; Rajan, 2010; Reddy, 2016).

The workforce in any economy is commonly categorized into formal and informal sectors. In developing countries, especially, there is a substantial presence of informal workers, estimated at approximately 900 million (Mishra, 2017). Recent data suggests that around 92.4% of the workforce in India is engaged in informal work (NSO, 2019; Ramana Murthy, 2019). This prevalence is largely attributed to high levels of poverty and unemployment in the country (Mishra, 2017). As per Census of India, 2011, nearly 33 million older population are in the workforce after the retirement age of 60 years and above (Census of India, 2011). Most of these workers belong to the informal sector, where majority of them lacks written contracts, paid leave, health benefits, pension support or social security (Gokhale, 2003; Rajan, 2010; Ramana Murthy, 2019). Even in selected formal sectors, only 10% of the population is covered under any social or voluntary health insurance schemes (Balarajan et al., 2011). The paucity of effective financial and health insurance schemes can hamper the health conditions of older people engaged in economic activities.

Previous studies have underscored the profound influence of work engagement on physical (Carr et al., 2018; Lee & Kim, 2017; Li et al., 2014; Padula et al., 2013; Silver et al., 2018; Tomioka et al., 2018) and mental health (Buckley et al., 2013; Forbes et al., 2015; Jang et al., 2009; Luo et al., 2019; Minami et al., 2015; Silver et al., 2018; Vives et al., 2018). A handful of these studies have specifically pointed out that participation in low-paying jobs can detrimentally affect the physical health of older people (Carr et al., 2018; Lee & Kim, 2017). Moreover, prolonged work under deteriorating health conditions can result in severe outcomes, including the need for long-term care, mental health issues, and functional disability (Lee & Kim, 2017; Tomioka et al., 2018). However, the relationship between work engagement and health may vary depending on the type of work (Luo et al., 2019; McPhedran, 2012; Virtanen et al., 2017). This variation was established in a study by Chowdhury et al. (2023), which found that informal older workers in India are more prone to mental health condition compared to their formal counterparts, while formal older workers are more likely to suffer from physical health conditions than their informal counterparts. Additionally, limited number of primary studies in few regions of India suggest that the work characteristics of informal workers, such as irregularity of employment (Mannila, 2015), uncertainty of wage rate (Mannila, 2015), long or uncertain working hours (Adsul et al., 2011; Khan, 2021; Mannila, 2015), and hazardous work conditions (Adsul et al., 2011; Jayakrishnan et al., 2013; Khan, 2021) are linked with poor socio-economic conditions, and risk of health problems (Mannila, 2015; Upadhyaya, 2003). Furthermore, the study by Khan (2021) suggests that older workers are

among the most vulnerable in the informal sector, as they continue to work to cover expenses and healthcare costs associated with longer lifespans, despite being in poor physical condition to work. A qualitative study on construction workers in southern India indicates that financial distress and distrust in the public health sector are major barriers to access healthcare services (Santalahti et al., 2020).

Thus, the differences in socio-economic conditions, work-characteristics, and health related issues of formal and informal workers coupled with the health conditions of the older population, generate an important research question: "Does healthcare visits differ between informal and formal older workers?". Moreover, presently there are no research nationally and internationally which has addressed this question. Therefore, it becomes important to study the healthcare visits by formal and informal older workers to elucidate their healthcare-related needs which could help policymakers to formulate improved policies to allocate resources and services for these vulnerable segments of the population.

Methods

Data Source

The current study utilized data from the first wave (2017-18) of Longitudinal Ageing Study in India (LASI) (IIPS. et al., 2020). LASI is a nationally representative survey that gathers information on the health, economic and social drivers of the ageing population in India. The key objective of the survey is to provide information on physical, social, and economic well-being of the older population in India. Additionally, it has collected in-depth information on the economically active older population, perceived economic security, workforce participation across older ages and different sectors, work characteristics, vulnerability, and expectations (IIPS. et al., 2020). This survey used a multistage stratified cluster sample design and includes 72,250 respondents aged 45 years and above, covering all states and union-territories. Among them, about 31,464 older people are aged 60 years and above, out of which nearly 10,746 older people are currently engaged in the workforce, which constitutes the final sample size of the present research.

Outcome Variables

The present research focuses on the healthcare visits, which provides on an average how many times an individual is utilizing the healthcare services. The LASI data provides the information on both inpatient and outpatient visits. However, the primary focus of the study is to investigate the differences in healthcare visits between formal and informal older workers. Therefore, the study has considered overall healthcare visits which is the combination of inpatient and outpatient visits. Descriptions of inpatient and outpatient care are given below.

1. Inpatient care consists of services provided at hospital or inpatient facility where a person is admitted for at least one night. In the LASI questionnaire, respondents

were asked about the number of in-patient care visits (admitted as patient to a hospital/long-term care facility for at least one night) over the last 12 months.

2. Outpatient care includes healthcare consultation, treatment, or other kind of services received from any healthcare provider without staying overnight at hospital. In the LASI questionnaire, respondents were asked about the number of out-patient care visits (received healthcare or consultation from a healthcare provider) over the last 12 months.

Exposure Variable: Type of Work

The International Classification of Occupation 2015 (NCO, 2004) has been used in the LASI survey to define occupational categories. Subsequently, the type of occupation is regrouped into formal and informal work based on the National Sample Survey Organization (66th round) report, which adopts the National Classification of Occupation 2004 (NCO, 2004; NSSO, 2004). The type of work variable is dichotomized as 0 (formal) and 1 (informal). The description of categories included under formal and informal work are considered from Chowdhury et al. (2023), as presented in Appendix table-A1.

Other Explanatory Variables

Chronic diseases and depression are the substantial health problems among older people (WHO, 2017). Studies have pointed out that the burden of NCDs escalates with age and is associated with higher healthcare utilization among the older population (Bose & Banerjee, 2019; Pati et al., 2014; Peltzer et al., 2014; Sahoo et al., 2021). Likewise, depression also increases the perception of poor health, healthcare utilization, and costs (WHO, 2017). The description of chronic health conditions and depression is given below.

Health Outcomes include:

1. Chronic Health Conditions (CHC) - CHC is created using nine major self-reported chronic illnesses. These health ailments include chronic heart diseases, hypertension, cancer, diabetes, chronic lung disease, arthritis, stroke, high cholesterol, and neurological problems. In this study, CHC is dichotomized into 0 (none) and 1 (at least one health condition), where 0 labelled as 'No' and 1 as 'Yes'.

2. Depression (Dep) - It is assessed using self-reported scale of Centre for Epidemiological Studies Depression (CES-D) with four categories: rarely or never (<1 day), sometimes (1 or 2 days), often (3 or 4 days), and most or all of the time (5–7 days). Participants were asked ten different questions about their experience in the week prior to the interview. Out of the 10-items, first seven are negative symptoms while the remaining three are positive symptoms. For negative symptoms, zero score is given to those who have responded "rarely or never (<1 day)", and "sometimes (1 or 2 days)", whereas remaining two categories are scored as one. However, the scoring is reversed for positive symptoms. The

overall score ranged from 0 to 10. Those participants with score of four or more are considered to have depressive symptoms (Ansari et al., 2022; IIPS. et al., 2020; Kumar et al., 2016; Peltzer & Peltzer, 2021) and coded as 1, while the rest are coded as 0 (Ansari et al., 2022; IIPS. et al., 2020).

CHC and depression, being common health problems, are also related to each other, as observed in previous studies, older people are at a higher risk of developing depression if they suffer from chronic conditions (Bisschop et al., 2004; Fiest et al., 2011; Meher et al., 2022). Thus, in this study, a combined variable of CHC and depression is constructed to understand the level of healthcare visits among those who are suffering from both CHC and depression. The description is given below:

$$Health = \begin{Bmatrix} 0, & if\ CHC = 0\ and\ Depression = 0 \\ 1, & if\ CHC = 1\ and\ Depression = 0 \\ 2, & if\ CHC = 0\ and\ Depression = 1 \\ 3, & if\ CHC = 1\ and\ Depression = 1 \end{Bmatrix}$$

Other Covariates

Studies on the older population and healthcare utilization in India have pointed out that age, place of residence, gender, educational level, wealth, marital status, caste groups, religion, household size and health insurance are the significant determinants of healthcare services (Anand, 2016; Banerjee, 2021; Brinda et al., 2015, 2016; Jeyashree et al., 2018; Joe et al., 2015; Kundu et al., 2022; Pandey et al., 2017; Sahoo et al., 2021). Furthermore, studies from other countries, along with a recent study in India, have revealed the other potential covariates for older life work engagement. These covariates include socio-economic and demographic attributes, lifestyle behaviours, work characteristics and childhood health (Adhikari et al., 2011; Chowdhury et al., 2023; Dantas et al., 2017; Giles et al., 2011; Larsen & Pedersen, 2017; Lee & Kim, 2017; Robroek et al., 2013; Vives et al., 2018). Based on previous research, the current study has considered five main dimensions of covariates. These dimensions are: (1) socio-economic and demographic, (2) work characteristics, (3) life-style behaviours, (4) childhood health, and (5) health insurance. The socio-economic and demographic dimensions consist of gender (male, female), age-groups (60–65, 65+), religion (Hindu, Muslim, Others), caste groups (general, scheduled tribe (ST), scheduled caste (SC), other backward class (OBC), education level (low, middle, high), wealth (low, medium, high), marital status (currently married, others), place of residence (rural, urban), and household size (1–3, 4–7, 8+). Lifestyle behaviours include drinking alcohol (no, yes), smoking/consuming tobacco (no, yes), vigorous activities (never, rarely, everyday), moderate activities (never, rarely, everyday), and Yoga/Pranayama (never, rarely, everyday). Work characteristics consist of working hours per week (less than 24 h, 24–48 h, 48+hours), and monthly wages (in natural log). Furthermore, other covariates includes childhood health (good/fair, poor), health insurance (no, yes), and regions (North (Jammu & Kashmir, Himachal

Pradesh, Uttarakhand, Punjab, Haryana, Rajasthan, Delhi), East (Bihar, Jharkhand, Odisha, West Bengal), Central (Uttar Pradesh, Chhattisgarh, Madhya Pradesh), North-East (Mizoram, Tripura, Meghalaya, Assam, Arunachal Pradesh, Nagaland, Manipur), West (Gujarat, Maharashtra, Goa), South (Karnataka, Kerala, Tamil Nadu, Telangana, Andhra Pradesh), and Union territories (Chandigarh, Daman & Diu, Dadar & Nagar Haveli, Lakshadweep, Puducherry, Andaman & Nicobar).

Statistical Analysis

Bivariate and multivariate analysis were used to study the relationship between type of work and healthcare visits. Initially, descriptive statistics were computed for older workers (60 years and above) in terms of their type of work, socio-economic status, and demographic variables. Healthcare utilization, defined as the percentage of older workers using healthcare services, was estimated for inpatient and outpatient rates by type of work (as shown in Table 3) and health conditions (as depicted in Fig. 3). The chi-square test was employed to determine the statistical significance of the association. Descriptive statistics (mean, median, and standard deviation) for inpatient and outpatient visits were calculated by type of work (presented in Table 3) and t-tests were performed to study the statistical significance of the difference. The analysis was conducted using the Stata 17 software.

The outcome variable of the study encompassed overall healthcare visits, which was constructed by combining the number of inpatient and outpatient visits (total number of older workers utilizing inpatient or outpatient services = 5,943). Healthcare visits are the count variable (see Fig. 1).

The Poisson regression, negative binomial regression and zero-inflated Poisson regression models are preferred, when dealing with count dependent variable. These three models are compared using AIC and BIC measures of goodness of fit. The zero-inflated Poisson regression model was selected for analysis as it provided lower values of AIC and BIC (See Appendix table-A2). A Sequential zero-inflated Poisson model was utilized for the analysis, and details of the models are mentioned in Table 1.

Zero-inflated Poisson (ZIP) regression model consists of two parts:

1. The first part is the Poisson regression model where the dependent variable is the count of healthcare visits. This part provides the incidence rate ratio of healthcare visits.
2. The second part is the zero-inflated model with a binary component dependent variable (Total visits). Here binary component with a value of 1 consists of all 0's and 0 for all other counts greater than 0. This part provides the odds ratio of zero healthcare visits.

Table 1 provides an overview of the zero-inflated Poisson regression model, where the primary outcome variable is the total number of healthcare visits. Three models are presented:

- The first model is basic, with TOW as the sole independent variable.

- The second model includes exposure variables TOW, Health, and their interaction. This model is controlled for SED.
- The third model, similar to the second, is controlled for additional variables: SED, HI, WC, LSB, CH, and regions.

In the second part of the ZIP model, all variables controlled in the first part are considered, excluding the interaction of TOW and health.

Results

Table 2 exhibits summary statistics of the background characteristics. Out of 10,746 older workers, 74.3% are working in informal sectors. Around 30.9% of older workers are suffering from CHC. Whereas about 12% are suffering from either depression (12.5%) or both CHC and depression (12.2%). The prevalence of healthcare utilization among older workers is 55.3% ($n=5,943$), and the average number of visits is 4.6 (median=3) times during one year prior to the survey. Of the 10,746 older workers, 31.9% are females, 44.7% are 65 years and above, 40.0% are Other Backward Class (OBC) and 75.2% are Hindu. Further, nearly 78.5% belong to the low educated group and 38.8% are from the low wealth group. Moreover, only 24.1% of older workers are covered by any health insurance scheme.

Table 3 shows that around half of the older workers utilize outpatient services, whereas 7.3% have experienced an inpatient admission. On average, the older workers visit 4.6 (median=3) times for outpatient care, and 1.2 times for inpatient care. The level of outpatient care is more among the formal older workers compared to informal older workers ($\chi^2=7.007$, $p<0.01$). However, the level of inpatient care is almost same for both formal and informal older workers ($\chi^2=0.021$, $p=0.884$). Figure 2 show the healthcare visits for formal and informal workers. It is observed from the figure that healthcare visits data are positively skewed, and the number of visits is more among formal older workers. Figure 3 shows that the healthcare visits are high among those suffering from CHC, as well as those who had both CHC and depression (Formal workers: $\chi^2=220.19$, $P<0.0001$; Informal workers: $\chi^2=423.8$, $P<0.0001$). Moreover, level of healthcare utilization is high among formal workers suffering from CHC, and CHC and Depression.

Results from Poisson models (Table 4) depict that type of work is significantly associated with healthcare visits in Model-1 and Model-3. From Model-1, the frequency of healthcare visits is 0.958 times ($P<0.0001$) low among informal workers in contrast to formal counterparts. The Model-2 includes health variable and the interaction of type of work and health and controlled for socio-economic and demographic variables. Whereas, Model-3 is controlled for work characteristics, health insurance, life-style behaviour, and poor childhood health. The Model-3 shows that the frequency of healthcare visits are 1.079 times ($P<0.01$) higher among informal older workers without health conditions as compared to formal older workers without health conditions. Further, formal older workers with CHC have 1.476 times ($P<0.0001$) more healthcare visits in contrast to formal without health conditions. Similarly, the healthcare visits are 1.171 times ($P<0.0001$) more among formal older

workers with depression than formal older workers without health conditions. Again, formal older workers with CHC and depression tend to have 1.746 times ($P<0.0001$) more healthcare visits compared to formal older workers without health conditions. Furthermore, the frequency of healthcare visits is 0.892 times ($P<0.05$) less among informal older workers with depression compared to formal workers with depression. Additionally, among informal older workers with CHC and depression, the healthcare visits are 0.847 times ($P<0.0001$) less compared to formal older workers with CHC and depression. Moreover, Fig. 4 shows the predicted estimate of the number of healthcare visits by type of work and health. It is observed from the figure that formal workers with CHC and depression utilize healthcare services 3.8 times, compared to 3.5 times for informal workers with the same conditions. Whereas informal workers without any health conditions have 1.8 times healthcare visits, which is higher than the 1.5 times visits of formal workers without any health conditions. In Model-3, other significantly associated covariates are socio-economic and demographic variables, work characteristics, life-style behaviours, health insurance and regions. The frequency of healthcare visits is 0.924 times ($P<0.0001$) lower among females than males. Among the scheduled tribe population, healthcare visits are 0.748 times ($P<0.0001$) less compared to older workers belonging to general caste group. Whereas the healthcare visits are 1.070 times ($P<0.0001$) more among Other Backward Class compared to their counterparts.

The frequency of healthcare visits increases with an increase in wealth, while it decreases with an increase in education among older workers. Further, the frequency of healthcare visits is 0.913 times ($P<0.0001$) less among those who have availed of any health insurance services.

In case of work characteristics, those who work for more than 48 h per week tend to have 1.062 times ($P<0.01$) more healthcare visits compared to those working less than 24 h. However, increase in wages is related to 0.951 times ($P<0.0001$) fewer healthcare visits.

Drinking alcohol is associated with a decline (IRR: 0.904, $P<0.0001$) in healthcare visits, while consuming/smoking tobacco is associated with rise (IRR: 1.046, $P<0.01$) in healthcare visits. Further, performing vigorous physical activity leads to 0.969 times ($P<0.05$) lower frequency of healthcare visits, whereas performing Yoga/Pranayam everyday also results in 1.085 times ($P<0.0001$) more frequency of healthcare visits as compared to their counterparts.

The inflate part of the model presents the factors contributing to certain zero, which represents no healthcare visits. In Model-1 of inflate part, the odds of zero healthcare visits among informal workers is 1.106 times ($P<0.05$) more compared to formal older workers. However, the type of work loses its significance level in Model-2 and Model-3 of the inflate part. The odds of zero healthcare visits are 0.383 times ($P<0.0001$) less among those suffering from CHC, and 0.446 times ($P<0.0001$) less among those suffering from CHC and Depression. Among socio-economic and demographic factors, older workers belonging to female population, the age group of 65 years & above, Muslims, and the high wealth group are associated with less odds of zero-healthcare visits. Whereas older workers belonging to Scheduled tribe are related to higher odds of zero-healthcare visits. In case of work characteristics, working longer is associated with lower odds of zero-healthcare visits. Further, vigorous

activity, moderate activity, smoking/consuming tobacco, and poor childhood health are related with lower odds of zero-healthcare visits. Among regions, central and north-eastern parts have 1.337 times ($P < 0.01$) and 2.207 times ($P < 0.0001$) higher odds of zero healthcare visits compared to the northern region.

Discussion

The present research aims to study the relationship between type of work and healthcare visits using nationally representative LASI data and a zero-inflated Poisson regression model. Based on the results of the study, the discussion section is segregated into three parts. The first part discusses the level of healthcare visits and its association with type of work. The second part elaborates on the role of other covariates in explaining the relationship between type of work and healthcare visits. Additionally, this part studies the association of other covariates with healthcare visits. The last part points out the limitations of the present research.

Association between Type of Work and Healthcare Visits

The descriptive statistics reveal that half of the older workforce is utilizing outpatient services, which is higher among formal older workers as compared to informal older workers. Further, the level of inpatient care is only 7.3% among older workforce. The Model-1 result in Table 4 shows that type of work significantly influences the frequency of healthcare visits. Moreover, after adding the interaction of type of work and health in Model-3, it is observed that formal workers suffering from either CHC, depression, or both CHC and depression utilize more healthcare services compared to formal workers without any health conditions. However, informal workers suffering from depression (IRR=0.892, $P < 0.05$), or both CHC and depression (IRR=0.847, $P < 0.01$) have a lower incidence of healthcare visits as compared to formal workers suffering from depression, or both CHC and depression. The predicted number of visits among informal workers suffering from CHC and depression is 3.52 times ($P < 0.0001$) which is low compared to the 3.85 times visits of formal workers suffering from both CHC and depression.

   A previous study by Chowdhury et al. (2023) revealed that formal older workers tended to suffer more from CHC compared to informal older workers. Moreover, the likelihood of CHC is more among wealthy and educated groups (Adaji et al., 2017; Ingle & Nath, 2008; Mini & Thankappan, 2017) which is closely related to the socio-economic profile of formal older workers. In case of depression, WHO reported that depression is linked with increased perception of poor health which could be related with higher healthcare visits and cost (WHO, 2017). However, under-diagnosis of depression is quite common among older population as the symptoms are considered to be the normal part of aging (Greenhalgh, 2010; Khattri, 2006; Sinha et al., 2013). Moreover, ignorance of depressive symptoms diagnosis is high among older people belonging to a poor socio-economic profile. Evidently, previous studies have clearly shown that poor socioeconomic status is related with lower healthcare utilization (Bose & Banerjee, 2019; Brinda et al., 2015; Jeyashree et al., 2018; Joe et

al., 2015; Pandey et al., 2017). This might be the reason that informal workers with depression or CHC and Depression are less likely to utilize healthcare services than formal workers because of their paying capacity. Further, older population with poor socio-economic profile tend to utilize less healthcare services especially when they are suffering from NCDs because the price of healthcare services are the major barriers which constraints them from seeking treatment (Balarajan et al., 2011; Bose & Banerjee, 2019; Dey et al., 2012; Srivastava & Gill, 2020). The similar reason could be drawn for informal older workers especially those who are daily wage labourer, because they could also lose their earnings if they visit healthcare facilities for treatment/consultation. Moreover, the public facilities in India are often ill-equipped to provide adequate healthcare services due to long waiting time, inadequate infrastructure, limited availability of drugs and consumables, and poor staff motivation (Brinda et al., 2015; Rajiv et al., 2003; Srivastava & Gill, 2020). The poor service delivery of public healthcare facility leads to low healthcare utilization among older population with poor socio-economic status.

The current study has also revealed that informal workers without health conditions are more likely to utilize healthcare services than formal workers without health conditions. This phenomenon could be explained by self-reported reasons for healthcare visits such as chronic pain in joints/back/neck, injury/accident, surgery for abdominal causes, surgery for ophthalmic cause, and generalized pain (in Appendix table A3-A4). Some of these reasons are closely attributed to physically demanding and inferior work conditions of informal sector (Rajan, 2010; Reddy, 2016) which might be the reason of increased incidence of healthcare visits despite of no CHC or Depression among informal workers. Apart from these reasons, the unobserved factors could be another reason of more incidence of healthcare visit among informal workers without health conditions.

Association of Other Covariates with Healthcare Visits

The healthcare visits among female workers are low compared to male counterparts. Besides, the odds of no healthcare visits are also low among female workers. The tendency of untreated ailment is high among older women irrespective of their poor health status and high morbidity (Sreerupa & Rajan, 2010; Srivastava & Gill, 2020). Further, the healthcare utilization is very low among female belonging to poor economic status and rural areas (Brinda et al., 2015; Jeyashree et al., 2018; Maharana & Ladusingh, 2014; Pandey et al., 2017).

It is observed from the results that health insurance is associated with low frequency of healthcare visits. Since, there is absence of adequate insurance provisions for older population (Brinda et al., 2012; Joe et al., 2015; Prinja et al., 2012; Sahoo et al., 2021) and increase in the choice for seeking private health facilities (Anand, 2016; Brinda et al., 2015; Jeyashree et al., 2018; Kastor & Mohanty, 2018; Prinja et al., 2012; Sahoo et al., 2021), it is possible that those who are coupled with adequate insurance coverage may prefer private facilities which are well known for providing better quality of healthcare services (Jeyashree et al., 2018; Joe et al., 2015; Katyal et al., 2015; Prinja et al., 2017; Srivastava & Gill, 2020). Moreover, because of the better quality of services of private facility, they might require fewer healthcare visits

Table 3 Healthcare utilization: Inpatient and Outpatient care, by type of work

Type of work	Inpatient			Outpatient		
	% (n)	Average visit mean (SD, Median)	Inter-Quartile range	% (n)	Average visit mean (SD, Median)	Inter-Quartile range
Formal	7.4% (204)	1.18 (0.547, 1)	1–1	55.0% (1519)	4.73 (4.529, 3)	2–6
Informal	7.3% (583)	1.23 (0.885, 1)	1–1	52.1% (4158)	4.56 (4.721, 3)	2–5
Total	7.3% (787)	1.22 (0.814, 1)	1–1	52.8% (5677)	4.61 (4.671, 3)	2–5

Fig. 3 Proportion of older workers utilising health services by the type of health conditions
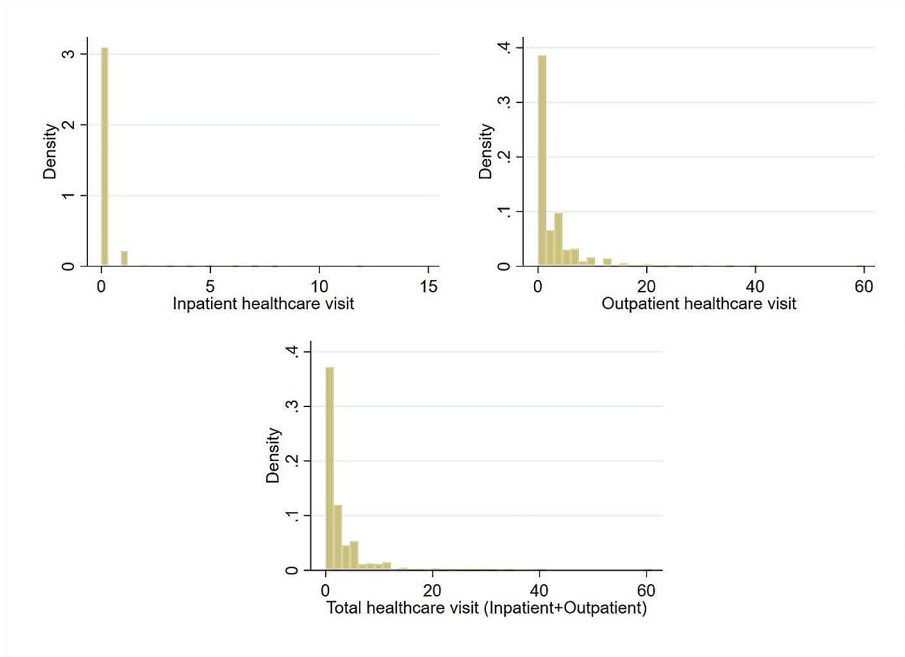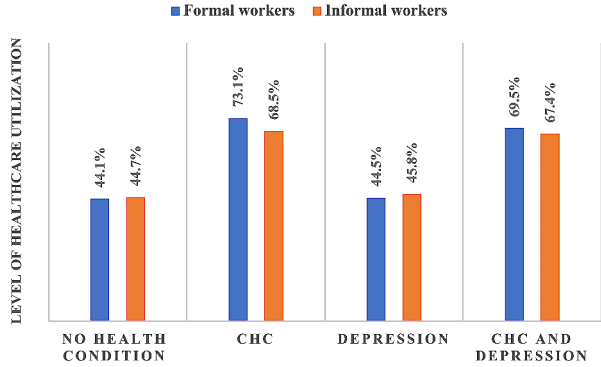

Fig. 1 Healthcare visits by type of care

Table 1 Description of zero-inflated Poisson regression

Notes TOW: Type of work, SED: socio-economic and demographic variables, HI: Health insurance, WC: work characteristics; LSB: lifestyle behavior, CH: Childhood health

Models	Independent variables	
	First part	Second part
Model-1	TOW	TOW
Model-2	TOW, Health, TOW*Health, SED	TOW, Health, SED
Model-3	TOW, Health, TOW*Health, SED, HI, WC, LSB, CH, Regions	TOW, Health, SED, HI, WC, LSB, CH, Regions

as compared to public facilities. For instance, beneficiaries of both the RSBY and the state level health insurance systems preferred private services. Private facilities were most widely used under RSBY, according to findings from the states of Gujarat, Uttar Pradesh, and Haryana (Prinja et al., 2019). This might be the reason for the low level of healthcare visits among older workers availing health insurance as they might prefer private facilities over public ones. Agrawal and Keshri (2014); Dey et al. (2012) stated that there is paucity of healthcare services in rural areas, which could act as barrier in availing healthcare services among those who are covered under any health insurance. On the other hand, there is an issue pertaining to the awareness of health insurance schemes in India (Agrawal & Mishra, 2021), in consequence older people despite of covered under any insurance are unable to take the benefits of such schemes. Additionally, health insurance does not cover all the cost of healthcare services and it could be possible older people may minimize their healthcare appointments in order to save money. According to Indian studies, despite being covered under public health insurance, older people still incur out-of-pocket expenses (Nandi et al., 2017; Prinja et al., 2017).

In terms of unhealthy lifestyle, it is observed that smoking and drinking are significantly associated with the higher incidence of healthcare visits among older workers. Similar finding among overall population was seen in prior studies where smoking is associated with increased incidence of healthcare utilization (Azagba et al., 2013; Vals et al., 2013) whereas drinking wine or beer is negatively associated with healthcare utilization (Vals et al., 2013).

The frequency of healthcare visits among scheduled tribe workers is lower compared to their counterparts. Previous research has found that socially disadvantaged population are less likely to use healthcare services (Ghosh, 2014; Pandey et al., 2017; Sahoo et al., 2021) owing to wide socio-economic disparities in healthcare utilization (Joe et al., 2015). Further, the frequency of untreated morbidity is also high among the scheduled tribe (Srivastava & Gill, 2020).

Study Limitations

Like other studies, the present study suffers from some limitations as well. First, the study has utilized cross-sectional information at a single point of time as no nationally representative longitudinal data pertaining to the older population is currently available in India. Therefore, the study cannot draw any causal relationship between type of work and healthcare visits. Further, the health outcome variables are obtained through self-reported information, which could be susceptible to recall or reporting

Table 2 Background characteristics of older workers (60 years and above), $N=10,746$

Covariates	Mean (SD, median) or Percentage	No. of older workers
Healthcare utilization: Yes	55.3%	5,943
Average healthcare visits	4.56 (4.66, 3)	5,943
Type of work: Informal	74.3%	7,984
Health		
No health condition	44.4%	4,770
CHC	30.9%	3,319
Depression	12.5%	1,345
CHC and Depression	12.2%	1,312
Gender: Female	31.9%	3,435
Age groups: 65+	44.7%	4,804
Caste groups		
General	21.8%	2,340
Scheduled Tribe	20.3%	2,183
Scheduled Caste	17.9%	1,922
Other Backward Class	40.02	4,301
Religion		
Hindu	75.2%	8,079
Muslim	9.6%	1,036
Others	15.9%	1,631
Education level		
Low	78.5%	8,440
Middle	15.8%	1,701
High	5.6%	605
Marital status: others	23.9%	2,578
Place of residence: Urban	25.3%	2,717
Wealth		
Low	38.8%	4,173
Medium	34.8%	3,735
High	26.4%	2,838
Household size		
1–3	38.1%	4,099
4–7	48.0%	5,154
8+	13.9%	1,494
Covered under health insurance: Yes	24.1%	2,594
Work Characteristics		
Working hours		
Less than 24 h	29.0%	3,115
24–48 h	44.2%	4,749
48+hours	26.8%	2,882
Ln(Wage)	6408.9 (8432.6, 4500)	10,746
Lifestyle behaviours		
Drinking Alcohol: Yes	15.5%	1,666
Smoking/Consuming Tobacco: Yes	49.9%	5,372
Physical Activity		
Vigorous		
Never	44.1%	4,737
Rare	21.2%	2,277

Table 2 (continued)

Covariates	Mean (SD, median) or Percentage	No. of older workers
Everyday	34.7%	3,728
Moderate		
Never	29.1%	3,131
Rare	15.5%	1,662
Everyday	55.4%	5,950
Yoga/Pranayam		
Never	85.9%	9,220
Rare	4.5%	479
Everyday	9.7%	1,039
Childhood health: Poor	2.6%	273
Regions		
North	13.4%	1,443
Central	14.1%	1,510
East	18.9%	2,032
Northeast	13.6%	1,464
West	11.0%	1,183
South	21.7%	2,335
Union Territories	7.3%	779
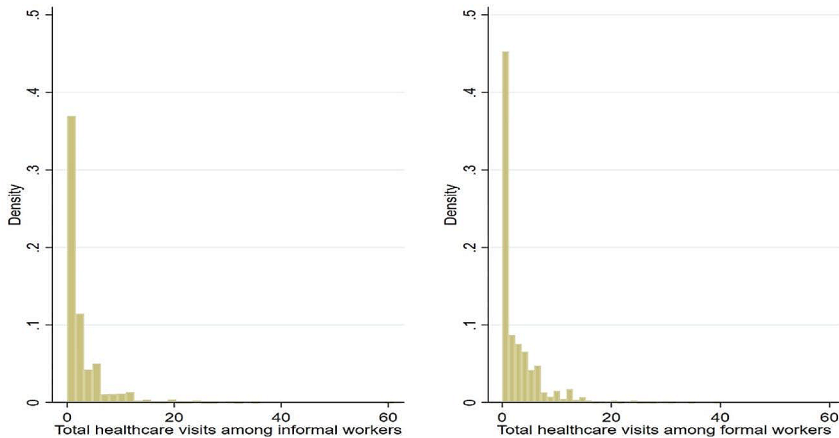
Fig. 2 Healthcare visits among informal and formal workers

bias, potentially impacting the accuracy of the results. To study the behavioural pattern of healthcare utilization among older working population, longitudinal data will be a better option where multiple indicators such as the reason for healthcare visits, cost of healthcare visits, interval period per visit, and other important aspects are presented for each healthcare visit. These types of information pinpoint the condition where an individual decides to seek or refuse treatment for an ailment. Thus, future studies based on such longitudinal data would provide a platform to address issue pertaining to healthcare utilization among most vulnerable groups of older workers.

Table 4 Result of zero-inflated regression model for healthcare visits

Covariates, Dependent var: Healthcare visits	Poisson model			Inflate model		
	Model-1 (IRR)	Model-2 (IRR)	Model-3 (IRR)	Model-1 (AOR)	Model-2 (AOR)	Model-3 (AOR)
Type of work						
Formal®						
Informal	0.958*** (0.932 0.984)	1.055 (0.997 1.117)	1.080*** (1.019 1.144)	1.106** (1.012 1.208)	1.049 (0.953 1.155)	1.002 (0.906 1.108)
Health						
No health condition						
CHC		1.444**** (1.357 1.536)	1.476**** (1.388 1.570)		0.380**** (0.343 0.420)	0.383**** (0.344 0.425)
Depression		1.297**** (1.178 1.426)	1.171**** (1.064 1.289)		1.043 (0.918 1.185)	1.088 (0.953 1.243)
CHC and Depression		1.767**** (1.645 1.898)	1.746**** (1.626 1.876)		0.441**** (0.385 0.504)	0.446**** (0.388 0.514)
TOW*Health						
Informal*CHC		0.957 (0.892 1.027)	0.943 (0.879 1.011)			
Informal*Depression		0.844** (0.756 0.943)	0.892** (0.799 0.996)			
Informal*CHC and Depression		0.846**** (0.778 0.919)	0.847**** (0.78 0.921)			
Gender						
Male®						
Female		0.927**** (0.899 0.956)	0.924**** (0.892 0.956)		0.868*** (0.785 0.961)	0.808**** (0.718 0.909)
Age groups						
60–65						
65+		1.035*** (1.009 1.061)	1.036*** (1.009 1.063)		0.926 (0.851 1.007)	0.888*** (0.813 0.97)
Caste groups						

Table 4 (continued)

Covariates, Dependent var: Healthcare visits	Poisson model			Inflate model		
	Model-1 (IRR)	Model-2 (IRR)	Model-3 (IRR)	Model-1 (AOR)	Model-2 (AOR)	Model-3 (AOR)
Type of work						
General®						
Scheduled Tribe		0.671**** (0.637 0.708)	0.748**** (0.708 0.791)		1.928**** (1.664 2.233)	1.589**** (1.35 1.869)
Scheduled Caste		1.078**** (1.037 1.122)	1.031 (0.991 1.073)		0.919 (0.801 1.056)	0.954 (0.826 1.102)
Other Backward Class		1.090**** (1.056 1.125)	1.070**** (1.035 1.105)		1.128** (1.008 1.262)	1.095 (0.972 1.235)
Religion						
Hindu®						
Muslim		1.087**** (1.045 1.131)	1.055*** (1.014 1.098)		0.751**** (0.649 0.87)	0.753**** (0.645 0.879)
Others		1.184**** (1.137 1.234)	1.294**** (1.239 1.351)		1.581**** (1.387 1.802)	1.057 (0.908 1.231)
Education level						
Low®						
Middle		0.930**** (0.897 0.964)	0.933**** (0.9 0.968)		1.035 (0.916 1.170)	0.753 (0.645 0.879)
High		0.913*** (0.863 0.967)	0.896**** (0.845 0.95)		1.332*** (1.100 1.613)	1.057 (0.908 1.231)
Marital status						
Currently married®						
Others		1.058**** (1.026 1.092)	1.026 (0.994 1.059)		1.003 (0.902 1.115)	0.980 (0.878 1.095)
Place of residence						
Rural®						

Table 4 (continued)

Covariates, Dependent var: Healthcare visits	Poisson model			Inflate model		
	Model-1 (IRR)	Model-2 (IRR)	Model-3 (IRR)	Model-1 (AOR)	Model-2 (AOR)	Model-3 (AOR)
Type of work						
Urban		0.994 (0.965 1.024)	1.012 (0.981 1.045)		1.252**** (1.131 1.386)	1.116 (0.998 1.247)
Wealth						
Low®						
Medium		1.038** (1.006 1.072)	1.075**** (1.041 1.11)		0.829**** (0.749 0.917)	0.813**** (0.731 0.904)
High		1.201**** (1.16 1.244)	1.208**** (1.165 1.253)		0.816*** (0.726 0.917)	0.768**** (0.677 0.872)
Household size		0.998 (0.984 1.012)	0.995 (0.981 1.01)		1.041 (0.995 1.09)	1.036 (0.987 1.088)
Covered under health insurance						
No®						
Yes			0.913**** (0.885 0.942)			0.938 (0.845 1.041)
Work Characteristics						
Working hours						
Less than 24 h®						
24–48 h			0.931**** (0.903 0.961)			0.849*** (0.766 0.942)
48+hours			1.062**** (1.028 1.097)			0.784**** (0.698 0.881)
Ln(Wage)			0.951**** (0.937 0.966)			1.016 (0.964 1.07)
Life style behaviour						
Drinking Alcohol						
No®						
Yes			0.904**** (0.869 0.941)			1.210*** (1.066 1.373)
Smoking/Consuming Tobacco						

Table 4 (continued)

Covariates, Dependent var: Healthcare visits	Poisson model			Inflate model		
	Model-1 (IRR)	Model-2 (IRR)	Model-3 (IRR)	Model-1 (AOR)	Model-2 (AOR)	Model-3 (AOR)
Type of work						
No®						
Yes			1.046*** (1.017 1.076)			0.671**** (0.61 0.739)
Physical Activity						
Vigorous						
Never®						
Rare			1.005 (0.971 1.041)			0.833*** (0.736 0.943)
Everyday			0.969** (0.939 0.999)			1.018 (0.915 1.134)
Moderate						
Never®						
Rare			0.919**** (0.882 0.959)			0.728**** (0.632 0.839)
Everyday			1.026 (0.994 1.06)			0.667**** (0.597 0.744)
Yoga/Pranayam						
Never®						
Rare			1.013 (0.957 1.072)			0.901 (0.728 1.116)
Everyday			1.085**** (1.041 1.131)			1.14 (0.982 1.323)
Childhood health						
Good/Fair®						
Poor			1.06 (0.989 1.136)			0.745*** (0.564 0.985)
Regions						
North						

Table 4 (continued)

Covariates, Dependent var: Healthcare visits	Poisson model			Inflate model		
	Model-1 (IRR)	Model-2 (IRR)	Model-3 (IRR)	Model-1 (AOR)	Model-2 (AOR)	Model-3 (AOR)
Type of work						
Central			1.263**** (1.206 1.323)			1.337*** (1.134 1.577)
East			0.863**** (0.826 0.902)			0.839** (0.714 0.984)
Northeast			0.525**** (0.486 0.567)			2.207*** (1.812 2.687)
West			0.914**** (0.87 0.96)			1.035 (0.869 1.234)
South			0.971 (0.931 1.014)			1.013 (0.865 1.187)
Union Territories			1.019 (0.961 1.082)			1.215 (0.993 1.487)
Constant	4.656	3.146	4.987	0.731	0.866	1.568
AIC	52950.6	50373.12	48620.51	-	-	-

Note® reference category; ****($P<0.0001$), ***($P<0.01$), **($P<0.05$); Ln: Natural Log; AOR: Adjusted Odds Ratio; IRR: Incidence rate ratio
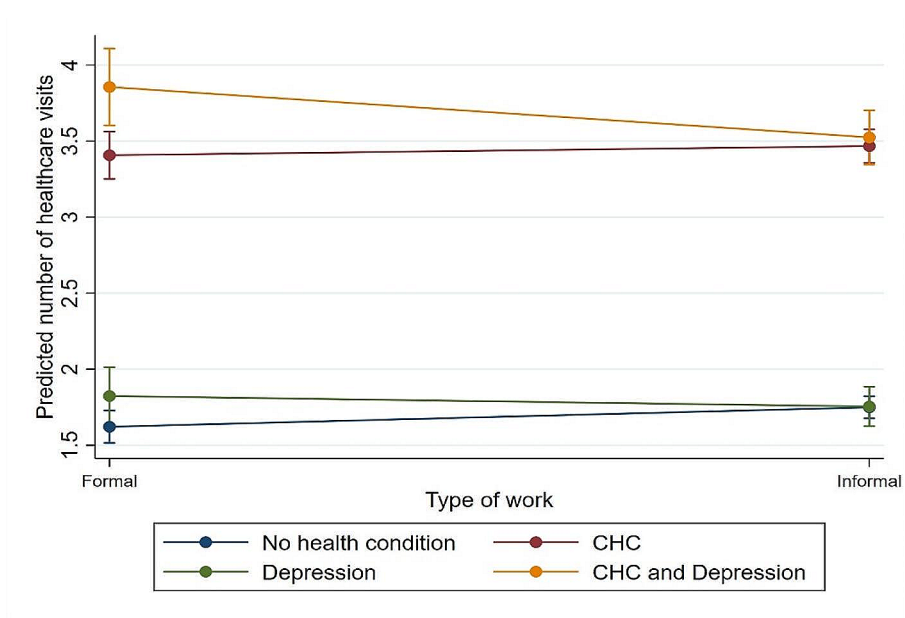
Fig. 4 Predicted number of healthcare visits by type of work and health status

Conclusion

Given the increasing older population in India, a vast number of them are working after the retirement age (60 years and above) due to financial insecurity and rising healthcare needs and costs. The present study elucidates that roughly half of the older workers are utilizing health services within a year. Further, the incidence of healthcare visits is different by type of work as informal older workers utilize fewer healthcare services compared to formal workers. The frequency of healthcare visits tends to decrease when informal older workers are afflicted by CHC or depression, rendering them more health-vulnerable compared to their formal counterparts. Furthermore, the combination of CHC and lack of social security contributes to the socio-economic vulnerability of informal older workers. Thus, proper economic support and healthcare provisions should be provided to financially motivate them to seek for healthcare services. However, most of the older population in India are less educated and unaware of ongoing government schemes. Thus, increasing the awareness among older population regarding government policies/programmes should be a top priority. This can be achieved through information, education, and communication activities which will boost the involvement of older people as well as older workers in ongoing programmes and improve the Indian healthcare system towards attaining universal health coverage.

Declarations

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