# RESEARCH



# Determinants of depression and anxiety in informal waste pickers: a cross-sectional study of informal waste pickers in Hong Kong

Siu-Ming Chan<sup>1\*</sup>, Heng Xu<sup>1</sup>, Yuen-Ki Tang<sup>1</sup>, Jasmine Zhang<sup>1</sup>, Kim Kwok<sup>1</sup>, Bess Yin-Hung Lam<sup>2</sup>, Wing-Him Tang<sup>3</sup> and Ka-Chun Lui<sup>4</sup>

## Abstract

**Background** There are growing global concerns about informal waste pickers and their health issues. This cross-sectional study drew on the structural violence theory to examine the mental health situation of informal waste pickers in Hong Kong and identified the determinants of depression and anxiety in them ranging from individual to societal and governmental levels.

**Method** The data from the largest territory-wide study of informal waste pickers in 2023 was analysed. Descriptive statistics and logistic regressions were used to investigate the association between mental health and socioeconomic variables, including demographic background, governmental measures against informal waste pickers, other negative experiences related to safety and public discrimination, and supportive resources. The symptoms of depression and anxiety were assessed using the Patient Health Questionnaire (PHQ) and General Anxiety Disorder (GAD).

**Results** The results showed that physical strain/illness and chronic illness caused by long-term scavenging works (for depression adjusted OR 3.33, 95% CI [1.75, 6.31]; for anxiety adjusted OR 5.01, 95% CI [2.45, 10.24]), recycling or personal property stolen (for depression adjusted OR 2.04, 95% CI [1.23, 3.36]; for anxiety adjusted OR 2.72, 95% CI [1.62, 4.56]), being treated rudely by citizens (for depression adjusted OR 2.16, 95% CI [1.32, 3.55]); for anxiety (adjusted OR 2.85, 95% CI [1.74, 4.67]) are the critical risk factors of informal waste pickers' mental health. While higher intention to continue scavenging work if financial conditions permit is the critical protective factor for depression (adjusted OR 0.46, 95% CI [0.24, 0.88]) and anxiety (adjusted OR 0.43, 95% CI [0.22, 0.86]), compared to lower intention to continue scavenging work if financial conditions permit in the multivariate model.

**Conclusions** This study discloses the close relationship between informal waste pickers' long-term physical strain/illness and mental health and identifies the governmental measures, other negative experiences related to safety issues and public discrimination as risk factors for informal waste pickers' mental health. Providing outreach, tailored medical services, increasing the unit price of recycling, developing specific recycling zones and establishing membershipbased organisations help alleviate the challenges of precarious employment and enhance the well-being of the informal waste pickers.

Keywords Informal waste pickers, Mental health, Precarious employment, Structural violence, Hong Kong

\*Correspondence: Siu-Ming Chan siuming.chan@cityu.edu.hk Full list of author information is available at the end of the article



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#### Background

# Precarious employment, informal waste pickers and health risks

Precarious employment, which is characterized by job insecurity, low wages, economic hardship, limited workplace rights, vulnerability to poor treatment and financial instability, is closely linked to poor mental health and self-rated health [1-3]. Informal waste pickers, which include approximately 15 million people globally, are engaged in the recycling of materials like plastics, metals, glass, and paper using relatively primitive techniques; they are a major group within the precariously employed population [4]. Informal waste pickers are characterized by low income, educational credentials, and social status. They have generally not been perceived as essential contributors to urban society even though they play a significant role in the urban recycling industry and sustainable development [5, 6]. Instead, they are commonly excluded from the formal waste management system and are further exposed to high levels of occupational hazard, including toxicants, excessive noise, and extreme temperatures [7]. These hazardous working conditions can lead to severe health issues, such as respiratory problems, skin diseases, and injuries, and contribute to lower life expectancy among informal waste pickers [4, 8–10]. Furthermore, informal waste pickers are often subject to discrimination and stigma, which further affect their mental health and well-being [11]. Research examining informal waste pickers' health conditions and risk factors through a more holistic lens remains limited. To address this gap, this study draws on structural violence theory to examine a series of factors ranging from the individual to the governmental level and their effect on informal waste pickers' mental health.

#### Theoretical framework: Structural violence theory

The theory of structural violence, developed by Johan Galthung and expanded by Paul Farmer, addresses how social structures systematically undermine the physical and mental health of individuals from disadvantaged groups. This theory redefines risks by considering structural forces rooted in social, economic and policy systems [12, 14]. Concerning informal waste pickers, structural violence can manifest in various ways that disadvantage them and undermine their health [15]. This includes discriminatory government measures, public discrimination, and obstacles that limit their access to waste [5, 16, 17]. Thus, this study will explore the risk factors which lead to structural violence on the mental health of informal waste pickers in Hong Kong.

#### The context of Hong Kong

In Hong Kong, there are approximately 2,900 individuals engaged in informal waste picking, mainly older women, known locally as "Cardboard Grannies" [17]. While informal waste pickers play an important role in local waste management and sustainable development, their social and economic conditions and contributions are not recognized. Instead, there is a stigma attached to people who take on this type of work. A 2018 survey of 505 recyclers by the Waste Pickers Platform found that the majority were over 60. They earned an average of HK\$716 (~USD 91) per month from recycling. Recent studies note that Hong Kong's informal waste pickers suffer from physical strain and illness, chronic diseases, discriminatory governmental measures, public discrimination, unfair treatment from intermediaries, and poor mental health [18, 19]. In exploring the dynamics of waste management, previous literature has predominantly focused on technological and policy-driven solutions, often neglecting the socio-economic contributions of informal waste pickers. Despite their integral role in the recycling ecosystem, these workers remain marginalized in academic discourse. Our research aims to fill this gap by delving into the socio-economic impacts of informal waste collection, providing a comprehensive understanding of how these individuals contribute to waste reduction and recycling efforts. By highlighting the economic and environmental significance of waste pickers, this study will offer a broader perspective on sustainable waste management strategies that include these often-overlooked stakeholders.

#### Method

#### Data and sample

This cross-sectional study utilizes data from a largescale, territory-wide survey examining the characteristics and well-being of informal waste pickers in Hong Kong. The survey was conducted by academic institutions and NGOs in 2023. Structured questionnaires were employed to gather data through face-to-face interviews in Hong Kong, specifically targeting 84 recycling shops and 11 recycling trolleys distributed across 18 districts. Data were collected daily from 9:00 AM to 4:00 PM over the week of November 18 to November 24, 2023. Data collection was facilitated by teams of two to three interviewers, comprising a total of 320 volunteer instructors and surveyors, who managed the survey process effectively at all sites. The survey successfully engaged 914 respondents during the specified period. Based on their reported recycling behaviours, respondents were categorized into two groups: those recycling at home and those recycling in community streets or buildings. The analysis

was confined to the second group, focusing on individuals engaged in recycling activities within community settings. From the initial pool of respondents, 100 were excluded due to their exclusive engagement in home recycling. An additional 103 respondents opted out of participation, and 10 were excluded due to providing inadequate responses, defined as answering fewer than five questions. After these exclusions, the analysis continued with a sample of 701 valid questionnaires.

#### Measurement

#### Mental health variables

The dependent variables in this study consist of two measures of mental health. Since the survey was conducted on the street and time for data collection was constrained, short versions of the Patient Health Questionnaire (PHQ) and General Anxiety Disorder (GAD) scales were employed, namely the two-item PHQ (PHQ-2) and two-item GAD (GAD-2). PHQ-2 and GAD-2 are screening tools for the presence of possible depression and anxiety but do not constitute a clinical diagnosis. The PHQ-2 consists of the first two items of PHQ-9, which is the full measurement scale for depression. The stem question is 'Over the last two weeks, how often have you been bothered by any of the following problems?' The two items of PHQ-2 are 'Little interest or pleasure in doing things' and 'Feeling down, depressed or hopeless.' Each item is scored on a Likert scale from 0 (not at all) to 3 (nearly every day), with total scores ranging from 0 to 6. The PHQ was validated as having high sensitivity in detecting major depression [20, 21]. The GAD utilizes the same stem question and scoring scale as the PHQ. The two items of GAD-2 are 'Feeling nervous, anxious or on edge' and 'Not being able to stop or control worrying'. PHQ-2 and GAD-2 scores larger than or equal to 3 are indicative of a possible case of major depressive disorder and generalized anxiety disorder, respectively [22-24]. The Chinese versions of PHQ-2 and GAD-2 have been validated in previous studies [25, 26].

#### Demographic and socioeconomic variables

Demographic and socioeconomic characteristics of the respondents were used in the analysis, including sex, age, and income level. In addition, four questions were asked to examine the living status of the respondents: 'Are you living alone?, 'Are you living with a spouse?', 'Are you living with your children?', and 'Are you living with other family members?' Each question consisted of a binary answer of 'yes' or 'no'.

#### Physical condition variables

Respondents were asked whether they have strain or illness caused by long-term waste picking work and

whether they have chronic disease. They responded 'yes' or 'no' to these two questions.

#### Government measures

Respondents were asked whether they had faced difficulties due to government measures during their waste picking work. Three common scenarios were investigated, including 'In last three months, have you been dispersed by the Food and Environmental Hygiene Department,' 'In last three months, have you been fined by the Food and Environmental Hygiene Department,' 'In last three months, have your properties been confiscated by the Food and Environmental Hygiene Department (including trolleys, wallets, belongings, etc.)'. Answers consisted of a binary 'yes' or 'no'.

#### Other negative experiences

Respondents were also asked whether they had suffered from other negative experiences in the past three months. These included whether they had their collected recyclables or personal property stolen, whether they had been in any traffic accidents, whether they had been treated rudely by the public, and whether they had been treated rudely by recycling shop owners.

#### Supportive resources

Respondents were asked about their sources of support or help. First, respondents were asked a multiple-choice question about what group activities they were currently participating in, including activities held by community centers/welfare agencies, religious groups, legislators/ district councilors, and others. While the answer 'No' is exclusive to other answers. For the analysis, this was simplified into a single binary indicator of whether the respondent participated in group activities. We then adapted six items from the frequency of seeking help question of the Hong Kong Community Investment and Inclusion Fund (CIIF) Social Capital Scale, a locally adapted scale designed to measure individual-level social capital. The question inquired about the sources from which respondents sought help when they encountered difficulties in the past year and was adapted to ask for binary yes/no answers rather than frequency. Respondents were asked whether they had sought help from family/relatives, neighbors, friends, legislators/district councilors, religious groups, and social work agencies/ welfare agencies /social workers, respectively, in the past year. During the analysis, the response to this question were consolidated into a variable consisting of three categories: 'Not asking help from others,' 'Asking one source for help, and 'Asking multiple sources for help'. Finally, the empirical findings of a recent study highlight that informal waste pickers who engage in waste picking work for

non-financial reasons, i.e., meaning/purpose, exercise, have high levels of happiness, well-being and self-esteem [19]. Therefore, we included a binary yes/no question asking, 'If financial conditions permit, will you continue to work as a waste picker?' to examine respondents' positive mindset towards the waste picking works.

#### Statistical analysis

Descriptive statistics are first provided to give an overview of the respondents' demographic, socioeconomic, and physical conditions, their treatment under governmental measures or by the public, their supportive resources, and their mental health. Univariate regressions were performed for preliminary analysis of the relationships between individual variables and the mental health outcome variables. Three multivariate logistic regression models were then tested to examine the association of the independent variables with the mental health outcomes of anxiety and depression. Model 1 examines the impact of the demographic, socioeconomic and physical condition variables on the dependent variables. In Model 2, the government measure and other negative experience variables were added to the model. In Model 3, support resource variables were added to examine their additional effects.

#### Results

#### **Descriptive analyses**

As shown in Table 1, in the present sample, 58.4% of respondents had worked as waste pickers for less than 10 years, 26.7% had worked more than 10 years but less than 19 years, and 14.9% had worked for more than 20 years. With respect to gender, 18.6% were male and 81.4% female. The vast majority of respondents were over 60 years old, with 1.1% of respondents between 18 and 39, 13.4% between 40 and 59, 38.1% between 60 and 69, and 47.4% aged 70 or older. 29.2% of respondents earned less than 3000 HKD/month, 25.1% of respondents earned more than 3001 HKD but less than 5000 HKD/month, 24.8% of respondents have earned more than 5001 HKD but less than 10,000 HKD/month, and 21.0% earned more than 10,001 HKD/month. Meanwhile, 29.9% of respondents were living alone, 37.3% were living with their spouses, 39.8% were living with their children, and 12.8% were living with other family members. Notably, 63.2% of respondents reported physical strain or illness caused by long-term waste picking work. Respondents with chronic diseases comprised 49.1% of the sample.

Concerning discriminatory government measures, 17.6% of respondents reported that they had been dispersed by the government, 3.0% reported that they had been fined by the Food and Environmental Hygiene Department, and 10.7% reported that their property **Table 1** Demographic, socioeconomic information, and physical condition of respondents

	Ν	%
Years of working as a waste picker		
10<	380	58.4
10~19	174	26.7
≥20	97	14.9
Gender		
Male	123	18.6
Female	537	81.4
Age range		
18–39	7	1.1
40–59	88	13.4
60–69	251	38.1
>=70	312	47.4
Income		
0–3000	186	29.2
3001–5000	160	25.1
5001-10000	158	24.8
≥10,001	134	21.0
Living status = living alone		
No	459	70.1
Yes	196	29.9
Living status = spouse		
No	411	62.7
Yes	244	37.3
Living status = living with children		
No	394	60.2
Yes	261	39.8
Living status = living with other family members		
No	571	87.2
Yes	84	12.8
Physical strain or illness caused by long-term waste	picking	work
No	241	36.8
Yes	414	63.2
Chronic illness		
No	333	50.9
Yes	321	49.1

had been confiscated by the Food and Environmental Hygiene Department (including trolleys, wallets, belongings, etc.). Furthermore, 48.3% of respondents reported that they had experienced theft of their collected recyclables or personal property, 3.9% reported having been in traffic accidents, 27.9% reported experiences of rude treatment by citizens, and 51.5% reported being treated rudely by recycling shop owners (Table 2).

With respect to their supportive resources, 28.0% of respondents reported having participated in group activities. Meanwhile, 58.2% of respondents reported

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Table 2	Governmenta	l measures a	and oth	her negative
experien	ces against info	ormal waste	r picke	ers

		/0
Governmental measures against informal waste picker	rs	
Dispersed by the Food and Environmental Hygiene Depart	ment	
No	542	82.4
Yes	116	17.6
Charged by Food and Environmental Hygiene Department	:	
No	636	97.0
Yes	20	3.0
Property confiscated by the Food and Environmental Hygie ment (including trolleys, wallets, belongings, etc.)	ene Depa	rt-
No	587	89.3
Yes	70	10.7
Other negative experiences		
Theft of recycling or personal property		
No	337	51.7
Yes	315	48.3
Have there ever been traffic accidents?		
No	624	96.1
Yes	25	3.9
Rude treatment by citizens		
No	471	72.1
Yes	182	27.9
Rude treatment by recycling shop owner		
No	271	48.5
Yes	288	51.5

that they had not asked for help from others, 25.0% reported one source of help, and 16.8% reported multiple sources. Concerning their willingness to continue engaging in waste picking work, 61.7% indicated they would continue to work as waste pickers if financial conditions permit (Table 3).

Tab	le 3	Supportive	resources <sup>-</sup>	for int	forma	waste	picke	r
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	Ν	%
Have you participated in group activities?		
No	433	72
Yes	168	28
If financial conditions permit, will you continu- picker?	e to work as a was	te
No	222	38.3
Yes	358	61.7
Asking others for help		
Not asking for help from others	373	58.2
Asking one source for help	160	25.0
Asking multiple sources for help	108	16.8

As shown in Table 4, the mean PHQ score was 0.87 (SD=1.48), with 11.3% of informants' scores suggestive of major depressive disorder (PHQ-2 score $\geq$ 3). The mean GAD score was 0.83 (SD=1.54), with 11.6% indicative of generalized anxiety disorder (GAD-2 score $\geq$ 3).

#### Logistic regression models

In the univariate models of depression, physical strain and illness caused by long-term waste picking work, having recyclables or property stolen, traffic accidents, being rudely treated by citizens, and participation in group activities were significantly associated with greater odds of depression. Notably, living with a spouse is significantly associated with lower odds of major depressive disorder compared to living alone (adjusted OR 0.50, 95% CI [0.29, 0.88]). Higher categories of total income were also generally associated with lower odds of depression, compared to respondents with income below 3000 HKD/month. However, only the 3001–5000 HKD/month (adjusted OR 0.46, 95% CI [0.23, 0.92]) and 10,001+HKD/month (adjusted OR 0.33, 95% CI [0.15, 0.75]) income levels were statistically significant. In terms of willingness to continue work as a waste picker, respondents who reported they would continue to work as a waste picker if financial conditions permitted showed significantly lower risks of being depressed compared to those who reported they would not (adjusted OR 0.44, 95% CI [0.26, 0.74]) (Table 5). In Model 1, physical strain and illness was associated with a stronger risk of depression (adjusted OR 3.51, 95% CI [1.77, 6.97]). Meanwhile, respondents with total income equal to or over 10,001 HKD/month showed significantly lower risks of being depressed compared to respondents with income below or equal to 3000 HKD (adjusted OR 0.38, 95% CI [0.16, 0.90]). In Model 2, none of the government measures or negative experiences showed a significant effect on depression. In Model 3, which included all the independent variables, respondents who reported they would continue their waste picking work if financial conditions permitted showed significantly lower risks of depression (adjusted OR 0.46, 95% CI [0.24, 0.88]).

Table 4	Depression ar	d anxiety of res	spondents (A	√=660)
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	Mean	SD
PHQ-2 score	0.87	1.48
GAD-2 score	0.83	1.54
	Ν	%
PHQ-2 score < 3	583	88.7
PHQ-2 score ≥3	74	11.3
GAD-2 score < 3	582	88.4
GAD-2 score ≥3	76	11.6

### Table 5 Logistic regression models

Variables	DV – Depression: (PHQ-2 score $\geq$ 3)				DV – Anxiety (GAD-2 score ≥3)			
	Univariate model crude OR	Model 1 adjusted OR	Model 2 adjusted OR	Model 3 adjusted OR	Univariate model crude OR	Model 1 adjusted OR	Model 2 adjusted OR	Model 3 adjusted OR
Demographic,	socioeconomic	information, a	nd physical cond	dition of respon	dents			
Years of worki	ng as a waste pi	icker (ref:<10)						
10–19	0.76 (0.42, 1.36)	0.72 (0.39, 1.35)	0.68 (0.35, 1.35)	0.72 (0.33, 1.59)	0.82 (0.46, 1.46)	0.81 (0.44, 1.52)	0.62 (0.29, 1.30)	0.50 (0.21, 1.21)
≥20	0.71 (0.33, 1.49)	0.58 (0.26, 1.27)	0.49 (0.19, 1.23)	0.69 (0.25, 1.94)	0.90 (0.45, 1.82)	0.80 (0.38, 1.69)	0.68 (0.28, 1.65)	0.67 (0.23, 1.93)
Gender (ref: m	ale)							
female	2.03 (0.95, 4.34)	1.62 (0.72, 3.64)	1.28 (0.55, 2.99)	1.48 (0.54, 4.05)	2.43 (1.09, 5.42)*	2.04 (0.84, 4.96)	1.77 (0.65, 4.84)	3.08 (0.82, 11.55)
Age range (ref:	≥70)							
18–39	1.23 (0.15, 10.54)	1.93 (0.19, 19.90)	1.58 (0.14, 17.44)	4.91 (0.34, 70.74)	2.97 (0.56, 15.88)	6.53 (0.88, 48.69)	6.86 (0.82, 57.17)	31.06 (2.28, 422.55)*
40–59	0.96 (0.46, 2.02)	1.40 (0.61, 3.25)	0.83 (0.32, 2.14)	0.92 (0.31, 2.69)	0.85 (0.39, 1.83)	1.39 (0.58, 3.35)	0.78 (0.27, 2.29)	1.16 (0.36, 3.74)
60–69	0.86 (0.51, 1.46)	0.86 (0.48, 1.54)	0.76 (0.40, 1.45)	0.91 (0.43, 1.90)	0.94 (0.56, 1.59)	0.98 (0.55, 1.75)	0.96 (0.50, 1.87)	1.31 (0.60, 2.85)
Living status (re	ef: living alone)							
Spouse	0.50 (0.29, 0.88)*	0.61 (0.34, 1.09)	0.63 (0.33, 1.19)	0.70 (0.34, 1.42)	0.50 (0.29, 0.87)*	0.59 (0.33, 1.06)	0.52 (0.26, 1.04)	0.48 (0.22, 1.06)
Living with children	0.80 (0.48, 1.32)	0.84 (0.48, 1.45)	0.94 (0.52, 1.73)	0.94 (0.47, 1.89)	0.81 (0.49, 1.33)	0.82 (0.47, 1.42)	0.73 (0.38, 1.40)	0.70 (0.33, 1.48)
Living with other family mem- bers	0.56 (0.25, 1.29)	0.65 (0.27, 1.57)	0.71 (0.28, 1.78)	0.46 (0.14, 1.52)	0.74 (0.35, 1.57)	0.81 (0.35, 1.87)	0.79 (0.31, 1.99)	0.41 (0.12, 1.37)
Physical strain	and illness cau	sed by long-ter	m waste picking	y work (ref: No)				
Yes	3.33 (1.75, 6.31)***	3.51 (1.77, 6.97)***	2.89 (1.37, 6.08)**	3.58 (1.50, 8.54)**	5.01 (2.45, 10.24)***	4.72 (2.24, 9.92)***	3.42 (1.50, 7.79)**	3.55 (1.44, 8.79)**
Need to go to	the hospital's sp	pecialist clinic fo	or regular follow	/-up visits (ref: N	lo)			
Yes	1.51 (0.93, 2.47)	1.43 (0.83, 2.44)	1.16 (0.64, 2.09)	1.20 (0.61, 2.36)	1.81 (1.11, 2.96)*	1.70 (0.98, 2.94)	1.42 (0.76, 2.66)	1.50 (0.73, 3.07)
Income amoun	t(ref: 0–3000)							
3001-5000	0.46 (0.23, 0.92) *	0.51 (0.25, 1.04)	0.55 (0.26, 1.19)	0.71 (0.31, 1.61)	0.46 (0.25, 0.87)*	0.50 (0.26, 0.97)*	0.53 (0.25, 1.12)	0.56 (0.25, 1.27)
5001-10000	0.80 (0.44, 1.47)	0.94 (0.50, 1.77)	0.87 (0.43, 1.77)	0.67 (0.28, 1.58)	0.48 (0.25, 0.90)*	0.50 (0.26, 0.97)*	0.41 (0.19, 0.90)*	0.32 (0.12, 0.83)*
≥10,001	0.33 (0.15, 0.75)**	0.38 (0.16, 0.90)*	0.52 (0.21, 1.29)	0.62 (0.21, 1.80)	0.20 (0.08, 0.48)***	0.21 (0.08, 0.54)**	0.22 (0.07, 0.69)*	0.23 (0.06, 0.89)*
Governmenta	l measures							
Dispersed <b>by t</b>	ne Food and Env	vironmental Hyg	giene Departme	ent (ref: No)				
Yes	1.33 (0.73, 2.40)		1.00 (0.45, 2.21)	1.11 (0.44, 2.82)	1.66 (0.95, 2.92)		0.94 (0.41, 2.15)	0.85 (0.31, 2.30)
Fined by Food	and Environme	ental Hygiene D	epartment (ref:	No)				
Yes	2.73 (0.96, 7.73)		2.73 (0.58, 12.77)	1.07 (0.16, 7 .38)	4.41 (1.70, 11.43)**		2.06 (0.44, 9.63)	1.25 (0.18, 8.68)
Property confi	scated by the F	ood and Enviro	nmental Hygien	e Department (	including trolley	rs, wallets, belo	ngings, etc.) (ref	: No)
Yes	1.20 (0.57, 2.53)		0.67 (0.21, 2.14)	0.63 (0.18, 2.22)	2.15 (1.13, 4.09)*		1.49 (0.53, 4.23)	2.00 (0.63, 6.35)
Other negative	experiences		<b>`</b>					
Recycling or p	ersonal propert	ty stolen (ref: No	D)				/_ /	
Yes	2.04 (1.23, 3.36)**		1.56 (0.84, 2.88)	1.31 (0.66, 2.60)	2.72 (1.62, 4.56)***		1.52 (0.80, 2.90)	1.22 (0.59, 2.52)

#### Table 5 (continued)

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Ask multiple 0.81(0.39,

105(059

1.68)

ables	DV – Depressi	DV – Depression: (PHQ-2 score ≥3)				DV – Anxiety (GAD-2 score ≥3)			
	Univariate model crude OR	Model 1 adjusted OR	Model 2 adjusted OR	Model 3 adjusted OR	Univariate model crude OR	Model 1 adjusted OR	Model 2 adjusted OR	Model 3 adjusted OR	
e there ev	ver been traffic a	ccidents? (ref: N	lo)						
S	2.70 (1.04, 7.01)*		1.87 (0.54, 6.47)	1.50 (0.33, 6.80)	2.18 (0.79, 6.04)		0.86 (0.21, 3.48)	0.49 (0.08, 3.18)	
g treated	rudely by citize	ns (ref: No)							
S	2.16 (1.32, 3.55)**		1.47 (0.79, 2.76)	1.88 (0.93, 3.82)	2.85 (1.74, 4.67)***		1.91 (1.00, 3.65)*	2.46 (1.17, 5.17)*	
cling sho	op owner (ref: No	)							
S	1.67 (0.99, 2.83)		1.23 (0.67, 2.26)	1.13 (0.57, 2.25)	1.90 (1.11, 3.25)*		1.51 (0.79, 2.87)	1.53 (0.73, 3.21)	
ortive net	tworks								
you parti	cipated in group a	activities? (ref: No	c)						
S	1.74 (1.03, 2.94)*			1.67 (0.82, 3.39)	1.54 (0.91, 2.61)			1.51 (0.71, 3.20)	
ancial con	ditions permit, wi	ll you continue to	o work as a waste	picker? (ref:No)					
S	0.44 (0.26, 0.74)**			0.46 (0.24, 0.88)*	0.45 (0.27, 0.75)**			0.43 (0.22, 0.86)*	
or help (re	ef: Not asking for h	elp from others)							

Significant level, Odd ratio (OR) and 95% confidence interval (CI). Model 1 = demographic and socioeconomic factors + physical conditions; Model 2 = Model 1 + Governmental measures and public attitude against cardboard grannies; Model 3 = Model 2 + Supportive networks

073 (032

0.76 (0.31.

1.66)

1.86)

1 10 (0 62

072 (034

1.94)

1.53)

sources

for help

Concerning anxiety, in univariate models, gender (adjusted OR 2.43, 95% CI [1.09, 5.42]), physical strain and illness caused by long-term waste picking work (adjusted OR 5.01, 95% CI [2.45, 10.24]), chronic illness (adjusted OR 1.81, 95% CI (1.11, 2.96)], being fined by the Food and Environmental Hygiene Department (adjusted OR 4.41, 95% CI [1.70, 11.43]), having property confiscated by the Food and Environmental Hygiene Department (adjusted OR 2.15, 95% CI [1.13, 4.09]), having recycling or personal property stolen (adjusted OR 2.72, 95% CI (1.62, 4.56)]), being treated rudely by citizens adjusted OR 2.85, 95% CI [1.74, 4.67]), and being treated rudely by recycling store owners (adjusted OR 1.90, 95% CI [1.11, 3.25]) were significantly positively associated with anxiety.

Notably, living with a spouse was significantly associated with lower odds of generalized anxiety disorder compared to living alone (adjusted OR 0.50, 95% CI [0.29, 0.87]). In terms of income level, higher levels of income were all significantly associated with lower odds of anxiety compared to respondents with income below or equal to 3000 HKD/month. Incomes of 3001-5000 HKD/ month, 5001-10000 HKD/month, and 10,000+HKD/ month were associated with adjusted OR of 0.46 (95% CI [0.25, 0.87]), 0.48 (95% CI [0.25, 0.90]), and 0.20 (95% CI [0.08, 0.48]), respectively. Respondents who would continue work as a waste picker if financial condition permitted also showed a significant negative association with anxiety compared to those who would not (adjusted OR 0.45, 95% CI [0.27, 0.75]) (Table 5). In Model 1, respondents with physical strain and illness showed a stronger association with anxiety (adjusted OR 4.72, 95% CI [2.24, 9.92]). All higher levels of income were significantly associated with lower odds of anxiety compared to those with income below 3000 HKD/month, with an adjusted OR of 0.50 (95% CI [0.26, 0.97]) for the 3001-5000 HKD/ month, 0.50 (95% CI [0.26, 0.97]) for the 5001-10000 HKD/month group, and 0.21 (95% CI [0.08, 0.54]) for the 10,000 or above HKD/month group. In Model 2, which added government measures and other negative

1.21 (0.53, 2.77)

0.96 (0.38, 2.39)

<sup>\*</sup> p < .05

<sup>.</sup> \*\*p<.01

<sup>\*\*\*\*</sup>p<.001

experiences, being treated rudely by citizens was associated with a greater likelihood of anxiety (adjusted OR 1.91, 95% CI [1.00, 3.65]). In Model 3, respondents who would continue to work as waste pickers if financial condition permitted showed significantly lower risks of anxiety (adjusted OR 0.43, 95% CI [0.22, 0.86]).

#### **Discussion and Conclusion**

This cross-sectional study investigated the mental health conditions of informal waste pickers and the determinants of depression and anxiety specifically in these individuals. The results revealed that informal waste picking in Hong Kong like other precarious employments is characterized by low wages, exposure towards occupational hazards, and physical strain/illness, which are closely related to poor mental health [1–3]. Meanwhile, informal waste pickers in Hong Kong suffered from punitive governmental measures and public discrimination which intensified their precarious employment status. Therefore, this study identified physical strain and illness caused by long-term waste picking work, governmental measures related to waste picking works, and other negative experiences related to safety issues and public discrimination as the key risk factors for informal waste pickers' mental health. The high intention of continuing to work as a waste picker if financial conditions permit was identified as the main protective factor.

This study first disclosed a series of risk and protector factors of informal waste pickers' mental health at the micro level. In terms of the protective factors, the increase in income levels prevented informal waster pickers from depression and anxiety [10]. We explain that the increase in income provides material resources for informal waste pickers to counter the economic hardship brought by precarious employment and improve their well-being. Thus, we proposed various tactics to raise the occupational income of informal waste pickers. First, setting the minimum unit price of recycling waste is a timely and effective way to increase their occupational income. The Environmental Protection Department has introduced a minimum price standard for waste paper recycling since June 1st 2024. This standard mandates that contractors providing waste paper collection and recycling services, as well as their associated recyclers, must purchase waste paper meeting quality standards at a specified recycling price of no less than HKD 0.65 per kilogram from providers [13]. The standard might be the important milestone for ensuring the minimum occupational income for informal waste pickers. Meanwhile, NGOs can cooperate with relevant governmental organizations to ensure the intermediaries have strictly followed the standard and protect the interests of informal waste pickers in the recycling businesses. Last but not least, we advocate for non-governmental organizations to collaborate closely with relevant government departments, such as the Labour Department, to provide targeted re-employment training services for informal waste pickers, particularly the middle-aged and elderly among them. This initiative aims to enhance their competitiveness in the formal job market, enabling them to secure higher-paying and more stable employment.

Living with spouse is also a protective factor while living with children or other family members displays a non-significant impact on mental health. This may be attributed to the fact that Hong Kong is a society at the crossroads of cultural traditionalism and modernism [27]. On the one hand, the companion from the spouse provides support for informal waste pickers to counter the adversities brought by precarious employment. On the other hand, the value conflict in waste-picking activities between informal waste pickers and their children is documented in previous literature [19]. The value conflict and tension may undermine the possibility of informal waste pickers in receiving support from their children.

In terms of risk factors, this study echoed previous literature and found that physical strain and illness caused by long-term waste picking work is the key risk factor of informal waster pickers' mental health [9]. Chronic disease continually exists as a significant risk factor for anxiety of informal waste pickers. These results may reflect the vicious circle informal waste pickers face, whereby they are more prone to physical strain and illness as well as chronic illnesses resulting from long-term waste picking works, and thus more likely to suffer from depression and anxiety. Previous study [18] documented that informal waste pickers in Hong Kong are exposed to occupational health hazards and are accompanied by physical decline, i.e., allergies, and bodily pains. Thus, it would be difficult for informal waste pickers to escape from the vicious circle unless more tailored physical health services are provided. Although local NGOs have made essential steps in providing protective gear and education to informal waste pickers, more physical health programs targeting physical strain and chronic illness caused by long-term waste picking works are needed.

Second, this study draws on the structural violence theory framework and identifies a series of key risk factors at governmental and societal levels. Governmental measures related to waste picking works demonstrate significant impacts in disadvantaging informal waster pickers and deteriorating their mental health. Informal waste pickers with experiences of being charged and property confiscated by the Food and Environmental Hygiene Department are more likely to have anxiety. One possible explanation was that these two discriminatory measures resulted in the loss of informal waste pickers' incomes, which further undermined their protective factor against anxiety. Governmental measures against informal waste pickers run counter to governmental objectives of promoting waste reduction and recycling but form structural violence which criminalizes the picking activities outside the formal recycling system [5]. Thus, these punitive governmental measures should be avoided. Instead, the Food and Environmental Hygiene Department should be actively engaged in cooperating with the Environmental Protection Department and NGOs to incorporate informal waste pickers' voices into the optimization of waste recycling regulation and management.

Other negative experiences related to safety issues and public discrimination display varying impacts on the mental health of informal waste pickers. Specifically, the experience of recycling or personal property being stolen could predict both the depression and anxiety of informal waste pickers. This may be because recycling or personal property being stolen would also lead to the loss of informal waste pickers' income and further undermine their mental health condition. The experience of traffic accidents also predicted informal waste pickers' depression. This finding echoes previous literature on exposure towards hazardous working conditions and its impact on informal waste picker's health condition [4, 8]. On the other hand, the experience of being treated rudely by citizens was identified as the critical risk factor for informal waste picker's depression and anxiety. A possible explanation is that being treated rudely by citizens in daily work enforces informal waste pickers to internalize the stigma related to picking, which deteriorates their mental health [11]. Along the same line, the experience of being treated rudely by recycling shop owner predicted the anxiety of informal waste pickers. This may be attributed to discrimination from and dispute with recycling shop owners not only contribute to the internalization of stigma but also intensify informal waste pickers' inferior position in the price bargaining [15]. Therefore, it is worthwhile to develop unused public spaces, i.e., open space near the park, market or under the highway flyover, as specific recycling zone with CCTV monitoring for informal waste pickers to store personal belonging and clean the recycling. This method could decrease their exposure to occupational hazards, i.e., traffic accident, and protect their personal property. More importantly, it is imperative that NGOs closely collaborate with governmental organizations to promote public education. This initiative aims to increase awareness and recognition of the significant contributions that informal waste pickers make to the recycling industry and environmental protection in Hong Kong. Furthermore, such educational efforts should ultimately work towards redefining and enhancing the positive image of informal waste pickers in the eyes of the general public.

Third, this study identified the higher intention of continuing to work as a waste picker if financial conditions permit as the predictor of lower depression and anxiety. As those who engage in picking activities for non-economic reasons are more likely to have positive mindset towards informal waste picking [19], our study further explains that the positive mindset may enable informal waste pickers to negotiate with the adversities, i.e., stigma, attached to picking activities and avoid following anxiety or depression. Unexpectedly, asking others, ranging from family to social work agencies, for help do not have significant impact on informal waste pickers' mental health condition. On the contrary, informal waste pickers who participate in more group activities are more likely to have depression. The explanation might be that turning to others directly for help cannot nurture informal waste pickers' capacity to negotiate with adversities experienced in daily work but increases their reliance on others. This finding also implies that the surrounding environment towards informal waste pickers maybe unfriendly. Thus, future intervention should be developed around the enhancement of positive mindset which enables informal waste pickers to re-assess the value of their occupation and exert agency to cope with the adversities even if they could not receive external assistance.

This study provides several policies and service suggestions. First, it highlights the mental health needs of cardboard grannies. It is suggested that the government needs to allocate more resources for providing outreach mental health services. Staff with medical or psychiatry training, such as doctors and psychiatric nurses, could provide intensive intervention and treatment to cardboard grannies with mental health problems. The medical team could work closely with NGOs and social workers to enhance service to cardboard grannies. As risk factors at societal and governmental levels intertwine in forming the structural violence stigmatizing informal waste pickers and deteriorating their health conditions, developing a bottom-up platform to empower informal waste pickers is necessary. Establishing membership-based organizations (MBOs) is a feasible measure to recognize informal waste pickers as key contributors in waste management system and facilitate the representations of their interests in policymaking process. The successful experience of inclusive program in Global South highlights that MBOs provides an institutional framework to recognize informal waste pickers as service providers, circumvents intermediaries, and prevents harassment and violence [5]. Therefore, increasing resources for community-based NGOs and social work agencies to assist informal waste pickers in Hong Kong to build their MBOs is the most crucial measure to improve their working conditions, raise their income, self-esteem, and facilitate their wellbeings. Meanwhile, comprehensive supportive network for the informal waste picker group should be strengthened, including the more proactive involvement of NGOs and religious organizations. Additionally, NGOs, religious organizations, and relevant government departments should collaborate closely to build a more friendly community in which informal waste pickers can form the effective peer support.

There are several limitations to this study. First, the survey was conducted from morning to mid-afternoon for 7 days. The limited time and human resources may lead to the under-representation of those who work at night or highly mobile status in this study. Nevertheless, the research team attempted to ask experienced social workers to cover 84 recycling shops and 11 recycling trolleys distributed across 18 districts, to increase the chance of reaching the respondents. Second, since the interviews were conducted on the street, the interview time and the number of questions were constrained, some questionnaires were not completed with some missing data. In addition, conducting a comprehensive clinical diagnosis of the mental health conditions was not feasible given the limits of data collection. Nevertheless, validated measurements of mental health screening tools have been applied. Fourth, the data used was cross-sectional, and this limited the explanatory power in the causal relationship between structural violence formed by potential risk factors and mental health outcome of depression and anxiety.

#### Authors' contributions

Author Statement: Siu-Ming CHAN: Conceptualization, Methodology, Research design and Data collection, Writing - Original Draft, Writing - Review & Editing, Supervision, Project administration; Heng Xu: Writing - Original Draft, Writing - Review & Editing, and Formal analysis; Yuen-Ki TANG: Formal analysis, Investigation, and Writing - Review & Editing; Jasmine Zhang: Writing - Review & Editing; Kim KWOK: Writing - Review & Editing; Bess Yin-Hung Lam: Writing - Review & Editing. Wing-Him TANG: Research design and Data collection; Ka-Chun Lui: Research design and Data collection.

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#### Data availability

Data available on request from the authors.

#### Declarations

#### Ethics approval and consent to participate

This study was approved by the Human and Artefacts Ethics Sub-Committee of City University of Hong Kong (Application No: HU-STA-00000448) on May 9th, 2023. Informed consent was obtained from each respondent in the survey.

#### **Competing interests**

The authors declare no competing interests.

#### Author details

<sup>1</sup>Department of Social and Behavioural Sciences, City University of Hong Kong, Hong Kong SAR, China. <sup>2</sup>Department of Counselling and Psychology, Hong Kong Shue Yan University, North Point, Hong Kong SAR, China. <sup>3</sup>Waste Picker Platform, New Arrivals Limited, Hong Kong, China. <sup>4</sup>Communion Lutheran Elderly Health Centre, Evangelical Lutheran Church Social Service-Hong Kong, Hong Kong, China.

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#### References

- 1. Lee J, Di Ruggiero E. How does informal employment affect health and health equity? Emerging gaps in research from a scoping review and modified e-Delphi survey. International Journal for Equity in Health. 2022Jun 21;21(1):87.
- Pulford A, Thapa A, Thomson RM, Guilding A, Green MJ, Leyland A, et al. Does persistent precarious employment affect health outcomes among working age adults? A systematic review and meta-analysis. J Epidemiol Community Health. 2022Sep 22;76(11):909–17.
- Pförtner TK, Pfaff H, Hower KI. Trends in the association of different forms of precarious employment and self-rated health in Germany. An analysis with the German Socio-Economic Panel between 1995 and 2015. J Epidemiol Community Health (1979-). 2019;73(11):1002–11.
- Yang H, Ma M, Thompson JR, Flower RJ. Waste management, informal recycling, environmental pollution and public health. J Epidemiol Community Health. 2018Mar;72(3):237–43.
- 5. Dias SM. Waste pickers and cities. Environ Urban. 2016Oct 1;28(2):375-90.
- Hartmann C, Hegel C, Boampong O. The forgotten essential workers in the circular economy? Waste picker precarity and resilience amidst the COVID-19 pandemic. Local Environment. 2022 Nov 2 [cited 2024 Aug 14]; Available from: https://www.tandfonline.com/doi/abs/10.1080/13549839. 2022.2040464.
- Uhunamure SE, Edokpayi JN, Shale K. Occupational Health Risk of Waste Pickers: A Case Study of Northern Region of South Africa. J Environ Public Health. 2021;2021(1):5530064.
- Singh K, Singla N, Sharma M, Singh J. Urban informal economy and vulnerabilities of domestic waste-pickers: A case of Chandigarh. India Waste Manag Res. 2023Aug 1;41(8):1360–71.
- Made F, Ntlebi V, Kootbodien T, Wilson K, Tlotleng N, Mathee A, et al. Illness, Self-Rated Health and Access to Medical Care among Waste Pickers in Landfill Sites in Johannesburg, South Africa. Int J Environ Res Public Health. 2020Mar 27;17(7):2252.
- Martínez L, Zuluaga B, Prada SI. Analyzing Factors Associated with Trash Pickers' Health Status: Census Data in a Major City in Colombia. J Community Health. 2020Feb 1;45(1):133–40.
- Dada OT, Faniran GB, Ojo DB, Taiwo AO. Waste pickers' perception of occupational hazards and well-being in a Nigerian megacity. Int J Environ Stud. 2023Jul 4;80(4):933–47.
- 12. De Maio F, Ansell D. "As Natural as the Air Around Us": On the Origin and Development of the Concept of Structural Violence in Health Research. Int J Health Serv. 2018Oct;48(4):749–59.
- Environmental protection department. (2024, June 1). Waste Paper Collection and Recycling Services. Hong Kong Waster Reduction Website. https://www.wastereduction.gov.hk/en-hk/waste-reduction-progr amme/waste-paper-collection-and-recycling-services.
- Macassa G, McGrath C, Rashid M, Soares J. Structural Violence and Health-Related Outcomes in Europe: A Descriptive Systematic Review. Int J Environ Res Public Health. 2021 Jun 30;18(13):6998.
- Guillot-Wright S, Cherryhomes E, Wang L, Overcash M. Systems and subversion: A review of structural violence and im/migrant health. Curr Opin Psychol. 2022Oct;47: 101431.
- Fergutz O, Dias S, Mitlin D. Developing urban waste management in Brazil with waste picker organizations. Environ Urban. 2011Oct 1;23(2):597–608.
- 17. Gutberlet J, Carenzo S, Kain JH. Mantovani Martiniano de Azevedo A. Waste Picker Organizations and Their Contribution to the Circular

Economy: Two Case Studies from a Global South Perspective. Resources. 2017;6(4):52.

- Waste Pickers Platform. Hong Kong Waste Pickers Research Report.
   2018. Available from: https://www.newarrivals.org.hk/News/2783/Final\_ Report\_Ragpicker\_Research\_2018.pdf.
- Kwan C, Wong AYL, Tam HC, Ngai EKN, Lam WT, Tang WH, et al. Evaluating a Multimodal Intervention for Hong Kong's Older Informal and Precarious Workers. Res Soc Work Pract. 2024May;5:10497315241249442.
- Kwan C, Tam HC. Leaving No One behind in Healthy Ageing: A Unique Sub-Group, the "Cardboard Grannies of Hong Kong." Int J Environ Res Public Health. 2022Jan;19(15):9691.
- Arroll B, Goodyear-Smith F, Crengle S, Gunn J, Kerse N, Fishman T, et al. Validation of PHQ-2 and PHQ-9 to screen for major depression in the primary care population. Ann Fam Med. 2010;8(4):348–53.
- Löwe B, Kroenke K, Gräfe K. Detecting and monitoring depression with a two-item questionnaire (PHQ-2). J Psychosom Res. 2005Feb;58(2):163–71.
- Kroenke K, Spitzer RL, Williams JBW, Monahan PO, Löwe B. Anxiety disorders in primary care: prevalence, impairment, comorbidity, and detection. Ann Intern Med. 2007Mar 6;146(5):317–25.
- Löwe B, Wahl I, Rose M, Spitzer C, Glaesmer H, Wingenfeld K, et al. A
   4-item measure of depression and anxiety: validation and standardization of the Patient Health Questionnaire-4 (PHQ-4) in the general population. J Affect Disord. 2010Apr;122(1–2):86–95.
- Plummer F, Manea L, Trepel D, McMillan D. Screening for anxiety disorders with the GAD-7 and GAD-2: a systematic review and diagnostic metaanalysis. Gen Hosp Psychiatry. 2016;39:24–31.
- Luo Z, Li Y, Hou Y, Zhang H, Liu X, Qian X, et al. Adaptation of the two-item generalized anxiety disorder scale (GAD-2) to Chinese rural population: A validation study and meta-analysis. Gen Hosp Psychiatry. 2019;60:50–6.
- Yu X, Stewart SM, Wong PTK, Lam TH. Screening for depression with the Patient Health Questionnaire-2 (PHQ-2) among the general population in Hong Kong. J Affect Disord. 2011Nov;134(1–3):444–7.

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