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The coverage and impact of community health worker programmes in South Africa's Gauteng province

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The coverage and impact of community health worker programmes in South Africa's Gauteng province

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Abstract

Objectives

To provide an analysis of household coverage and the impact of community health worker (CHW) programmes in South Africa's Gauteng province. More specifically, the study aims to explore the key characteristics of household coverage of CHW programmes and assess the impact of CHW visits on physical and mental health.

Methods

Analyses of waves IV and V of the Quality of Life (QoL) survey, from 2016 and 2018 respectively, using Stata's multiple logistic regression and treatment effects models.

Results

Only 11.3% of households reported a visit from a CHW in the last year in 2016. Household coverage was positively associated with being female (OR: 1.11, P=0.01), age (OR: 1.01, P<0.001), employment status (OR for unemployed versus employed: 1.28, P<0.001), and negatively associated with health insurance (OR for insured versus uninsured: 0.80, P=0.002), wealth quintile (OR for quintile five versus one: 0.57, P<0.001), and population group (OR for Coloured versus African: 0.77, P=0.026; OR for White versus African: 0.53, P<0.001). Household coverage varied widely by municipality. On average, respondents visited by a CHW reported higher degrees of experiencing depressed moods, higher likelihood of being classified as having a potential depressive disorder, and lower likelihood of reporting good health. This would apply if all households in Gauteng were to be visited by a CHW. The results vary by sex and wealth quintile.

Conclusions

Household coverage of the CHW programme in Gauteng is falling short of universal coverage for households in need. Overall, respondents visited by CHWs have worse physical and mental health outcomes. This may be owing to effective targeting of households in need in Gauteng, but this study highlights the need to evaluate and improve CHW programmes in Gauteng.

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Abbreviations and Acronyms

AIPW	augmented inverse-probability weighting
ATE	average treatment effect
ATET	average treatment effect on the treated
IPW	inverse-probability weighting
IPWRA	inverse-probability weighting regression adjustment
NNM	nearest-neighbour matching
POMs	potential-outcome means
PSM	propensity-score matching
RA	regression adjustment
UHC	universal health coverage
WHO	World Health Organisation

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1. Introduction

For the past few decades, Community Health Workers (CHWs) have been used to contribute towards universal health care provision and to address the shortage of health workers in low- and middle-income countries (LMICs) such as South Africa (Lehmann & Sanders, 2007). With an estimated global shortage of 18 million health workers by 2030 (which is more pronounced in LMICs), this cadre of health care workers is incredibly valuable (Perry & Hodgins, 2021; World Health Organization, 2021). Currently, there is a worldwide scarcity of adequately trained health workers, and the United Nations fears that universal health coverage (UHC) will not be achieved for up to one third of the world's population (Perry & Hodgins, 2021) until 2050 (Ledikwe et al., 2013; le Roux, K., le Roux, I.M., Mbewu, & Davis, 2015). This is concerning countries within Africa in particular as a mere 3% of the global health workforce services the African region, which makes up almost a quarter of the world's burden of disease (Ballard et al., 2020; Lehmann, Twum-Danso & Nyoni, 2018).

In South Africa, it is estimated that there are nine physicians and 13 nurses/midwives per 10,000 people (World Bank, 2017). This means that the existing health services are not coping with the rate of population growth and the quality of the services is therefore low (Ludwick, Morgan, Kane, Kelaher, & McPake, 2020). In addition, 84% of the population in South Africa uses the public health care system, mainly through clinics and hospitals, which are government-run (Mahlathi & Dlamini, 2015). The workforce in these systems is crucial to achieving full health care coverage in the country, but the retention of health workers in various areas of the country is limited (Mahlathi & Dlamini, 2015).

In these circumstances, municipalities in South Africa are presented with a unique opportunity to retain health workers and maintain the connection between communities and the health system by training and upskilling members of the community (Ledikwe et al., 2013; le Roux et al., 2015). The contribution of such workers towards achieving UHC and the sustainable development goal for health (World Health Organization, 2021) arises from the fact that they require less training than other medical professionals, have lower employment costs, and have easier access to communities, thereby reducing, or eliminating, geographical barriers and increasing knowledge and understanding of the community (Geldsetzer et al., 2017; Ludwick et al., 2020; Perry & Hodgins, 2021). According to researchers (Geldsetzer et al., 2017; Goudge et al., 2020; McCollum,

Gomez, Theobald, & Taegtmeyer, 2015; van Rie et al., 2018), CHWs are used for the following tasks: health promotion and education; disease prevention; screening services; promoting equity within the health care system; access to care; and onward referrals to clinics, doctors and/or hospitals for more specialised care.

The national CHW programme in South Africa (known as 'ward-based outreach teams'), was launched in 2011 as a method to re-engineer the primary health care system to include CHWs (JPHCF, 2011). This design was based on similar programmes in Brazil, which closely integrated CHWs into their health system, which then saw improvements in various health indicators and reductions in the horizontal inequality of health care provision (Geldsetzer et al., 2017; Zulliger, 2017). Similar improvements have been seen in countries such as Botswana, Bangladesh, India, and Zambia, as well as in a limited number of areas studied in South Africa (Geldsetzer et al., 2017; Goudge et al., 2020; Ledikwe, et al., 2013; Ludwick et al., 2020; Rotheram-Borus et al., 2014).

In two studies conducted in Africa which analysed coverage (the first in Swaziland and the second in South Africa), only 44.5% and around 10-20% of households respectively reported ever being visited by a CHW (Geldsetzer et al., 2017; Goudge et al., 2020). In both studies, the programmes are reported to be falling far short of their coverage goals. Geldsetzer et al. (2017) motivate that for increased coverage, additional CHWs need to be recruited and/or assigned more households. Similarly, Gouge et al. (2020) estimate that if the number of visits per CHW could be increased to four per day, coverage would increase by 60%. However, as noted by Nkonki, Cliff, and Sanders (2011), attrition rates of CHWs would need to be improved concurrently. CHW programmes globally have been shown to demonstrate high rates of attrition, a rate often neglected when analysing CHW programmes. In many cases, the programmes will be judged based on the number of CHWs recruited and trained, but the authors have found that this is not sufficient. If the rate of attrition is high for a CHW programme, this programme will likely have frequent disruptions in the continuity of care and the health outcomes of these programmes will likely be less affected (Nkonki, Cliff & Sanders, 2011). This is an important aspect to consider when developing policies regarding CHWs in South Africa.

In terms of mental health in South Africa, the need is as great as for physical health care provision. Mental disorders are a problem in Africa and, in many cases, result in exclusion from social

situations, suffering and disability (Chibanda et al., 2011). The WHO has advised that an additional 1.18 million mental health workers are needed globally to assist in minimising the treatment gap (Liana & Windarwati, 2021). Although mental health contributes significantly to the global burden of disease, the health resources allocated to it are comparatively low. In LMICs, there are only 0.9 health care workers per 100,000 individuals contributing to mental health care, and untreated individuals suffering from mental illness reaches 90% (Sibeko et al., 2018). Evidence demonstrates that psychosocial treatments are feasible, low-cost, and effective and, with appropriate training and supervision, CHWs can be used to deliver these treatments (Beaglehole et al., 2008; Chibanda et al., 2011; Ludwick et al., 2020; Perry, Zulliger & Rogers, 2014; Scott et al., 2018).

During the Covid-19 pandemic, high levels of stress meant that people in South Africa were more susceptible to depression and anxiety (SASOP, 2021). Moreover, such mental health problems are expected to rise as the repercussions of the pandemic become more evident (SASOP, 2021). Worsened household economic conditions (owing in part to structural inequality, unemployment, and a lack of access to quality health care) are expected to exacerbate these mental health issues, meaning that the poorer households of South Africa will be the most severely affected (SASOP, 2021).

However, as Burns (2011) notes, the South African health and social services that assist those with mental health issues are under-funded and not adequately developed to assist those in need. This is evidenced by the fact that in the 2016/17 financial year, South Africa's expenditure on mental health was around 5% of the country's health budget (Docrat et al., 2019). Some barriers to providing mental health care in South Africa are the lack of available human resources, inadequate supply of medication, and lack of infrastructure (Docrat et al., 2019). However, since the inclusion of mental health in the sustainable development goals in 2015 (WHO, 2018), South Africa has needed to increase commitment to providing adequate and equal care to the country. Consequently, by shifting certain tasks within the mental health care space, it has been suggested that the mental health gap can begin to shrink by using CHWs as additional human resources in health care.

To date, in South Africa, most influential papers on this topic have looked at CHWs in more rural areas (le Roux et al., 2015). Studies in the Western Cape and Kwa-Zulu Natal found positive effects resulting from CHW health programmes, with mothers in Cape Town reporting significantly lower levels of depression, and women living with HIV in KwaZulu-Natal showing

significant benefits from psychosocial support provided by 'peer mentors' (Rotheram-Borus et al., 2014; Rotheram-Borus et al., 2015). The research on areas surrounding Gauteng has been limited in previous literature, yet specific evaluations within each region and the policies they adopt has been shown to be beneficial in informing the design of new CHW programmes in the future (Geldsetzer, et al., 2017). This paper will look specifically at the key characteristics of the coverage of CHW programmes within the province of Gauteng, as well as the impact that CHW visits have on the physical and mental health outcomes of the households visited.

2. Methodology

The paper is split into two sections in order to answer the two research questions. Section 1 will look at household coverage of CHW programmes in South Africa's Gauteng province and Section 2 will look at the impact of the programme on self-reported mental and physical health in Gauteng. Section 2 further shows the results disaggregated by sex and wealth quintile respectively. This is because previous research indicates that changes in health outcomes are often different amongst male and female individuals, as well as amongst households which fall into different wealth quintiles. With this in mind, this paper considers whether this same distinction in health outcomes is prevalent in these data when separated by these subgroups.

2.1 Study setting

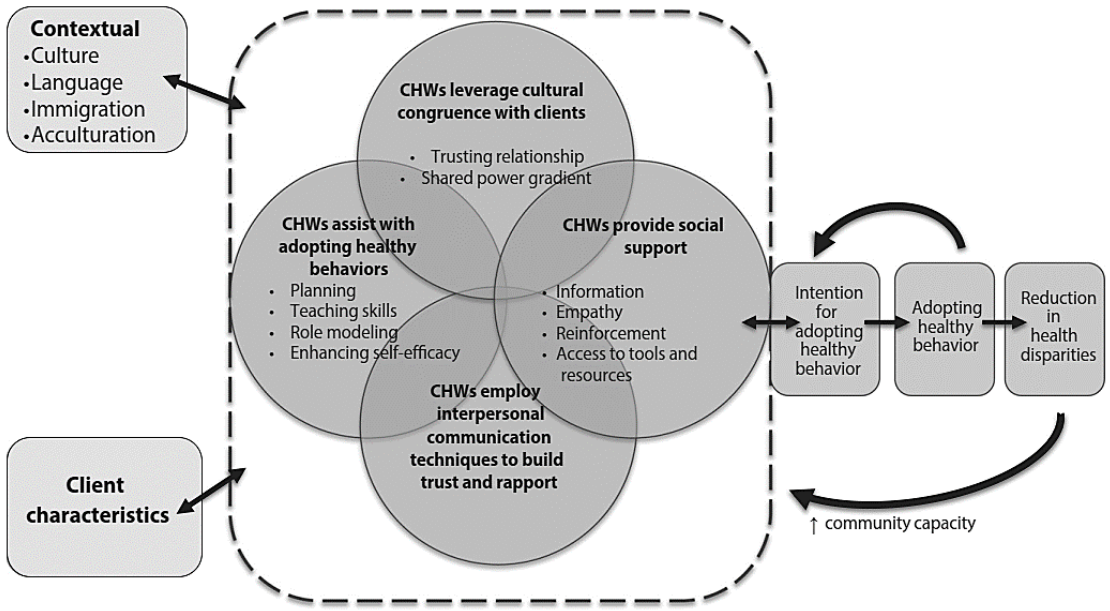
The two Quality of Life surveys on which this paper is based took place in 2016 and 2018 in nine municipal regions of the Gauteng province in South Africa, namely Ekurhuleni, Johannesburg, Tshwane, Emfuleni, Lesedi, Midvaal, Merafong, Mogale City, and Rand West. The employment rate of the sample across these regions was 48.0% in 2016 and 36.3% in 2018, with 61.5% of households falling within wealth quintile three or below in 2016 and 62,3% in 2018. Many households lack running water, electricity, and accessible toilet facilities.

2.2 Conceptual framework

The basic transmission mechanisms between a CHW visit and the chosen health outcomes can be seen in Figure 1 obtained from Katigbak, VanDevanter, Islam and Trinh-Shevrin (2015). One of the key areas that this paper will look at will involve the psychosocial support provided by the

CHWs, which could affect mental health outcomes and translate into health outcomes as shown below in Figure 1. This paper will extend the areas outlined in Figure 1 by additionally looking at the provision of health information. Figure 1 is focusing on health behaviour rather than health outcomes, which this paper will focus on.

Figure 1: Conceptual framework of community health workers (CHWs) and patients as partners in health.



Source: Katigbak, VanDevanter, Islam, & Trinh-Shevrin, 2015

During the visits conducted by CHWs, health outcomes are influenced through four key areas: (1) provision of health information to increase health awareness, (2) offering empathy to the recipients and listening to their concerns, (3) making patients aware of the health resources available to them to improve health outcomes, and (4) formulating constructive feedback for the patients to be able to monitor their progress and developing health outcomes (Katigbak, VanDevanter, Islam, & Trinh-Shevrin, 2015). Through these areas, the CHWs provide health information as well as psychosocial support to the patients, expectantly leading to improved overall health outcomes.

2.3 Data

The data used for this research report were obtained from waves IV and V of the Quality of Life (QoL) survey, which is conducted by the Gauteng City-Region Observatory (GCRO). This is a biennial survey, which measures various characteristics surrounding quality of life in the Gauteng province of South Africa (GCRO, 2016; GCRO, 2018). Randomly selected respondents in Gauteng are interviewed in person regarding political, social, and personal issues (GCRO, 2021). This methodology and the framing of the questions is kept consistent over all surveys as much as possible to ensure that results can be compared between different time periods (GCRO, 2021). The survey includes questions on the prevalence of CHW visits in Gauteng and is thus applicable to this paper. The survey asks questions relating to various health outcomes, both mental and physical, which will be used in the analysis.

2.4 Ethics

The design of the survey from which the data are obtained has met various standards to ensure the quality of the survey design and sampling methodology (GCRO, 2018). The survey has been approved by the Wits University Research Ethics Committee (non-medical) (University of the Witwatersrand, 2021). Verbal consent (and photographic confirmation if allowed by the respondent) was obtained from all participants in the original survey.

3. Section 1: Household coverage of the CHW programme

3.1 Data analysis

Multivariable logistic regression models were used to ascertain how household coverage varies according to different sociodemographic characteristics. This analysis was extended to analyse how household coverage varies for each of the nine municipalities within the Gauteng region. All analyses were conducted using Stata 17.0.

3.2 Explanatory variables

The explanatory variables used were based on previous research regarding CHW coverage and the impacts of CHW programmes. The choice of these variables was adjusted according to the data

available from the surveys. A wealth index was calculated with the aid of multiple correspondence analysis (MCA) using household-level questions regarding the household's (i) main water source; (ii) whether the household has access to safe drinking water; (iii) flushing toilet facilities; (iv) dwelling type; (v) main electricity supply; and (vi) ownership of various household assets. The explanatory variables used to inform CHW visits were sex; age; population group; education; employment status; years of residence in the community; municipality; dwelling type (formal or informal); health insurance; relationship status; and household wealth index.

3.3 Dependent variable

In Section 1, the dependent variable in the regression analysis will be household CHW coverage. This is defined as a household visited by a health care worker in the past year. The wave IV survey (2016) frames the question as follows: 'Have you been visited by a health care worker in your home in the past year?' (GCRO, 2016).

3.4 Sample characteristics

Table 1: Sociodemographic characteristics (2016).

Characteristic	Total
Female (%)	53.5
Age (years [SD])	39.8 (15.1)
Relationship status (%)	
In a relationship	75.0
Population group (%)	
African	80.9
Coloured	3.8
Indian/Asian	2.1
White	13.2
Employed (%)	48.0
Years lived in community (SD)	6.3 (11.8)
Education (%)	
None	1.6
Primary school	11.0
Secondary school incomplete	29.9
Matric	33.0
>secondary school	22.5
Unspecified	2.0

Wealth quintile (%) ⸸	
1 (poorest)	20.6
2	20.4
3	20.5
4	20.0
5 (richest)	18.6
Informal dwelling (%)	13.0
Health insurance (%)	
Insured	25.6
Sample (n)	*30,002*

%, percentage; SD, standard deviation; n, number of individuals.
⸸ As described in the methods, this is a naïve wealth index score that was divided into five groups, referred to as 'wealth quintiles' in this paper.
Note: Results are weighted.

Table 1 above summarises the basic sociodemographic characteristics of the sample for the 2016 survey. The wave IV survey yielded 30,002 household respondents in Gauteng in total. The mean age was 39.8 years and 53.5% of the respondents were women, while 80.9% of respondents were African; Coloured (3.8%); Indian/Asian (2.1%); and White (13.2%). In this sample, 75.0% of respondents were in a relationship. The employment rate was 48.0% with 20.6% of respondents falling within the lowest wealth quintile, 20.5% within the third, and 18.6% within the highest wealth quintile. At the time of this survey, 1.6% of respondents had no education, 11.0% had primary school level, 29.9% did not complete secondary school, 33.0% obtained matric passes, and 22.5% obtained education levels beyond matric. The mean number of years living in the community was 6.3 and 13.0% of respondents lived in informal dwellings, while 25.6% of respondents had health insurance (classified as medical aid covering health care in private facilities, private primary health care, government hospitalisation, and hospital plan schemes).

Table 2: Sociodemographic characteristics, by municipality (2016).

Characteristic	Ekurhuleni	Johannesburg	Tshwane	Emfuleni	Lesedi	Midvaal	Merafong	Mogale City	Rand West
Female (%)	53.7	51.8	54.2	57.2	53.5	60.4	51.1	56.8	52.9
Age (years [SD])	39.5 (14.6)	38.9 (14.5)	40.1 (15.8)	42.9 (16.7)	40.8 (15.6)	42.3 (16.2)	39.4 (14.3)	41.3 (15.9)	40.5 (15.8)
Relationship status (%)									
In a relationship	77.5	74.8	75.9	71.5	70.4	71.9	74.8	73.6	73.4
Population group (%)									
African	80.6	79.4	81.0	86.9	84.3	57.6	92.5	81.7	83.6
Coloured	3.2	6.5	2.5	0.9	0.5	1.4	0.8	0.1	5.7
Indian/Asian	2.1	3.5	1.3	1.3	1.0	0.9	0.2	1.0	0.1
White	14.0	10.7	15.2	10.9	14.1	40.1	6.5	17.1	10.6
Employed (%)	48.0	52.8	49.6	29.1	34.7	47.1	47.3	48.5	44.5
Years lived in community (SD)	6.1 (11.7)	5.9 (11.0)	6.0 (11.4)	6.6 (14.5)	4.4 (11.4)	6.45 (12.5)	9.7 (12.6)	8.1 (13.5)	8.3 (13.0)
Education (%)									
None	1.2	1.4	1.9	0.9	16.4	2.5	4.5	1.4	2.5
Primary school	10.3	8.7	11.2	17.5	37.5	16.3	17.7	10.6	14.9
Secondary school incomplete	29.2	27.7	26.8	37.4	47.7	27.6	41.0	38.3	43.4
Matric	35.2	34.0	31.5	32.1	48.6	35.1	24.9	31.2	26.3
>secondary school	21.0	25.6	26.9	11.9	25.6	18.6	11.8	17.8	12.7
Unspecified	3.0	2.4	1.6	0.2	5.0	(-)	0.2	0.7	0.3
Wealth quintile (%)⸸									
1 (poorest)	19.0	18.5	23.1	15.5	19.1	21.5	32.5	22.9	29.0
2	19.7	20.4	19.8	28.5	33.2	14.9	20.8	16.1	18.8
3	22.1	19.6	18.7	26.3	24.9	15.6	20.6	19.3	20.7
4	20.0	20.5	18.4	20.0	14.6	24.9	17.5	25.4	21.7
5 (richest)	19.3	20.9	20.0	9.7	8.3	23.1	8.6	16.2	9.8
Informal dwelling (%)	13.7	11.9	11.4	11.9	8.1	15.8	20.4	19.8	22.5
Health insurance (%)									
Insured	25.3	27.2	29.0	17.6	18.4	31.3	17.0	20.3	17.3
Sample (n)	*7,266*	*9,821*	*7,242*	*1,693*	*398*	*442*	*893*	*1,059*	*1,188*

%, percentage; SD, standard deviation; n, number of individuals.
⸸ As described in the methods, this is a naïve wealth index score that was divided into five groups, referred to as 'wealth quintiles' in this paper.
Note: Results are weighted.

Table 2 above summarises basic sociodemographic characteristics according to the municipality where the respondent lives. The majority of respondents were from Johannesburg (n=9,821) and the minority were from Lesedi (n=398). In each of the nine municipalities, more than half were female respondents with a mean age above 38 years old. Respondents in a relationship accounted for over 70.0% of total respondents in all municipalities. The percentage of African respondents was similar in all municipalities, except Midvaal where 57.6% of respondents were African. In the other municipalities, African respondents numbered over 75.0% of total respondents. Johannesburg had the highest rate of employment (52.8%) and Emfuleni the lowest (29.1%). Merafong had the highest average number of years lived in the community (9.7) and Lesedi the lowest (4.4). Tshwane reported the highest percentage of education beyond secondary school (26.9%) and Merafong the lowest (11.8%). Merafong had the highest percentage of respondents falling within the lowest quintile (32.5%) and Johannesburg the highest within the highest quintile (20.9%). The highest percentage of respondents living in informal dwellings was in Rand West (22.5%) and the lowest in Lesedi (8.1%). Health insurance rates were highest in Lesedi (31.3%) and lowest in Merafong (17.0%).

Table 3: Household coverage rates according to sociodemographic characteristics, by municipality (2016).

Characteristic	Ekurhuleni	Johannesburg	Tshwane	Emfuleni	Lesedi	Midvaal	Merafong	Mogale City	Rand West	**Total**
Sex (%)										
Male	15.4	7.9	10.2	10.2	4.9	5.1	7.1	7.9	6.8	10.2
Female	17.5	9.4	12.2	13.2	4.7	9.7	13.6	8.0	7.2	12.2
Age (years [SD])										
Visited	40.6 (16,3)	40.8 (16,4)	42.6 (17,9)	48.5 (19.2)	43.7 (20.2)	43.7 (17.9)	40.6 (16.5)	44.8 (17.5)	41.9 (16.8)	41.8 (17.1)
Not visited	39.3 (14.2)	38.7 (14.2)	39.8 (15.6)	42.2 (16.2)	40.6 (15.3)	42.1 (16.0)	39.2 (14.0)	41.0 (15.8)	40.4 (15.7)	39.5 (14.9)
Relationship status (%)										
Single	19.4	8.5	13.8	14.9	4.2	8.1	12.9	6.8	8.2	12.6
In a relationship	15.7	8.8	10.5	10.7	5.0	7.9	9.6	8.3	6.5	10.9
Population group (%)										
African	19.0	9.2	12.6	13.3	5.7	11.8	10.3	9.2	8.0	12.6
Coloured	10.7	8.2	7.3	13.3	0.0	0.0	14.3	0.0	4.5	8.4
Indian/Asian	5.8	7.4	4.1	4.5	0.0	0.0	0.0	0.0	0.0	6.2
White	5.4	5.9	5.7	2.2	0.0	2.8	12.1	2.8	0.0	5.1
Employment status (%)										
Unemployed	21.1	10.1	15.4	12.7	4.7	15.3	13.1	6.5	9.2	14.4
Employed	12.8	7.8	8.3	8.9	6.5	3.8	6.6	7.4	5.9	9.0
Years lived in community (SD)										
Visited	7.0 (13.0)	6.5 (13.0)	6.8 (13.3)	7.9 (16.9)	5.1 (13.3)	10.28 (16.0)	9.6 (15.0)	8.6 (13.4)	8.9 (14.3)	7.1 (13.5)
Not visited	6.0 (11.4)	5.9 (10.8)	5.9 (11.1)	6.4 (14.1)	4.4 (11.3)	6.1 (12.2)	9.7 (12.3)	8.1 (13.5)	8.3 (12.9)	6.2 (11.5)
Education (%)										
None	21.8	12.8	19.1	13.3	0.0	18.2	15.0	6.7	6.7	15.7
Primary school	25.0	11.2	15.2	22.6	10.4	16.7	10.8	7.1	8.5	16.1
Secondary school incomplete	21.6	10.1	13.9	12.8	5.0	11.5	12.8	9.9	7.0	13.7
Matric	14.5	9.0	12.2	7.0	3.3	4.5	8.1	7.6	7.4	10.8
>secondary school	9.2	6.1	5.6	7.0	0.0	0.0	4.8	4.8	4.6	6.5
Unspecified	10.6	4.2	10.4	0.0	0.0	-	0.0	14.3	0.0	7.8
Wealth quintile (%)⸸										
1 (poorest)	18.4	9.8	12.7	13.7	14.5	11.6	11.0	11.1	9.6	12.9
2	23.2	9.8	14.6	14.5	3.8	12.1	15.1	7.6	7.6	14.4
3	20.5	11.2	14.6	12.6	2.0	14.5	9.2	10.8	7.3	14.2
4	12.9	7.4	9.5	8.3	1.7	4.5	10.3	6.3	4.7	9.1
5 (richest)	6.9	5.6	4.9	7.3	0.0	1.0	0.0	2.9	2.6	5.4
Dwelling type (%)										
Informal	17.7	8.9	13.6	13.3	6.3	14.3	14.9	10.1	9.1	12.7
Formal	16.4	8.7	11.1	11.6	4.7	6.8	10.4	7.3	6.7	11.1
Sample (n)	*7,266*	*9,821*	*7,242*	*1,693*	*398*	*442*	*893*	*1,059*	*1,188*	*30,002*

%, percentage; SD, standard deviation; n, number of individuals.

⸸ As described in the methods, this is a naïve wealth index score that was divided into five groups, referred to as 'wealth quintiles' in this paper.

Note: Results are weighted.

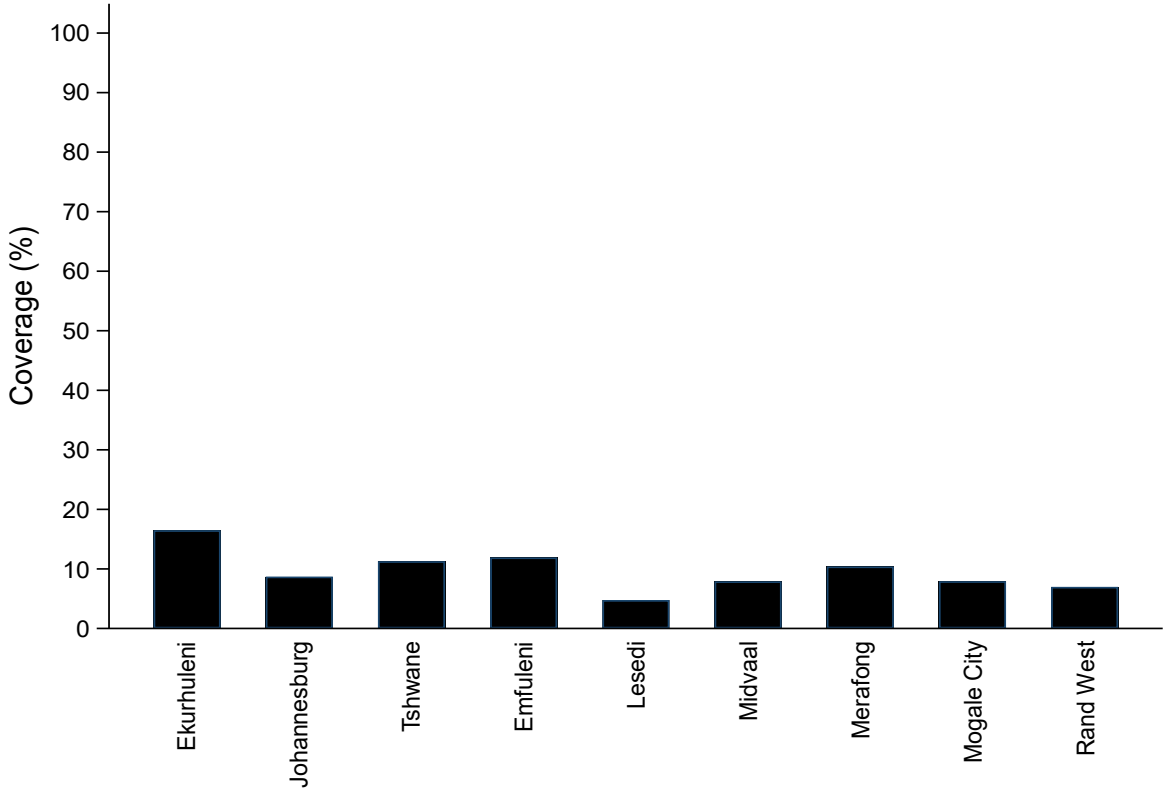
Table 3 above looks at the household coverage rates for each characteristic according to the municipality in which the respondent belongs. In eight of the municipalities (excluding Lesedi), a higher percentage of female respondents were visited by a CHW than male respondents. In all nine of the municipalities, the respondents visited by a CHW were on average older than those not visited. A higher proportion of respondents not in a relationship were visited by a CHW in Ekurhuleni, Tshwane, Emfuleni, Midvaal, Merafong, and Rand West than were respondents in a relationship. In Johannesburg, Lesedi, and Mogale City, the household coverage rates were higher amongst respondents in a relationship. The highest proportion of respondents visited were African in most municipalities, except in Emfuleni (13.3% for both African and Coloured respondents), and Merafong (14.3% of Coloured respondents were visited compared to 10.3% of African respondents).

In seven municipalities, unemployed respondents had higher household coverage rates than employed respondents. This was not the case in Lesedi and Mogale City. Merafong was the only municipality where the respondents that had lived in the community for comparatively less time had a higher household coverage rate, although it was a small difference of only 0.1 years on average between the two groups. In all other municipalities, those that lived in the community for more years on average had higher household coverage rates.

In Johannesburg, Tshwane, Midvaal, and Merafong, respondents with no education had the highest household coverage rates. In Ekurhuleni, Emfuleni, Lesedi, and Rand West, respondents with primary school level education had the highest household coverage rates. Merafong was the only municipality where the highest household coverage rates were not in the first two education levels (14.3% of respondents had unspecified education levels and 9.9% had incomplete secondary school educations). The variation in household coverage for respondents in different wealth quintiles per municipality was more spread out than for other characteristics. In six out of the nine municipalities, respondents in wealth quintiles one and two had the highest household coverage rates, with Lesedi, Mogale City, and Rand West having highest household coverage in quintile one. Ekurhuleni, Emfuleni, and Merafong had highest household coverage in quintile two. Tshwane had highest household coverage in quintiles two and three (equal rates). Johannesburg and Midvaal had highest household coverage rates in quintile three. In all nine municipalities,

respondents living in informal dwellings had higher household coverage rates than those in formal dwellings.

Figure 2: Percentage of households visited by a CHW in the last year, by municipality.



Total household coverage over the nine municipalities is shown in Figure 2 above. Household coverage varied from 4.8% in Lesedi to 16.5% in Ekurhuleni, while aggregate household coverage was 11.3%.

3.5 Regression results

Table 4: Correlates of household coverage of CHW visits (2016).

Characteristic	OR (SE)
Sex	
Female	1.11*
	(0.045)
Age	1.01***
	(0.002)
Population group	
Coloured	0.77*

	(0.091)
Indian/Asian	0.74
	(0.135)
White	0.53***
	(0.050)
Relationship status	
In a relationship	0.99
	(0.045)
Municipality	
Johannesburg	0.48***
	(0.025)
Tshwane	0.65***
	(0.034)
Emfuleni	0.55***
	(0.047)
Lesedi	0.20***
	(0.048)
Midvaal	0.57**
	(0.106)
Merafong	0.56***
	(0.069)
Mogale City	0.38***
	(0.048)
Rand West	0.34***
	(0.043)
Years lived in community	1.00
	(0.002)
Dwelling	
Informal	0.86
	(0.070)
Education	
Primary school	1.02
	(0.150)
Secondary incomplete	0.99
	(0.143)
Matric	0.9
	(0.133)
>secondary school	0.71*
	(0.113)
Unspecified	0.69
	(0.151)
Employment Status	
Unemployed	1.28***
	(0.063)
Other	1.13*

	(0.060)
Wealth index	1.07
	(0.045)
Wealth quintile ⸸	
2	0.96
	(0.075)
3	0.94
	(0.083)
4	0.67***
	(0.070)
5	0.57***
	(0.076)
Health insurance	
Insured	0.80**
	(0.057)
Sample (n)	*28,428*
X^2 (29, N =28428) = 752.9, p < .01	

OR, odds ratio; SE, standard error

⸸ As described in the methods, this is a naïve wealth index score that was divided into five groups, referred to as 'wealth quintiles' in this paper.
Note: Results are weighted

Table 4 above shows the sociodemographic characteristics associated with CHW household coverage, obtained from regression results; namely, female, age, primary school level of education compared to no education, unemployment and wealth index were all positively associated with household coverage, whereas being in a relationship, living in an informal dwelling, and being insured were negatively associated with coverage. Female respondents are 11.0% more likely to be visited by a CHW than male respondents, significant at the 5% level.

When compared to African respondents, Coloured respondents were 13.0% less likely to be visited (significant at the 5% level), Indian/Asian respondents were 16% less likely (insignificant), and White respondents were 47.0% less likely to be visited (significant at the 0.1% level). Compared to Ekurhuleni, respondents in all other municipalities were less likely to be visited (all significant), with Lesedi showing the largest difference of being 80.0% less likely for respondents to be visited by a CHW (significant at the 0.1% level). One additional year of age is associated with a 1.0% increase in the likelihood of a household being visited by a CHW (significant at the 0.1% level).

Unemployed respondents are 28.0% more likely to be visited (significant at the 0.1% level) and respondents in quintile two were 4.0% less likely to be visited than respondents in quintile one

(insignificant). This pattern continues into each quintile with household coverage decreasing as the quintile level increases. Only quintiles four and five are significantly different from quintile one. Respondents that reported being in a relationship were 1.0% less likely to be visited than single respondents (not significant). Respondents living in an informal dwelling were 14.0% less likely to be visited (not significant). Respondents with primary school level education were 2.0% more likely to be visited than those with no education, but as education levels increase, it is less likely that the respondent is visited. The only education level which is significantly different from no education is higher than secondary school. Respondents that had health insurance were 20.0% less likely to be visited than those without (significant at the 1% level).

Table 5: Correlates of household coverage of CHW visits, by municipality (2016).

	Ekurhuleni	Johannesburg	Tshwane	Emfuleni	Lesedi	Midvaal	Merafong	Mogale City	Rand West
	OR (SE)	OR (SE)	OR (SE)	OR (SE)	OR (SE)	OR (SE)	OR (SE)	OR (SE)	OR (SE)
Characteristic									
Sex									
Female	1.03	1.19*	1.07	1.30	1.15	2.41*	1.62	0.76	0.94
	(0.072)	(0.092)	(0.088)	(0.225)	(0.583)	(1.040)	(0.434)	(0.208)	(0.253)
Age	1.01*	1.01**	1.01***	1.02***	1.01	1.00	1.00	1.04***	1.01
	(0.003)	(0.003)	(0.003)	(0.007)	(0.025)	(0.017)	(0.010)	(0.010)	(0.011)
Population group									
Coloured	0.52**	0.99	0.71	1.77	1.00	1.00	2.52	1.00	0.76
	(0.118)	(0.161)	(0.217)	(1.402)	(-)	(-)	(2.749)	(-)	(0.491)
Indian/Asian	0.51	1.05	0.46	0.57	1.00	1.00	1.00	1.00	1.00
	(0.192)	(0.250)	(0.231)	(0.626)	(-)	(-)	(-)	(-)	(-)
White	0.41***	0.90	0.60**	0.15***	1.00	0.17*	2.67	0.17***	1.00
	(0.073)	(0.147)	(0.105)	(0.076)	(-)	(0.155)	(1.490)	(0.085)	(-)
Relationship status									
In a relationship	0.90	1.22*	0.86	1.02	1.31	1.91	0.98	1.65	0.83
	(0.072)	(0.107)	(0.078)	(0.193)	(0.690)	(0.846)	(0.256)	(0.531)	(0.238)
Years lived in community	1.00	1.00	1.00	1.00	1.01	1.03	1.00	1.00	1.00
	(0.003)	(0.004)	(0.003)	(0.006)	(0.017)	(0.015)	(0.011)	(0.009)	(0.010)
Dwelling									
Informal	0.75*	0.85	1.02	0.82	0.36	1.13	1.41	0.95	0.52
	(0.109)	(0.135)	(0.168)	(0.267)	(0.373)	(0.883)	(0.544)	(0.397)	(0.273)
Education									
Primary school	0.99	0.90	0.98	1.45	1.00	0.49	0.70	2.13	1.15
	(0.286)	(0.266)	(0.263)	(1.174)	(-)	(0.464)	(0.387)	(2.692)	(0.944)
Secondary incomplete	0.96	0.89	1.06	1.08	2.92	0.48	0.76	4.54	0.96
	(0.273)	(0.252)	(0.279)	(0.890)	(2.056)	(0.469)	(0.425)	(5.706)	(0.744)
Matric	0.74	0.87	1.21	0.61	1.00	0.16	0.51	7.01	1.22
	(0.216)	(0.248)	(0.328)	(0.523)	(0.683)	(0.168)	(0.323)	(9.192)	(1.008)

>secondary school	0.68	0.65	0.72	0.78	1.00	1.00	0.40	4.26	1.06
	(0.210)	(0.200)	(0.209)	(0.684)	(-)	(-)	(0.317)	(5.825)	(0.943)
Unspecified	0.82	0.43	0.86	1.00	1.00	(-)	1.00	53.28*	1.00
	(0.301)	(0.189)	(0.368)	(-)	(-)	(-)	(-)	(99.698)	(-)
Employment Status									
Unemployed	1.37***	1.11	1.42***	1.28	0.69	2.12	1.42	0.83	1.46
	(0.112)	(0.106)	(0.140)	(0.295)	(0.417)	(1.176)	(0.436)	(0.296)	(0.477)
Other	1.26*	0.96	1.22	0.97	0.40	2.88	1.57	1.55	0.89
	(0.118)	(0.098)	(0.128)	(0.233)	(0.310)	(1.756)	(0.538)	(0.467)	(0.377)
Wealth index	1.08	1.09	1.07	1.00	1.87	1.02	1.33	0.69*	0.77
	(0.079)	(0.092)	(0.108)	(0.172)	(0.979)	(0.407)	(0.245)	(0.129)	(0.174)
Wealth quintile ⸸									
2	1.08	0.79	1.06	0.91	0.07***	1.77	0.79	1.10	0.91
	(0.155)	(0.120)	(0.154)	(0.320)	(0.052)	(2.207)	(0.341)	(0.601)	(0.498)
3	0.90	0.90	1.11	0.93	0.03***	2.53	0.41	2.04	1.22
	(0.142)	(0.151)	(0.185)	(0.364)	(0.034)	(3.497)	(0.202)	(1.222)	(0.716)
4	0.64*	0.59**	0.83	0.85	0.08	0.76	0.43	1.07	0.98
	(0.121)	(0.118)	(0.168)	(0.389)	(0.134)	(1.243)	(0.239)	(0.739)	(0.648)
5	0.56*	0.49**	0.61	1.92	1.00	0.54	1.00	0.67	0.64
	(0.135)	(0.123)	(0.160)	(1.184)	(-)	(1.049)	(-)	(0.618)	(0.647)
Health insurance									
Insured	0.73*	1.01	0.63***	0.46*	1.39	1.09	1.62	1.27	0.96
	(0.090)	(0.138)	(0.086)	(0.168)	(1.114)	(1.083)	(0.695)	(0.649)	(0.525)
Sample (n)	*6,879*	*9,366*	*6,812*	*1,591*	*291*	*345*	*734*	*1,027*	*980*
	$X^2(21, N=6879) = 260.4, p<.01$	$X^2(21, N=9366) = 83.7, p<.01$	$X^2(21, N=6812) = 188.6, p<.01$	$X^2(20, N=1591) = 88.8, p<.01$	$X^2(14, N=291) = 42.7, p<.01$	$X^2(17, N=345) = 50.2, p<.01$	$X^2(18, N=734) = 26.1, p=.098$	$X^2(19, N=1027) = 63.0, p<.01$	$X^2(18, N=980) = 13.0, p=.79$

OR, odds ratio; SE, standard error

⸸ As described in the methods, this is a naïve wealth index score that was divided into five groups, referred to as 'wealth quintiles' in this paper.

Note: Results are weighted.

Table 5 above shows the variation between municipalities in the sociodemographic characteristics associated with household coverage, obtained from multivariable regression results. The respondent being female was positively associated with CHW visits in the sample, excluding respondents from Mogale City and Rand West, where female respondents were 24.5% and 6.4% less likely to be visited respectively. Only the results for sex of respondents in Johannesburg and Midvaal were significant at the 5% level. Coloured, Indian/Asian, and White respondents were on average less likely to be visited by a CHW than African respondents. This was not the case for Indian/Asian respondents in Johannesburg, Coloured respondents in Emfuleni and Merafong, and White respondents in Merafong. However, in the significant results, the three population groups were less likely to be visited than African respondents.

Age was positively associated with household coverage in all municipalities except for respondents in Merafong, where an additional year of age meant that respondents were 0.1% less likely to be visited (however, this result was insignificant). Only the results for age of respondents in Ekurhuleni, Johannesburg, Tshwane, Emfuleni, and Mogale City were significant at the 5% level.

Respondents living in an informal dwelling were less likely to have a CHW visit in Ekurhuleni, Johannesburg, Emfuleni, Lesedi, Mogale City, and Rand West. This was only significant at the 5% level for respondents in Ekurhuleni.

Unemployed respondents were more likely to have a visit from a CHW in all provinces except Lesedi and Mogale City (only significant for Ekurhuleni and Tshwane at the 0.1% level). Health insurance did not clearly impact household coverage in a particular direction, with Ekurhuleni, Tshwane, Emfuleni, and Rand West seeing insured respondents being less likely to be visited by a CHW, and Johannesburg, Lesedi, Midvaal, Merafong, and Mogale City seeing insured respondents more likely to be visited. However, the results for health insurance were only significant in Ekurhuleni, Tshwane, and Emfuleni at the 5% level at least.

Respondents with education levels higher than secondary school were less likely to be visited in Ekurhuleni, Johannesburg, Tshwane, Emfuleni, and Merafong. Only the result for the unspecified group of respondents in Merafong was significant. The results for household coverage amongst respondents in different wealth quintiles were not in a clear direction or of a similar magnitude. However, the only significant results were for quintiles two and three in Lesedi, and quintiles four

and five in Ekurhuleni and Johannesburg. In Lesedi, respondents in quintiles two and three were less likely (93.0% and 97.0% respectively) to be visited by a CHW than respondents in quintile one. In Ekurhuleni, respondents in quintiles four and five were less likely (36.0% and 44.0% respectively) to be visited by a CHW than respondents in quintile one. In Johannesburg, respondents in quintiles four and five were less likely (41.0% and 51.0% respectively) to be visited by a CHW than respondents in quintile one. Several results could not be estimated owing to insufficient sample sizes within some sub-groups.

3.6 Discussion

Analysing household coverage by CHW programmes is an important starting point in ascertaining the level of efficacy of the programmes. The CHW programme in South Africa aims to improve access to primary health care, but in this sample, only 11.3% of respondents reported their household being visited by a CHW and the programme, therefore, has not met expectations (Khuzwayo & Moshabela, 2017). Within each municipality in Gauteng, this result is seen, with Ekurhuleni showing the highest household coverage rate at only 16.5%. The probable reason for this is insufficient planning and/or resources. In Africa particularly, CHW programmes have been found to be poorly planned with a lack of supervision and training and weak links to the health care system (van Rie et al., 2018). There are many limitations faced by CHWs, including a lack of leadership; low commitment levels from government; low renumeration; lack of medical equipment; access to transport; poor career progression; poorly described job roles; and/or management and organisational structures (Goudge et al., 2020; Ledikwe et al., 2013; Lehmann, Twum-Danso & Nyoni, 2018; le Roux et al., 2015; Schneider et al., 2018; van Rie et al., 2018). In a previous study by Goudge et al. (2020), household coverage across the sites studied in Sedibeng, Gauteng, was estimated at 10%-20%. The results in this paper are in line with this estimate, although on the lower end for the Gauteng area overall.

Some findings overall show that age is positively associated with household CHW coverage and that older respondents are more likely to be visited (significant at the 0.1% level). In all nine of the municipalities, the respondents visited by a CHW were on average older than those not visited and in all significant results, age was positively associated with household coverage. This is in line with previous studies that found that households with older members (>60 years old) were more

likely to be visited by CHWs in South Africa and Swaziland (Geldsetzer et al., 2017; Goudge et al., 2020). This is likely because older people require more frequent deliveries of medication, a service which is often carried out by CHWs and/or because their mobility and ability to get to health care facilities is limited (Goudge et al., 2020). In a paper by Geldsetzer et al. (2017), this positive relationship between age and CHW visits is seen to likely be owing to increased coverage being a function of worsened health in older individuals. Another possible reason for this positive association is because CHW programmes are commonly used to target older populations which are more dependant on care (Neto et al., 2021). Furthermore, treatment amongst older populations is often inadequate in developing countries in particular and the ward-based outreach programme in South Africa could be focusing on this area of care inadequacy (Rahmawati and Bajorek, 2015).

The result that unemployed respondents overall are significantly more likely to be visited is in line with previous literature. This could arise since CHW visits occur during working hours in the day where many individuals may be at work, meaning that those absent from the home are being underestimated and thus the percentage of unemployed individuals seen by a CHW is overestimated. Conversely, it could be the case that unemployed respondents have lower income levels and cannot afford health care outside of CHW visits. This might be owing to the lack of resources to travel to the health care facilities. Significant results are seen in Johannesburg and Tshwane where unemployed respondents are more likely to report their household being visited by a CHW.

As the level of wealth quintile increases, respondents are less likely to report being visited by a CHW. This could be because wealthier households in the community generally would not seek the service of a CHW, but rather seek private health care or have the ability and resources available to travel to clinics and/or hospitals. However, only the results for wealth quintiles four and five (compared to wealth quintile one) are significant. Significant results are seen in quintiles four and five in Ekurhuleni and Johannesburg, and quintiles one and two in Lesedi, where respondents in the higher quintiles are less likely to report their household being visited by a CHW. A possible explanation for quintiles two and three not having significant results is that there exist large differences in individuals in different wealth quintiles in South Africa, owing to the structuring of the measure. In a study by Mukong, van Walbeek and Ross (2017), it is seen that inequalities in self-reported ill-health are prevalent with poorer communities. When comparing the quintiles to

quintile one, it would therefore be expected that quintiles four and five would show significant results.

The result for respondents in a relationship is not significant at the 5% level and thus difficult to draw any conclusions. The only significant result across municipalities is for respondents in Johannesburg where respondents in a relationship are more likely to be visited by a CHW than those not in relationships. This could be owing to one member in the relationship not being employed and thus being at home when the visits from the CHW takes place, meaning that the result may be overestimated.

The only significant result for education levels is that respondents overall with levels higher than secondary school are less likely to be visited by a CHW. A possible reason for this is that respondents with higher levels of education might have higher employment rates and fall within higher wealth quintiles. This may mean that they have health insurance or can afford health care outside of relying on CHW visits in the household.

The surprising result is of respondents living in informal settlements who are 14.0% less likely to be visited. This result was expected to be positive as respondents living in informal dwellings would usually belong to a lower wealth quintile and have higher rates of unemployment. While the lower wealth quintile may not provide conclusive results, being unemployed is significantly associated with being visited by a CHW. Furthermore, CHW programmes are designed to target households which are more resource constrained and it is expected that these households reside in informal dwellings. Both the bivariate comparison (between informal dwellings and visits from CHWs) and the regression result is statistically insignificant, though, at the 5% level and will need to be disregarded. However, in Ekurhuleni, respondents living in informal dwellings are significantly less likely to be visited than respondents in formal dwellings. This may be because informal settlements are often harder to reach (because of poor transport routes) and this might discourage CHWs from travelling to visit these households. It was expected that the dwelling type (which is used as a proxy for socioeconomic status here) being informal would increase the likelihood of a CHW visiting the household, which was not the case here. A similar result was found in the paper by Gouge et al. (2020) and was equally as unexpected to these authors. Further

research in this area alone would be beneficial to assessing the efficacy of CHW programmes in South Africa.

Respondents with health insurance were less likely to be visited (significant at the 1% level), which is in line with what is expected. Insured respondents would most likely seek health care elsewhere (often in the private sector) and not have any need for a CHW. This is seen in Ekurhuleni, Tshwane, and Emfuleni where respondents with health insurance are significantly less likely to be visited by a CHW. This illustrates that CHW programmes effectively extend access to households that do not otherwise have ready access to health care services.

The results for the average number of years living in the community were insignificant. This is unexpected as the CHW visiting the households would likely have stronger relationships with those respondents that had lived in the communities for more years and thus lean towards visiting these households. In the study by Geldsetzer et al. (2017), the number of years lived in the community was positively associated with household coverage.

Many of the results varied according to the municipality that the household belongs to. When looking at the sociodemographic characteristics, once can see that the regions are relatively diverse. This illustrates how the different underlying characteristics impact household coverage rates in the province.

The focus now shifts to the discussion of the results of the treatment effect models.

4. Section 2: Impact of the CHW programme

4.1 Data analysis

Treatment effect models are used to identify the effects of CHW visits on depression indicators (both scale and binary) and self-reported health status. For each health outcome, three parameters are used to analyse the treatment effects. These are the average treatment effect (ATE), the average treatment effect on the treated (ATET), and the potential-outcome means (POMs). The ATE looks at the impact expected of the programme if full programme participation is achieved. The ATET will show results which assess the expected effect on the current participants of the programme (Millimet and Tchernis, 2013). There exist five categories of estimators which are implemented

by Stata's teffects model. These five estimators are: regression adjustment (RA); inverse-probability weighting (IPW); inverse-probability weighting regression adjustment (IPWRA); augmented inverse-probability weighting (AIPW); and matching on the propensity-score (PSM) or nearest-neighbour (NNM). Within these five categories, there are choices regarding whether to model the probability of treatment, the outcomes, or both. Certain models have a double-robust property (IPWRA and AIPW), meaning that the effects will still be consistently estimated even if only one of the two models is specified correctly. In this paper, all five approaches are used to ensure the full scope of the treatment effects are captured and to account for any misspecifications. The IPWRA was used as the base case. This is known as Woolridge's doubly robust estimator, meaning that the outcome modelling strategy of RA is combined with the treatment modelling strategy of IPW (StataCorp, 2013), and is derived by Wooldridge (2007). The estimator requires two models to be built, but only requires that one of the two models is specified correctly. This ensures that the results of the treatment for the baseline case are more accurate. No literature exists (to this researcher's knowledge) that compares AIPW and IPWRA in terms of the relative efficiency and the choice between the two methods is a matter of preference. All estimators will be compared to the IPWRA estimates to ascertain the robustness of the results. The sociodemographic characteristics (descriptive analyses) are weighted using probability weights provided in the 2018 QoL dataset ("Weight"). However, the results for the treatment effects are not weighted in the 2018 QoL dataset insofar as the nearest neighbour and propensity score matching options in the teffects function in Stata does not allow the use of survey weights. In order to compare results across the various models, none of the results were weighted. All analyses were conducted using Stata 17.0.

4.2 Treatment variable

The treatment variable will be household CHW visitation. The wave V survey (2018) frames the question as follows: 'Have you or anyone in your household been visited by a community health worker in your home in the past year?' (GCRO, 2018).

4.3 Explanatory variables

The variables used in both Sections 1 and 2 were consistent, although adapted slightly according to the way in which questions were phrased (see Section 1 for elaboration on the variables used).

In Section 2, there were additional explanatory variables used as predictors of physical and mental health status. From previous research, it became evident that the variables which affected health outcomes were sex; population group; dwelling type; education; wealth quintile; employment status; disability status; receipt of emotional support; geographic area of residence; and food security (Compton, 2015; Motrico et al., 2021; Shim & Compton, 2018; World Health Organization, 2014).

4.4 Outcome variables

Three outcome variables are analysed: depression indicators (both scale and binary) and self-reported health status. To obtain the variables for depression indicators, the PHQ-2 component of the Patient Health Questionnaire was used, which includes questions pertaining to anhedonia and low mood (Gilbody et al., 2007). The survey asks respondents how many days over the past two weeks they have had little interest or pleasure in doing things and/or felt down, depressed or hopeless. The respondents can answer: 'Not at all'; 'A few days'; 'More than half the days'; 'Nearly every day'. Both a scalar and binary version of the variables were used to ascertain whether the results differ across the two measures. The self-reported health status variable will be used to ascertain general health status of the respondents and to analyse if a respondent reporting good health was related to visits from a CHW. The survey asks respondents how they would describe their own health status in the past four weeks. The respondents can answer: 'Excellent'; 'Good'; 'Poor'; 'Very poor'. The responses were collapsed into a binary variable for this paper as it is only looking at respondents that reported good health status. The three outcome variables will be referred to throughout the paper as 'PHQ-2 scale', 'PHQ-2 binary', and 'Good health'.

4.5 Sample characteristics

Table 6: Sociodemographic characteristics (2018).

Characteristic	Total
Female (%)	53.2
Age (years [SD])	40.7 (14.9)
Relationship status (%)	
In a relationship	74.0
Population group (%)	
African	84.5
Coloured	3.6

Indian/Asian	1.5
White	10.4
Employed (%)	36.3
Years lived in community (SD)	7.3 (12.1)
Education (%)	
None	2.8
Primary school	9.6
Secondary school incomplete	27.9
Matric	31.8
>secondary school	26.1
Unspecified	1.9
Wealth quintile (%) ⸸	
1 (poorest)	20.0
2	21.4
3	20.9
4	20.1
5 (richest)	17.5
Informal dwelling (%)	14.9
Health insurance (%)	
Insured	26.2
Sample (n)	*24,889*

%, percentage; SD, standard deviation; n, number of individuals.
⸸ As described in the methods, this is a naïve wealth index score that was divided into five groups, referred to as 'wealth quintiles' in this paper.
Note: Results are weighted.

Table 6 above summarises the basic sociodemographic characteristics of the sample in the 2018 survey. The wave V survey yielded 24,889 household respondents in Gauteng in total. The mean age was 40.7 years and 53.2% of the respondents were women. In terms of populations groups, 84.5% of respondents were African; 3.6% were Coloured; 1.5% were Indian/Asian; and 10.4% were White. In this sample, 74.0% of respondents were in a relationship. The employment rate was 36.3% with 20.0% of respondents falling within the lowest wealth quintile; 21.4% within the second; 20.9% within the third; 20.1% within the fourth; and 17.5% within the highest wealth quintile. At the time of this survey, 2.8% of respondents had no education; 9.6% had primary school level; 27.9% did not complete secondary school; 31.8% obtained matric passes; and 26.1% obtained education levels beyond matric. The mean number of years living in the community was 7.3 and 14.9% of respondents lived in informal dwellings.

Table 7: Sociodemographic characteristics, by sex (2018).

Characteristic	Male	Female	**Total**
Age (years [SD])	40.1 (14.2)	41.2 (15.6)	40.7 (14.9)
Relationship status (%)			
In a relationship	77.4	70.9	74.0
Population group (%)			
African	84.3	84.7	84.5
Coloured	3.3	3.9	3.6
Indian/Asian	1.6	1.4	1.5
White	10.8	10.0	10.4
Employed (%)	44.7	28.9	36.3
Years lived in community (SD)	7.5 (11.6)	7.1 (12.3)	7.3 (12.1)
Education (%)			
None	2.4	3.1	2.8
Primary school	8.6	10.4	9.6
Secondary school incomplete	25.8	29.8	27.9
Matric	32.6	31.1	31.8
>secondary school	28.7	23.8	26.1
Unspecified	14.0	1.8	1.9
Wealth quintile (%) ⸸			
1 (poorest)	20.9	19.2	20.0
2	19.7	23.0	21.4
3	19.2	22.4	20.9
4	21.3	19.1	20.1
5 (richest)	18.9	16.4	17.6
Municipality (%)			
Ekurhuleni	24.6	25.9	25.3
Johannesburg	32.9	30.5	31.6
Tshwane	17.4	17.3	17.4
Emfuleni	6.3	7.4	6.9
Lesedi	1.6	2.1	1.9
Midvaal	2.3	1.9	2.1
Merafong	4.1	4.2	4.1
Mogale City	5.5	5.7	5.6
Rand West	5.3	5.1	5.2
Informal dwelling (%)	15.4	14.6	14.9
Sample (n)	*11,636*	*13,253*	*24,889*

%, percentage; SD, standard deviation; n, number of individuals.
⸸ As described in the methods, this is a naïve wealth index score that was divided into five groups, referred to as 'wealth quintiles' in this paper.
Note: Results are weighted.

Table 7 above summarises the basic sociodemographic characteristics, separated by male and female respondents in 2018. Male respondents were on average 1.1 years younger than female

respondents with 77.4% of male respondents reporting being involved in a relationship compared to 70.9% of females. 44.7% of male respondents were employed, compared to only 28.9% of female respondents. Male respondents had higher levels of educational attainment with 32.6% having completed matric (compared to 31.1% for female respondents) and 28.7% achieving levels beyond matric (compared to 23.8% of female respondents). More male respondents reported living in informal dwellings (15.4%) compared to female respondents (14.6%).

Table 8: Sociodemographic characteristics, by wealth quintile ⸸ (2018).

Characteristic	Quintile 1	Quintile 3	Quintile 5	**Total**
Female (%)	51.2	57.0	49.6	53.3
Age (years [SD])	38.6 (13.8)	41.3 (15.9)	41.1 (13.0)	40.7 (14.9)
Relationship status (%)				
In a relationship	71.8	70.7	83.7	74.0
Population group (%)				
African	97.8	92.4	50.5	84.5
Coloured	1.3	3.2	6.9	3.6
Indian/Asian	0.2	0.7	4.8	1.5
White	0.7	3.7	37.9	10.4
Employed (%)	31.8	31.3	50.2	36.3
Years lived in community (SD)	9.5 (11.6)	7.0 (12.9)	5.2 (10.0)	7.3 (12.1)
Education (%)				
None	5.7	2.4	0.3	2.8
Primary school	16.6	9.8	1.1	9.6
Secondary school incomplete	40.5	31.9	6.8	27.9
Matric	29.1	38.2	21.8	31.8
>secondary school	6.3	15.9	67.8	26.1
Unspecified	1.7	1.8	2.2	1.9
Municipality				
Ekurhuleni	25.4	25.8	25.4	25.3
Johannesburg	25.4	30.2	38.4	31.6
Tshwane	19.3	15.7	18.5	17.4
Emfuleni	6.0	9.0	3.4	6.9
Lesedi	1.3	2.7	1.3	1.9
Midvaal	2.6	1.6	2.9	2.1
Merafong	5.7	4.6	1.8	4.1
Mogale City	6.3	5.4	5.6	5.6
Rand West	8.1	5.1	2.8	5.2
Informal dwelling (%)	64.5	1.9	0.0	14.9
Sample (n)	*4,980*	*5,200*	*4,367*	*24,889*

%, percentage; SD, standard deviation; n, number of individuals.
⸸ As described in the methods, this is a naïve wealth index score that was divided into five groups, referred to as 'wealth quintiles' in this paper.
Note: Results are weighted.

Table 8 above summarises the basic sociodemographic characteristics, separated by wealth quintiles. To ascertain the spread of the influence of social demographic characteristics within the wealth quintiles, the lowest quintile (one), the median quintile (three), and the highest quintile (five) are examined. In quintile one, 97.8% of respondents were African; 1.3% were Coloured; 0.2% were Indian/Asian; and 0.7% were White. In quintile three, 92.4% of respondents were African; 3.2% were Coloured; 0.7% were Indian/Asian; and 3.7% were White. In quintile five, 50.5% of respondents were African; 6.9% were Coloured; 4.8% were Indian/Asian; and 37.9% were White. 31.8% of respondents were employed in quintile one; 31.3% in quintile three; and 50.2% in quintile five. Education levels completed was highest in quintile five with 67.8% obtaining levels higher than Matric. In quintile three, this was 15.9% and in quintile one, 6.3%. The percentage of respondents living in informal settlements was 64.5% in quintile one; 1.9% in quintile three; and 0% in quintile five. Respondents in quintile one had lived in the community the longest on average (9.5 years), followed by respondents in quintile three (7.0), and finally respondents in quintile five (5.2 years). The average age in quintile one was 38.6 years old, in quintile three was 41.3 years old, and in quintile five 41.1 years old.

Figure 3 above shows the distribution of respondents visited by a CHW in the last year according to sex. Fewer male respondents reported being visited by a CHW than female respondents with 10.1% of male respondents and 13.6% of female respondents reporting a household visit.

Figure 4: Percentage of households visited by a CHW in the last year, by wealth quintile.

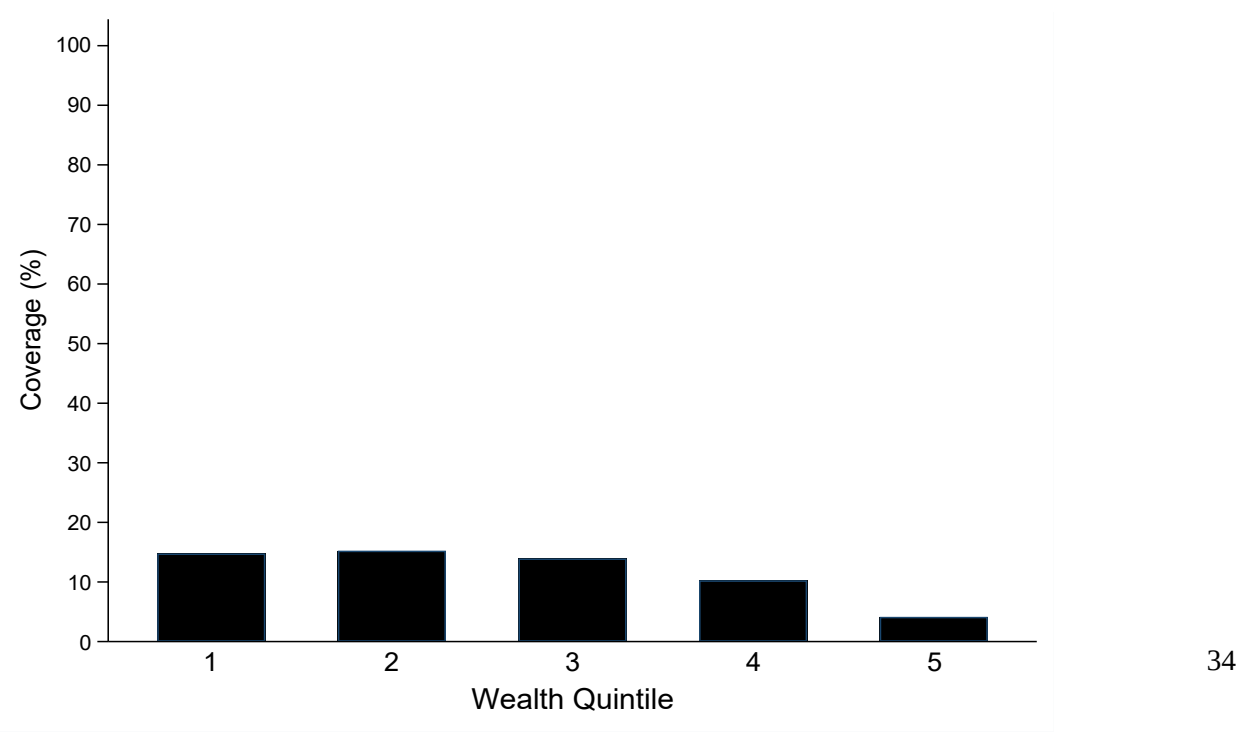


Figure 4 above shows the distribution of households visited by a CHW in the last year according to wealth quintiles. Looking in line with the three chosen wealth quintiles, it is seen that in quintile one, 14.8% of households reported being visited by a CHW; 13.9% in quintile three; and 4.1% in quintile five.

4.6 Treatment effects

Aggregate

Table 9: Treatment effects, by estimator.

	PHQ-2 scale	PHQ-2 binary	Good health
	Coefficient (SE)	Coefficient (SE)	Coefficient (SE)
IPWRA			
POM			
Control	1.120***	0.120***	0.928***
	(0.010)	(0.002)	(0.002)
Treatment	1.226***	0.136***	0.907***
	(0.032)	(0.008)	(0.006)
ATE	0.107**	0.016	-0.021**
	(0.033)	(0.008)	(0.006)
ATET	0.094**	0.017*	-0.024**
	(0.030)	(0.008)	(0.007)
RA			
POM			
Control	1.117***	0.118***	0.930***
	(0.009)	(0.002)	(0.002)
Treatment	1.260***	0.140***	0.900***
	(0.032)	(0.008)	(0.007)
ATE	0.142***	0.022**	-0.029***
	(0.034)	(0.008)	(0.007)
ATET	0.127***	0.021**	-0.031***
	(0.029)	(0.007)	(0.007)
IPW			
POM			
Control	1.115***	0.119***	0.930***
	(0.010)	(0.002)	(0.002)
Treatment	1.283***	0.149***	0.897***
	(0.032)	(0.008)	(0.006)
ATE	0.168***	0.030***	-0.032***
	(0.033)	(0.008)	(0.006)
ATET	0.131***	0.026**	-0.032***
	(0.030)	(0.008)	(0.007)

AIPW			
POM			
Control	1.120***	0.120***	0.928***
	(0.010)	(0.002)	(0.002)
Treatment	1.235***	0.138***	0.906***
	(0.032)	(0.008)	(0.006)
ATE	0.115**	0.018*	-0.022**
	(0.034)	(0.008)	(0.006)
NNM			
ATE	0.120***	0.035***	-0.054***
	(0.034)	(0.008)	(0.008)
ATET	0.182***	0.031***	-0.050***
	(0.030)	(0.007)	(0.007)
PSM			
ATE	0.209***	0.036***	-0.053***
	(0.038)	(0.009)	(0.008)
ATET	0.188***	0.032***	-0.050***
	(0.030)	(0.007)	(0.007)

SE, standard error
* p < .05; ** p < .01; *** p<0.001
Note: Results are not weighted.

Table 9 above shows the effects of CHW visits on the three outcome variables: PHQ-2 scale, PHQ-2 binary, and good self-reported health status. The smallest and largest significant effects for the ATE and the ATET for each outcome variable are denoted in grey to illustrate the differences in the results from the five estimators.

The IPWRA estimator reveals that the ATE shows that for PHQ-2 scale, if all households were visited by a CHW, the degree to which respondents have experienced depressed moods would be higher than if they were not seen. For PHQ-2 binary, it shows that if all households were to be visited by a CHW, they would be 1.6% more likely to be classified as having a potential depressive disorder (a PHQ-2 score of three and above) than those not visited. The ATE for good health shows that if all households were to be visited by a CHW, they would be 2.1% less likely to report their health as being good than those not visited. A concern is the ATE on PHQ-2 binary, which is not significant at the 5% level. The ATET shows that the degree to which respondents have experienced depressed moods would be higher for respondents visited by a CHW. Respondents that were seen by a CHW were 1.7% more likely to be classified as having a potential depressive disorder than those not visited. Respondents that were seen by a CHW were 2.4% less likely to be

report their health as being good than those not visited. The result for PHQ-2 binary is not significant. The other ATE and ATET results are all significant to at least the 5% level.

Compared to IPWRA, the five other estimators produce results which match in the signs (positive for PHQ-2 variables and negative for self-reported health status being good), but they differ in magnitude. For all outcome variables, the IPWRA estimator produces the smallest magnitude of the effect of the CHW visits. The results from the PSM and NNM estimators are the largest in magnitude and differ the most from the IPWRA. All ATE and ATET results are significant at least at the 5% level.

Table 10: Treatment effects per estimator, by sex.

	PHQ-2 scale		PHQ-2 binary		Good health	
	Coefficient (SE)		Coefficient (SE)		Coefficient (SE)	
	Male	Female	Male	Female	Male	Female
IPWRA						
POM						
Control	0.999***	1.222***	0.106***	0.131***	0.946***	0.912***
	(0.013)	(0.014)	(0.003)	(0.003)	(0.002)	(0.003)
Treatment	1.111***	1.332***	0.119***	0.151***	0.927***	0.890***
	(0.048)	(0.041)	(0.013)	(0.010)	(0.008)	(0.008)
ATE	0.112*	0.109*	0.012	0.020	-0.019*	-0.022**
	(0.050)	(0.043)	(0.013)	(0.011)	(0.009)	(0.008)
ATET	0.058	0.123**	0.006	0.026*	-0.014	-0.030**
	(0.044)	(0.041)	(0.011)	(0.010)	(0.010)	(0.009)
RA						
POM						
Control	0.999***	1.220***	0.105***	0.130***	0.947***	0.914***
	(0.013)	(0.013)	(0.003)	(0.003)	(0.002)	(0.003)
Treatment	1.127***	1.376***	0.120***	0.158***	0.921***	0.882***
	(0.049)	(0.043)	(0.012)	(0.010)	(0.009)	(0.009)
ATE	0.127*	0.158***	0.015	0.029**	-0.026**	-0.032**
	(0.050)	(0.045)	(0.013)	(0.011)	(0.009)	(0.009)
ATET	0.094**	0.150***	0.009	0.030**	-0.019**	-0.037***
	(0.043)	(0.039)	(0.011)	(0.010)	(0.009)	(0.009)
IPW						
POM						
Control	0.996***	1.217***	0.106***	0.130***	0.947***	0.913***
	(0.013)	(0.013)	(0.003)	(0.003)	(0.002)	(0.003)
Treatment	1.146***	1.405***	0.129***	0.167***	0.922***	0.875***
	(0.048)	(0.043)	(0.012)	(0.011)	(0.008)	(0.009)

ATE	0.150**	0.188***	0.023	0.037**	-0.025**	-0.038***
	(0.050)	(0.045)	(0.013)	(0.011)	(0.009)	(0.009)
ATET	0.091*	0.159***	0.013	0.035**	-0.022*	-0.039***
	(0.045)	(0.041)	(0.011)	(0.010)	(0.009)	(0.009)
AIPW						
POM						
Control	0.999***	1.223***	0.106***	0.131***	0.946***	0.912***
	(0.013)	(0.014)	(0.003)	(0.003)	(0.002)	(0.003)
Treatment	1.110***	1.348***	0.119***	0.154***	0.926***	0.888***
	(0.049)	(0.042)	(0.013)	(0.010)	(0.009)	(0.009)
ATE	0.111*	0.126**	0.013	0.023*	-0.021*	-0.024**
	(0.051)	(0.044)	(0.013)	(0.011)	(0.009)	(0.009)
NNM						
ATE	0.138**	0.229***	0.018	0.044***	-0.041**	-0.066***
	(0.050)	(0.047)	(0.013)	(0.012)	(0.012)	(0.011)
ATET	0.139**	0.210***	0.016	0.040***	-0.033***	-0.057***
	(0.044)	(0.040)	(0.011)	(0.010)	(0.009)	(0.009)
PSM						
ATE	0.159**	0.250***	0.021	0.049***	-0.044***	-0.072***
	(0.049)	(0.047)	(0.013)	(0.012)	(0.011)	(0.011)
ATET	0.141**	0.216***	0.016	0.041***	-0.033***	-0.058**
	(0.043)	(0.040)	(0.011)	(0.010)	(0.009)	(0.009)

SE, standard error
* p < .05; ** p < .01; *** p<0.001
Note: Results are not weighted.

Table 10 above shows the effects of CHW visits on the three outcome variables: PHQ-2 scale, PHQ-2 binary, and good self-reported health status, according to the respondent's sex. The smallest and largest significant effects for ATE and ATET for each outcome variable are denoted in grey to illustrate the differences in the result from the five estimators.

Male respondents

Using the IPWRA estimator, the ATE shows that if all households were visited by a CHW, the degree to which male respondents experienced depressed moods would be higher than if they had not been seen. These respondents would be 1.2% more likely to be classified as having a potential depressive disorder, and 1.9% less likely to report their health as being good than those not visited. The ATET shows that the degree to which all respondents visited by a CHW experience depressed moods is higher than for those not visited. Respondents that were seen by a CHW were 0.6% more

likely to be classified as having a potential depressive disorder than those not visited. Respondents that were seen by a CHW were 1.4% less likely to be report their health as being good than those not visited. The only results significant at the 5% level were for the ATE on PHQ-2 scale and good health.

When compared to IPWRA, all five estimators produce results which match in the direction of the effect (positive for PHQ-2 variables and negative for self-reported health status being good), but they differ in magnitude. For all outcome variables, the IPWRA estimator produces the smallest magnitude of the effect of the CHW visits, except for the ATE produced by AIPW for PHQ-2 scale for male respondents, which is 11.1% lower compared to 11.2% from IPWRA. The results from the PSM estimator show the largest difference in magnitude from IPWRA in most cases, with the magnitudes for the ATET being the same for NNM and PSM on outcomes PHQ-2 binary and reported health status being good. None of the results for PHQ-2 binary were significant for any of the estimators. The other results are significant.

Female respondents

Using IPWRA, the ATE shows that if all households were visited by a CHW, the degree to which female respondents experience depressed moods would be higher than if they were not seen, they would be 2.0% more likely to be classified as having a potential depressive disorder, and they would be 2.2% less likely to report their health as being good. The ATET shows that the degree to which respondents visited by a CHW experience depressed moods was higher, respondents were 2.6% more likely to be classified as having a potential depressive disorder, and they were 3.0% less likely to be report their health as being good than for those not visited.

When compared to IPWRA, all five estimators produce results which match in the direction of the effect (positive for PHQ-2 variables and negative for self-reported health status being good), but they differ in magnitude. For all outcome variables, the IPWRA estimator produces the smallest magnitude of the effect of the CHW visits. The results from the PSM estimator show the largest difference in magnitude from IPWRA in all cases. All results are significant to at least the 5% level.

In most cases (excluding ATE and ATET results from IPWRA for PHQ-2 scale), female respondents visited by a CHW are less likely to report good health than male respondents and more likely to experience a higher degree of depressed moods and being classified as having a potential depressive disorder.

The focus now shifts to the discussion of the treatment effect results disaggregated by wealth quintile.

Table 11: Treatment effects per estimator, by wealth quintile.

	PHQ-2 scale			PHQ-2 binary			Good health		
	Coefficient (SE)			Coefficient (SE)			Coefficient (SE)		
	Quintile 1	Quintile 3	Quintile 5	Quintile 1	Quintile 3	Quintile 5	Quintile 1	Quintile 3	Quintile 5
IPWRA									
POM									
Control	1.246***	1.158***	0.865***	0.143***	0.112***	0.098***	0.906***	0.917***	0.967***
	(0.023)	(0.021)	(0.020)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)	(0.003)
Treatment	1.335***	1.281***	1.068***	0.158***	0.127***	0.133***	0.908***	0.898***	0.941***
	(0.062)	(0.053)	(0.107)	(0.016)	(0.013)	(0.030)	(0.011)	(0.012)	(0.015)
ATE	0.089	0.123*	0.203	0.015	0.015	0.034	0.002	-0.019	-0.026
	(0.066)	(0.056)	(0.109)	(0.017)	(0.014)	(0.030)	(0.012)	(0.013)	(0.015)
ATET	0.039	0.149*	0.184	-0.002	0.035	0.035	-0.001	-0.013	-0.013
	(0.063)	(0.060)	(0.112)	(0.016)	(0.016)	(0.028)	(0.013)	(0.014)	(0.018)
RA									
POM									
Control	1.235***	1.159***	0.865***	0.142***	0.111***	0.097***	0.909***	0.917***	0.967***
	(0.023)	(0.020)	(0.020)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)	(0.003)
Treatment	1.355***	1.317***	1.137***	0.164***	0.130***	0.146***	0.904***	0.893***	0.937***
	(0.060)	(0.053)	(0.112)	(0.015)	(0.013)	(0.028)	(0.011)	(0.013)	(0.020)
ATE	0.120	0.158**	0.272*	0.023	0.020	0.049	-0.005	-0.024	-0.030
	(0.064)	(0.057)	(0.113)	(0.016)	(0.014)	(0.029)	(0.012)	(0.013)	(0.020)
ATET	0.076	0.166**	0.185	0.007	0.033*	0.037	-0.009	-0.016	-0.012
	(0.061)	(0.058)	(0.110)	(0.015)	(0.015)	(0.027)	(0.013)	(0.013)	(0.018)
IPW									
POM									
Control	1.242***	1.151***	0.862***	0.142***	0.111***	0.098***	0.907***	0.918***	0.968***
	(0.023)	(0.021)	(0.020)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)	(0.003)
Treatment	1.322***	1.339***	1.119***	0.153***	0.148***	0.148***	0.905***	0.897***	0.948***
	(0.060)	(0.054)	(0.107)	(0.015)	(0.014)	(0.029)	(0.011)	(0.011)	(0.016)
ATE	0.080	0.188**	0.256*	0.011	0.037*	0.050	-0.002	-0.021	-0.020
	(0.064)	(0.058)	(0.109)	(0.016)	(0.015)	(0.029)	(0.012)	(0.012)	(0.016)
ATET	0.060	0.194**	0.242*	0.006	0.040**	0.047	-0.004	-0.023	-0.018

	(0.063)	(0.060)	(0.110)	(0.015)	(0.015)	(0.027)	(0.013)	(0.014)	(0.018)
AIPW									
POM									
Control	1.246***	1.158***	0.865***	0.143***	0.112***	0.098***	0.906***	0.917***	0.967***
	(0.023)	(0.021)	(0.020)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)	(0.003)
Treatment	1.335***	1.292***	1.077***	0.158***	0.129***	0.134***	0.907***	0.898***	0.937***
	(0.062)	(0.054)	(0.112)	(0.015)	(0.013)	(0.029)	(0.011)	(0.013)	(0.016)
ATE	0.089	0.134*	0.212	0.014	0.017	0.036	0.001	-0.019	-0.030
	(0.066)	(0.058)	(0.114)	(0.017)	(0.014)	(0.030)	(0.012)	(0.013)	(0.016)
NNM									
ATE	0.177*	0.260***	0.188	0.033	0.040**	0.033	-0.035*	-0.046**	-0.050*
	(0.070)	(0.060)	(0.112)	(0.018)	(0.015)	(0.028)	(0.015)	(0.015)	(0.025)
ATET	0.100	0.238***	0.243*	0.011	0.044**	0.044	-0.019	-0.039**	-0.027
	(0.063)	(0.058)	(0.107)	(0.016)	(0.015)	(0.027)	(0.013)	(0.013)	(0.017)
PSM									
ATE	0.145*	0.256***	NE	0.027	0.037*	NE	-0.031	-0.042**	NE
	(0.070)	(0.061)	NE	(0.018)	(0.015)	NE	(0.016)	(0.015)	NE
ATET	0.099	0.237***	NE	0.009	0.044**	NE	-0.019	-0.039**	NE
	(0.062)	(0.058)	NE	(0.016)	(0.015)	NE	(0.013)	(0.013)	NE

SE, standard error; NE, not estimated
* p < .05; ** p < .01; *** p<0.001
Note: Results are not weighted.

Table 11 above shows the effects of CHW visits on the three outcome variables: PHQ-2 scale, PHQ-2 binary, and good self-reported health status, according to wealth quintile. The smallest and largest significant effects for ATE and ATET for each outcome variable are denoted in grey to illustrate the differences in the result from the five estimators.

Wealth Quintile 1

For respondents in wealth quintile one, the ATE shows that if all households were visited by a CHW, the degree to which respondents experience depressed moods would be higher than if they were not seen, they would be 1.5% more likely to be classified as having a potential depressive disorder, and they would be 0.2% more likely to report their health as being good than those not visited. The ATET results show that the degree to which respondents visited by a CHW experience depressed moods was higher, they would be 0.2% less likely to be classified as having a potential depressive disorder, and 0.1% less likely to be report their health as being good than those not visited. None of these results are significant at the 5% level.

When compared to IPWRA, all five estimators produce results for PHQ-2 scale which match the positive direction of the effect. For PHQ-2 binary, the five estimators match the direction for the ATE, but not the ATET. For good health, all five of the estimators match the direction for ATET, but not for ATE (excluding the AIPW estimator). The results from estimators are smaller in magnitude for the effect of the ATE on PHQ-2 scale from IPW and AIPW; ATE on PHQ-2 binary for IPW and AIPW; and ATE on good health for IPW and AIPW. The rest of the effects are larger.

Wealth quintile 3

For respondents in wealth quintile three, the ATE shows that if all households were visited by a CHW, the degree to which respondents experience depressed moods would be higher, they would be 1.5% more likely to be classified as having a potential depressive disorder, and they would be 1.9% less likely to report their health as being good than those not visited. The only result significant at the 5% level is the ATE on PHQ-2 scale. The ATET results show that the degree to which respondents visited by a CHW experience depressed moods was higher, they were 3.5% more likely to be classified as having a potential depressive disorder, and they were 1.3% less likely to report their health as being good than those not visited. None of these results are significant at the 5% level.

When compared to IPWRA, all five estimators produce results which match in the direction of the effect (positive for PHQ-2 variables and negative for self-reported health status being good), but they differ in magnitude. The result from the RA estimator is smaller for ATET on PHQ-2 binary. The rest of the results are larger than (or equal to) those estimated using the IPWRA. All results on PHQ-2 scale are significant. The results for ATE from the RA and AIPW estimators are not significant for PHQ-2 binary. For good health, only the results from the NNM and PSM estimators are significant.

Wealth Quintile 5

For respondents in wealth quintile five, the ATE shows that if all households were visited by a CHW, the degree to which respondents experience depressed moods would be higher, they would be 3.4% more likely to be classified as having a potential depressive disorder, and they would be 2.6% less likely to report their health as being good than those not visited. The only result

significant at the 5% level is the ATE on PHQ-2 scale. The ATET results show that the degree to which respondents visited by a CHW experience depressed moods was higher, they were 3.5% more likely to be classified as having a potential depressive disorder, and they were 1.3% less likely to be report their health as being good than those not visited. None of these results are significant at the 5% level.

All five estimators produce results which match in the direction of the effects seen in the IPWRA estimator, but they differ in magnitude. The ATE result from the IPW is smaller for good health. The result from the NNM estimator is smaller for all three outcomes. The ATET result from the RA estimator is smaller in magnitude. The significant outcomes for PHQ-2 scale are ATE from the RA estimator; ATE and ATET from IPW; and ATET from NNM. There are no significant outcomes for PHQ-2 binary and the only significant outcome for good health is from the NNM estimator for the ATE.

Wealth quintile three had larger magnitudes of the treatment effects than quintile one. Quintile five had the largest effects out of the three groups.

4.7 Discussion

In most results of the treatment effect, visits from CHWs are seen to increase depressed moods and the chance of depressive disorders in respondents. Furthermore, the CHWs are seen to have a negative impact on respondents reporting that their health status is good. This is contrary to what was expected as CHW visits should be contributing to better mental and physical health amongst respondents. This suggests various reasons as follows. The first is that CHWs may be targeting households comprised of individuals with worse mental and physical health to try to improve these health outcomes. This would mean that the respondents that reported a CHW visit could be respondents with worsened health status to start. If this is the case, the respondents may still be reporting negative health outcomes in general, but the CHW may have improved these outcomes, nonetheless. Since the survey is not longitudinal, it is not possible to follow the same respondents in each wave of the survey. This means that it is not possible to determine whether the health outcomes of the same respondents have in fact improved or worsened compared to a year ago before the CHW visit occurred. This is an important area for future research where studies such as

this would benefit from longitudinal or panel studies to allow better causal inference regarding the impact of community health worker programmes on health, mental health, and well-being. Another reason in the mental health space is that CHWs may bring issues to focus which respondents may not have considered before. As is often the case with mental health issues, bringing them to the surface and discussing them with a health care professional can sometimes make the problems feel worse before they improve. Patients are seen to benefit from psychotherapy, but short-term treatment is seen to perform considerably worse than long-term treatment (Seligman, 1995). Furthermore, mental health care often requires frequent follow-ups and a maintenance programme. If CHWs are only able to visit households infrequently, this may leave them worse-off than when they started. Another possible reason for worse mental health outcomes is that the CHWs administering this type of care are not trained properly to handle this work. As mentioned in the review of the literature, CHWs require less training than other health care professionals and, in a mental health space, this may not be adequate. Furthermore, CHW programmes in Africa particularly have been found to be poorly planned with a lack of supervision and training. For psychosocial treatments to be effective, multiple studies stress the importance of adequate training (Beaglehole et al., 2008; Ludwick et al., 2020; Perry, Zulliger & Rogers, 2014; Scott et al., 2018). Another explanation for this result could be the methodological limitation resulting from not being able to ascertain individual-level coverage from the survey data. Since the individual respondent is not necessarily the one being visited by a CHW in the household, it is difficult to attribute better or worse mental and physical health outcomes of the respondents to work completed (or not completed) by the CHW. These limitations in the data may explain the somewhat contradictory results.

Both female and male respondents show higher degrees of depressed moods, increased likelihood of being classified as having a potential depressive disorder, and worse self-reported health status than those not visited by a CHW. This is in line with the aggregate results discussed above. However, in most cases, female respondents visited by a CHW are less likely to report good health than male respondents, and more likely to experience a higher degree of depressed moods and being classified as having a potential depressive disorder. This could be owing to women in general being excluded from schooling and thus not receiving the same level of health education as men (Vlassoff, 2007). Another possible reason is that women on average have a higher rate of chronic

diseases, including mental health issues, than men (Williams, 2011). Results from various studies have shown that women have higher rates of depression and anxiety than men, regardless of sociodemographic characteristics (Vlassoff, 2007). However, this research is limited in developing countries such as South Africa (Vlassoff, 2007). Lastly, females might experience depression during pregnancy (antenatal) and in the postnatal period, which could partly explain the worse mental health outcomes amongst women (Garman, Schneider & Lund, 2019). In South Africa, between 21.0% and 39.0% are at high risk for experiencing antenatal depression and between 16.0% and 32.0% are at high risk for experiencing postnatal depression (Garman, Schneider & Lund, 2019).

Wealth quintile three had larger magnitudes of the treatment effects than quintile one. Quintile five had the largest sized effects out of the three groups. For all three outcomes, the significant results show that across the three chosen sub-groups, respondents had higher degrees to which they experience depressed moods, they were more likely to be classified as having a potential depressive disorder, and they were more likely to not report good health. This is an unexpected result and not in line with previous studies where individuals in lower wealth quintiles and with lower levels of socioeconomic status were found to have worse mental health issues (Smith et al., 2019). However, the studies available for LMICs are limited (Smith et al., 2019). A potential reason for worse mental health conditions in higher quintiles may be owing to the stress associated with occupational status amongst respondents in higher wealth quintiles, and it may not be related to CHW visits at all.

5. Limitations

There are several limitations in this study to consider when interpreting the results. Firstly, it is not completely appropriate to use individual-level characteristics to estimate household coverage. However, individual-level data is not available in the surveys used in this paper and the researcher had to look at the results with regard to each respondent and their characteristics. In an ideal scenario, data is needed about the characteristics of the person that was visited to ascertain the accurate level of coverage for all characteristics. This could mean that a household visit may not translate in improved outcomes because someone else in the household (other than the survey respondent) may have been visited by the CHW.

Secondly, the information regarding CHW visits captured in the survey was self-reported and thus could be subject to recall bias. It may be the case that households visited more recently would remember the visit and confirm, while those visited near to one year ago may not recall ever being visited. This would mean that the household coverage estimates for the more distant past could be underestimated.

Thirdly, households in the surveys were not revisited (owing to the survey design) and those absent from the home during the time that the surveys were conducted may be underestimated. Overall, the data fall short in providing a holistic picture of the CHW programme. This is especially owing to the data not being able to reflect supply-side factors or constraints.

Fourthly, the sample sizes for the analyses within some municipalities were relatively small, limiting the statistical power to detect differences within the comparisons. There are also several limitations with regards to the treatment effect analyses. There does not exist a single statistical test for balance that can be used across all five of Stata's teffects estimators which were used in this paper. This means that the quality of matching for these five estimators cannot be compared. Again, using a study with data that is not longitudinal is a limitation and cohort studies would be needed to better determine what the effects of CHW programmes truly are.

Lastly, econometrically, there are potential issues with multicollinearity in the multiple logistic regression models which could impact the interpretations on certain variables. This has been accounted for and adjusted where possible.

6. **Conclusion**

The CHW programme in Gauteng is falling far short of ensuring national household coverage for targeted households. When looking at different municipalities and respondent characteristics, significant discrepancies exist in household coverage. These are as follows. Respondents in wealth quintiles four and five were less likely to be visited than respondents in quintiles one and two. In eight of the municipalities, a higher percentage of female respondents were visited by a CHW than male respondents. In all nine of the municipalities, the respondents visited by a CHW were on average older than those not visited. In seven municipalities, unemployed respondents had higher household coverage rates than employed respondents. Respondents that had health insurance were

less likely to be visited than those without, illustrating the extension of care to households that would not otherwise have ready access to health care services. The average effects of the CHW programme are found to be counterintuitive with respondents experiencing higher degrees to which they have experienced depressed moods, were more likely to be classified as having a potential depressive disorder, and less likely to report their health status as good. This may be owing to effective targeting of households in poor health and in need of care in Gauteng. There are also significant discrepancies in the effects of the CHW programme between municipalities, sex, and wealth quintiles. There is a need for continual research within this sphere of the health system to ensure that future policies are effectively designed to utilise this valuable health resource.

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