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## Article

# Factors Associated with Competence in Preventing Non-Communicable Diseases Among Community Health Workers in Japan

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**Abstract:** Background: Community health workers (CHWs) drawn from the general population are an important human resource in health care systems, preventing non-communicable diseases (NCDs) and contributing to an increase in healthy life expectancy in Japan. Thus, we have developed the Community health workers perceptual and behavioral Competency Scale for preventing Non-communicable diseases (COCS-N) to measure CHWs' competence in preventing NCDs. The purpose of this study is to examine individual and community factors affecting CHWs' COCS-N scores. Methods: Municipal public health nurses and other public health professionals are responsible for training and supporting CHWs in Japan. Therefore, the existence of CHWs and their willingness to participate in the study were confirmed with the municipalities, who were asked to distribute the self-administered questionnaire to CHWs where consent was obtained (N = 6,480). Variables used included demographic characteristics, COCS-N scores, and individual- and community-related factors. Logistic regression analysis was used to assess associations between variables. Results: A total of 3,120 people completed the questionnaire, a valid response rate of 48.1%. The respondents' mean age was 67.0 years (standard deviation = 9.0), and 88.0% were female. Comparison of the high- and low- competence groups in terms of NCD prevention based on COCS-N scores identified 13 factors associated with significant differences, including years spent working as a CHW ( $p < 0.001$ ), subjective sense of health ( $p = 0.005$ ), European Health Literacy Survey Questionnaire (HLS-EU-Q47) scores ( $p < 0.001$ ), and community commitment scale (CCS) scores ( $p < 0.001$ ). Logistic regression analysis revealed that HLS-EU-Q47 scores (odds ratio [OR]: 1.02, 95% confidence interval [CI]: 1.02–1.03) were a significant individual factor, while CCS scores (OR: 1.14, 95% CI: 1.11–1.16) were a significant community factor. Conclusions: We found that the COCS-N score was associated with the individual factors overall health literacy (HL), perceptions of HL, and subjective sense of health, and with the community factor CCS scores. These results suggest that strengthening individual factors such as HL and subjective sense of health, and community factors such as sense of community is an effective strategy for increasing CHWs' competence in preventing NCDs.

**Keywords:** community health workers; competence in prevention of non-communicable diseases; associated factors literacy; community commitment

## 1. Background

Community health workers (CHWs) are defined as local residents who are elected to provide primary health care on behalf of professional health-care providers. CHWs are usually selected by the community, are responsible to the community for their activities, and are supported by a health-care system created by a national or municipal public health organization such as a ministry of health or health center [1]. They have four main roles and functions: health education, social support, advocacy, and coordination and mediation. Health education is designed to increase the knowledge of patients and community members and to reduce disease and its major risk factors. Social support includes emotional, evaluative, informational, instrumental, and material support. Advocacy, coordination and mediation help residents to access health facilities and local health professionals,

with the CHWs acting as collaborative bridges [2,3]. The presence of CHWs facilitates improved health among large numbers of people at a reasonable burden. However, for CHWs to be effective in solving health-related problems within their communities, the quality of their activities needs to be assured. Recruitment, training, roles, remuneration, knowledge security, and professional development of CHWs have been identified as challenges in this regard [4]. Moreover, the greatest current challenges regarding CHWs include adequate remuneration, integrating CHW activities into the health system without disturbing or interfering with their position in the community, combining CHWs' inputs with other types of social support, and achieving an adequate return on investment while delivering significantly improved outcomes [4]. In particular, there are two types of CHWs, those who are employed and paid by national and municipal health organizations, and those who work on a voluntary basis, and thus how to set remuneration commensurate with their activities is a major challenge.

Furthermore, when discussing CHWs, the diverse range of activities they undertake as a result of their location and the diseases they must target need to be taken into account [4,5]. Previous studies on CHWs have shown that developing countries often train CHWs to undertake infectious disease- and maternal and child health-related activities, whereas developed countries often train CHWs to undertake the prevention and management of non-communicable diseases (NCDs) such as heart disease, various cerebrovascular diseases, and diabetes [6–11].

NCDs, also known as chronic diseases or lifestyle-related diseases, include cancer, diabetes, cardiovascular disease, respiratory disease, and mental illness, and are caused by a range of factors including an unhealthy diet, lack of exercise, smoking, excessive alcohol consumption, and air pollution. NCDs are also characterized by their lengthy duration, and are exacerbated by a combination of genetic, physiological, environmental and behavioral factors [12,13]. In 2016, a group of international professional bodies, including the International Diabetes Federation, reported that there were 523 million people with cardiovascular disease, 463 million people with diabetes, and 40 million stroke survivors worldwide [14–16]. Further, the incidence of cardiovascular disease had doubled during the preceding 30 years, and the incidence of diabetes had more than tripled during the previous decade [14,16]. Thus, given the global rise in NCD-related morbidity and mortality, it is essential that measures to prevent NCDs are taken at the national level. Previous studies have found that the results of using CHWs for the management of diabetes were no different from those of using nursing professionals [17]. While other studies have developed models regarding the workforce of CHWs for primary health care systems [18].

In Japan, the second and third leading causes of death are heart disease and cerebrovascular disease, respectively, and NCDs continue to be the leading overall cause of death [19]. Therefore, as an early response to NCDs, the concept of metabolic syndrome, which combines obesity and abnormalities in cardiovascular blood test data such as blood pressure, blood glucose levels, and lipid abnormalities, has been introduced, and specific check-ups and health guidance have been implemented to enable early detection and treatment of people with metabolic syndrome, and thus at high risk of NCDs [20]. However, NCD prevention efforts require not only the identification of high-risk people, but also an approach that addresses the overall population. Thus, the Ministry of Health, Labour and Welfare (MHLW) has formulated the Health Japan 21 promotion aimed at the entire Japanese population, which includes targets for lifestyle-related diseases and lifestyle habits aimed at increasing healthy life expectancy and correcting health disparities [21]. The measures are carried out by public health nurses (who have a different national qualification to that of general nurses) who have acquired knowledge regarding community assessment, legislation, and social resources, and by voluntary CHWs recruited from the local population [22]. The composition of the community health system, in which both public health nurses and CHWs contribute to the delivery of primary health care in the community, is unique to Japan [23,24]. With its history and system of community health care, as well as the world's longest life expectancy at the lowest cost among developed countries, Japan has been successful not only in delivering primary health care, but also in providing universal health coverage, which refers to 'a state in which all people have access to appropriate preventive, therapeutic, rehabilitative and other health services at a cost they can afford'

[25]. The efforts of the public health nurses and CHWs who have contributed to this achievement are considered to be meaningful activities that can make a contribution to improved global health.

Therefore, we developed the COMMunity health workers perceptual and behavioral Competency Scale for preventing Non-communicable diseases (COCS-N) to measure competence in NCD prevention among CHWs in Japan [26]. Competency theory states that there are two types of competencies: those that are visible, such as knowledge and skills, and those that are hidden, such as beliefs and values [27,28]. Therefore, the COCS-N includes perceptual and behavioral subscales. CHWs are also described as having both a health-care aspect and a community aspect in relation to their activities [29]. Therefore, the COCS-N was developed based on the concepts of health care and community. Our aim is to provide solutions to the problems CHWs face in relation to recruitment, training, roles, remuneration, knowledge assurance, and professional development. We believe that this will also lead to effective solutions to the biggest problems CHWs face, namely, appropriate remuneration, protecting their position in the community and keeping them motivated, and positioning them effectively within the community care system in combination with other physical and social support providers. To do this, we need to identify the factors that determine CHWs' competence in NCD prevention. Thus, in this study, we examine the individual- and community-related factors affecting CHWs' COCS-N scores.

## 2. Methods

### 2.1. Aim, Design, and Setting of the Study

The aim of our study was to examine the associations between competence in the prevention of NCDs with various individual-related factors (modifiable physical, mental, and social characteristics among community health workers) and community-related factors (modifiable structural and systematic elements of community group activities) that affect CHWs. We conducted a cross-sectional national survey of CHWs in Japan from September to November 2020.

### 2.2. Participants

Local governments in Japan include prefectures and municipalities, with CHW training and support provided by the municipalities. Therefore, we wrote to all 1,743 municipalities in Japan between July and September 2020 explaining the purpose of the study, asking whether there were CHWs in their municipality, and if so, whether they were prepared to distribute the questionnaire to their CHWs. A total of 194 municipalities (11.1%) expressed their willingness to participate in the study. The questionnaires were distributed to participants by municipal public health nurses and other administrative professionals supporting CHWs. The eligibility criteria for participants were (1) having participated in health promotion activities for at least one year, and (2) being assessed by the supporting health worker as being in sufficiently good health to participate in the survey. The CHWs' health promotion activities included delivering health check-up notices to neighborhood residents, teaching healthy recipes and weight training exercises that could be undertaken at home, and conducting physical fitness tests. A total of 6,580 CHWs received the questionnaire, and 6,480 responded, of which 3,651 (56.3%) met the inclusion criteria. A further 531 individuals were excluded as follows: (1) CHWs whose responses to the questionnaire revealed insufficient participation in health promotion activities (i.e., in response to the question asking how long they had been active as CHWs, they answered 'Less than one year', despite having received the questionnaire on the understanding that they had been active for at least one year ( $n = 17$ )), (2) CHWs who did not respond to the COCS-N or community commitment scale (CCS) items ( $n = 268$ ), and (3) CHWs who failed to respond to at least two items in the European Health Literacy Survey Questionnaire (HLS-EU-Q47,  $n = 246$ ). This left 3,120 participants for inclusion in the analysis, a valid response rate of 48.1%.



## 2.3. Measurements

### 2.3.1. Demographic Characteristics

The participants' demographic characteristics that we measured included age, sex, family structure (living alone/with a spouse/with children/with a spouse and children/with children and grand-children/other), years of residence, level of education (primary school and below/junior high school/senior high school/vocational school or technical college/university/graduate school).

### 2.3.2. Dependent Variable

The Community Health Workers Perceptual and Behavioral Competency Scale for Preventing Non-communicable diseases (COCS-N) is an instrument used to assess competence in the prevention of NCDs among CHWs [26]. The COCS-N has a Cronbach's alpha, which conveys the internal consistency of the scale, of 0.86 in Japan, and includes eight items, four in each of the subscales perceptual competence and behavioral competence. Each item is scored on a four-point Likert-type scale as follows: 0 = not applicable, 1 = somewhat inapplicable, 2 = somewhat applicable, and 3 = entirely applicable. A higher overall score (range 0–24) indicates a higher degree of competence in the prevention of NCDs. No cutoff point for the COCS-N has been determined, and thus we set a cutoff point based on the distribution of our study population.

### 2.3.3. Independent Variables

#### Individual Factors

We assumed that individual factors included years of working as CHWs, health literacy, subjective sense of health, and number and types of diseases under treatment. Years of working as CHWs was measured by the participants' responses to the question "How long have you been working as a CHW?" Health literacy was measured using the HLS-EU-Q47 (Japanese version) [30,31]. The HLS-EU-Q47 is a 12-dimension instrument consisting of a total of 47 items measuring the four information-related competencies of health literacy (obtaining, understanding, evaluating and using) across three subdomains (health care = HLS-EU-Q47-HC, disease prevention = HLS-EU-Q47-DP, and health promotion = HLS-EU-Q47-HP). In this study, scores were recorded for the overall HLS-EU-Q47 and the subdomains HLS-EU-Q47-HC, HLS-EU-Q47-DP, and HLS-EU-Q47-HP. Responses were measured using a four-point Likert-type scale where 1 = very difficult, 2 = somewhat difficult, 3 = somewhat easy, and 4 = very easy. Overall scores ranged from 47 to 188, with a higher score indicating a higher degree of health literacy. Subjective sense of health was measured by participants' responses to the question "How do you rate your health status?" using a four-point Likert-type scale where 1 = very healthy, 2 = reasonably healthy, 3 = reasonably unhealthy, and 4 = very unhealthy. Participants who responded with either 1 or 2 were defined as healthy, while those who responded with either 3 or 4 were defined as unhealthy. Whether they were currently receiving treatment for any disease was determined by asking them whether they were currently undergoing treatment for each of the diseases listed in Health Statistics on the Number of Elderly Medical Care Beneficiaries in Japan, with responses recorded as either 'Yes' or 'No.'

#### Community factors

We assumed that community factors could be represented by the participants' sense of community, which was measured using the CCS [32]. This scale has a Cronbach's alpha of 0.75 among local volunteers, and consists of eight items, four in each of the subscales on socializing and belonging. Similar to HL, CCS scores were recorded for the overall CCS and the subscales on socializing and belonging. Responses were measured using a four-point Likert-type scale where 0 = not confident at all, 1 = slightly unconfident, 2 = slightly confident, and 3 = fully confident. A higher overall score (range 0–24) indicated a higher degree of community commitment.

## 2.4. Statistical Analysis

The high and low COCS-N score groups were analyzed separately. Then, based on previous studies that conducted stratified analysis, differences between the COCS-N scores and the independent variables were compared using t-tests and  $\chi^2$  tests [33]. Logistic regression analysis was performed in an attempt to identify the key determinants of COCS-N scores. In our single-factor logistic regression analysis, covariates were adjusted for age and sex. The results were considered statistically significant where  $p < 0.05$  or the 95% confidence interval (CI) did not include 1. IBM SPSS software version 28.0 (IBM Corp., Armonk, NY, USA) was used for the analysis.

## 2.5. Ethical Considerations

Participants were informed, both in writing and verbally, of the purpose and methods of the study, and that there would be no repercussions if they withdrew from or refused to participate in the study. They were informed that participation was voluntary and that completing and returning the questionnaire indicated their consent to participate in the study. This study was approved by the Ethical Review Board of Soka University (No. 2020-019).

## 3. Results

### 3.1. Dependent Variable

Table 1 shows the COCS-N scores. We set a cutoff of 16/17 for our analysis. Of the 3,120 participants, 1,468 (47.1%) were in the high score group and 1,652 (52.9%) were in the low score group. Both the mean and median COCS-N scores differed by seven points between the high and low groups. The mean  $\pm$  SD (range) of COCS-N scores was  $16.2 \pm 4.4$  (0–24) for all participants,  $19.9 \pm 2.2$  (17–24) for the high group, and  $12.8 \pm 2.8$  (0–16) for the low group (see Table 1).

**Table 1.** Univariate analysis of COCS-N scores.

	All (n=3,120)	High (n=1,468)	Low (n=1,652)
Mean (SD)	16.2(4.4)	19.9(2.2)	12.8(2.8)
Median	16.0	20.0	13.0
Mode	16	17	16
Range	0-24	17-24	0-16
Skewness	-0.205	-1.076	1.552
Kurtosis	-0.268	0.305	-1.154

### 3.2. Demographic Characteristics

Table 2 shows the demographic characteristics of the participants. The mean overall age was 67.0 years (SD = 9.0 years), while that of the high group was 68.7 years (SD = 8.4 years) and that of the low group was 65.4 years (SD = 9.3 years). The prevalence of females was the same for both the high and low groups (88.8%). The most common family structure among all participants was living with a spouse, which accounted for 37.9% of all participants, 36.2% of the high group, and 40.0% of the low group (Table 2).

**Table 2.** Demographic characteristics of participants by group.

	Total (n=3,120)		High (n=1,468)		Low (n=1,652)	
	n or mean	% or SD	n or mean	% or SD	n or mean	% or SD
Age	67.0	9.0	68.7	8.4	65.4	9.3
Sex						
Female	2771	88.8	1,304	88.8	1,467	88.8
Missing	11	0.4	3	0.2	8	0.5
Living arrangements						

Living alone	361	11.6	170	10.3	191	13.0
Living with spouse	1184	37.9	597	36.2	587	40.0
Living with children	623	20.0	363	22.0	260	17.7
Living with spouse and children	184	5.9	99	6.0	85	5.8
Living with children and grandchild	72	2.3	32	1.9	40	2.7
Other	694	22.2	389	23.6	305	20.8
Missing	2	0.1	0	0.0	2	0.1
Final Education						
Primary and secondary schools	180	5.8	92	6.3	88	5.4
High schools	1505	48.2	701	48.1	804	49.1
Junior college or vocational schools	984	31.5	468	32.1	516	31.5
Universitys	403	12.9	186	12.8	217	13.2
Graduate Schools	13	0.4	7	0.5	6	0.4
Other	10	0.3	3	0.2	7	0.4
Missing	25	0.8	11	0.7	14	0.8
Area of residence						
Hokkaido	38	1.2	15	1.0	23	1.4
Tohoku	465	14.9	200	13.7	265	16.1
Kanto	482	15.4	260	17.8	222	13.5
Tubu	802	25.7	315	21.5	487	29.6
Kansai	686	22.0	338	23.1	348	21.2
Chuugoku/Shikoku	240	7.7	109	7.4	131	8.0
Kyusyu/Okinawa	396	12.7	227	15.5	169	10.3
Missing	11	0.4	4	0.3	7	0.4
Years of residence	35.7	16.1	36.7	15.8	34.8	16.3

Under medical treatment was asked for multiple response.

### 3.3. Independent Variables

Table 3 lists the related factors in the univariate analysis (independent variables) of the COCS-N scores. The demographic characteristics that were related to significant differences in the COCS-N scores were age ( $p < 0.001$ ), family structure ( $p = 0.001$ ), and years of residence ( $p = 0.001$ ). Individual factors related to significant differences in the COCS-N scores were years working as a CHW ( $p < 0.001$ ), subjective sense of health ( $p = 0.005$ ), number of diseases under treatment ( $p = 0.008$ ), and overall HLS-EU-Q47 scores ( $p < 0.001$ ) and scores for the subdomains HLS-EU-Q47 HC ( $p < 0.001$ ), HLS-EU-Q47 DP ( $p < 0.001$ ), and HLS-EU-Q47 HP ( $p < 0.001$ ). Community factors related to significant differences in COCS-N scores were overall CCS scores ( $p < 0.001$ ) and scores for the subscales on socializing ( $p < 0.001$ ) and belonging ( $p < 0.001$ ). Thus, after considering multicollinearity, seven of the 13 factors were selected as independent variables and included in the final multivariate logistic regression analysis (see Table 3).

**Table 3.** Results of tests for differences between groups of factors related to COCS-N scores.

	All (n=3120)		High (n=1,468)		Low (n=1,652)		P-value
	n or mean	% or SD	n or mean	% or SD	n or mean	% or SD	
Demographic characteristics							
Age	67.0	9.0	68.7	8.4	65.4	9.3	<0.001
Sex							
Female	2771	88.8	1,304	88.8	1,467	88.8	0.842
Missing	11	0.4	3	0.2	8	0.5	

Family structure							
Living alone	361	11.6	170	10.3	191	13.0	
Living with spouse	1184	37.9	597	36.2	587	40.0	
Living with children	623	20.0	363	22.0	260	17.7	
Living with spouse and children	184	5.9	99	6.0	85	5.8	0.001
Living with children and grandchild	72	2.3	32	1.9	40	2.7	
Other	694	22.2	389	23.6	305	20.8	
Missing	2	0.1	0	0.0	2	0.1	
Final Education							
Primary and secondary schools	180	5.8	92	6.3	88	5.4	
High schools	1505	48.2	701	48.1	804	49.1	
Junior college or vocational schools	984	31.5	468	32.1	516	31.5	0.705
Universitys	403	12.9	186	12.8	217	13.2	
Graduate Schools	13	0.4	7	0.5	6	0.4	
Other	10	0.3	3	0.2	7	0.4	
Missing	25	0.8	11	0.7	14	0.8	
Years of residence	35.7	16.1	36.7	15.8	34.8	16.3	0.001
<b>Individual factors</b>							
Years of CHWs	8.2	7.7	10.3	8.8	6.3	6.1	<0.001
Subjective sense of wellbeing							
Good	2,381	76.3	1,154	78.6	1,227	74.3	0.005
Missing	111	3.6	55	3.5	56	3.2	
Disease under treatment	0.9	1.0	1.0	1.0	0.9	1.0	0.008
None	1994	63.9	954	65.6	1040	63.6	0.226
Missing			13	0.9	15	0.9	
HLS-EU-Q47 Total	30.5	7.5	32.9	7.6	28.4	6.8	<0.001
HLS-EU-Q47 HC	28.3	8.2	30.5	8.5	26.5	7.6	<0.001
HLS-EU-Q47 DP	34.3	8.3	36.5	8.3	32.4	7.8	<0.001
HLS-EU-Q47 HP	29.2	8.5	32.0	8.5	26.6	7.7	<0.001
<b>Community factors</b>							
CCS Total	16.4	3.9	17.7	3.7	15.3	3.7	<0.001
CCS Socializing	8.3	2.2	9.0	2.1	7.7	2.1	<0.001
CCS Belonging	8.1	2.3	8.7	2.2	7.6	2.2	<0.001

Subjective sense of wellbeing (Good/Poor). Years of residence & Years of CHWs (years). HLS-EU-Q47 Total (47.0-188.0). HLS-EU-Q47 HC (15.0-60.0). HLS-EU-Q47 DP (16.0-64.0). HLS-EU-Q47 HP (16.0-64.0). CCS Total (8.0-32.0). CCS Socializing (4.0-16.0). CCS Belonging (4.0-16.0).

#### Factors Related to COCS-N Scores

Table 4 shows the related factors following multiple logistic analysis of the COCS-N scores. Factors that were associated with COCS-N scores were age (odds ratio [OR]: 1.02, 95% CI: 1.01–1.03), years of residence (OR: 0.99, 95% CI: 0.98–0.99), years working as a CHW (OR: 1.06, 95% CI: 1.05–1.07), overall HLS-EU-Q47 scores (OR: 1.02, 95% CI: 1.02–1.03), and overall CCS scores (OR: 1.14, 95% CI: 1.11–1.16, see Table 4).

**Table 4.** Logistic analysis of factors related to COCS-N scores.



	$\beta$	P-value	OR	(95% CI)	
Age	0.02	***	1.02	1.01	1.04
Years of residence	-0.01	*	0.99	0.99	1.00
Years of CHWs	0.06	***	1.06	1.05	1.07
Family structure	-0.01	n.s	0.99	0.95	1.04
Health Status (Disease under treatment)	0.00	n.s	1.00	0.92	1.10
HLS-EU-Q47 Total	0.02	***	1.02	1.02	1.03
CCS Total	0.13	***	1.20	1.11	1.16

Years of residence & Years of CHWs, years.

Family structure were asked about the number of people living together.

in the same household (multiple answers).

Health Status (Disease under treatment), number.

HLS-EU-Q47 Total: European Health Literacy Survey Questionnaire Japanese version.

CCS Total: Community Commitment Scale.

n.s. Not significant.

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

#### 4. Discussion

The aim of this study was to compare high and low COCS-N score groups and to examine the associated factors to identify implications for the recruitment, training, and professional development of CHWs. To our knowledge, this is the first study to examine competencies and related factors among CHWs in Japan. The clinical and policy implications of this study are related to strategies aimed at improving the competencies of CHWs, who act as a bridge between community residents and health-care professionals, by examining relevant factors to ensure effective and equitable delivery of health care to the local population. A total of 11.1% of Japanese municipalities participated in this study, with a valid response rate of 48.1%. The valid response rate for surveys of CHWs in Japan is generally in the vicinity of 80% [34,35], and thus the response rate for this study was relatively low. In national surveys in difficult environments, it is around 50% [36,37]. However, the national surveys in prior studies [36,37] were collected by surveyors through contact. In contrast, this study is a non-contact survey, and the collection rate is based on a situation in which no reminder was given. Considering this, the high collection rate for this study, conducted as a national survey, indicates the high level of interest among the study participants. The mean age of the study participants was 67.0 years (SD = 9.0 years) for all participants, 68.7 years (SD = 8.4 years) for the high COCS-N score group and 65.4 years (SD = 9.3 years) for the low COCS-N score group, while the prevalence of females was 88.8% in both the high and low COCS-N score groups. This value shows a trend identical to the characteristics of CHWs in Japan [38]. Therefore, it was inferred that the participants in this study were representative of CHWs in Japan.

The mean COCS-N score was 16.2 for all participants, 19.9 for the high score group, and 12.8 for the low score group. The COCS-N is designed to take into account various aspects of CHWs' health-care and community activities, which are likely to be related to differences in the CHWs' competencies. The relevant factors in this study include both individual- and community-related factors, with individual factors considered to be related to CHWs' health-care activities. The individual factor that was found to be significantly associated with COCS-N scores was HL. Risky behavioral choices, poor health status, and increased health-care costs are common consequences of low HL[39], which is important not only for patients in clinical settings, but also for people trying to improve their own and others' health using health-care services and making appropriate health-related decisions. We found that Japanese CHWs were more likely to be involved in health promotion activities. The results of this study showed that the mean overall HL of Japanese CHWs was 30.5 (SD = 7.5), which corresponded to the category "somewhat inadequate." All three HL subdomains were also classified as "somewhat inadequate", with scores of 28.3 (SD = 8.2) for health-care HL, 34.3 (SD = 8.3) for disease prevention HL, and 29.2 (SD = 8.5) for health promotion HL [40]. The high score

group achieved scores of 32.9 (SD = 7.6), 30.5 (SD = 8.5), 36.5 (SD = 8.3), and 32.0 (SD = 8.5), respectively, while the low score group achieved scores of 28.4 (SD = 6.8), 26.5 (SD = 7.6), 32.4 (SD = 7.8), and 26.6 (SD = 7.7), respectively. In a previous study examining the HL of the Japanese population, the overall HL score of older urban residents, based on the standardized index of the HLS-EU-Q47, was 27.5 (SD = 8.8), while the subdomain scores were 26.0 (SD = 9.7) for health-care HL, 31.2 (SD = 9.8) for disease prevention HL, and 25.6 (SD = 10.2) for health promotion HL [41]. In addition, the overall HL score for the general Japanese population was 25.3 (SD = 8.2), while the scores for the subdomains were 25.7 (SD = 8.6) for health-care HL, 22.7 (SD = 9.2) for disease prevention HL, and 25.5 (SD = 9.2) for health promotion HL [31]. The same study also compared HL scores in Japan with those in Europe, which were 33.8 (SD = 8.0) for overall HL, 34.7 (SD = 8.3) for health-care HL, 34.2 (SD = 8.8) for disease prevention HL, and 32.5 (SD = 9.1) for health promotion HL. Thus, based on these studies, the HL of Japanese CHWs was higher than that of both older urban Japanese people and the general population, while their disease prevention HL was significantly higher than that of the general population. In addition, a comparison of the high and low COCS-N score groups showed that there were differences of more than four points in all four domains. It can be inferred that CHWs have higher health-care competencies in terms of HL than the general population because of their role as a bridge between the general population and health-care professionals, which in turn increases their COCS-N scores. Therefore, it was suggested that the first strategy for increasing the COCS-N scores of CHWs should be to address individual factors such as HL.

In this study, the community-related factor for CHWs was considered to be community awareness, which was measured by CCS scores. The results showed that the CHWs' average overall CCS scores were 16.4 (SD = 3.9), with the high COCS-N score group averaging 17.7 (SD = 3.7) and the low COCS-N score group averaging 15.3 (SD = 3.7). Previous studies found average CCS scores of 14.5 (SD = 4.1) for the general urban older population [42], 13.0 (SD = 4.3) for mothers raising children [43], and 17.2 (SD = 3.7) for older people participating in community activities in urban areas [33]. Thus, the overall scores we obtained were higher than those of mothers raising children and older people in general, but lower than those of older people participating in community activities in urban areas. Furthermore, the high COCS-N score group achieved similar scores to older people participating in community activities in urban areas. Thus, it can be inferred that CHWs have a higher sense of community than the general population because they work within their communities, which in turn increases their COCS-N score. Therefore, the second strategy for increasing the COCS-N scores of CHWs is to increase CHW-related local factors such as community awareness, suggesting that it is necessary to foster the sense of belonging and neighborhood that the CCS reflects.

#### 4.1. Limitations

This study has several limitations. First, the cross-sectional design meant that it was not possible to determine causal relationships between COCS-N scores and individual- and community-related factors. Therefore, longitudinal and interventional studies are necessary to enable us to observe how CHWs' activities and self-learning affect their competencies, and to examine how these change over time. Second, this study only included 11.1% of all municipalities in Japan, which might have biased the results. It is hoped that future studies will include municipalities where CHWs are active but did not participate in this study, making the results more representative. Third, community-related factors were measured only in terms of CHWs' degree of local awareness. However, community-related factors that enhance CHWs' competence in preventing NCDs are likely to be influenced by the physical resources available for local health care and the level of support provided by health-care professionals. Thus, further observation and verification of those community factors that enhance competence in NCD prevention is also necessary.

## 5. Conclusions

We examined the relationship between COCS-N scores and individual- and community-related factors affecting CHWs. We found that COCS-N scores were positively associated with the individual-related factors overall HL, the subdomain health prevention HL, and subjective sense of

health, and with the community-related factor CCS scores. These results suggest that strengthening individual-related factors such as HL and subjective sense of health, and community-related factors such as community awareness is an effective strategy for increasing competence in NCD prevention among CHWs.

## Abbreviations

CCS: Community commitment scale; CHW: Community health worker; COCS-N: Community Health Workers Perceptual and Behavioral Competency Scale for Preventing Non-Communicable Diseases; HLS-EU-Q47: European Health Literacy Survey Questionnaire; NCD: Non-communicable disease

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**Data Availability Statement:** The datasets generated and analyzed during this study are not publicly available because the Ethical Guidelines for Epidemiological Research by the Japanese Government and the National Basic Resident Registration System administered by the Ministry of Internal Affairs and Communications in Japan prohibit researchers from providing their research data to third-party individuals. However, they are available from the corresponding author upon reasonable request.

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