Table 3
Multiple regression analysis of factors associated with empathy score ($N = 60$).

Factor	Coefficient β	Standardized β	t	p value
Age[a]	−0.335	−0.289	−0.289	0.033
Sex; male/female	2.325	0.112	0.862	0.392
Specialism; internal medicine/the other	−2.159	−0.138	−0.995	0.324

Multiple $R = 0.461$, multiple $R^2 = 0.165$, adjusted multiple $R^2 = 0.120$.
  [a] Continuous variable.

3.3. Relationships between characteristics and empathy

In the multivariate model, only age was related to the empathy score: younger oncologists scored higher than older oncologists (Table 3).

4. Discussion and conclusion

4.1. Discussion

This is the first reported study on the relationship between oncologists' characteristics and the verbal and non-verbal empathic behavior of oncologists, performed by videotaping oncologists delivering bad news to a SP.

In Western countries, characteristics such as age, sex, and specialism have been found to be associated with oncologists' empathic behavior [8]. In a multivariate model in this study, age was the only factor related to the empathy score: younger oncologists scored higher than older ones. This was in agreement with a previous study and could be because younger oncologists are less likely to have experienced emotional burnout from cancer care [9].

Additionally, younger oncologists may score higher because of changes in educational methods and content. In Japanese medical settings, "empathy" is often confused with "sympathy"—feelings of pity or sorrow for patients' suffering [10]—and senior Japanese physicians are more likely to have been discouraged from empathizing by mentors, because intense emotional involvement with patients could lead to difficulties in making clinical judgments [11] or cause physician burnout [12]. Physician-patient communication skills were commonly taught in medical schools and residencies in the early 1990s in Western countries: however, such practices did not begin in Japan until the early 2000s.

None of the oncologists in this study had taken a communication skills course; education *via* these courses might be the key to unlocking more empathetic behavior and improving patient–physician communication. Some researchers believe that empathy is a personality trait that can decline over time with medical education and medical care [13], and Fujimori et al. have reported that oncologists, who participate in communication skills course, behave more empathic than the oncologists who have not participated in [14]. Therefore, further investigation should be conducted to determine the best timing for communication skills courses during the medical career.

In multivariate analysis, sex and specialism were not significantly associated with empathic behavior.

Regarding specialism, Hojat et al. reported that average empathy ratings were significantly higher among physicians in "people-oriented" specialties (primary care, psychiatry, *etc.*) than among those in "technology-oriented" specialties (surgery, surgical subspecialties, *etc.*) [15,16].

Gender differences in empathy have been attributed to intrinsic factors (*e.g.*, evolutionary-biological gender characteristics) and extrinsic factors (*e.g.*, socialization and gender role expectations) [1,8,17]. For example, women are believed to develop more caregiving attitudes toward their offspring than men, according to the evolutionary theory of parental investment. Furthermore, women are more receptive to emotional signals [15]. Other researchers reported that female physicians spend more time with fewer patients and conduct more patient-oriented care [18]. Although we found no significant correlation between sex and the empathy score, this might be due to a small number of women in the sample, resulting in a lack of statistical power to detect any effect of sex. It could be inequality in sex among Japanese doctors, the ratio that women occupy is around 20%, but increases of late years.

This study has several limitations. First, the sample size was small. Second, data from SPs, not real cancer patients, was used; furthermore, the conversation was video-recorded, so oncologists could have modified their behavior to meet the experimental demands. However, all participants had reported that the SPs had seemed like real patients, they did not give thought to being recorded. Finally, all oncologists who participated in this study belonged to the National Cancer Center Hospitals, and this may limit generalization. Many oncologists employed by these hospitals communicate daily with their patients, and thus, most would score well. Nevertheless, this study is a step toward measuring and improving oncologists' empathy in Japan.

4.2. Conclusion

This report investigated the relationship between oncologists' personal characteristics and their empathic behavior. In multivariate analysis, age was the only factor related to the empathy score: younger oncologists scored higher than older ones.

4.3. Practice implications

Our research could have implications for the selection and education of oncologists. The findings indicate that communication skills training in Japan should be provided not only to younger physicians, but perhaps more importantly also to more experienced physicians.

Disclosure

I confirm that all personal identifiers have been removed or disguised so the persons described are not identifiable and cannot be identified through the details of the story.

Conflict of interest

Acknowledgements

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An ERP Study of Autistic Traits and Emotional Recognition in Non-Clinical Adolescence

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Autistic-like traits are characterized by impaired emotional recognition and proposed to be continuously distributed in the entire population. In the non-clinical population, however, the relationship between the autistic-like traits and the behavioral/physiological patterns of emotion processing ability has not been examined. In this study, we investigated the autistic traits (even including moderate-AQ participants) of typically developing adolescents, measured with the Autism Spectrum Quotient (AQ), and the spectral property of their behavioral and physiological responses during emotion-discrimination tasks. Participants were screened and divided into three groups (high-, moderate-, and low-AQ groups) according to AQ scores. Each group participated in the subsequent emotion-discrimination (using angry, happy and neutral facial expressions) experiment involving event-related potentials (ERPs). The results indicated that high-AQ group displayed significant different patterns (lower late positive potentials) of the emotional processing involved in behavioral and physiological tasks compared with the moderate-AQ group. In contrast, their behavioral and physiological patterns were comparable to those shown in the low-AQ group. Thus, in the non-clinical adolescents, the spectrum of emotion recognition patterns might show a non-linear relationship with AQ scores, even suggesting that AQ could not be considered as a simple index for emotional processing.

Keywords: Autistic Traits; AQ; Emotions; Facial Expression; Event-Related Potentials

Introduction

Autism spectrum disorders (ASD) are neurodevelopmental disorders that interrupt social functioning, language, or communication and involve stereotyped repetitive behaviors and highly restricted interests (DSM-IV; American Psychiatric Association, 1994, ICD-10; World Health Organization, 1992). Previous researches have shown that recognition of emotional facial expressions was interrupted by autism (Dawson, Webb, Carver, Panagiotides, & McPartland, 2004; Dawson, Webb, & McPartland, 2005; Golan, Baron-Cohen, Hill, & Golan, 2006; Golan, Baron-Cohen, & Golan, 2008; Wong, Fung, Chua, & McAlonan, 2008; Wong, Fung, McAlonan, & Chua, 2009), and deficits in emotional processing are one of the central manifestation of autism.

Autistic characteristics are proposed to be continuously distributed in the entire population and can therefore be measured in a quantitative way by using an appropriate screening tool. Baron-Cohen et al. (2001) indicated that autistic-like traits in typically developing (non-clinical) individuals are measured with the Autism Spectrum Quotient (AQ). The AQ enables quantitative investigation of autistic traits among normally developing individuals. Previous articles have used AQ to compare between individuals with high AQ score and those

with low AQ score in studies of visual processing (Almeida, Dickinson, Maybery, Badcock, & Badcock, 2010; Grinter, Maybery, Van Beek, Pellicano, Badcock, & Badcock, 2009), mirror-neuron activity (Puzzo, Cooper, Vetter, & Russo, 2010), or emotional processing (Poljac, Poljac, & Wagemans, 2012). These previous studies found that the high-AQ group displayed abnormal patterns compared to the low-AQ group, which validates the assumption that autism is a continuum even in the non-clinical population.

To attain an integrated view of the autistic-like trait continuity in non-clinical population, however, we have limited knowledge of the moderate-AQ group property, because previous AQ researches just conducted the comparison between two groups (high- and low-AQ groups). Also, these studies mainly addressed cognitive or behavioral patterns, and issues involving the relationship between physiological aspects and autistic traits remained almost unaddressed.

As a step toward elucidating the emotional spectral property or linearity of autistic traits distributed in the entire population, we investigated the behavioral (measured by accuracy and reaction times), and physiological (measured by ERPs) aspects of emotional face processing in non-clinical adolescents, even including the high-, moderate-, and low-AQ groups.

Methods

Participants

A total of 533 typical developing students (380 males, 153 females; aged 19.5 ± 1.6) at the University of Tokyo were initially screened with the Autism Spectrum Quotient-Japanese version (Wakabayashi, Tojo, Baron-Cohen, & Wheelwright, 2004). The Autism Spectrum Quotient (Baron-Cohen et al., 2001) is a self-report instrument (total scores range from 0 to 50) consisting of five subscales (Social, Attention Switching, Local Detail, Communication, and Imagination). The mean score on the AQ was 22.4, and the standard deviation was 6.74. We divided participants into three groups according to AQ scores; participants with scores that were at least one standard deviation higher (>29) or lower (<16) than the mean were placed in the high- and low-AQ groups respectively. Participants with scores around the mean (21 - 24) were placed in the moderate-AQ group. These three groups (high-AQ group, n = 97; moderate-AQ group, n = 135; low-AQ group, n = 111) were contacted via e-mail and invited to participate in the subsequent ERP experiment.

A total of 55 individuals (high-AQ group, n = 22; moderate-AQ group, n = 17; low-AQ group, n = 16) responded our invitation e-mail and agreed to participate in the ERP experiment. In the whole ERP study, 13 (out of 55) participants were excluded from the analysis due to excessive artifacts (n = 11; see EEG Recording section), equipment failure (n = 1), or sleepiness (n = 1). The high-AQ group comprised 14 adolescents (nine males and five females) aged 18 - 25 (M = 20.3, SD = 2.3) with AQ scores >29 (M = 31.7, SD = 2.4). The moderate-AQ group comprised 14 adolescents (nine males and five females) aged 18 - 22 (M = 20.1, SD = 1.4) with AQ scores 21 - 24 (M = 22.6, SD = .9). The low-AQ group comprised 14 adolescents (nine males and five females) aged 18 - 25 (M = 20.1, SD = 2.0) with AQ scores <16 (M = 11.8, SD = 2.7). All participants were right handed and had no history of neurological disease. All procedures were approved in advance by the Ethics Committee of the University of Tokyo, and all participants provided written informed consent before each experiment.

Stimuli

The stimuli for this study consisted of 144 photographs of 16 healthy professional actors (targets; eight males and eight females) displaying an emotional facial expression. Targets were instructed to direct their gaze toward the lens of camera, and instructed to express three emotions (anger, happiness, and neutrality) at three levels (high, medium, and low) of intensity. Each photograph was shown to a sample of 20 healthy participants (10 males and 10 females, age range: 22 - 58; randomly sampled separate from the present ASD study) who were asked to rate the emotions experienced by targets on a 7-point Likert scale ranging from "not at all" (0) to "extremely" (6). The resulting mean ratings ranged between 0 and 5.0 (high anger: M = 3.1, SD = 1.6; medium anger: M = 2.1, SD = 1.4; low anger: M = 1.7, SD = 1.4; high happiness: M = 4.0, SD = 1.4; medium happiness: M = 2.9, SD = 1.6; low happiness: M = 2.1, SD = 1.3; neutrality: M = .2, SD = .4) for the 144 photographs.

Procedure

The 144 photographs were pseudo-randomized to generate a sequence of 720 trials (each photograph was shown five times). Each face was presented for 500 ms on a screen (15-inch monitor), and inter-stimulus intervals varied between 1500 and 2000 ms to eliminate the effects of any anticipation experienced by participants. Participants were asked to look at a fixation point on a monitor situated 100 cm in front of them and not to move their eyes. Before each block of 48 trials, participants were instructed to press one of two buttons with their thumbs that corresponded to "emotional" (angry/happy) and "neutral" expressions in response to stimuli. Presentation version 14.1 (Neurobehavioral Systems, Inc., USA) was used to present the stimuli and to record the behavioral data (reaction times and button-press responses).

EEG Recording

A 32-channel NeuroScan scan system (Neuroscan, Inc., USA) was used to record scalp EEGs ranging from nasion to inion and from the right to the left ear. Electrode impedances were kept below 10 kΩ before recording. The continuous signal was amplified (×1000) and sampled at 500 Hz using the nasal-apex electrode as a reference. All electrodes were re-referenced to linked electrodes placed on the left and right earlobes, and a low-pass filter with a bandwidth of 30 Hz was applied. Vertical and horizontal electrooculograms (EOG) were also recorded to exclude trials with eye blinks and movements. ERPs and EOGs were recorded with a 100-ms pre-stimulus baseline and an 800-ms post-stimulus interval. A semiautomatic artifact-rejection procedure was applied to the continuous data. First, epochs containing amplitude changes exceeding 75 μV for the EOG and EEG channels were excluded. Next, all epochs and channels were scanned manually for additional disturbances. ERP data including more than 480 (out of 720) noise-free trials were used for the data analysis.

Data Analysis

We analyzed the behavioral data (accuracy and reaction times) using repeated-measures ANOVA with emotion (angry/happy/neutral) as the within-subject factor and group (high-, moderate-, and low-AQ) as the between-subjects factor. One participant in the high-AQ group was excluded from the analysis of behavioral data due to equipment failure.

The ERP data was analyzed by averaging the mean scores for each participant on the individual trials for each emotion and intensity. Using the components commonly analyzed in other ERP studies of emotional processing (Schupp, Ohman, Junghofer, Weike, Stockburger, & Hamm, 2004; see details in discussion), the late positive potential (LPP) was identified based on the direction of the peak and the grand-average latency of each component across the groups. To identify the LPP, the average PZ amplitudes between 500 and 600 ms post-stimulus were analyzed using a one-way ANOVA for emotion (anger, happiness, and neutrality) and using repeated-measures ANOVA for emotion (anger, happiness) and intensity (high, medium, and low). The mean LPP amplitude of each emotion was examined with a one-way ANOVA for group (high-, moderate-, and low-AQ). We applied the Greenhouse-Geisser adjustment for the violation of the sphericity assumption and performed the least-significant-difference (LSD) post-hoc test to assess specific differences. These calculations were performed with SPSS Statistics 19 (IBM, USA).

Results

Behavioral Data

Accuracy. The three groups did not differ significantly with respect the mean accuracy of responses {$F_{(2, 38)} = .138$, $p =$ n.s., power $(1 - \beta$ error prob$) = .70$, effect size $(\eta^2) = .0070$; **Figure 1(a)**}. Data on response accuracy reflected a significant main effect of emotion {$F_{(1.2, 47.1)} = 13.98$, $p < .001$, $1 - \beta = .98$, $\eta^2 = .27$}. Participants found it easier to discriminate between happy and neutral expressions than between any other pairs of expressions (anger vs neutral & anger vs happy); this effect was beyond that for group membership ($p < .001$).

Reaction time. We found a significant main effect of emotion on the reaction times for accurate responses ($F_{(1.3, 50.8)} = 98.715$, $p < .001$, $1 - \beta = 1.00$, $\eta^2 = .72$; **Figure 1(b)**). The participants responded more rapidly to emotional (angry $p < .001$; happy $p < .001$) faces than to neutral faces. Additionally, we found a significant interaction between group and emotion ($F_{(2.7, 50.8)} = 3.843$, $p < .05$, $1 - \beta = .76$, $\eta^2 = .17$). The post-hoc test has shown that the moderate-AQ group tended to respond more rapidly to angry or neutral expressions than did the high-AQ group, and to happy faces than did the low-AQ group ($p < .10$).

The positivity of the average Pz amplitudes between 500 and 600 ms post-stimulus was significantly greater in response to emotional faces than to neutral faces ($F_{(1.7, 69.9)} = 7.637$, $p < .01$, $1 - \beta = .91$, $\eta^2 = .16$; **Figure 2(a)**). Additionally, we found a significant main effect of intensity ($F_{(1.4, 58.1)} = 33.419$, $p < .001$, $1 - \beta = 1.00$, $\eta^2 = .45$; **Figure 2(b)**) in that greater emotional intensity triggered greater positivity. Overall, this positive potential was identified as the LPP that is correlated with the emotional processing (see LPP details in discussion).

We observed a significant main effect of group beyond that of emotion (**Figure 2(c)**; angry: $F_{(2, 39)} = 4.121$, $p < .05$, $1 - \beta = .70$, $\eta^2 = .17$; happy: $F_{(2, 39)} = 3.322$, $p < .05$, $1 - \beta = .60$, $\eta^2 = .15$; neutral: $F_{(2, 39)} = 5.032$, $p < .05$, $1 - \beta = .79$, $\eta^2 = .21$)

on the mean LPP amplitudes. The moderate-AQ group showed significantly higher LPP amplitudes than did the high-AQ group in response to angry ($p < .05$), happy ($p < .05$), and neutral faces ($p < .01$). The moderate-AQ group also showed significantly higher amplitudes than did the low-AQ group in response to all emotions ($p < .05$).

Discussion

In the present study, we investigated the relationship between autistic traits and the emotion recognition to verify the emotional spectral property of autistic traits in the entire population. Our data suggest that the high-AQ (and low-AQ) group might experience greater difficulty (lower LPPs) with emotion recognition than did the moderate-AQ group.

Behavioral Data

The response accuracy of individuals in the high-AQ group was comparable to that shown by other groups on the behavioral task. This result corresponds with the Interpersonal Reactivity Index (Davis, 1980) data in our cognitive study (Nixima, data not shown) and indicates that these individuals appropriately discriminate among the emotions of others. In contrast, the high-AQ group tended to require more time to detect facial emotions, which supports the findings of a previous study (Celani, Battacchi, & Arcidiacono, 1999). Consistent with a previous study of autistic individuals (Hubl et al., 2003), the behavioral data imply that the high-AQ group are able to correctly discriminate among emotional faces, although they sometimes require more time for processing.

It is important to note that the behavioral pattern of the low-AQ group was similar to that of the high-AQ group. They tended to require more time for emotional discrimination compared to the moderate-AQ group, but no significant differences in accuracy were observed among the three groups. The behavioral patterns in the low-AQ group should be further investigated in the future.
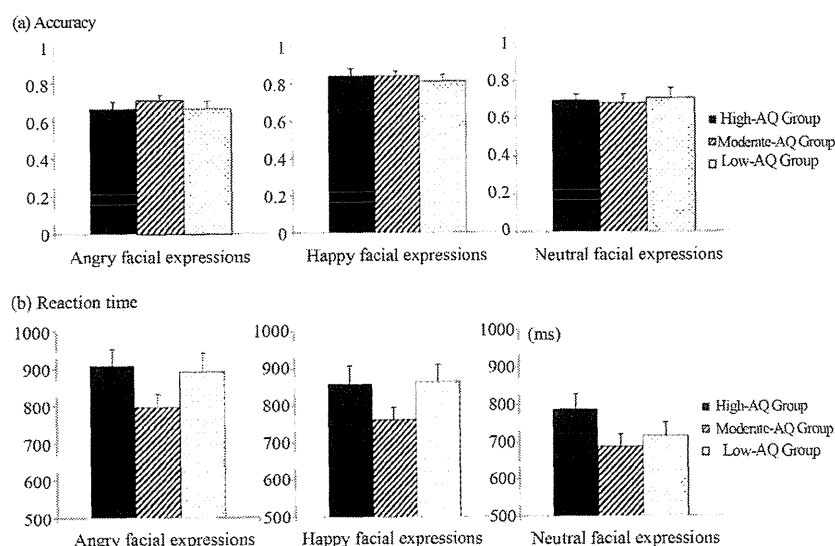

Figure 1.
(a) Accuracy results of the high-, moderate-, and low-AQ group for angry, happy, and neutral facial expressions; (b) Reaction time results of the high-, moderate-, and low-AQ group for angry, happy, and neutral facial expressions. Error bars indicate standard error of the mean (s.e.m), respectively.
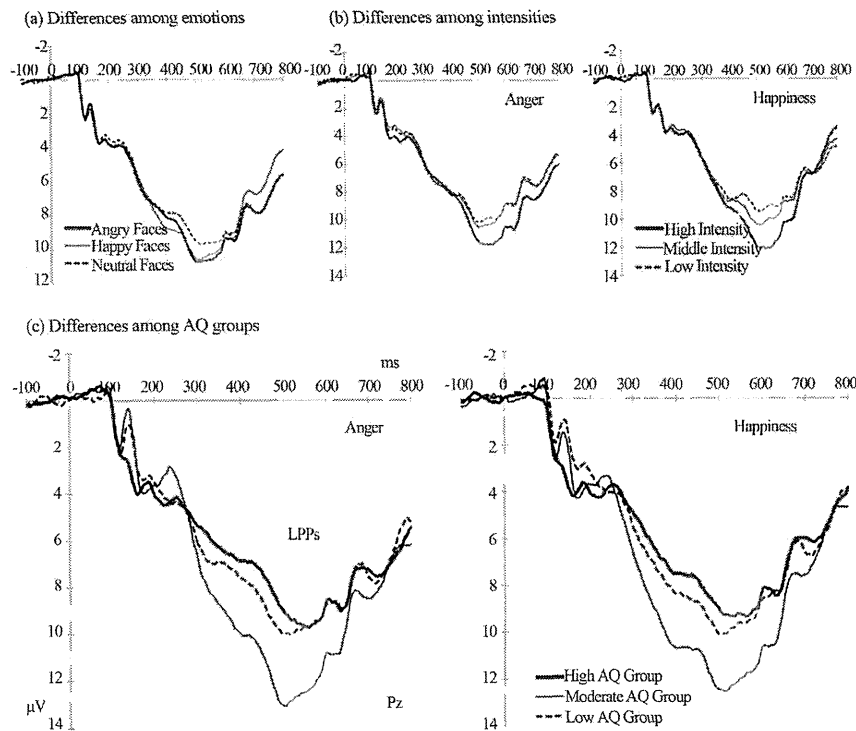
Figure 2.
(a) Grand-averaged ERPs elicited at Pz for angry, happy, and neutral facial expressions presented in a continuous sequence; (b) Grand-averaged ERPs for the high, middle, and low intensities of angry and happy facial expressions; (c) Grand-averaged ERPs for each AQ group elicited at Pz for angry and happy facial expressions.

ERP Data

We found significant group differences of late positive potentials (LPPs), late ERP components commonly analyzed in previous ERP studies of emotional processing (Schupp et al., 2004). LPPs have been considered to correlate with emotional processing and defined as the positive potentials of the ERPs over the centro-parietal sites between 400 and 600 ms post-stimulus (Schupp et al., 2004; Schupp, Flaisch, Stockburger, & Junghofer, 2006) that might reflect activity within neocortical brain circuits (Eimer & Holmes, 2007). Such LPP patterns for angry and happy faces in this study were consistent with a previous ERP study (Eimer & Holmes, 2003).

In the present study, the high-AQ group displayed significant lower LPP amplitudes than the moderate-AQ group. The neural activity difference between these two groups can be supported by the results of previous ERP studies of autistic individuals (Dawson et al., 2004; Wong et al., 2008; as described below). In contrast, the low-AQ group also demonstrated lower LPP amplitudes than did the moderate-AQ group. Although these results are consistent with the result of the reaction time patterns in this study, the similar patterns between the high- and low-AQ groups should be further investigated in the future.

The abnormal ERP patterns of autistic individuals compared with the typical developing participants have been reported by previous studies (Dawson et al., 2004; Wong et al., 2008). For example, Dawson et al. (2004) utilized high-density ERPs to investigate responses to fearful versus neutral faces in children with autism, and found that children with autism demonstrated impaired neural responses to both kinds of faces. These previ-

ous researches mainly addressed early ERP components (such as P1 or N170), which might represent an early-low level stage of holistic face perception or the structural encoding of a face (Taylor, 2002; Itier & Taylor, 2002). In our own study, we also analyzed these early ERP components at each channel, but there were no significant difference among groups (data not shown). The early ERP components (P1 or N170) are generally smaller components than LPPs, and the difference among groups in the non-clinical participants might be hardly detected.

Autistic Traits and Emotional Recognition in Non-Clinical Adolescence

The relationship of behavioral and physiological patterns between the high- and moderate-AQ group, taken together, validate the conceptualization of autistic traits as a continuum that includes normally developing individuals. We suggest that the presence of high autistic traits interrupts the instantaneous discrimination of emotions.

In contrast, the low-AQ group demonstrated comparable behavioral and physiological patterns to the high-AQ group. If this is the case, the spectrum of emotional recognition possibly shows a non-linear relationship with AQ scores. The emotional continuum of autistic traits might be ambiguous in the non-clinical population, rendering the AQ unable to identify autistic traits in those with low scores. The difference between low and moderate AQ score means little in terms of the presence of autistic traits for emotional recognition, given that the AQ, as a clinical screening tool, identifies only high autistic-like individuals. In other words, the AQ can be considered to be sensitive to

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the spectrum of emotional processing in high or moderate autistic traits, and might not adequately capture the variability in the normal range including low autistic traits. To apply the AQ for comparison with high autistic traits in normal individuals, moderate autistic traits should be more remarked than low autistic traits, from the behavioral/physiological aspect of emotional processing. Consequently, investigations of the usefulness of the AQ for quantifying autistic traits in non-clinical individuals, especially those with low autistic-like traits, must continue.

Conclusion

Our results suggest that the high-AQ group have different patterns (longer reaction times and lower LPPs) of the emotional processing underpinning behavioral and physiological responses compared to the moderate-AQ group, which affirms the autistic-like trait continuity underlying the AQ as well as the results of previous studies. This study has also shown that, similar to the high-AQ group, the low-AQ group shows a comparable pattern of emotion recognition, suggesting that the spectrum of emotion recognition in autism would show a non-linear relationship with AQ scores. The results in our study possibly mean that AQ could not be considered as a simple index for emotional processing and needs to be further investigated in the future.

Acknowledgements

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Impaired mental health among the bereaved spouses of cancer patients

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Abstract

Objective: Few cancer physicians routinely provide bereavement follow-up in clinical practice. The purpose of this study was to identify the prevalence of impaired mental health among the bereaved spouses over several years and explore the indicators for early detection of high-risk spouses during end-of life (EOL) care.

Methods: A cross-sectional mail survey was conducted for the bereaved spouses of patients who had died at the National Cancer Center Hospital of Japan. Bereaved spouses with potential psychiatric disorders were identified by the cut-off score of the 28-item General Health Questionnaire. Associated factors of potential psychiatric disorders were explored by logistic regression analysis.

Results: A total of 821 spouses experiencing bereavement from 7 months to 7 years returned the questionnaires. Overall mean prevalence of potential psychiatric disorders was 44% (360/821). Bereaved spouses 'under 55 years' (71%) or '2 years after bereavement' (59%) revealed a significantly higher prevalence ($p < 0.01$). Associated factors during EOL care were several characteristics such as 'spouses' history of psychiatric disorder (odds ratio (OR) = 3.19), 'patients' with stomach cancer (OR = 1.87), and 'patients' using psychiatric consultation services (OR = 1.52) as well as spouses' dissatisfaction with EOL care such as 'physicians' treatment of physical symptoms' (OR = 3.44) and 'time spent communicating with patients' (OR = 1.55).

Conclusions: Nearly half the bereaved spouses showed potential psychiatric disorders even 7 years after bereavement. Patients' psychological distress, spouses' history of psychiatric disorder, and dissatisfaction with EOL care were indicators of high-risk spouses.
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Introduction

Conjugal bereavement was the strongest risk factor for depression among elderly community subjects in a meta-analysis of 20 studies (odds ratio (OR) = 3.3) [1] and bereaved spouses showed a significant increase in the risk of depression compared with married people in large cohort studies (1.5-fold, 3.6-fold) [2,3]. In oncology settings, spouses experienced the highest levels of distress among family members at the time of patient death [4] and bereavement brought an increased risk of major depressive disorder [5,6]. Cancer is a leading cause of death worldwide and accounted for 7.6 million deaths (around 13% of all deaths) in 2008 [7]; however, few cancer physicians routinely provide bereavement follow-up in clinical practice [8].

Several longitudinal studies have reported that impaired mental health among the bereaved clearly diminishes over time. The prevalence of major depressive disorder among caregivers of cancer patients was identified by clinical interview: 28% at the time of hospice enrollment, 12% at 6 months after death, and 7% at 1 year after death [5,6]. Depression, anxiety, and grief measured by self-administered questionnaire decreased during the first year after bereavement [9–11] and then remained unchanged over the next year [11]. On the other hand, cross-sectional studies reported that negative effects such as anger, sadness, self-blame, and guilt did not decrease among those who had been bereaved for more than 4 years [12,13] and 25% of the bereaved parents had not worked through their grief even 4–9 years after the loss [14]. However,

these persistent symptoms could not predict the prevalence of potential psychiatric disorders among the bereaved.

Impaired mental health among the bereaved who have lost a relative to cancer is associated with several characteristics of the patients and the bereaved. As for clinical characteristics of cancer patients, 'short duration of hospice enrollment' [5,6], 'intensive end-of-life (EOL) care' [15], and 'ICU death' [16] were associated with impaired mental health among the bereaved. In addition, bereaved characteristics of 'under 65 years' [9], 'female' [5,17,18], 'spouse' [5], 'prior physical symptoms' [5], 'prior depression' [5,9,17], and 'anticipatory grief' [16] were also reported. However, these associated factors are not useful as indicators for early detection of high-risk spouses during EOL care in clinical practice at a hospital even though 90% of cancer patients in Japan die in a hospital [19].

In the present study, the primary purpose was to identify the prevalence of impaired mental health that can be used to predict the prevalence of potential psychiatric disorders among the bereaved who have lost their spouse to cancer. The secondary purpose was to investigate associated factors of the prevalence so that we could suggest the indicators for early detection of high-risk spouses during EOL care.

Methods

Study sample

We conducted a cross-sectional mail survey for the bereaved spouses whose partner had died at the National Cancer Center Hospital East (NCCHE). This study was approved by the Institutional Review Board and Ethics Committee of the National Cancer Center of Japan in January 2009.

First, in January 2009, we found it necessary to identify family members to whom we intended to mail study participation invitations; this was because of a lack of accurate data about marital status in the hospital patient database. Eligibility criteria were (i) patient's primary clinician belonging to the eight divisions cooperating with this study (Hematology, Pancreatic, Head and Neck, Gastric Surgery, Gastrointestinal, Thoracic Surgery, Thoracic Oncology, and Palliative Care), which covered 98% of the patients who died at NCCHE; (ii) patient's data available in the hospital's patient database operating since January 2001; and (iii) patient's death occurring at least 6 months earlier. Exclusion criteria and flow of the study sample are explained in Figure 1.

We matched the demographic characteristics of the deceased cancer patients drawn from the hospital patient database with those of the bereaved spouses based on the completed questionnaires. Respondents' characteristics ($n = 821$) showed a lower proportion of males (30%, $n = 242$ vs. 36%, $n = 753$, $p < 0.01$) and a shorter duration of bereavement (3.0 ± 1.9 vs. 3.2 ± 2.0 years, $p < 0.01$) compared with the non-responders ($n = 2081$) among the 2902 candidate participants; the difference in values of the deceased patients' characteristics such as age, duration of last hospital admission, place of death, history of usage of psychiatric consultation services, and cancer site was not significant.
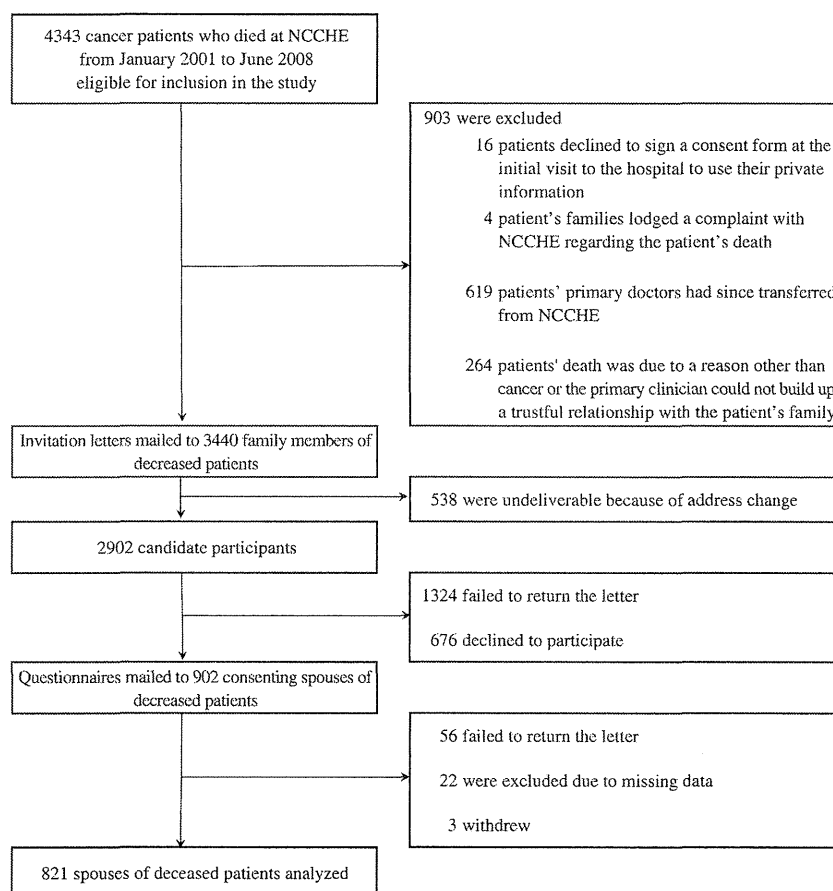

Figure 1. Flow of study sample

Measures

Deceased patients' characteristics

We examined the overall computerized patient database of NCCHE to identify cancer patients' characteristics. Time since cancer diagnosis to death was declared in the questionnaires completed by the bereaved. History of usage of psychiatric consultation services was identified by using the consultation database developed by the Psychiatric Services Division of the NCCHE. This computerized database [20] includes demographic variables and psychiatric disorders of patients who were referred to the Psychiatric Services Division.

Bereaved spouses' characteristics

The questionnaires completed by the bereaved spouses included physical and psychological information such as physical illness under treatment and history of psychiatric disorder prior to their partner's death as well as demographic variables.

Dissatisfaction with EOL care

The bereaved spouses retrospectively reported their dissatisfaction with EOL caregiving (five items) and physician's EOL care (four items) during the month prior to the patient's death using a five-point Likert-type scale (0: very satisfied, 1: fairly satisfied, 2: neutral 3: fairly dissatisfied, 4: very dissatisfied). We rescored each item as 0 (absence of dissatisfaction, 0–2) or 1 (presence of dissatisfaction, 3–4) in this study.

Impaired mental health

The General Health Questionnaire (GHQ), using a four-point Likert-type scale (possible range, 0–3; higher scores indicate impaired mental health), has been widely used to detect persons with nonspecific psychiatric disorders [21]. We used the validated Japanese 28-item version (GHQ28 [22]). Persons with potential psychiatric disorders were identified by the cut-off score of the GHQ scoring method (0-0-1-1; possible range, 0–28; cut-off score, 5/6). This cut-off score showed the best sensitivity and specificity when compared with the ratings of the clinical interview [23,24] and this approach has shown its applicability to the Japanese version [22].

Statistical analysis

Impaired mental health was compared using analysis of variance with the Bonferroni multiple comparison method or t-test. Potential psychiatric disorders were compared by using the chi-square test with residual analysis. Variables showing p-values < 0.05 in the univariate analysis were entered as independent variables in a multivariate logistic regression analysis with backward elimination to identify associated factors of potential psychiatric disorders.

P-values < 0.05 were considered significant and all p-values were two-tailed. All statistical analyses were carried out using SPSS ver.12.0J for Windows (SPSS Japan Institute Inc., Tokyo, Japan).

Results

Characteristics of deceased patients/bereaved spouses

Table 1 summarizes the characteristics of the 821 participants experiencing bereavement from 7 months to 7 years.

Table 1. Characteristics of deceased patients and bereaved spouses ($n = 821$)

	Mean ± SD (median, range)	n	(%)
Deceased patients' characteristics			
Age, years	64 ± 9.0 (65, 32–88)		
Time since cancer diagnosis to death, months	27 ± 29 (16, 1–187)		
Duration of last hospital admission, days	27 ± 29 (17, 1–208)		
Bereaved spouses' characteristics			
Age, years	66 ± 9.0 (66, 32–89)		
Time since bereavement, years	3.0 ± 1.9 (3.0, 0.6–7.2)		
Gender			
Male		242	30
Female		579	70

SD, standard deviation.

In this study, 579 bereaved (70%) were female, 441 patients (54%) died in the Palliative Care Unit, and 629 bereaved (77%) were involved in EOL caregiving 'everyday'.

Prevalence of impaired mental health and potential psychiatric disorders

As shown in Table 2, we estimated the population of bereaved spouses to be 2649 by multiplying the total number of 4343 deceased patients by 0.61, which is the approximate ratio of Japanese cancer patients who have a spouse at the time of death among overall cancer deaths in Japan in 2007 (206,389/336,139)[19]. As a result, the overall sampling rate (estimated) was 31% (821/2,649), and the prevalence of potential psychiatric disorders was 44% (360/821, 95% CI = 40.6–47.4).

With impaired mental health, three-way interaction (age × gender × time) was not significant (F (18, 689) = 1.56, $p = 0.07$). Two-way interaction (age × gender: F (3, 689) = 2.75, $p = 0.04$) was significant: males 'under 55 years' showed significantly greater prevalence than males '55–64 years' or 'over 75 years' (F (3, 214) = 3.66, $p = 0.01$, A0 > A1, A3, $p < 0.05$) and females 'under 55 years' or '55–64 years' showed significantly greater prevalence than females '65–74 years' (F (3, 533) = 4.65, $p < 0.01$, A0, A1 > A2, $p < 0.05$). The main effect of time was significant (F (6, 689) = 2.71, $p = 0.01$): the bereaved who had lost their spouse '2 years ago' revealed significantly greater prevalence than those who had lost their spouse '4 years ago' with multiple comparison (F (2, 738) = 3.31, $p < 0.01$, T2 > T4, $p < 0.05$).

The prevalence of the bereaved varied with age and time: 'under 55 years' (71%) revealed significantly higher prevalence than those '65–74 years' (42%) (χ^2 (3) = 23.17, $p < 0.01$, A0 > A2, $p < 0.01$) and the bereaved who had lost their spouse '2 years ago' (59%) revealed significantly higher prevalence than those who had lost their spouse '4 years ago' (37%) (χ^2 (6) = 17.81, $p < 0.01$, T2 > T4, $p < 0.01$). No significant difference was observed between genders (χ^2 (1) = 1.08, $p = 0.34$).

Factors associated with potential psychiatric disorders

In the univariate analysis, 14 variables were significantly associated with potential psychiatric disorders ($p < 0.05$, Table 3). Table 4 shows the results of a multivariate logistic regression analysis: 'patients using psychiatric consultation

Table 2. Prevalence of impaired mental health and potential psychiatric disorders among bereaved spouses of cancer patients

		Deceased patients	Population[a] (estimated)	Sample	Sample rate (estimated)	Impaired mental health (GHQ28, 0–28)		Potential psychiatric disorders (GHQ28 ≥ 6)	
Year	Group	N	N'	n	% (n/N')	Mean (SD)	n'	% (n'/n)	95% CI
Total		4343	2649	821	31	7.17 (6.79)	360	44	40.6–47.4
Age									
-54	A0			75		(9.95) 6.59	53	71	60.4–81.0
55–64	A1			232		7.65 (6.77)	118	51	44.5–57.3
65–74	A2			339		6.37 (6.68)	141	42	36.4–46.9
75–	A3			109		6.62 (6.77)	46	42	32.9–51.5
Gender									
Male		1494	911	220	24	6.93 (6.65)	98	45	37.9–51.1
Female		2849	1738	538	31	7.27 (6.86)	262	49	44.5–52.9
Time since bereavement									
<1	T0	258	157	55	35	8.67 (7.41)	30	55	41.3–67.7
<2	T1	668	407	133	33	7.79 (7.38)	66	50	41.1–58.1
<3	T2	611	373	134	36	8.60 (6.92)	79	59	50.7–67.3
<4	T3	616	376	111	30	6.00 (6.29)	44	40	30.5–48.7
<5	T4	643	392	96	24	5.48 (6.05)	35	37	26.9–46.1
<6	T5	671	409	108	26	6.74 (6.56)	45	42	32.4–51.0
≥6	T6	876	534	108	20	6.97 (6.55)	55	51	41.5–60.3

Some percentages do not add up to 100% because of missing data.
SD, standard deviation; CI, confidence interval.
[a]Population was estimated by multiplying the number of deceased patients (N) by 0.61, which is the approximate ratio of Japanese cancer patients who have a spouse at the time of death among overall cancer deaths in Japan in 2007.

services' (OR = 1.52), 'patients with stomach cancer' (OR = 1.87), and 'bereaved with a history of psychiatric disorder' (OR = 3.19) were significantly associated factors among the characteristics of patients/bereaved prior to the patient's death. Additionally, 'time spent communicating with patients' (OR = 1.55) and 'physician's treatment of physical symptoms' (OR = 3.44) were significantly associated factors among the bereaved spouses' dissatisfaction with EOL care during the final month.

Discussion

In this study, we identified a considerably high prevalence of potential psychiatric disorders among the bereaved (44% of total respondents). Patients' psychological distress, bereaved spouses' history of psychiatric disorder, and dissatisfaction with EOL care were indicators for early detection of high-risk spouses prior to the patient's death.

Our results indicated that, even 7 years after losing their spouse, a significant number of the bereaved have potential psychiatric disorders (37–59%). This is a higher prevalence than that of consecutive patients in general practice in Britain (35%) [25] and is three-fold higher than that of a healthy sample in Japan (14%) [22]. We discuss this high prevalence from two aspects of the results. First, more than half the spouses within less than 3 years since bereavement showed potential psychiatric disorders. This high prevalence might be inflated by normal grief, a common psychological reaction among the bereaved. Our results support those of the previous studies in which prevalence decreased during the first year after bereavement [9–11]. However, our results do not support previous results where prevalence remained unchanged over the second year [11]. This discrepancy might partly be because of spouses participating in the Japanese Buddhist rite of *sankaiki* where bereaved families gather together on the second anniversary of the death and reminisce about the deceased. This mourning ceremony might increase

the psychological distress of the bereaved by triggering negative psychological states such as yearning, an unfulfilled desire to reunite with the deceased. Second, around 40% of the respondents whose bereavement was 3–7 years earlier showed potential psychiatric disorders. Even though their psychological distress might have eased somewhat after the mourning ceremony in the second year, the prevalence of both impaired mental health and potential psychiatric disorders was considerably high among the spouses after bereavement. This result could be because of subsequent physical problems of the bereaved because 'physical illness under treatment' was significantly associated with morbidity. However, this persistent prevalence might suggest prolonged bereavement distress because dissatisfaction with EOL (their caregiving and the physician's care) was strongly associated with potential psychiatric disorders in this study.

Among the characteristics of patients/bereaved, 'bereaved spouse's history of psychiatric disorders prior to the patient's death' was the most highly correlated factor (OR = 3.19) and replicated previous studies on the indicators of vulnerability to bereavement stress [5,9,17]. Patients with stomach cancer in this study might have a higher rate of psychological symptoms because the highest rate of mixed anxiety/depression symptoms (20%) was seen with stomach cancer patients among 22 cancer types in a large cohort study [26]. Considering the positive association between patient and caregiver psychological distress in meta-analyses [27,28], patients' psychological distress factors of 'stomach cancer' or 'usage of psychiatric consultation service' could raise spouses' psychological distress prior to the patient's death. In addition, because psychological distress of caregivers prior to the patient's death predicted its prevalence after bereavement in a longitudinal multisite study [16], the initial detection of spouses with high psychological distress prior to the patient's death might be the most useful strategy for preventing subsequent impaired mental health among the bereaved.

Table 3. Factors associated with potential psychiatric disorders among bereaved spouses of cancer patients: univariate analysis

| | Total | | Potential psychiatric disorders | | | | Analysis | |
| | | | Presence | | Absence | | | |
Variables	n	(%)	n	(%)	n	(%)	χ^2	p
Deceased patients' characteristics								
Age (< 65 years)	386	(47.0)	198	(51.3)	188	(48.7)	4.56	0.04
Time since cancer diagnosis to death (< 1 year)	285	(34.7)	144	(50.5)	141	(49.5)	1.69	0.20
Duration of last hospital admission (< 1 week)	182	(22.2)	93	(51.1)	89	(48.9)	1.25	0.27
Place of death (Palliative care unit)	402	(49.0)	190	(47.3)	212	(52.7)	0.02	0.94
History of usage of psychiatric consultation service	152	(18.5)	87	(57.2)	65	(42.8)	7.24	<0.01
Cancer site				(51.3)		(48.7)		
Lung	241	(29.4)	113	(46.9)	128	(53.1)	0.05	0.88
Pancreas	88	(10.7)	39	(44.3)	49	(55.7)	0.40	0.57
Stomach	60	(7.3)	38	(63.3)	22	(36.7)	6.56	0.02
Colon	63	(7.7)	24	(38.1)	39	(61.9)	2.42	0.15
Head and neck	60	(7.3)	25	(41.7)	35	(58.3)	0.89	0.42
Esophagus	45	(5.5)	26	(57.8)	19	(42.2)	2.03	0.17
Breast	41	(5.0)	20	(48.8)	21	(51.2)	0.03	0.87
Liver	38	(4.6)	17	(44.7)	21	(55.3)	0.12	0.74
Biliary tract	33	(4.0)	19	(57.6)	14	(42.4)	1.41	0.29
Lymphoma	9	(1.1)	4	(44.4)	5	(55.6)	0.03	1.00
Bereaved spouses' characteristics								
Age (< 65 years)	307	(37.4)	171	(55.7)	136	(44.3)	13.94	<0.01
Gender (Male)	220	(26.8)	98	(44.5)	122	(55.5)	1.08	0.34
Time since bereavement (< 3 years)	322	(39.2)	175	(54.3)	147	(45.7)	10.55	<0.01
Living status (Living alone)	363	(44.2)	171	(47.1)	192	(52.9)	0.04	0.88
Employment status (Employed)	216	(26.3)	106	(49.1)	110	(50.9)	0.30	0.63
Education (≤9 years)	121	(14.7)	51	(42.1)	70	(57.9)	1.65	0.23
Physical illness under treatment	424	(51.6)	227	(53.5)	197	(46.5)	14.10	<0.01
History of any psychiatric disorder prior to patients' death	60	(7.3)	43	(71.7)	17	(28.3)	15.37	<0.01
Bereavement experience after the death of spouse	196	(23.9)	91	(46.4)	105	(53.6)	0.12	0.74
Religiousness	311	(37.9)	157	(50.5)	154	(49.5)	1.89	0.18
Involvement in end-of-life caregiving (Everyday)	579	(70.5)	285	(49.2)	294	(50.8)	2.94	0.09
Dissatisfaction with end-of-life caregiving								
Knowledge of physical symptoms and management	235	(28.6)	130	(55.3)	105	(44.7)	9.01	<0.01
Professional supports for physical symptoms and management	177	(21.6)	104	(58.8)	73	(41.2)	12.31	<0.01
Knowledge of psychological symptoms and management	228	(27.8)	119	(52.2)	109	(47.8)	3.20	0.08
Professional supports for psychological symptoms and management	208	(25.3)	122	(58.7)	86	(41.3)	14.99	<0.01
Time spent communicating with patients	169	(20.6)	99	(58.6)	70	(41.4)	10.93	<0.01
Dissatisfaction with physicians' end-of-life care								
Treatment of physical symptoms	67	(8.2)	49	(73.1)	18	(26.9)	19.44	<0.01
Treatment of psychological symptoms	119	(14.5)	71	(59.7)	48	(40.3)	8.66	<0.01
Time spent communicating with patients	191	(23.3)	104	(54.5)	87	(45.5)	5.21	<0.01
Time spent communicating with patients' families	232	(28.3)	123	(53.0)	109	(47.0)	4.17	0.05

Fisher's exact test was performed when the sample number was less than 10. All variables were coded as: 0 = absence, 1 = presence.

Table 4. Factors associated with potential psychiatric disorders among bereaved spouses of cancer patients: multivariate logistic regression analysis

Variables	Beta	SE	OR	95% CI	p
Deceased patients' characteristics					
History of usage of psychiatric consultation service	0.42	0.20	1.52	1.02–2.26	0.04
Stomach cancer	0.63	0.30	1.87	1.04–3.38	0.04
Bereaved spouses' characteristics					
Age (< 65 years)	0.72	0.17	2.06	1.47–2.88	<0.01
Time since bereavement (< 3 years)	0.46	0.16	1.58	1.15–2.17	<0.01
Physical illness under treatment	0.82	0.17	2.26	1.62–3.16	<0.01
History of any psychiatric disorder prior to the patient's death	1.16	0.33	3.19	1.68–6.06	<0.01
Dissatisfaction with end-of-life caregiving					
Knowledge of physical symptoms and management	0.32	0.18	1.38	0.97–1.96	0.07
Time spent communicating with patients	0.44	0.20	1.55	1.05–2.30	0.03
Dissatisfaction with physicians' end-of-life care					
Treatment of physical symptoms	1.24	0.31	3.44	1.89–6.26	<0.01

Beta values indicate standardized regression coefficients on the final model after backward elimination. All variables were coded as: 0 = absence, 1 = presence.
SE, standard error; OR, odds ratio; CI, confidence interval.

For the dissatisfaction with EOL care, 'dissatisfaction with physician's treatment of physical symptoms' was the most highly associated with potential psychiatric disorders (OR = 3.44). Unrelieved pain of female cancer patients during their last months of life showed a positive association with psychological morbidity such as sleep disorders in the widowers 4–5 years after bereavement [29]. Additionally, EOL care discussions are associated with less aggressive medical care, such as ventilation and resuscitation and less major depressive disorders in bereaved caregivers [15]. Therefore, satisfactory discussions about physical treatment in EOL care are helpful not only for the patients but also for the caregivers' psychological adjustment. Another factor, 'dissatisfaction with time spent communicating with patients' was significantly associated (OR = 1.55). A recent systematic review of communication with terminally ill patients and their families [30] indicated a lack of quantitative study. Communication skills training for healthcare professionals to improve discussions between patients and caregivers about EOL issues fostering realistic forms of hope is an essential future task for preventive intervention of spousal morbidity after bereavement [30].

We derived several implications for practice and research. In practice, we could obtain the following several indicators for early detection of high-risk spouses prior to the patient's death: 'patients using psychiatric consultation service', 'patients with stomach cancer', 'bereaved with a history of psychiatric disorder', 'dissatisfaction with time spent communicating with patients', and 'dissatisfaction with physician's treatment of physical symptoms'. Along with the early detection of spouses with these risk factors, nurse-assisted [31] or pharmacist-assisted [32] psychiatric referral programs using the 'Distress and Impact Thermometer' might be useful for directly evaluating psychological distress among spouses in EOL practice. In research, we could obtain the following possible strategies for preventive intervention of spousal morbidity after bereavement: assistance for improving 'discussions with physicians about physical treatment in EOL care' and 'discussions between patients and caregivers about EOL issues' would be effective. Development of communication skills training for healthcare professionals to improve these discussions must be considered in future research.

For the study limitations, first, the lack of an exact response rate was a critical methodological limitation. Nevertheless, we believe our estimated sample rate (31%) was adequate because the population of bereaved spouses included those who had died after the patient's death. Second, two sample biases might exist. One was caused by the data collection site, a single cancer center in Japan. However, we do not believe that this institutional bias had a serious effect on the representation of Japanese bereaved spouses of cancer patients because 90% of cancer patients in Japan die in a hospital [19]. In addition, the bereaved with high impaired mental health might have been more motivated to take part in the study. This might have resulted in an inflated number of potential psychiatric disorders. Third, this was a cross-sectional study, and we could not discuss the time course of the prevalence or any causality between impaired mental health and associated factors. In addition, it remains possible that there was a recall bias in answering the question about dissatisfaction with EOL care because it was such a long period for a retrospective report by the bereaved who had lost their partner several years earlier. Fourth, other important factors were not investigated in this study, such as the bereaved spouse's 'style of attachment to the deceased', 'function level among family members', 'perception of the dying process and whether this was traumatic', and 'available social support'. Finally, we have no objective data on EOL care; individuals whose spouses died 7 years ago would likely have had a very different experience in the oncology care setting compared with those whose spouses died more recently.

Conclusions

Nearly half the bereaved spouses showed potential psychiatric disorders even 7 years after bereavement. Patients' psychological distress, bereaved spouses' history of psychiatric disorder, and dissatisfaction with EOL care were indicators of high-risk spouses.

Acknowledgements

Conflicts of interest

All authors declare that the answers to the questions on your competing interest form are all 'No' and therefore have nothing to declare.

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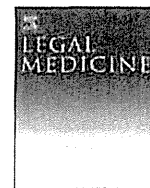
Causes of death in forensic autopsy cases of malnourished persons

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ABSTRACT

Purpose: Medical examiners and forensic pathologists often encounter emaciated bodies in postmortem examinations. However, the main disease that caused death is often not clear and measures to prevent the unexpected death of malnourished persons have not been established. In this study, we examined the underlying causes of death among a large number of forensic autopsy cases that showed emaciation to clarify the features of sudden, unexpected death in malnourished persons.

Methods: Documents of autopsy cases without putrefaction handled during 2007–2010 by the Tokyo Medical Examiner's Office were reviewed ($n = 7227$). The body mass index (BMI) was calculated for each case. The causes of death for cases with severe malnutrition (BMI < 16; $n = 885$) were closely examined.

Results: About 70% of all deaths in malnourished cases (BMI < 16) was due to disease, and the causative diseases are more varied than in those with less severe malnutrition and those without malnutrition (BMI ⩾ 16). A higher proportion of malnutrition as the cause of death was observed in younger persons for both sexes, and a higher proportion of having a history of psychiatric diseases was observed in younger deceased women. In addition, a higher proportion of alcohol-related digestive diseases was observed especially in younger men, some of whom had a history of alcohol dependence. On the other hand, the proportion of organic diseases, such as neoplasms and gastroduodenal ulcer, was higher in older deceased persons, especially among men. Around 70% of all respiratory diseases comprised pneumonia in both sexes. Among non-disease-related causes of death, poisoning was the most frequent cause in women under 55 years old (35.3%), with the majority having had a history of psychiatric disease.

Conclusions: Because autopsy cases of malnourished persons show various causes of death, physicians have to pay more attention in making death diagnosis in such cases. From a preventative point of view, early detection of organic diseases, a better approach toward managing psychiatric diseases, and implementation of vaccination for pneumonia will contribute to reduction of future unexpected deaths among malnourished persons.

1. Introduction

Obesity is known to increase the risk of cardiovascular disease [1] and has been associated with sudden death of circulatory disease origin among forensic autopsy cases [2,3]. Accordingly, obesity across all age groups is considered a major public health problem worldwide, and justifiably many countries are preoccupied with finding ways to decrease obesity rates [4,5].

On the other hand, being underweight is also associated with increased risks of morbidity and mortality in the older population [6]. Indeed, medical examiners and forensic pathologists often encounter emaciated bodies in postmortem examinations. Malnutrition is frequently associated with chronic diseases, which can lead to anorexia and in an increase in nutrient demands of the body [7,8]. In addition, malnourished persons may subsequently

develop acute conditions, such as infection [8]. However, the important or frequent causes of death due to disease are not clear, and measures to prevent unexpected death in malnourished persons have not been established yet because of a lack of large-scale studies concerning such cases.

In this study, we examined the underlying causes of death in a large number of forensic autopsy cases that showed emaciation to clarify the features, and hence determine measures to prevent such deaths in malnourished persons.

2. Materials and methods

All sudden unexpected deaths in the special wards of Tokyo Metropolis are reported to Tokyo Medical Examiner's Office. Medical examiners perform autopsy, when they cannot determine a cause of death from a past history, death course and situational/external investigation of the deceased. We reviewed the documents of autopsy cases handled during 2007–2010 in the Tokyo Medical Examiner's Office ($N = 10,942$). Then, we selected the cases that

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did not show putrefaction and calculated the body mass index (BMI) in each case by using the value of height and weight (n = 7227). To select particularly lean deceased to clarify the features of death cause among malnourished persons, we considered as malnourished cases those with a BMI of <16 (n = 885), because cases with a BMI of <16 are defined as severe underweight according to the World Health Organization classification [9]. Causes of death were classified according to the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) [10]. We used the chi-square test for independence for comparison of causes of death from disease between malnourished cases (BMI < 16) and "less severely malnourished and non-malnourished cases" (BMI ≥ 16). Then, the malnourished cases were divided into four groups according to age (20–54, 55–64, 65–74 and 75–), and the chi-square test for independence was also used to analyze correlation between death cause (or prevalence of psychiatric disease) and age among the malnourished cases. The chi-square test for independence was performed by two means, according to the four age groups and according to the two age groups (under 65 years old, above 65 years old). Values of P < 0.05 were considered statistically significant. The ethical committee of the Tokyo Medical Examiner's Office approved the protocol of this study.

3. Results

3.1. Manner of death and non-disease-related causes of death in malnourished cases

The proportion of the cases with emaciation (BMI < 16) is higher in older deceased persons for both sexes (Fig. 1). Around 70% of all
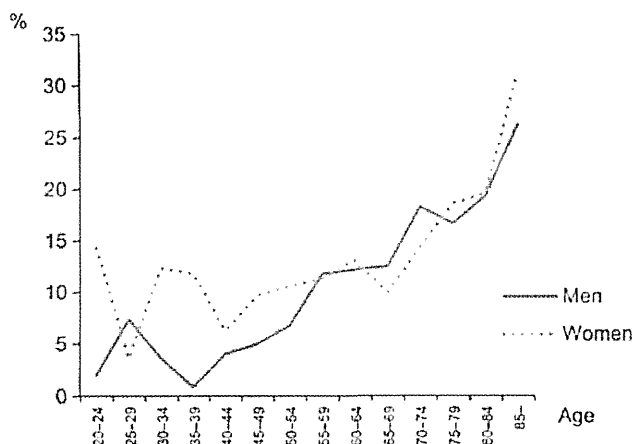

Fig. 1. Proportion of the autopsy cases with emaciation (BMI < 16) across all age groups.

deaths were due to disease irrespective of age group and sex (Table 1).

Among non-disease-related causes of death, two cases were confirmed to be deaths due to starvation. One deceased person was identified as homeless, and another was an elderly woman neglected by her family. In men, around 50% of non-disease-related causes of deaths in those younger than 75 years old was due to hypothermia. Poisoning by sedative or psychotropic drugs was the most frequent cause of death in women under 55 years old (36.8%), with the majority having had a history of psychiatric disease. Blunt trauma due to a fall was the most frequent in older persons for both sexes (42.4% in men, 30.8% in women).

3.2. Disease-related causes of death in malnourished cases

First, we compared the causative diseases of death between the malnourished cases (BMI < 16) and "less severely malnourished and non-malnourished cases" (BMI ≥ 16). Although more than 60% of disease-related deaths were due to circulatory diseases in cases with a BMI of ≥16, the proportion of circulatory diseases was significantly lower in malnourished cases. On the other hand, the proportions of respiratory diseases, neoplasms, and endocrine/nutritional/metabolic diseases were significantly higher in malnourished cases for both sexes than in "less severely malnourished and non-malnourished cases" (Fig. 2a and b). In addition, the proportions of digestive diseases and certain infectious/parasitic diseases were higher in malnourished cases among men (Fig. 2a).

We next compared the proportions of each disease in malnourished cases (BMI < 16) among age groups. In men, the proportion of digestive diseases tended to be higher in younger deceased persons (P = 0.020 according to the four age groups, P = 0.003 according to the two age groups), and the proportion of malnutrition tended to be higher in younger deceased persons (P = 0.028 according to the two age groups, not significant according to the four age group). On the other hand, the proportion of neoplasms tended to be higher in older persons (P = 0.046 according to the four age groups, P = 0.024 according to the two age groups) (Table 2a). In women, the proportion of malnutrition was also higher in younger persons (P < 0.001 by two means) (Table 2b).

Among digestive diseases, alcoholic liver/pancreatic disease was more prevalent in younger persons, especially in men (P = 0.007 according to the four age groups, P = 0.010 according to the two age groups) (Table 3). We noted chronic alcoholism (alcohol dependence) in the history of some cases of alcoholic liver/pancreatic disease in both sexes. On the other hand, the proportion of gastroduodenal ulcer was higher than that of alcohol-related digestive diseases in persons above 55 years old for both sexes. Around 70% of respiratory diseases comprised infectious diseases, mainly pneumonia in both sexes. The majority of infectious/parasitic diseases were respiratory tuberculosis in both sexes.

Table 1
Manner of death according to sex and age group (BMI < 16).

Manner of death	Total case		Age group							
			20–54		55–64		65–74		75–	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Disease	424	224	60	39	134	38	120	46	110	101
	(76.0%)	(68.5%)	(75.0%)	(63.9%)	(77.0%)	(73.1%)	(75.5%)	(79.3%)	(75.9%)	(64.7%)
Non-disease related cause	126	98	17	19	38	14	37	10	34	55
	(22.6%)	(30.0%)	(21.3%)	(31.1%)	(21.8%)	(26.9%)	(23.3%)	(17.2%)	(23.4%)	(35.3%)
Unknown	8	5	3	3	2	0	2	2	1	0
	(1.4%)	(1.5%)	(3.8%)	(4.9%)	(1.1%)		(1.3%)	(3.4%)	(0.7%)	
Total	558	327	80	61	174	52	159	58	145	156
	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)

Parentheses indicate the proportion of the corresponding manner of death to total death in each group.
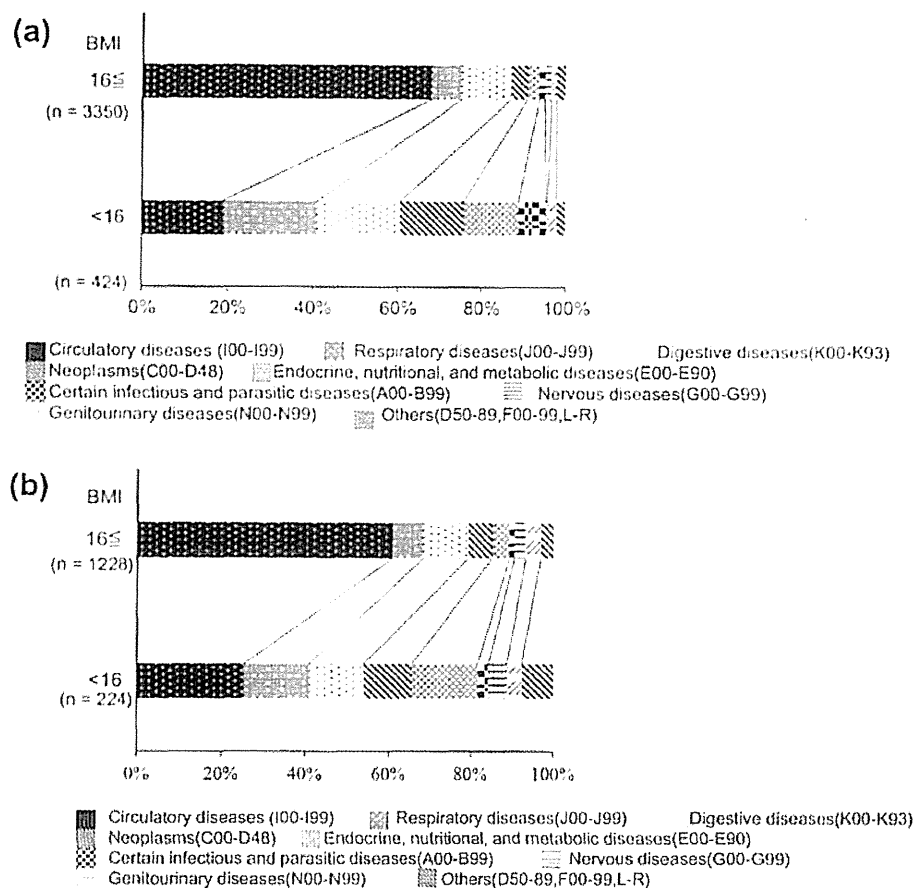
Fig. 2. Comparison of disease-related causes of death between the malnourished cases (BMI < 16) and "less severely malnourished and non-malnourished cases" (BMI ≥ 16). The ICD code for each classification is shown in parenthesis (a: male, b: female).

Third, we examined the medical histories among the cases that were confirmed to be deaths due to malnutrition. Psychiatric disorders, including alcohol dependence, eating disorders, and depression, were the most frequently observed conditions, especially in women. The proportion of psychiatric diseases in women tended to be higher in younger deceased persons ($P = 0.026$ according to the two age groups, not significant according to the four age groups) (Table 4).

4. Discussion

In our previous study on medico-legal diagnosis of deaths in areas without a medical examiner [11], the majority of the cases classified as "death due to malnutrition or starvation" did not undergo autopsy. Physicians may tend to indicate "malnutrition" as the underlying cause of death when the deceased person shows emaciation. However, as shown in this study, the proportion of malnutrition as the underlying cause of death is not as high as expected (only around 10% among disease-related deaths) (Tables 2a and 2b). Thus, the absence of autopsy among such cases might have led to inaccurate mortality statistics, which may have negative implications for public health.

Several important age-associated physiologic changes predispose an elderly person to weight loss, such as declining chemosensory function (smell and taste), reduced efficiency of chewing, and slowed gastric emptying [12,13]. This is evident from the higher proportion of older deceased persons with emaciation in this study. Nevertheless, the causes of death of older persons varied like

in the young and middle-aged groups. Thus, physicians should not readily make diagnoses such as "death due to old age" because various diseases or injuries, and sometimes even neglect, may be the underlying causes of death among the elderly with emaciation.

Although various causes of death were noted among the malnourished cases, we observed several features that could be used as targets for the prevention of future unexpected deaths. About 70% of respiratory-related deaths in malnourished cases (BMI < 16) in this study comprised infections, mainly pneumonia. Several studies have shown the effectiveness of the 23-valent pneumococcal polysaccharide vaccine (PPV) for middle-aged and older adults in preventing pneumococcal pneumonia, the most common respiratory pathogen [14,15]. PPV, together with annual influenza vaccination, may reduce the number of unexpected deaths among the malnourished population.

The higher proportion of psychiatric diseases in women confirmed to have died of malnutrition (under 65 years old), in addition to the higher proportion of deaths due to alcohol-related digestive diseases in men (under 55 years old), suggests that psychiatric diseases may be strongly associated with death among malnourished young or middle-aged persons. On the other hand, a higher proportion of deaths due to organic diseases that may be treatable if detected early, such as neoplasms and gastroduodenal ulcer, was observed in middle-aged or older persons. A better approach toward managing nutritional status for psychiatric patients, early detection of organic disease by means of periodic medical checkups, and improvement in participation rate for medical checkups will be helpful in preventing deaths associated with malnutrition.

Table 2a

Classification of disease according to age group (men; BMI < 16).

Cause of death	Total case	Age group			
		20-54	55-64	65-74	75-
Circulatory disease (I00-I99)	81 (19.1%)	14 (23.3%)	19 (14.2%)	22 (18.3%)	26 (23.6%)
Respiratory disease (J00-J99)	93 (21.9%)	14 (23.3%)	21 (15.7%)	28 (23.3%)	30 (27.3%)
Digestive disease (K00-K99)	83 (19.6%)	13 (21.7%)	37 (27.6%)	16 (13.3%)	17 (15.5%)*
Neoplasms (C00-D48)	64 (15.1%)	4 (6.7%)	17 (12.7%)	26 (21.7%)	17 (15.5%)*
Malnutrition (E40-46, 50-64)	44 (10.4%)	7 (11.7%)	20 (14.9%)	11 (9.2%)	6 (5.5%)
Certain infectious and parasitic diseases (A00-B99)	27 (6.4%)	4 (6.7%)	11 (8.2%)	8 (6.7%)	4 (3.6%)
Others	32 (7.5%)	4 (6.7%)	9 (6.7%)	9 (7.5%)	10 (9.1%)
Total death from disease	424 (100%)	60 (100%)	134 (100%)	120 (100%)	110 (100%)

Parentheses in cause of death indicate ICD code for each classification. Other parentheses indicate the proportion of the corresponding cause of death to total death from disease in each group.
* P < 0.05 (according to the four age groups)

Table 2b

Classification of disease according to age group (women; BMI < 16).

Cause of death	Total case	Age group			
		20-54	55-64	65-74	75-
Circulatory disease (I00-I99)	57 (25.4%)	6 (15.4%)	8 (21.1%)	13 (28.3%)	30 (29.7%)
Respiratory disease (J00-J99)	35 (15.6%)	4 (10.3%)	6 (15.8%)	8 (17.4%)	17 (16.8%)
Digestive disease (K00-K99)	29 (12.9%)	3 (7.7%)	7 (18.4%)	3 (6.5%)	16 (15.8%)
Neoplasms (C00-D48)	26 (11.6%)	5 (12.8%)	2 (5.3%)	5 (10.9%)	14 (13.9%)
Malnutrition (E40-46, 50-64)	29 (12.9%)	12 (30.8%)	8 (21.1%)	7 (15.2%)	2 (2.0%)**
Certain infectious and parasitic diseases (A00-B99)	6 (2.7%)	1 (2.6%)	1 (2.6%)	0	4 (4.0%)
Others	42 (18.8%)	8 (20.5%)	6 (15.8%)	10 (21.7%)	18 (17.8%)
Total death from disease	224 (100%)	39 (100%)	38 (100%)	46 (100%)	101 (100%)

Parentheses in cause of death indicate ICD code for each classification. Other parentheses indicate the proportion of the corresponding cause of death to total death from disease in each group.
** P < 0.01 (according to the four age groups).

Table 3

Subclassification of digestive diseases according to age group (men; BMI < 16).

Cause of death	Total case	Age group			
		20-54	55-64	65-74	75-
Alcoholic liver disease, alcoholic-induced chronic pancreatitis (K70, K86.0)	23 (27.7%)	8 (61.5%)	11 (29.7%)	1 (6.3%)	3 (17.6%)**
Gastroduodenal ulcer (K25, 26)	42 (50.6%)	2 (15.4%)	21 (56.8%)	9 (56.3%)	10 (58.8%)
Others	18 (21.7%)	3 (23.1%)	5 (13.5%)	6 (37.5%)	4 (23.5%)
Total death from digestive diseases	83 (100%)	13 (100%)	37 (100%)	16 (100%)	17 (100%)

Parentheses in cause of death indicate ICD code for each classification. Other parentheses indicate the proportion of the corresponding cause of death to total digestive diseases in each group.
** P < 0.01 (according to the four age groups).

Table 4

The cases having psychiatric diseases among cases confirmed death due to malnutrition (BMI < 16).

Sex	Total case	Age group			
		20-54	55-64	65-74	75-
Women	12	7	4	1	0
	(29, 41.4%)	(12, 58.3%)	(8, 50.0%)	(7, 14.3%)	(2, 0%)
Men	8	2	3	2	1
	(44, 18.2%)	(7, 28.6%)	(20, 15.0%)	(11, 18.2%)	(6, 16.7%)
Both	20	9	7	3	1
	(73, 27.4%)	(19, 47.4%)	(28, 25.0%)	(18, 16.7%)	(8, 12.5%)

Parentheses indicate the total numbers of the cases certified death from malnutrition and the proportions of the cases having psychiatric diseases in each group.

In conclusion, the causes of death among malnourished persons are more varied than those among non-malnourished ones. Thus, physicians have to pay more attention in making a death diagnosis in such cases. From a preventative point of view, early detection of organic diseases, a better approach toward managing psychiatric diseases, and implementation of vaccination to prevent pneumonia will contribute to reducing future unexpected deaths associated with malnutrition.

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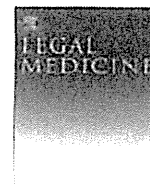
Medicolegal death of homeless persons in Tokyo Metropolis over 12 years (1999–2010)

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ABSTRACT

Background: Recently, the number of homeless persons in Japan has steadily decreased. However, it is not certain whether unexpected death of the homeless have actually decreased in proportion to decrease in total number of cases.

Methods: The documentation of medicolegal deaths among homeless persons handled in the Tokyo Medical Examiner's Office during 1999–2010 were reviewed, and we compared the number and manner/cause of death between cases occurring before 2004 and those occurring after 2004. In addition, we compared manner/cause of death between homeless and non-homeless persons.

Results: The number of medicolegal deaths of homeless persons remained almost the same during the study period in spite of a marked decrease in the total number of homeless persons after 2004. Age distribution shifted to older after 2004, and a higher proportion of the deceased had longer postmortem periods after 2004. Comparison between the manners/causes of death of the cases occurring before 2004 and those occurring after 2004 showed little difference. Disease constituted about 70% of all cases, and causes of death from disease were more various than those of non-homeless persons. Certain specific patterns included a higher proportion of death from circulatory disease in elderly homeless persons and a higher proportion of death from alcohol-related digestive disease and tuberculosis among younger homeless persons. Regarding accidental death, hypothermia was a leading cause of death irrespective of age group.

Conclusion: Aging and isolation among homeless persons might contribute to an unchanged number of medicolegal death of them. In addition to measures to address frequent causes of death in each age group, better intervention for isolated homeless persons might be a key factor to prevent unexpected deaths of homeless persons in the future.

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1. Introduction

The number of homeless persons in Japan increased during the 1990s, when the bubble economy collapsed, and homelessness became a major social problem in Japan at the beginning of the 21st century, as in most other countries [1,2]. Many homeless people lack health insurance and obtain medical care only sporadically, resulting in them being undertreated for common medical problems [3]. Indeed, homeless people are reported to die from a variety of preventable causes, such as pulmonary tuberculosis, in other countries [4–6]. Similarly, a previous study conducted in 2000 in Osaka City, the second largest city in Japan, showed that many homeless people died untimely deaths from preventable causes such as pneumonia, malnutrition, and starvation [2]. After that,

the Japanese government closely examined the actual situation of the homeless in 2003, finding that 47.4% of homeless people had some physical complaint and that majority of them did not have access to medical treatment [1].

Accordingly, the Japanese government and that of each municipality started to take comprehensive measures to address homeless problems, such as supplying temporary shelters, providing jobs, and securing health guidance/medical consulting [7]. As a result, the number of homeless persons in Japan has steadily decreased from 25,296 (in 2003) to 10,209 (in 2011) [1,8]. However, it is not certain whether health problems among homeless people have improved in accordance with the decrease in total number of homeless persons. In this study, we investigated changes in the number and manner/cause of death in cases of medicolegal death of homeless persons in the special wards of Tokyo Metropolis during 1999–2010, when a marked decrease in the total number of homeless persons was observed. This study aims to contribute to future improved health strategies for homeless persons by clarifying the nature of critical health problems among them.

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