The Health Risks of Informal Waste Workers in the Kathmandu Valley: A cross-sectional survey

Abstract

Objective
To describe the health and occupational risks of informal waste workers (IWW) in the Kathmandu valley and explore factors associated with not using personal protective equipment (PPE).

Study Design
A cross-sectional survey of IWWs.

Method
Data was collected on the health and occupational risks of adult IWWs working on waste sites in the Kathmandu Valley and in the adjacent Nuwakot District, Nepal in November 2017, through convenience sampling. Using a standardized health assessment questionnaire, face to face interviews were undertaken to record sociodemographic data, indicators of general and occupational health, data on healthcare access and use, physical risks, perception of occupational risks and use of PPE. Associations between use of PPE and gender, age, education, country of origin, injury and perception of occupational risks were examined using multivariate logistic regression analyses.

Results
In 1278 surveyed IWWs, prevalent physical risks included injuries (66.2% in the previous 12 months) and the main reported symptoms were respiratory in nature (69.9% in the previous 3 months). Most prevalent injuries were glass cuts (44.4%) and metal cuts (43.9%). Less than half of IWWs (46.8%) had been vaccinated against Tetanus and 7.5% against Hepatitis B. 72.5% of IWWs considered their work as 'risky', but 67.6% did not use PPE. Non-use of PPE was independently associated with male gender (odds ratio [OR] 2.19; p <0.001), Indian origin (OR 1.35; p=0.018), older age (OR 2.97 for over 55 years old; p=0.007) and low perception of occupational risks (OR 2.41; p<0.001). Low perception of occupational risk was associated with older age (55+ years) and lack of receipt of information on the risks.

Conclusion
IWWs are at increased risk of injury in their work, yet are poorly protected in relation to vaccine-preventable infections and work wear. The results suggest that information is important in relation to perception of occupational risk, which in turn is associated with the use of PPE. There is a need for policymakers and public health practitioners to have a robust understanding of the needs and vulnerabilities of this group, as well as identify effective interventions that can be taken to safeguard the health and welfare of IWWs.

Keywords
Informal Waste Workers, Health, Occupational Risks, Personal Protective Equipment, Nepal.

Introduction

In a world of increasing consumption comes increasing waste. Globally it is estimated that 56 million people[1],15 million in developing countries[2], work in dangerous and unhygienic conditions collecting sorting and disposing of waste. In resource limited countries waste recovery activity is a major source of livelihood, mainly for the urban poor. This 'work' is usually outside legal and institutional frameworks and those undertaking it are known as Informal Waste Workers (IWW).[3] They make a significant contribution to waste management achieving recycling rates of 20-50%.[4] However, their role and value is not always appreciated by society.[1,2]

Studies undertaken in many countries including Brazil, the Philippines, Argentina and India have highlighted a wide range of occupational risks faced by IWWs such as; chemical hazards, infection, musculoskeletal damage, risk of injury, emotional vulnerabilities and environmental contamination.[5,6,7] However, the use of Personal Protective Equipment (PPE) such as face masks, gloves and boots as well as IWWs understanding of the occupational risks is reported to be poor in India and Thailand.[8,9,10] Little is known with regards to factors that facilitate the use of PPE by IWWs. There is therefore a need to understand the full extent of the risks faced by this vulnerable group and how they can be better protected.

Similar to other developing countries, solid waste management is a major environmental and public health issue in Nepal.[11] The Kathmandu Valley produces approximately 620 tonnes of waste per day.[12] Despite the Government of Nepal's Solid Waste Management Act in 2011 placing a duty on municipalities to have a solid waste management system that keeps urban centres clean, the IWW sector has grown, as municipalities do not have the financial or human resources to effectively manage solid waste.[12] IWWs are among the poorest communities in the Kathmandu Valley; in addition, poor hygiene practices and compromised living conditions make them vulnerable to ill-health.[13] The health inequality is compounded further as the impacts of poor waste management are more keenly felt by those living in urban areas due to the lack of open spaces and indiscriminate dumping that takes place.[14]

The aim of this study was to describe the sociodemographic profile of IWWs in the Kathmandu Valley and to characterise their main health and occupational risks. In addition, to add to the literature in this area, the study aimed to determine their perceptions of the occupational health risks and explore factors associated with not using PPE. A more detailed understanding of this population increases knowledge of their health needs, serving as a baseline to measure the effectiveness of any health improvement interventions and also provides the information required to inform local policy makers of the health needs of a marginalised population.

Method

Study Design and Setting

The study involved conducting a cross-sectional survey of IWWs working in the urban areas of Shanti Nagar and Teku in the Kathmandu Valley and Sisdole in the neighbouring Nuwakot district, from November to December 2017. These areas were selected due to their high concentration of waste collection and processing sites. Sisdole was selected as it is the primary landfill site for Kathmandu Metropolitan City (KMC). The majority of IWWs live and work in the Kathmandu Valley and there is only a few hundred IWWs that work on the Sisdole site.

Selection of Participants

Male and female informal waste workers aged 18 years and over were included in the study. As IWWs are a hard to reach population there are inherent difficulties in identifying and recruiting through random sampling in the community. Therefore, convenience sampling was

used. Study respondents were invited to participate by enumerators who visited the waste sites and snowballing was used to identify further respondents.

Sample Size

The number of IWWs in the Kathmandu valley has been reported to be between 7,000 and 15,000.[13 15,16,] However, it is known to be a mobile and transient population that is not limited to a defined geographical area. Based on the quality of available information on the IWW population we used a population estimate of 7000 IWWs for the total population size of this group in the Kathmandu Valley. Assuming a 10% non-response rate it was calculated, using a standard sample size calculator,[17] that a sample size of 614 was needed to allow a 4% level of precision with the anticipated prevalence of risk factors of 50% and with a confidence level of 95%. As this is a non-probability sampling method, one approach to mitigate selection bias was to double the sample size.[18] Therefore, a sample size of at least 1228 IWWs was judged to be what was required. However, we sampled 1278 IWWs in total, 50 more participants than initially planned. This is because several enumerators were recruiting participants in a snowball sampling approach and some enumerators interviewed more IWWs than instructed. The implication of slightly increasing the sample size by 50 workers is that the anticipated level of precision (which was set to 4%) should be expected to be slightly better (slightly lower than 4%)

Measurement Tool and Data Collection

Face-to-face individual interviews with participants, at the waste sites, were undertaken by local enumerators using a bespoke standardized demographic health assessment questionnaire. The questionnaire was devised for the purpose of this survey. It consisted of several components including; sociodemographic, general health, tobacco drugs and alcohol use, access to health services, mental health and wellbeing, sexual and reproductive health, occupational health risks, social, employment and financial information, personal protection and knowledge of risks. Internationally validated assessment tools were used for relevant components where available, such as AUDIT C for alcohol screening[19] and the modified PHQ-9 depression screening questionnaire validated for Nepal.[20]

PPE was defined as any of the following; gloves, apron, cap/net, facemask, glasses/goggles, safety boots, helmet, and hi-visibility jackets. Participants were asked whether they used any of these materials. Those who responded ‘sometimes’, ‘often, or ‘always’ to at least one item of these items were classed as PPE users. Those who responded ‘never’ or ‘rarely’ were classed as non-users. Knowledge of risks was defined as those who answered ‘yes’ to the question ‘do you think waste work is a risky job’.

The questionnaire was translated into Nepali prior to use. Initial piloting of the questionnaire was carried out to check for clarity or errors, and to ensure it was fit for purpose. Local enumerators conversant in the local languages (Nepali and Hindi) were recruited and trained to administer the survey questionnaire using paper copies. The survey interviews were carried out in Nepali and in some cases Hindi.

Statistical Analysis

Data were processed and analyzed using IBM SPSS version 24. Categorical data are presented using frequencies and percentages. Numerical data are summarised using mean values with standard deviations or median values with interquartile ranges (IQR) depending on the degree of skewness in the distributions. Multivariable logistic regression was employed to assess risk factors for not using PPE and factors associated with perceiving work as a ‘risky job’ among study participants. Independent variables examined were gender, age, education, country of origin, receipt of information on occupational risks and injury in the last 12 months. These variables were included in a multiple regression model, therefore, controlling for confounding effects. We did not test for interaction effects in multivariable analysis. This was because of two reasons: (a) we did not have prior

information from other studies or a theory supporting effect modification between study variables, and (b) exploratory testing of all possible two-way interactions would increase the chances of a false positive finding for effect modification.
The strength and direction of associations are presented using adjusted odds ratios (OR) and corresponding 95% confidence intervals and p-values as calculated by a complete records analysis. The study complies with the transparent reporting of observational cross-sectional studies.[21]

Results

Study population

A total of 1278 IWWs were surveyed and fully interviewed. Non-response rates were not recorded, but the enumerators reported that most of the IWWs approached agreed to participate in the survey. A large majority (95%) of respondents were surveyed in the Kathmandu Valley and only 5% at Sisdole in Nuwakot. Sociodemographic characteristics are presented in Table 1. Surveyed IWWs were predominantly male (78.8%), married (77.5%), Hindu (88.9%) and below the age of 39 years (75%). IWWs were either of Indian (48.0%) or Nepali (51.9%) origin. About half of participants were illiterate (50.4%), without formal education (51.3%).

Table 1. Sociodemographic characteristics of surveyed informal waste works (IWW) in Kathmandu valley, Nepal (n = 1278)

Characteristic		n	%
Country of Birth			
	Nepal	663	51.9
	India	614	48
	Not reported	1	0.1
Gender			
	Male	1007	78.8
	Female	258	20.2
	Not reported	13	1
Age			
	18-24	346	27.1
	25-39	613	47.9
	40-54	261	20.4
	55+	56	4.4
	Not reported	2	0.2
Marital Status			
	Single	242	18.9
	Married	991	77.5
	Divorced/Separated	8	0.6
	Widowed	33	2.6
	Not reported	4	0.3
Religion			
	Hindu	1136	88.9
	Other religion	139	10.8
	Not reported	3	0.2
Literacy			
	Illiterate		
	Can read and write with difficulty	644	50.4
	Can read and write	177	13.8

Not reported	456	35.7
Highest Educational Level	1	0.1
No education	656	51.3
Informal Class	89	7
Primary	259	20.3
Secondary	242	18.9
Higher than Secondary	32	2.5

General Health: Physical and Mental Health, Tobacco and Alcohol

General health characteristics are presented in Table 2. The prevalence of illness in the preceding three months was 32.9% (420/1278), of which 76.2% had been ill 1-3 times. 94.7% reported symptoms in the previous three months. The main symptoms reported were respiratory in nature (69.9%). Other prevalent symptoms were tiredness, backache and headache.

The prevalence of depression based on the PHQ9 questionnaire was 27.4%. 40.3% reported being smokers and 41.5% consumed alcohol.

Table 2:.Indicators of physical health, mental health and tobacco and alcohol use among surveyed informal waste works (IWW) in Kathmandu Valley, Nepal (n = 1278)

Health indicator	**n**	**%**
Ill in the last three months		
Illness experienced	420	32.9
No illness	846	66.2
Can't Remember	6	0.5
Not reported	6	0.5
Frequency of Illness in the last 3 months (n=420)		
1 -3	320	76.2
>3	80	19
Not reported	20	
Symptoms in the last 3 months	1211	94.7
Depression (Nepal PHQ9 score)		
None	927	72.6
Mild	264	20.7
Moderate	54	4.2
Moderately Severe	21	1.6
Severe	11	0.9
Not reported	1	0.1
Smoking status		
Smoker	515	40.3
Non-smoker	761	59.5
Not reported	2	0.2
Drink Alcohol		
Yes	531	41.5
No	745	58.3
Not reported	2	0.2

Sexual and reproductive health

Within the workforce sample there was a high awareness of contraceptive methods (72.7%) but use was lower at 51.2% There was less awareness of how to prevent sexually transmitted infections at 43.2%. Women comprised 20.2% (258) of the IWW workforce and 18.5% (39) of those of child bearing age had given birth in the previous 3 years. 89.7% of them had received at least one antenatal checkup in pregnancy and 35.9% received the recommended number of four antenatal checks during their last pregnancy. A large proportion (56.4%) did not have a postnatal check.

Healthcare access and use

Almost two thirds (61.7%) of the population had access to government health services and for most (81.1%) this was within a 30-minute walk.

Less than half (46.8%) of respondents had been vaccinated against Tetanus, and far fewer had been immunized against Hepatitis B (7.5%). Very few (5.9%) have been tested for human immunodeficiency virus (HIV), and most (92.6%) respondents did not know their infectious disease status for Hepatitis B, Hepatitis C or HIV.

823 respondents had children living with them. Of these 46.2% reported their children had been vaccinated whilst a large proportion (43.1%) had not.

Financial Security

The median duration of work in this occupation was seven years (IQR 3-12). The main reason given for working in this field was the lack of other available work (56.7%). Many also reported the reason for working as an IWW was because it was an ‘easy job’ (46.8%). The median hours worked per day was eight hours and the median number of days worked per month was 30 days. IWWs earn a median of 500 Nepalese Rupee (NPR) per day (equivalent to USD$4.57 per day). Many (40.8%) had some form of debt or loans and a large proportion (58.8%) were without work at some point during the year. The median duration without work was 2 months.

Occupational risks and risk perception

Most respondents collect around 60kg of waste per day (IQR 40-100kg). The main type of waste collected were plastic bottles (85.0%), papers (81.3%), glass (78.7%), iron (74.7%), plastic bags (68.1%) and medical waste (37.7%).

Table 3 presents data on occupational risks and risk perception. IWWs experience considerable physical risk from their work with over two thirds reporting an injury in the previous 12 months; with a median number of injuries of three. The main injuries reported were glass (44.4%) and metal cuts (43.9%).

IWWs were aware their work carried risks to health. Nearly three-quarters (72.5%) reported their work as ‘risky’. More than two-thirds (68.9%) said they had received some information about the risks of waste work although the sources of these are unknown.

Table 3. Physical hazards and perception of occupational risks among surveyed informal waste works (IWW) in Kathmandu Valley, Nepal (n = 1278)

Indicator	n	%
Injured in the last 12 months*		
No injury	432	33.8
Metal cut	562	43.9
Glass cut	567	44.4
Injuries from medical sharps	43	3.4
Hit by a truck/vehicle	21	1.6
Fall during waste work	53	4.1
Animal bite	86	6.7
Number of times injured in past 12 months, median (IQR)	3 (2-5)	
Perception of work as a risky job		
Risky job	927	72.5
Not a risky job	318	24.9
Don't know	30	2.3
Not reported	3	0.2
Received information about the risks of waste work		
Had received information	880	68.9
Had not received information	339	26.5
Don't know	54	4.2
Not reported	5	0.4
Personal Protective Equipment		
Users	411	32.2
Non-users	864	67.6
Not reported	3	0.2
Other Protections Used		
Use of own clothes (scarves, caps)	667	52.2
None	611	47.8

***May answer more than 1 response

Use of PPE

Of the IWWs surveyed, a third (32.2%) used some form of PPE but two-thirds (67.6%) never used PPE. Facemasks were the most likely piece of protective equipment worn (18.3%) followed by gloves (16%). More than half (52.2%) of the participants said they protected themselves with some other means of protection such as using their own clothing.

Independent risk factors for IWWs not using PPE included male gender (OR 2.19; p <0.001), Indian origin (OR 1.35; p=0.018), older age (OR of 1.72; p=0.005 for those aged 40-54 years age and OR of 2.97; p=0.007 for IWWs over 55 years old) and perception of occupational risks (Table 4). The odds of not using PPE were 2.41 times higher in those who perceive their job as 'not risky' compared to those who see it as a 'risky' job, (OR 2.41; p<0.001). The likelihood of not using PPE decreases with increasing level of education attained but this association was not found to be statistically significant. There was no association found between either the receipt of information on risks or previous history of injuries and PPE use.

Table 4. Multivariable logistic regression analysis of risk factors for non-use of personal protective equipment among surveyed informal waste workers

Characteristic	Use of personal protective equipment		Odds ratio (95% CI)	P
	Non-users, n^ (%)	Users, n^ (%)		
Gender				
Female	141 (17)	116 (28)	1.00	
Male	712 (83)	294 (72)	2.19(1.61 – 2.98)	<0.001
Age				
18-24 years	223 (26)	122 (30)	1.00	
25-39 years	404 (47)	208 (51)	1.19 (0.88 – 1.60)	0.241
40-54	189 (22)	72 (17)	1.72 (1.18 – 2.52)	0.005
55+ years	47 (5)	9 (2)	2.97 (1.34 – 6.55)	0.007
Country of Origin				
Nepali	420 (29)	242 (59)	1.00	
Indian	444 (51)	169 (41)	1.35 (1.05 – 1.74)	0.018
Education				
No education	426 (50)	216 (53)	1.00	
Informal class	64 (7))	23 (6)	1.44 (0.85 – 2.43)	0.175
Primary	185 (22)	74 (18)	1.37 (0.97 – 1.93)	0.072
Secondary and higher	178 (21)	96 (23)	0.94 (0.67 – 1.31)	0.709
Occupational risk perception				
Risky job	582 (69)	345 (85)	1.00	
Not a risky job	257 (31)	61 (15)	2.41 (1.73 – 3.33)	<0.001
Receipt of information on occupational risks				
Yes	582 (67)	298 (72)	1.00	
No	280 (33)	113 (27)	1.09 (0.82 – 1.47)	0.544
Injury in the last 12 months				
No	305 (35)	127 (31)	1.00	
Yes	559 (65)	284 (69)	1.11 (0.85 – 1.46)	0.436

^Frequencies for separate categories may not add up to overall sample size due to missing values.
Based on complete records analysis (n =1275).

Sociodemographic characteristics, receipt of information and risk perception

The sociodemographic characteristics that may be associated with risk perception were examined using multivariate analysis and presented in Table 5. Characteristics associated with risk perception were older age (over 55 years) and having received information on the risks. Older IWWs were less likely to consider their job risky compared to the younger IWWs (OR 0.38; p = 0.004). Those who have not received information on the risks of their work had lower odds of perceiving their job as risky (OR 0.33; p <0.001).

Table 5. Multivariable logistic regression analysis of factors associated with informal waste workers perceiving their work as a 'risky job'

Characteristic	Occupational Risk Perception		Odds ratio (95% CI)	P
	Risky job, n^ (%)	Not a risky job, n^ (%)		
Gender				
Female	174 (19)	70 (22)	1.00	
Male	747 (81)	242 (78)	1.12 (0.79–1.58)	0.507
Age				
18-24 years	252 (27)	87 (27)	1.00	
25-39 years	464 (50)	140 (44)	1.09 (0.78 - 1.51)	0.61
40-54	183 (20)	69 (22)	0.85 (0.58 – 1.27)	0.436
55+ years	27 (3)	22 (7)	0.38 (0.20 – 0.73)	0.004
Country of Origin				
Nepali	494 (53)	159 (50)	1.00	
Indian	433 (47)	159 (50)	0.83 (0.63 – 1.08)	0.177
Education				
No education	442 (48)	174(56)	1.00	
Informal class	62 (7)	25 (8)	0.85 (0.51 – 1.45)	0.559
Primary	208 (22)	48 (15)	1.38 (0.93 – 2.03)	0.107
Secondary and higher	210 (23)	64 (21)	0.90 (0.63 – 1.29)	0.580
Receipt of information on occupational risks				
Yes	710 (77)	168 (53)	1.00	
No	215 (23)	150 (47)	0.33 (0.25 – 0.44)	<0.001

^Frequencies for separate categories may not add up to overall sample size due to not reported values.
Base on complete records analysis (n =1245).

Discussion

This survey highlights a vulnerable population that is predominantly male, under the age of 39 years, working in a high risk environment. Most had very little protections with low vaccination rates against infectious diseases as well as low use of PPE, and most worked long hours. Physical risks included injuries and respiratory symptoms were common. Less than half of IWWs had been vaccinated against Tetanus and even fewer against Hepatitis B. Despite many IWWs reporting their work as 'risky', most did not use PPE. Non-use of PPE was independently associated with male sex, Indian origin, older age and low perception of occupational risk. The latter was associated with older age (55+ years) and lack of receipt of information on the risks.

In relation to their sociodemographic and health status, there were clear health and socioeconomic inequalities present. According to reports from UNICEF[22], WHO[23], Nepal Demographic Health Survey 2016[24] and others[25,26,27], compared with the Nepali population, the IWWs surveyed had lower literacy levels and lower earnings as well as higher prevalence of smoking, alcohol consumption and depression. Their children had lower rates of vaccination uptake, female waste workers had poorer uptake of antenatal care and there was lower awareness of how to prevent sexually-transmitted infections. This suggests a need for more information, education and communication to promote better sexual and reproductive health and vaccination uptake. It also indicates the need for more support and access to smoking cessation, alcohol, and mental health services for IWWs. One further issue of note in particular from our study was the fact that half of the IWWs are migrant workers from India. Their migrant status may also add further vulnerabilities especially around access to public services in the host country.

Our study found that IWWs in Nepal face similar occupational health and safety risks to those in other developing countries including injuries, emotional vulnerabilities and risk of infection.[5] The prevalence of injury in the previous 12 months was broadly similar to what has been reported from other studies in IWWs in Brazil (82%)[28] and formal waste workers in Ethiopia (43%).[29] The predominance of risk of injuries from glass and metal is as expected from the literature.[5] Worryingly, a significant number had handled medical waste that legally they should not have had contact with. This highlights the need for vaccination of IWWs against relevant infectious diseases such as Tetanus and Hepatitis B, as well as access to testing for HIV and Hepatitis C. Our study found low vaccination rates despite the potential risks in relation to their handling of waste. That said, there are likely to be barriers faced by IWWs in accessing these vaccines and tests and this issue needs to be further understood and explored. In addition, whilst the literature is clear in relation to the theoretical risk of infection little is known about the actual prevalence of these infectious diseases in waste workers.[30] One recent study reported an increased prevalence of Hepatitis B and C in waste workers in Pakistan.[31] The lack of data of the infectious disease risk may further limit policy action.

The majority of respondents reported not using PPE and this is similar to other studies.[32] [29] [33] That said, half of respondents used some form of 'improvised protection' such as their own clothing to protect themselves. The high use of 'improvised protection' suggests that if there was better access to PPE, the level of use could be higher. There may be several barriers to formal PPE use such as accessibility, cost and usability, which need to be explored. The sample appeared to be knowledgeable that their work carries health risks. Our finding that low risk perception is associated with non-use of PPE mirrors findings from studies of waste workers in Nigeria [34], India[9] and Thailand.[10] Interestingly, our study did not show any association between the prevalence of injury and non-use of PPE unlike other studies which have shown higher odds of injury in those not using PPE.[29]

The receipt of information was an important determinant of risk perception; IWWs who had not previously received information about the risks of their work were less likely to perceive

their job as risky. Worryingly, the commonest information source cited was 'experience' which is highly subjective and of questionable validity. Our results suggest that the receipt of information could improve occupational risk perception that in turn may improve protective behaviours such as increased PPE use. This corroborates findings from the Thai study that demonstrated how improvements in the knowledge of IWWs led to attitudinal change and changes in practice in PPE use.[10] However, there are conflicting findings elsewhere; another study found that despite receiving education about the risks of their work the waste workers were still untroubled about their possible occupational injuries.[8] The relationships between knowledge and awareness of occupational risks, risk perception, attitudes and the actual behaviours of IWWs is likely to be complex. Further qualitative work is therefore required to better understand these complex relationships in order to identify effective mechanisms to facilitate IWW behaviour change to reduce their occupational risks and optimise protective practices.

In many developing countries IWWs currently play a significant role in the waste management economy whose contribution should not be underestimated For many countries, the development of an entirely formalised waste management system may be the ultimate idealized aim. However, unless consideration is given as to how IWWs could be engaged in the formal waste management sector[35] or other employment avenues, a formalized waste management system will adversely affect the livelihoods of informal waste workers. There may also be consequences for the health and wellbeing of IWWs and their families arising from the loss of income. Therefore, identifying the health risks to this vulnerable group, and informing policy-makers, is an important step towards the recognition of this segment of the informal sector, and the contribution of these skilled workers for cleaner and healthier cities. Their recognition would be a first step towards their inclusion in the formal waste management sector. The Labour Act 2017 and recently enacted Labour Rules 2018 highlight the progressive steps being taken by the Government of Nepal to secure better working rights for employees and clarifies the law for employers and employees.[36,37] However, by definition IWWs are not formally employed and consequently these new rules confer little or no benefit or protection to them. This further re-iterates the need to integrate the informal waste sector into the formal employment sector.

One potential limitation of this study was the use of snowballing as a non-probability sampling method, which is subject to selection bias. However, IWWs are a hard to reach population and as such there are difficulties in applying a randomised sampling method to recruit respondents given the migrant/mobile nature of the IWW population. We sought to address this limitation by recruiting a fairly large sample. Indeed, this is one of the largest studies of informal waste workers in the world to-date. Another limitation, as with any questionnaire is recall bias. For example, in this study a large proportion were male who may be less likely to recall vaccinations details for their children as vaccinations tended to be led by mothers in the post-partum period. Another potential weakness was the fact the survey had to be carried out in two different languages (Nepali and Hindi) which could potentially lead to small subjective differences in interpretation of questions by respondents.

Recognizing the contribution made to society by waste workers and using this data to understand their main health and healthcare access needs, could help to formulate a strategy to improve the health and working conditions of the waste workers in reducing health inequalities in the valley. In relation to Nepal this fits with the broad public health ambitions of the Nepal Health Sector Strategy [38], in particular as federalism progresses the handover of local health facilities to local government [39], enabling local progress.

Conclusion

IWWs are at increased risk of injury in their work, yet are poorly protected in relation to vaccine-preventable infections and work wear. The results suggest that information is important in relation to perception of occupational risk, which in turn is associated with the use of PPE. IWWs are a socioeconomically disadvantaged population and may lack the

financial resilience to cope with the loss of income or work. There is therefore an urgent need for policymakers and public health practitioners to have a robust understanding of the needs and vulnerabilities of this group, as well as identify effective interventions that can be taken to safeguard the health and welfare of IWWs.

Ethics

Ethical approval was sought from the Nepal Health Research Council and granted in October 2017. Informed consent was obtained in writing from respondents and assurance with regard to data confidentiality provided. Participation was entirely voluntary and no incentive was given for participation. As IWWs are a vulnerable population their values, rights, dignity and safety were considered very carefully. Privacy and confidentiality was ensured and participants were provided reassurance of this prior to interview. The interviews were conducted at a place of participants choosing. It was explained that it was their right not to participate, or to dropout from the study at any time. It was explained that there would be no direct benefits to participants but that there could be indirect benefits to IWWs over time, by identifying the problems they face and using this information to inform policy and advocacy. It was emphasised that the results would inform a program of work currently implemented by Phase Nepal with the objective of reinforcing IWWs capacities, improving their access to health care and mitigating their occupational exposure.

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Competing Interests

AL is currently on the editorial board for the journal.

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