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# Development of the Essential Individual Care Needs Assessment Tool for Public Health Nurses

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**Received:** 2 September 2024 | **Revised:** 22 January 2025 | **Accepted:** 12 February 2025

**Funding:** This work was supported by Ministry of Health, Labour and Welfare Research on Health Security Control Program Grant Number JPMH22LA1004 (to K.Y.M.). The funding agency is not directly involved with the research.

**Keywords:** case management | information technology | needs assessment | public health nursing | real-world data

## ABSTRACT

**Objective:** This study aimed to develop essential individual care needs assessment (EICNA) items and evaluate the validity of that judgment.

**Design:** We used a sequential two-phase design for this study.

**Methods:** Item selection was conducted using $\varphi$ coefficients between these items' values and the care need levels and discussions with supervisory PHNs. Phase 1 was a cross-sectional, nationwide survey of 275 mid-level public health nurses (PHNs) from 196 municipalities in Japan (December 2022 to January 2023), including 46 potential EICNA items. In Phase 2, PHNs piloted the EICNA items in clinical settings, entering data into a web-based system that used an algorithm to determine care need levels based on the weighted sum of 21 items (August 2023 to January 2024). Thereafter, the PHNs evaluated the appropriateness of the algorithm's judgments.

**Results:** Twenty-one essential items were identified. Among 1867 cases, care need levels were categorized as low ($n = 1008$, 54.0%), moderate ($n = 652$, 34.9%), and high ($n = 207$, 11.1%), with 94.9% of PHNs considered the algorithm's classifications appropriate.

**Conclusion:** Twenty-one EICNA items were identified to assess the care needs, and the level of care needs determined by the weighted sum of these items was deemed appropriate by PHNs.

**Trial Registration**: UMIN000051509 (https://www.umin.ac.jp/ctr/; August 1, 2023).

## 1 | Background

Assessing care needs is fundamental for developing effective public health services (U. S. Centers for Disease Control and Prevention 2020). Public health nurses (PHNs) play a central role as public health service providers in the community (Canales and Drevdahl, 2022), combining individual care, community-based activities, and policy development (Harmon et al. 2020). The

PHNs integrate multiple resources and data to assess individual care needs within their community, and consider primary, secondary, and tertiary prevention levels, addressing individuals' health, healthcare systems, and socioeconomic contexts (Harmon et al. 2020). Acting as community safety nets, PHNs offer critical support to individuals regardless of their health status or age, helping prevent health deterioration (Wu et al. 2023).

Prior studies found that standardized terminology or taxonomy helps to accurately identify care need levels within a society (Herdman et al. 2024; Moorhead et al. 2023). The International Classification of Functioning, Disability, and Health and the Omaha System are widely used in community settings (Martin and Scheet 1992; Park et al. 2022). Previous studies have focused on assessing unmet care needs across various life stages, diseases, and disabilities, including physical, psychological, and social domains (Jones et al. 2023; Kinchin et al. 2022; Miller et al. 2022). In Japan, under the long-term care insurance system launched in 2000, PHNs can identify the care need levels of older adults using 74 assessment items (Japanese Nursing Association 2023). However, the existing tools have several problems. First, PHNs are responsible for individuals outside the scope of health and long-term care insurances, leaving many unmet needs unaddressed. Second, the focus of the existing tools is the target population of specific life stages and/or domains, whereas PHN's target population spans all life stages and domains. Given the demanding clinical responsibilities, a minimum set of assessment items is necessary to efficiently determine individual care needs in the public sector.

Digital nursing records have transformed patient care in hospitals, helping to visualize nursing assessments to evaluate and improve patient outcomes and care quality (Hants et al. 2023; World Health Organization 2021); however, adaptation in public health is lagging (Yoshioka-Maeda et al. 2023). Japan has increased PHN staffing amid rising demands due to the recent COVID-19 pandemic (Taira et al. 2022); however, many novice PHNs lack practical training and have limited opportunities to provide individual care due to the COVID-19 pandemic and need to improve their assessment skills. Additionally, owing to the successive retirements of expert PHNs, human resource development issues arise because of the difficulty in transferring their tacit knowledge of individualized care needs assessment developed over many years of experience to novices. Thus, there is an urgent need to transfer PHNs' tacit knowledge of individual care assessment to novices. Digital tools could facilitate this transfer, enabling new PHNs to quickly assess care needs at a comparable level to their seniors. The newly appointed PHNs require assessment skills and knowledge similar to those of their seniors. However, no existing studies have focused on this perspective. Therefore, the current study aimed to develop and validate essential individual care needs assessment (EICNA) items for PHNs using a web-based nursing record system in the public health sector. Phase 1 involved a nationwide survey to identify EICNA items and calculate the EICNA total score. Phase 2 validated this algorithm using the EICNA total score in real-world practice through pilot implementation.

## 2 | Methods

### 2.1 | Design

We used the sequential two-phase design for this study. Phase 1 was a cross-sectional web-based nationwide survey to select the EICNA items and calculate the EICNA total score in Japan from December 2022 to January 2023. In Phase 2, EICNA items were utilized and validated in a clinical setting of a local government. The PHNs used the EICNA items with a web-based nursing record system using the Kintone application (Cybozu, Inc., Japan) on iPads from August 2023 to January 2024.

### 2.2 | Phase 1: Identifying EICNA Items and Algorithm Development to Determine Individual Care Need Levels

#### 2.2.1 | Sampling of Phase 1

The study sample comprised mid-level PHNs in Japan. Inclusion criteria required that PHNs (1) had 6 to 20 years of experience and (2) worked as full-time staff with the local government. Exclusion criteria were applied to (1) PHNs who are not at work due to maternity or parental leave, (2) PHNs in departments that do not handle individual care, and (3) individuals unable to access the study website. The required sample size was set at 400, calculated using the formula ($n = (k/E) * 2 \times P \times (100 - P)$, where $k$ was the confidence coefficient (1.96 for 95% confidence), $E$ was the margin of sampling error (5%), and $P$ was the assumed response rate (50%). This sample size was also considered reasonable for statistical estimation.

For participant recruitment, we mailed the survey URL and QR codes to 1776 supervisory PHNs, representing all local governments in Japan, excluding five local governments that participated in a protocol study for this survey (Yoshioka-Maeda et al. 2023) and those with no assigned PHNs. The supervisory PHNs then forwarded the survey to eligible mid-level PHNs.

#### 2.2.2 | Measurements of Phase 1 Survey

The scores for the potential EICNA items were obtained for high/low care needs cases. Based on the participants' clinical experiences, we asked them to select and provide information on one case each for high and low care needs from the past month. The cases that the participants reported as high care need cases were classified as high care need group (coded as 1), and the cases that they reported as low need cases were classified as low care need group (coded as 0).

They rated 46 potential assessment items (yes/no/unknown) for these cases and the case was coded 1 if it was marked as "yes" on the assessment item and 0 if it was not. The participants were also asked about their demographic information, including sex, years of public health nursing experience, educational background, department, and designation.

#### 2.2.3 | Analysis

**2.2.3.1 | EICNA Item Selection.** We calculated the $\varphi$ coefficient to quantify the strength of the relationship between the care need group and the rating of each of the 46 assessment items. First, following the previous study, those greater than 0.3 were included in the preliminary EICNA items (Cohen 1992). To improve the clarity of the items, the researchers (K.Y.M., M.S., H.M., C.H., and K.T.) merged similar items through research meetings. To confirm the clinical meaning of selected items, we discussed the results of item selection with all researchers and three supervisory PHNs. We finalized the total number of EICNA items after a discussion.

**2.2.3.2 | Calculating the EICNA Total Score and Developing the Algorithm.** The EICNA total score was calculated by summing items marked as "yes" (1 point) and assigning 0 points to those marked "no" or "unknown," weighted by the $\varphi$ coefficient. Missing values were replaced with mean substitution. For the algorithm to determine the care need levels, tertile cutoff points were used to divide the scores into three groups: low, moderate, and high.

### 2.3 | Phase 2: A Pilot Implementation Study Using Real-World Data

#### 2.3.1 | Development of the Data Collection System

We developed the web-based electrical PHN activities record system using the Kintone application (Cybozu, Inc., Japan), which has two main functions—one is registering the demographics of PHNs and the other is entering the characteristics and assessments of individual cases. The data obtained from these functions is designed to be combined by linking it with the PHN ID. Kintone is a no-code application builder provided by Cybozu, Inc. that can be used to develop business applications that function in the cloud.

The system included user guidelines and tooltips to ensure the understanding of each assessment item. It also automatically copied prior records using case IDs and notified users of upcoming support dates. Before starting this study, all supervisory bodies confirmed the system that could be used in their staff's daily practice.

#### 2.3.2 | Sampling for Phase 2 Survey

The inclusion criteria for Phase 2 were that the PHNs should be working with the local government to participate in this study. Interestingly, the participants were able to use iPads for data entry. Those who were unable to input data on iPads due to technical problems were excluded. Both, full-time and part-time PHNs expressed willingness to participate in the study. To accurately assess the PHNs' actual ability to evaluate the care needs for cases, we collected data on their national career ladder levels, which range from A1 (novice) to A5 (expert) as defined by the Ministry of Health, Labour, and Welfare (2016).

The participants were recruited using snowball sampling (K.Y.M., M.S., and N.H.). In Japan, supervisory PHNs act as contact persons within each local government. We initially contacted three supervisory PHNs and explained the study's aims and procedures. Given that PHNs are public employees, departmental approval, in addition to individual consent, was required for participation. The supervisory PHNs who provided research cooperation helped us select and coordinate the departments that were providing care for individual cases. The PHNs willing to participate in this study attended an orientation session on data entry procedures and were provided with iPads for the study.

**2.3.2.1 | Measurements for Phase 2 Survey.** The participants provided their demographic information, including sex, age, years of experience in public health nursing, national career ladder level, educational background, department, and designation.

Through a web-based electrical PHN activities record system, the PHNs entered all activities on individual support cases, excluding cases that lasted less than 10 min. The criterion of 10 min or less was decided in consultation with the supervisory PHNs because recording minor inquiries and telephone responses would increase the burden of participating in the research, despite the fact that there are few cases that require individual support. For each support case, PHNs recorded demographic details (such as sex, age, and subject categories), completed assessments using EICNA items, appropriateness evaluation of the level of care needs automatically determined by an algorithm based on EICNA items and subjective level of care needs as rated by PHNs on a 10-point Likert scale. After the PHNs completed the EICNA assessments, the system automatically calculated EICNA total scores and judged care need levels (low, moderate, or high) based on the algorithm developed in Phase 1. Appropriateness evaluation of the level of care needs automatically determined by an algorithm based on EICNA items was classified into three categories: "appropriate," "too high," or "too low."

#### 2.3.3 | Analysis Strategy

In cases where there were multiple records for the same case, the initial assessment for each case was used for analysis to maintain consistency. To validate the algorithm's effectiveness, we compared the total $\varphi$ coefficient scores for the 21 EICNA items with the subjective care need levels assessed by PHNs, examining the degree of agreement between the algorithm-based levels and their judgments.

For sub-group analysis, descriptive statistics were used to analyze the distribution of the PHNs' subjective assessments across each case category, as determined by the algorithm. We created a stacked bar chart to examine the relationship between their subjective care need levels and algorithm-determined care needs. The y-axis was transformed to a logarithmic scale to better visualize differences in case counts across the subjective care need levels, especially for categories with smaller counts. This approach aimed to highlight trends in the distribution of algorithm-determined care needs across varying subjective levels.

### 2.4 | Ethical Considerations

This study adhered to the principles of the Declaration of Helsinki and was approved by the primary investigator (Phase 1:

**TABLE 1** | Demographics of the participants.

| | | Study 1 ($n = 275$) | | Study 2 ($n = 57$) | |
|---|---|---|---|---|---|
| | | Mean (SD)/$n$ (%) | | Mean (SD)/$n$ (%) | |
| Sex | Male | 25 | (9.1) | 0 | (0.0) |
| | Female | 248 | (90.2) | 54 | (94.7) |
| Years of public health nursing experience | Mean (SD) | 12.5 | (6.0) | 12.6 | (11.8) |
| The national career ladder for PHN | A1 (novice) | — | — | 13 | (22.8) |
| | A2 | — | — | 17 | (29.8) |
| | A3 (middle-level) | — | — | 13 | (22.8) |
| | A4 | — | — | 10 | (17.5) |
| | A5 (expert) | — | — | 1 | (1.8) |
| Education background | Vocational training school | 58 | (21.1) | 18 | (31.6) |
| | Junior college | 22 | (8.0) | 1 | (1.8) |
| | University | 189 | (68.7) | 34 | (59.6) |
| | Graduate school | 5 | (1.8) | 0 | (0.0) |
| | Other | 0 | (0.0) | 1 | (1.8) |
| | Unknown | 1 | (0.4) | 3 | (5.3) |
| Department | Health promotion | 164 | (59.6) | 32 | (56.1) |
| | Health and Welfare | 66 | (24.0) | 20 | (35.1) |
| | Welfare | 8 | (2.9) | 1 | (1.8) |
| | Other | 37 | (13.4) | 4 | (7.0) |
| Designation | Staff | 178 | (64.7) | 40 | (70.2) |
| | Unit chief | 68 | (24.7) | 13 | (22.8) |
| | Assistant section chief | 10 | (3.6) | 1 | (1.8) |
| | Section chief | 1 | (0.4) | 0 | (0.0) |

*Note:* In Phase 2, 59 PHNs participated in the study and 57 entered daily report data.
Abbreviations: PHN, public health nurse; SD, standard deviation.

2022114NI-(2), Phase 2:2023056NI). Informed consent was obtained from all participants, and the study was registered in the UMIN Clinical Trials Registry.

## 3 | Results

### 3.1 | Phase 1

#### 3.1.1 | Participants' Demographics

A total of 275 mid-level PHNs from 196 municipalities participated in the nationwide survey, resulting in a response rate of 11.0%. The demographics of the participants are summarized in Table 1. Among the participants, 248 (90.2%) were female. The age distribution was as follows: 20 participants (7.3%) were in their 20s; 133 (48.4%) in their 30s, 97 (35.3%) in their 40s, and 24 (8.7%) were 50 years or older. The mean experience as a PHN was 12.5 years (SD = 6.0).

Table 2 shows the demographics of individual cases supported by PHNs. Most cases handled by these PHNs were related to mental health ($n = 100$, 22.2%) and maternal and child health ($n = 88$, 19.6%).

#### 3.1.2 | Finalized EICNA Items and Algorithm to Determine the Care Need Levels of Individual Case

Table 3 shows the $\varphi$ coefficients for the 46 preliminary assessment items used to determine individual care need levels. The researchers refined this list by merging items with overlapping meanings, combining "unstable symptoms" with "sudden deterioration of illness" and "inability to accept the situation" with "problem recognition and problem coping skills." The item, "need for urgent medical treatment," was excluded from the list, as it represents an outcome that can be identified directly through a PHN's assessment, rather than a predictor of care need level.

To ensure that the selected items had clinical relevance, the researchers reviewed the list with all team members and three supervisory PHNs. These supervisory PHNs recommended adding four items with important clinical implications, even though their $\varphi$ coefficients were low, as these factors have a

**TABLE 2** | Demographics of individual cases supported by PHNs.

| | Study 1 ($n = 450$) | | Study 2 ($n = 1867$) | |
|---|---|---|---|---|
| | $n$ (%) | | $n$ (%) | |
| Sex | | | | |
| Male | 202 | (44.9) | 926 | (49.6) |
| Female | 210 | (46.7) | 898 | (48.1) |
| Missing | 38 | (8.4) | 5 | (0.3) |
| Age (in years) | | | | |
| Under 6 | 83 | (18.4) | 687 | (36.8) |
| Under 20 | 26 | (5.8) | 0 | (0.0) |
| 20s | 26 | (5.8) | 175 | (9.4) |
| 30s | 39 | (8.7) | 240 | (12.9) |
| 40s | 50 | (11.1) | 149 | (8.0) |
| 50s | 47 | (10.4) | 230 | (12.3) |
| 60s | 43 | (9.6) | 144 | (7.7) |
| 70s or more | 116 | (25.8) | 148 | (7.9) |
| Missing | 20 | (4.4) | 94 | (5.0) |
| Category of subject | | | | |
| Mental health | 100 | (22.2) | 613 | (32.8) |
| Maternal and child health | 88 | (19.6) | 834 | (44.7) |
| Health promotion | 70 | (15.6) | 126 | (6.7) |
| Aging and long-term care | 64 | (14.2) | 21 | (1.1) |
| Intractable disease | 48 | (10.7) | 17 | (0.9) |
| Infectious disease | 40 | (8.9) | 167 | (8.9) |
| Disability | 16 | (3.6) | 58 | (3.1) |
| Occupational health | 16 | (3.6) | 0 | (0.0) |
| Child welfare | 8 | (1.8) | 24 | (1.3) |
| Other | 0 | (0.0) | 7 | (0.4) |

Abbreviations: PHN, public health nurse; SD, standard deviation.

significant impact on the care need levels for individual cases. The added items were: "Abuse," "Mental health problems such as depressive tendencies," "Neighborhood problems/concerns," and "Use of some kind of services or programs." Notably, the fourth item was included to indicate a lower care need level (as it suggests a desirable condition), thus enhancing the algorithm's ability to discriminate between different care need levels. Thus, the final EICNA comprised 21 items.

We developed an algorithm to determine the care need levels for individual cases by calculating a total score based on the $\varphi$ coefficients for these 21 items. Each item contributes to the total score based on its $\varphi$ coefficient, where items marked as "yes" (assigned a score of 1) add their respective weight to the total, while items marked as "no" or "unknown" (assigned a score of 0) do not contribute. Using the nationwide survey data, we calculated the mean care need score for all cases as 2.23 (median = 1.69). The care need levels were categorized into three groups using tertile cutoffs: the first tertile was 0.62 (indicating low care need), the second tertile was 2.55 (indicating moderate care need), and scores above this threshold were categorized as high care need.

## 3.2 | Phase 2

### 3.2.1 | Participants' Demographics

Among 187 eligible PHNs, 59 participated in the study (participation rate: 31.6%), and 57 entered data for their support cases (Table 1). Across the three participating municipalities, the average total number of PHNs per municipality was 61.3 (SD = 28.0), with an average of 19.0 participants per municipality (SD = 20.6). All participants were female, and approximately 20% were classified as novice to mid-level in their career stage. Most participants were staff members in the Department of Health Promotion.

Table 2 shows the demographics of individual cases supported by PHNs. The most common types of cases handled were related to maternal and child health ($n = 834$, 44.7%) and mental health ($n = 613$, 32.8%).

### 3.2.2 | Comparison of Algorithm-Determined Care Need Levels With PHNs' Subjective Assessments

A total of 1867 cases were assessed (Table 4). Based on the algorithm, the distribution of care need levels was as follows: 1008 cases (54.0%) were classified as low need, 652 (34.9%) as moderate need, and 207 (11.1%) as high need. The majority of cases classified as high need were maternal and child health and mental health.

To examine the validity of the algorithm-determined care need levels, the PHNs evaluated each level using a three-point scale to indicate whether they found the algorithm's classification "appropriate," "too high," or "too low." The results showed that the PHNs considered the algorithm's classification appropriate for 1772 cases (94.9%), while they judged it "too high" for 27 cases (1.4%), and "too low" for 68 cases (3.6%).

The stacked bar chart demonstrates that as the subjective care need level assessed by PHNs increases, the proportion of cases categorized as "medium" and "high" care needs by the algorithm also rises. The logarithmic scale on the y-axis highlights the exponential increase in case counts as subjective care need levels rise (Figure 1).

## 4 | Discussion

This study aimed to develop and validate an algorithm for assessing care needs levels using the EICNA items through a nationwide survey. The algorithm was tested in real-world practice by PHNs, primarily focusing on cases of mental health and maternal and child health. Our results showed that cases with high-level care needs often involved mental health issues.

**TABLE 3** | $\varphi$ coefficients for 46 preliminary assessment items to determine care need levels for individual cases.

| | Total | Care need level of PHN's subjective assessment | | | | $\varphi$ coefficient (= weight) | $\varphi > 0.3$ | Included in the list |
|---|---|---|---|---|---|---|---|---|
| | | Low | | High | | | | |
| | *n* | *n* | (%) | *n* | (%) | | | |
| Bio | | | | | | | | |
| Insufficient medical care | 333 | 28 | (16.6%) | 95 | (57.9%) | 0.428 | x | x |
| Sudden deterioration of disease | 302 | 33 | (21.4%) | 88 | (59.5%) | 0.388 | x | x |
| Unstable symptoms | 326 | 52 | (31.7%) | 113 | (69.8%) | 0.380 | x | |
| Poor daily care and/or lifestyle habits | 318 | 32 | (19.9%) | 88 | (56.1%) | 0.373 | x | x |
| Need for urgent medical treatment | 332 | 8 | (4.7%) | 54 | (33.1%) | 0.364 | x | |
| Dependent ADL | 332 | 36 | (21.4%) | 58 | (35.4%) | 0.155 | | |
| Home medical care | 264 | 30 | (21.9%) | 41 | (32.3%) | 0.117 | | |
| Underlying health conditions | 300 | 91 | (58.7%) | 97 | (66.9%) | 0.085 | | |
| Psycho | | | | | | | | |
| Inability to accept the situation | 319 | 42 | (25.6%) | 100 | (64.5%) | 0.391 | x | |
| Refusal attitude and/or refusal to intervention | 330 | 38 | (23.2%) | 98 | (59.0%) | 0.364 | x | x |
| Impairment in problem recognition and problem coping skills | 329 | 70 | (41.4%) | 116 | (72.5%) | 0.313 | x | x |
| Communication difficulties | 331 | 23 | (13.7%) | 67 | (41.1%) | 0.308 | x | x |
| Inappropriate interpersonal relationship building | 322 | 62 | (37.3%) | 89 | (57.1%) | 0.197 | | |
| Risk of self-inflicted injury | 322 | 16 | (9.7%) | 37 | (23.6%) | 0.187 | | |
| Mental health problems including depressive symptoms | 225 | 34 | (28.6%) | 46 | (43.4%) | 0.155 | | x |
| Intense anxiety | 313 | 67 | (41.1%) | 82 | (54.7%) | 0.136 | | |
| Foreign nationality | 336 | 6 | (3.6%) | 10 | (6.0%) | 0.056 | | |
| Social | | | | | | | | |
| Difficulty in coordinating support and treatment | 322 | 20 | (12.0%) | 93 | (59.6%) | 0.498 | x | x |
| Support immediately after hospital discharge | 112 | 5 | (8.8%) | 23 | (41.8%) | 0.382 | x | x |
| Economic deprivation (inadequate income) | 399 | 36 | (17.6%) | 103 | (53.1%) | 0.373 | x | x |
| Required cooperation with police, fire department, etc. | 330 | 15 | (8.9%) | 63 | (39.1%) | 0.356 | x | x |
| Inadequate therapeutic environment | 417 | 18 | (8.5%) | 73 | (35.6%) | 0.328 | x | x |
| Absence of confidants | 323 | 42 | (25.3%) | 85 | (54.1%) | 0.295 | | |
| Violent language and assault | 327 | 11 | (6.5%) | 45 | (28.3%) | 0.289 | | |
| Risk of harm to others | 320 | 11 | (6.6%) | 40 | (26.0%) | 0.264 | | |
| Abuse | 324 | 10 | (6.0%) | 38 | (24.1%) | 0.254 | | x |
| Need for urgent sheltering | 328 | 6 | (3.6%) | 27 | (17.0%) | 0.223 | | |
| Violation of rights | 316 | 8 | (4.8%) | 28 | (18.8%) | 0.220 | | |
| No/poor social resources available | 419 | 31 | (14.6%) | 67 | (32.5%) | 0.212 | | |
| Neighborhood problems/concerns | 403 | 23 | (11.0%) | 53 | (27.5%) | 0.211 | | x |
| Repeated relocation | 331 | 6 | (3.6%) | 17 | (10.3%) | 0.132 | | |
| Receiving welfare benefits | 335 | 25 | (14.8%) | 31 | (18.7%) | 0.052 | | |
| Neighborhood security and safety issues | 370 | 11 | (6.7%) | 16 | (7.8%) | 0.022 | | |
| Uses some kind of service or program | 429 | 17 | (7.9%) | 1 | (0.5%) | −0.185 | | x |
| Ability to solve problems | 407 | 66 | (31.7%) | 31 | (15.6%) | −0.190 | | |

(Continues)

**TABLE 3** | (Continued)

| | Total | Care need level of PHN's subjective assessment | | | | φ coefficient (= weight) | φ > 0.3 | Included in the list |
|---|---|---|---|---|---|---|---|---|
| | | Low | | High | | | | |
| | *n* | *n* | (%) | *n* | (%) | | | |
| Family | | | | | | | | |
| Family relationship problems | 294 | 37 | (24.2%) | 85 | (60.3%) | 0.366 | x | x |
| Family members' impairment in problem recognition and problem coping skills | 296 | 24 | (16.0%) | 72 | (49.3%) | 0.356 | x | x |
| Absence of confidant for family members | 286 | 17 | (11.6%) | 57 | (40.7%) | 0.332 | x | x |
| Multi-problem households (complex and multiple problem cases) | 302 | 16 | (10.4%) | 54 | (36.5%) | 0.309 | x | x |
| Absence of key persons | 326 | 43 | (26.1%) | 89 | (55.3%) | 0.298 | | |
| Domestic violence | 300 | 12 | (7.8%) | 41 | (28.1%) | 0.266 | | |
| Refusal attitude and/or refusal to intervention of family members | 303 | 16 | (10.5%) | 47 | (31.3%) | 0.257 | | |
| Mental health problems including depressive symptoms of family members | 282 | 21 | (14.4%) | 44 | (32.4%) | 0.213 | | |
| Poor health of family members | 292 | 30 | (20.1%) | 54 | (37.8%) | 0.195 | | |
| Sustained | | | | | | | | |
| Sustained support for high-risk cases | 369 | 22 | (13.0%) | 128 | (64.0%) | 0.517 | x | x |
| Contact from related agencies | 430 | 37 | (17.3%) | 120 | (55.6%) | 0.397 | x | x |

*Notes:* Percentages indicate the proportion of cases in which the item was checked. Algorithm for determining the care need level: (1) add up the φ coefficients (= weights) of the items included in the list that were responded as "yes"; (2) determine the care need level as "Low" if the sum is less than 0.62, "Medium" if the sum is between 0.62 and 2.55, and "High" if the sum is greater than 2.55.
Abbreviation: PHN, public health nurse.

**TABLE 4** | Comparison of algorithm-determined care need levels with PHNs' subjective assessments.

| | The algorithm-calculated care needs level | | | PHN's subjective care need levels | | | |
|---|---|---|---|---|---|---|---|
| | Low | Moderate | High | Appropriate | Too low | Too high | Total |
| Mental health | 227 | 264 | 122 | 582 | 15 | 16 | 613 |
| | (37.0) | (43.1) | (19.9) | (94.9) | (2.4) | (2.6) | (100.0) |
| Maternal and child health | 495 | 279 | 60 | 780 | 46 | 8 | 834 |
| | (59.4) | (33.5) | (7.2) | (93.5) | (5.5) | (1.0) | (100.0) |
| Health promotion | 97 | 26 | 3 | 123 | 2 | 1 | 126 |
| | (77.0) | (20.6) | (2.4) | (97.6) | (1.6) | (0.8) | (100.0) |
| Aging and long-term care | 11 | 7 | 3 | 20 | 0 | 1 | 21 |
| | (52.4) | (33.3) | (14.3) | (95.2) | (0.0) | (4.8) | (100.0) |
| Intractable disease | 11 | 4 | 2 | 15 | 2 | 0 | 17 |
| | (64.7) | (23.5) | (11.8) | (88.2) | (11.8) | (0.0) | (100.0) |
| Infectious disease | 134 | 30 | 3 | 167 | 0 | 0 | 167 |
| | (80.2) | (18.0) | (1.8) | (100.0) | (0.0) | (0.0) | (100.0) |
| Disability | 18 | 31 | 9 | 54 | 3 | 1 | 58 |
| | (31.0) | (53.4) | (15.5) | (93.1) | (5.2) | (1.7) | (100.0) |

(Continues)

**TABLE 4** | (Continued)

| | The algorithm-calculated care needs level | | | PHN's subjective care need levels | | | |
|---|---|---|---|---|---|---|---|
| | **Low** | **Moderate** | **High** | **Appropriate** | **Too low** | **Too high** | **Total** |
| Child welfare | 13 | 9 | 2 | 24 | 0 | 0 | 24 |
| | (54.2) | (37.5) | (8.3) | (100.0) | (0.0) | (0.0) | (100.0) |
| Other | 2 | 2 | 3 | 7 | 0 | 0 | 7 |
| | (28.6) | (28.6) | (42.9) | (100.0) | (0.0) | (0.0) | (100.0) |
| Total | 1008 | 652 | 207 | 1772 | 68 | 27 | 1867 |
| | (54.0) | (34.9) | (11.1) | (94.9) | (3.6) | (1.4) | (100.0) |

*Note:* The second decimal place is rounded off, so the total does not necessarily equal 100.

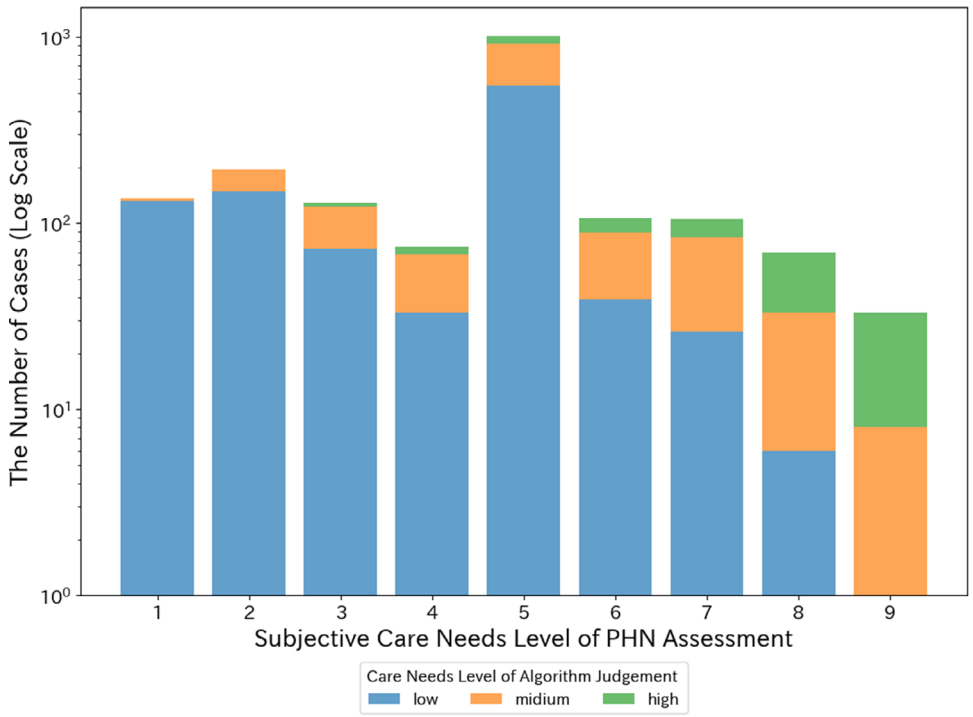


**FIGURE 1** | The intergroup significant differences between the algorithm's judgment and the PHNs' subjective assessment. The subjective care needs level of the PHN assessment is rated on a scale of 1 to 9, with higher numbers indicating a higher level of need. PHN, public health nurse. [Color figure can be viewed at wileyonlinelibrary.com]

Since the enactment of the Community Health Act in 1994, these sectors have been managed by Japanese municipalities, which were previously the responsibility of prefectures (Ministry of Health, Labor, and Welfare 1994). Additionally, the results reflected the stigma around mental illness in Japan because families generally care for mentally ill individuals in private, with limited access to formal mental health services (Yoshioka-Maeda and Fujii 2021). The PHNs are essential in bridging individual needs and community resources (Harmon et al. 2020). By accurately identifying individual care needs, PHNs can help design responsive healthcare systems that promote and protect the community's mental health.

In assessing individual care need levels, the PHNs considered mental health conditions, self-neglect status, refusal of support, financial problems, complex family dynamics, and neighborhood relationships. A previous study used a biopsychosocial model to identify patients' complex health needs and complicated context (Card 2023), and these results are consistent with that. This study uniquely incorporated self-neglect and neighborhood relationships, factors often predictive of emergency hospital visits and poor outcomes (Yu et al. 2021). Studies have found that these factors were associated with social inequities (Yip et al. 2022). These considerations reinforce the role of PHNs in effective case management—a core competency in public health nursing (Harmon et al. 2020)—and highlight the need for PHNs to assess these risks to support individuals' community living and promote health equity.

The $\varphi$ coefficients for the EICNA items provided a nationwide survey data-driven basis for categorizing care need levels, with 94.9% of PHNs agreeing with the algorithm-generated results.

The results suggest that the algorithm's determinations of care need levels to align well with the subjective evaluations made by the PHNs. This indicates that the algorithm is sensitive to factors influencing PHNs' judgments, potentially validating its utility in supporting decision-making in clinical practice. This validation demonstrates the potential for nursing practices to be standardized through a data-based approach using nursing diagnoses and terminology (Hants et al. 2023). Although the PHNs' roles are often less visible in tax-based public health services compared to reimbursable medical services, this study suggests that visualizing PHN practices could enhance the transfer of skills and tacit knowledge, especially for novice PHNs. The EICNA has the potential to help novices assess individual support needs just like experts. However, while the trend is clear, some variability in classifications across subjective levels may warrant further exploration to identify specific cases where subjective and algorithmic judgments differ. Future research should aim to refine the algorithm to better capture nuanced care needs, enhancing its reliability and integration into routine PHN workflows.

### 4.1 | Limitations

This study has four limitations. First, the sample size was limited, affecting the generalizability of the results. Most participants worked in the Japan Department of Health Promotion and Welfare, and thus, the sample may not represent all PHN roles. Second, the PHNs recorded more than 7 h of activity in Phase 2, potentially introducing data inaccuracies. Third, to protect privacy, we could not link the personal health records of each municipality, requiring us to rely on PHNs' subjective assessments for validation, which may have increased participant workload. In the future, the EICNA could integrate directly with health record systems to streamline data entry. Lastly, care need levels were calculated based on items marked "yes," treating "no," and "unknown" as equivalent, which may have led to response inconsistencies. Future studies should thus address these differences and consider larger sample sizes for validation.

Despite these limitations, this study had several strengths. First, it quantified PHN assessments using the EICNA, which was developed through nationwide data and discussion with supervisory PHNs. Second, it validated the items with real-world PHN data, demonstrating that 94.9% of the algorithm-calculated care need levels aligned with PHNs' subjective assessments. The EICNA tool allows PHNs to determine care need levels efficiently, potentially improving novice PHNs' clinical reasoning skills and responsiveness. Furthermore, by analyzing EICNA data, PHNs can identify community health trends, allowing for proactive, needs-based program development.

## 5 | Conclusion

This study developed the EICNA items and algorithm that uses these weighted sum scores to identify the level of individual care needs in public health nursing practice. We piloted the algorithm through real-world implementation and ensured the appropriateness of the algorithm's judgment and high usability. The EICNA may enhance human resource development and share senior nurses' tacit knowledge of individual care with novices to identify individual care need levels in community settings.


#### Author Contributions

All authors met the criteria of the International Committee for Medical Journal Editors through direct contributions to the design and conduct of this study. All authors had significantly revised the draft and confirmed the final version of the manuscript.

#### Acknowledgments

We would like to thank all public health nurses and research assistants who supported and participated in this study. This work was supported by MHLW Research on Health Security Control Program Grant Number JPMH22LA1004 (to K.Y.M.). The funding agency is not directly involved with the research.


#### Ethics Statement

The primary researcher's Institutional Review Board (IRB) approved the study protocol (phase 1: 2022114NI-(2), phase 2: 2023056NI). Informed consent was obtained from all participants, and the study was registered with the. There were no discrepancies between the trial registration entry and the report.

#### Conflicts of Interest

The authors declare no conflicts of interest.

#### Data Availability Statement

Research data are not publicly shared because of privacy restrictions.

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