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Clinical Section

Gerontology

Gerontology 2008;54:260–267
DOI: 10.1159/000134286

Received: September 20, 2007
Accepted: February 19, 2008
Published online: May 21, 2008

Serum C-Reactive Protein Even at Very Low (<1.0 mg/l) Concentration Is Associated with Physical Performance in a Community-Based Elderly Population Aged 70 Years and Over

Kaijun Niu[a] Atsushi Hozawa[e] Hui Guo[a] Shinichi Kuriyama[b] Satoru Ebihara[c] Guang Yang[a] Kaori Ohmori-Matsuda[b] Naoki Nakaya[b] Hideko Takahashi[b] Kazuki Fujita[d] Shirong Wen[c] Hiroyuki Arai[c] Ichiro Tsuji[b] Ryoichi Nagatomi[a]

[a]Department of Medicine and Science in Sports and Exercise, [b]Department of Public Health and Forensic Medicine, [c]Department of Geriatrics and Gerontology, Tohoku University Graduate School of Medicine, [d]Division of Life Sciences, Kansei Fukushi Research Center, Tohoku Fukushi University, Sendai, [e]Department of Health Science, Shiga University of Medical Science, Shiga, Japan

Key Words
Physical performance · Inflammation · High-sensitivity C-reactive protein

Abstract
Background: Although several studies have reported that C-reactive protein (CRP) is associated with physical performance, few studies have evaluated the relationships between CRP and physical performance among subjects who had a very low range of CRP. Therefore, it is still unclear whether a lower CRP is favorably associated with physical performance even within a very low range. ***Objective:*** The aim of this study was to investigate the relationships between CRP and physical performance among a Japanese population with a low serum CRP concentration (CRP <1.0 mg/l). ***Methods:*** We designed a cross-sectional survey for 775 persons aged 70 years and older living in Japan. High-sensitivity CRP was measured using a nephelometric method. The subjects whose serum CRP concentrations were higher than 10.0 mg/l were excluded. Physical performance was assessed using a 10-meter maximum walk test, leg extension power, and a timed 'up and go' test. ***Results:*** The median value (interquartile range) of CRP was 0.55 (0.29–1.20) mg/l. After adjustment for potential confounding factors, an inverse relation of CRP with the 10-meter maximum walk test and leg power was observed in all subjects (p for trend = 0.10 and 0.04, respectively). For subjects who had a CRP <1.0 mg/l, these inverse relations were unchanged (p for trend = 0.03 and 0.02, respectively). ***Conclusions:*** Serum CRP concentration is favorably related to physical performance, even within a very low range in a community-based elderly population aged 70 years and over. The findings suggest that maintaining as low CRP levels as possible may potentially maintain better physical performance.

Introduction

Aging is associated with decreased skeletal muscle mass, quality and function [1–4] that negatively impact quality of life and may eventually compromise independence [5, 6]. An accelerated decline in muscle mass and

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Kaijun Niu, MD, PhD
Department of Medicine and Science in Sports and Exercise
Tohoku University Graduate School of Medicine, 2-1 Seiryo-machi, Aoba-ku
Sendai 980-8575 (Japan)
Tel./Fax +81 22 717 8589, E-Mail ggg@mail.tains.tohoku.ac.jp

strength with aging is probably one of the major causes of disability in late life [7, 8].

A chronic inflammatory state has been proposed that may be detrimental by accelerating the progression of medical conditions that result in functional decline and disability [9, 10]. Furthermore, a direct role of inflammation in the development of disability can be hypothesized based on the catabolic effects that proinflammatory cytokines may have on muscles [11]. A biological mechanism recently proposed to underlie the decline in physical function is chronic inflammation [9, 12]. Therefore, relatively high-inflammatory levels have been hypothesized to play a role in the reduction of skeletal muscle mass and physical function among the elderly.

C-reactive protein (CRP) is a classical acute-phase marker and a member of the pentraxin family of innate immune response proteins [13]. The concentration of CRP in serum is generally <2 mg/l but increases by as much as 1,000-fold in response to stimuli such as tissue injury or inflammation [14]. Following removal of the inflammatory stimulus, CRP levels decline rapidly. These features have made CRP useful as a clinical marker of an inflammatory process. Recent studies have particularly focused on CRP as measured by a high sensitivity assay (hsCRP) [15]. High-sensitivity CRP detects the same CRP molecule as older CRP tests, but its lower limit of detection is substantially lower and it can therefore detect lower levels of inflammation [15].

Several epidemiological studies assessed the relationship between CRP and physical performance in an elderly population [9, 16–19]. Although these observational studies have demonstrated that there is an inverse association of serum CRP concentrations with physical performance, the serum CRP concentration in these studies was higher than it is in the Japanese [20–25]. Our previous study showed that a higher consumption of fish may be contributing to the lower serum CRP concentrations among the older Japanese population [26]. Moreover, although the CRP concentrations of <1.0, 1.0–3.0 and >3.0 mg/l have been associated with low, intermediate and high risk, respectively, for coronary heart disease (CHD) [27], serum CRP concentration may be positively associated with a preclinical inflammation status even within a very low range. However, few studies have reported the relationship between a very low range of serum CRP concentration and physical performance. Therefore, it is still unclear whether the serum CRP concentration is associated with physical performance even within a very low range.

Thus, to investigate whether lower serum CRP relates to a favorable physical performance even at concentrations <1.0 mg/l, we designed a cross-sectional study in a Japanese elderly population.

Subjects and Methods

Study Participants

Our study population was composed of subjects aged 70 years and older who were living in the Tsurugaya area of Sendai, one of the major cities in the Tohoku area of Northern Japan. At the time of the study in 2002, there were 2,730 individuals aged 70 years and older living in Tsurugaya. All of these individuals were invited to participate in a comprehensive geriatric assessment, which included medical status, physical function, cognitive function and dental status and 1,178 of them accepted, giving their informed consent for data analysis. The protocol of this study was approved by the Institutional Review Board of the Tohoku University Graduate School of Medicine.

We excluded subjects whose hsCRP had not been measured (n = 29). Those subjects whose serum CRP concentrations were higher than 10.0 mg/l (n = 35) were also excluded, because people with acute inflammatory conditions frequently have serum CRP concentrations ≥10.0 mg/l [28]. In addition, subjects who did not complete the measurement on the physical performance test were excluded (n = 89), as were all potential subjects with notable comorbidity factors that might influence the frequency and degree of physical activity by self-reported arthritis (n = 163) or a history of stroke (n = 39), as well as 48 subjects with peripheral arterial disease (PAD; lowest leg ankle brachial index, ABI, <0.90). As a result of these exclusions, the final study population was composed of 775 subjects [age 75.9 ± 4.7 years (mean ± standard deviation, SD); men: 43.0%].

Measurement of Serum CRP

The CRP concentrations were determined using an immunotechnique on a Behring BN II analyzer (Dade Behring, Tokyo, Japan). The BN II high sensitivity assay utilizes a monoclonal antibody coated on polystyrene particles and fixed-time kinetic nephelometric measurements [29]. The detection limit of this assay is 0.02 mg/l.

Physical Performance Tests

Physical performance was measured with three tests: 10-meter maximum walk test, leg extension power and a timed up and go test. The physical performance tests were measured by a well-trained physiotherapist as follows:

- Ten-meter maximum walk test [30]: Each participant was asked to walk 10 m at maximum walking speed. A stopwatch was used for timing, and a counter was used to obtain the number of steps. To eliminate periods of acceleration and deceleration, the subjects started their laps 3 m before the beginning of the walkway and concluded them 3 m beyond its end. The test was repeated three times, and the data of the fastest walk were recorded. These data were used to determine each subject's maximum walking speed in meters per second.

- Leg extension power: The participants were placed well back on a seat, and the waist was fixed with a belt. The knee joint was angled at 90°. The isometric contractions lasted for 5 s each and were separated by 15-second rest intervals. Peak power was detected, calculated, and recorded in watts by a microcomputer. The average of the two highest measurements among 5 trials was recorded as 'isometric strength performance' (Aneropress 3500, Combi Wellness, Tokyo). To minimize differences in body mass, leg extension power was expressed as the average peak of the leg relative to body weight (W/kg).
- Timed 'up and go' test [31]: The participants were seated in a free-standing padded armchair (46 cm high) and asked to rise (with or without using the arm rests), walk to a mark 3 m away, turn around, and walk back to the chair and sit down. The time between rising from the seat and making contact with the back of the seat was measured in seconds. This test was repeated three times and the time of the fastest trial was recorded.

Assessment of Other Variables

Anthropometrics (height, body weight) were recorded using a standardized protocol. Body mass index (BMI) was calculated as weight (kg)/height (m)^2. Blood pressure (BP) was measured at home with an HEM7471C device (Omron Life Science Co. Ltd, Tokyo, Japan), which uses the cuff-oscillometric method to generate a digital display of systolic and diastolic pressures. The mean of 15.6 ± 10.5 (SD) BP measurements were used as the BP values. Participants who did not measure their home BP on at least 3 days were treated as having missing information on hypertension. The ABI was measured using established methods [32]. The lowest leg ABI was used in this study.

Blood samples were drawn from the antecubital vein of the seated subject with minimal tourniquet use. Specimens were collected in siliconized vacuum glass tubes containing sodium fluoride for blood glucose, and no additives for albumin, lipids and CRP analyses.

Total cholesterol (T-C), high-density lipoprotein cholesterol (HDL-C) concentrations and blood glucose concentrations were measured by enzymatic methods (T-C, Denka Seiken, Tokyo, Japan; HDL-C, Daiichi Pure Chemicals, Tokyo, Japan; blood glucose, Shino-Test, Tokyo, Japan). Information on smoking status, drinking status, use of medication and histories of prior CHD, cancer and stroke were obtained from the questionnaire survey. The drug information was confirmed by a well-trained pharmacist. All individuals were told to bring their own drug to the scene of the conduct, and were checked and recorded by pharmacist. The 30-item Geriatric Depression Scale (GDS) [33] was used to assess depressive symptoms. Cognitive functioning was measured with the Mini-Mental State Examination (MMSE) [34]. The mean daily intake of nutrients including energy and n-3 polyunsaturated fatty acids (n-3 PUFA), was obtained from a brief self-administered diet-history questionnaire [35]. Detailed information is provided in our previous reports [26].

Definitions of Variables

We categorized the study participants on the basis of the recently proposed cutoff points for CRP as having low concentrations (<1.0 mg/l) or high concentrations (at least 1.0 mg/l) [35, 36].

Hypertension was defined as a home systolic BP (SBP) of 135 mm Hg or over and/or a home diastolic BP (DBP) of 85 mm Hg or over or use of antihypertensive agents [37]. Diabetes was defined as a casual blood glucose concentration of 200 mg/dl or over or current use of an antidiabetic medication. Hypercholesterolemia was defined as a concentration of T-C of 220 mg/dl or over, or current use of nonstatin lipid-lowering agents. We treated statin agents as independent confounding factors because they have been reported to lower CRP concentrations [38].

Physical activity (PA) was assessed first by a self-reported single-item question on whether the participant obtained any PA in the past year. If yes, questions were asked about the frequency and duration of walking, brisk walking, and sports. PA was then classified into 3 categories based on the frequency and duration in the participant: (1) High, at least 3–4 times per week for at least 30 min each time; (2) Low, reporting some activity in the past year, but not enough to meet high levels, and (3) None, no PA. PA was then further classified into six levels based on the above three categories and each physical activity such as walking, brisk walking, and sports: (1) Level 1, no walking, no brisk walking, no sports; (2) Level 2, low walking, no brisk walking, no sports; (3) Level 3, high walking, no brisk walking, no sports; (4) Level 4, any walking, low brisk walking, no sports; (5) Level 5, any walking, high brisk walking, no sports; (6) Level 6, any walking, any brisk walking, low or high sports. Detailed information is provided in previous reports [39]. Finally, the subjects were divided into two categories: level 3 or lower or higher than level 3. A GDS score of ≥11 was used to indicate depressive symptoms [40]. An MMSE score of <26 was used to indicate cognitive impairment [41].

Statistical Analysis

Descriptive data are presented as means (95% confidence interval, 95% CI) or percentages. The values of the physical performance measurement were used as the dependent variable and the serum CRP concentration level as the independent variable. The CRP levels were categorized as follows: CRP ≥1.0 mg/l and the tertiles of CRP <1.0 mg/l. The differences in variables among the CRP groups were examined by analysis of covariance (ANCOVA) for continuous variables or by multiple logistic regression analysis for variables of proportion after adjustment for age and sex. ANCOVA was used to examine the relation of CRP with physical performance after adjustment for age, sex, BMI, serum albumin concentration, hypercholesterolemia (nonstatin drugs), low HDL cholesterol (≤40 mg/dl), history of CHD, hypertension, diabetes, history of cancer, depressive symptoms, impaired cognitive function, smoking habits/history, PA, use of nonsteroidal anti-inflammatory drugs (NSAIDs), statin drugs, aspirin, angiotensin-converting enzyme inhibitors and n-3 PUFA intake levels (the consumption of n-3 PUFA per 2,000 kcal of energy intake categorized in tertiles) in all subjects or in subjects who had a very low serum CRP concentration (<1.0 mg/l). All p values for linear trend across the tertile of CRP and CRP >1.0 mg/l group were calculated by using the median of each CRP group. Tukey post-hoc analysis also was conducted. The interactions were assessed by testing the interaction term added to the adjusted model as a covariate. Furthermore, multiple linear regression analysis was used to establish the relationship between log-transformed CRP levels, treated as a continuous variable and physical performance after adjustment for the same covari-

Table 1. Age- and sex-adjusted baseline characteristics according to serum CRP levels (n = 775)

	CRP tertiles, mg/l			CRP 1.01–9.92 mg/l	p for trend[a]
	0.05–0.28	0.28–0.51	0.51–1.00		
Participants	181	182	182	230	–
Age, years[b]	75.51 (74.82–76.2)	76.19 (75.51–76.88)	75.96 (75.28–76.65)	75.68 (75.06–76.29)	0.36
Males, %	38.1	44.0	45.1	44.4	0.44
BMI[b]	22.05 (21.60–22.50)	23.33 (22.88–23.77)	24.37 (23.93–24.82)	24.86 (24.46–25.26)	<0.0001
Albumin, g/dl[b]	4.33 (4.29–4.37)	4.36 (4.32–4.39)	4.36 (4.32–4.39)	4.32 (4.29–4.36)	0.31
Hypercholesterolemia, %	28.2	33.0	37.4	43.5	<0.001
Low HDL cholesterol (≤ 40 mg/dl), %	7.7	7.7	13.2	14.8	0.02
History of CHD, %	6.6	10.4	11.0	10.4	0.44
Hypertension, %	54.7	68.1	72.0	75.2	<0.001
Diabetes, %	3.9	8.2	11.0	12.2	0.01
History of cancer, %	6.6	7.7	2.8	7.4	0.68
Depressive symptoms (GDS ≥ 11), %	35.9	25.3	30.2	28.7	0.58
Cognitively impaired (MMSE < 26), %	18.2	13.2	18.7	15.2	0.77
Smoker					
Current smoker, %	12.2	9.9	11.5	17.4	0.03
Ex-smoker, %	20.4	33.0	33.5	32.6	0.17
Nonsmoker, %	67.4	57.1	55.0	50.0	<0.001
Drinking					
Current drinker, %	44.3	45.6	42.3	41.4	0.26
Ex-drinker, %	8.6	13.0	12.0	14.1	0.21
Nondrinker, %	47.1	41.4	45.7	44.5	0.70
Use of NSAIDs, %	9.9	13.2	13.7	11.7	0.90
Use of statin drugs, %	13.8	12.6	17.0	14.8	0.69
Use of aspirin drugs, %	4.4	9.9	6.6	11.3	0.04
Use of ACE inhibitors, %	5.0	6.0	7.7	8.3	0.22
n-3 PUFA intake, g/day × 2,000 kcal	3.42 (3.27–3.58)	3.38 (3.23–3.53)	3.52 (3.36–3.67)	3.26 (3.13–3.40)	0.41

ACE = Angiotensin-converting enzyme.
[a] Analysis of covariance (age, albumin and BMI) or multiple logistic regression adjusted for age and sex where appropriate.
[b] Adjusted least squares mean (95% CI).

ates. When we calculated log-transformed CRP, 1.0 was added [CRP value (mg/l) + 1] before transformation. A significant difference was defined as $p < 0.05$. All statistical analyses were performed using Statistical Analysis System 9.1 edition for Windows (SAS Institute Inc., Cary, N.C., USA).

Results

In this study, the subjects whose serum CRP concentrations were higher than 10.0 mg/l were excluded. The median value (interquartile range) of CRP was 0.55 (0.29–1.20) mg/l.

Age- and sex-adjusted baseline characteristics according to the tertiles of a serum CRP concentration <1.0 mg/l or >1.0 mg/l are presented in table 1. Mean BMI was significantly higher across CRP levels (p for trend <0.0001). The prevalence of hypercholesterolemia, low HDL cholesterol, hypertension, diabetes and the use of aspirin drugs were significantly larger in the higher CRP levels (p for trend ≤0.04). The proportion of nonsmokers was significantly lower in the higher CRP levels (p for trend <0.001). In contrast, the proportion of current smokers was significantly higher in the higher CRP levels (p for trend = 0.03). Otherwise, no significant difference was observed among CRP levels (p for trend ≥0.17).

Table 2 shows the adjusted association between CRP level and physical performance. After adjustment for potential confounding factors, the significant inverse relation of the CRP level with leg power was observed in all subjects. Similarly, although not statistically significant, increasing CRP levels tended to relate inversely to 10-meter walk at maximum speed (p for trend = 0.10). For subjects who had CRP <1.0 mg/l, the CRP levels showed a significant inverse relationship with 10-meter walk at maximum speed (p for trend = 0.03) and leg power (p for

Table 2. Adjusted C-reactive protein levels in relation to physical activity

	CRP tertiles, mg/l			CRP 1.01–9.92 mg/l	p for trend	p for trend[b]
	0.05–0.28	0.28–0.51	0.51–1.00			
Participants	181	182	182	230	–	–
Ten-meter walk at max. speed, m/s						
Age-, sex-adjusted	1.80 (1.76–1.85)	1.75 (1.71–1.79)	1.73 (1.68–1.77)	1.69 (1.65–1.72)	<0.01	<0.01
Multiple adjusted[a]	1.44 (1.23–1.66)	1.40 (1.19–1.61)	1.39 (1.18–1.60)	1.36 (1.15–1.57)	0.10	0.03
Leg power, W/kg						
Age-, sex-adjusted	11.49 (11.03–11.95)	11.07 (10.61–11.52)	10.35 (9.90–10.81)	10.32 (9.91–10.73)	<0.001	<0.001
Multiple adjusted[a]	9.23 (6.92–11.53)	9.05 (6.76–11.34)	8.57 (6.32–10.81)	8.64 (6.37–10.91)	0.04	0.02
Timed up and go, s						
Age-, sex-adjusted	9.29 (8.98–9.59)	9.22 (8.92–9.52)	9.10 (8.8–9.41)	9.56 (9.29–9.83)	0.41	0.42
Multiple adjusted[a]	11.92 (10.37–13.47)	11.80 (10.26–13.35)	11.57 (10.05–13.08)	11.99 (10.46–13.52)	0.11	0.16

Variables are presented as least squares means (95% CI).

[a] Adjusted for age, sex, body mass index, serum albumin concentration, hypercholesterolemia (nonstatin drugs), low high-density lipoprotein-cholesterol (≤40 mg/dl), history of coronary heart diseases, history of cancer, hypertension, diabetes, depressive symptoms, impaired cognitive function, smoking habits/history, PA, use of nonsteroidal anti-inflammatory drugs, statin drugs, aspirin, angiotensin-converting enzyme inhibitors and tertile of n-3 polyunsaturated fatty acids intake.

[b] Only for subjects who had a C-reactive protein <1.0 mg/l.

trend = 0.02). No relation was found between the tertiles of serum CRP concentration <1.0 mg/l, >1.0 mg/l and timed up and go test in all models (p for trend ≥0.11). Furthermore, because the test for interaction between CRP levels and sex was statistically significant (p for interaction for 10-meter walk at maximum speed: 0.02; p for interaction for leg power: 0.04), we conducted stratified analysis for sex. Although not statistically significant, increasing CRP levels had a stronger relationship with 10-meter walk at maximum speed (p for trend = 0.23) and leg power (p for trend = 0.16) in men as compared to women (p for trend = 0.60 and 0.35, respectively).

The multiple regression model analysis also showed an inverse and significant relationship between log-transformed CRP and leg power (standard regression coefficient = −0.07, p = 0.03) after adjustment for covariates in table 2 in subjects who had CRP <1.0 mg/l. Although not statistically significant, log-transformed CRP was inversely related to 10-meter walk at maximum speed (standard regression coefficient = −0.06, p = 0.09). In contrast, no relation was found between log-transformed CRP and TUGT (standard regression coefficient = −0.05, p = 0.19).

Discussion

In this cross-sectional study, we examined the relationship between serum CRP concentrations and physical performance in an elderly Japanese population. We also examined the relationship between CRP and physical performance in subjects with a serum CRP concentration <1.0 mg/l. These results suggested that a lower serum CRP concentration is favorably associated with physical performance even within a very low range.

The comparisons of the various inflammatory markers, including soluble adhesion molecules (e.g. E-selectin, P-selectin, intracellular adhesion molecule-1, vascular cell adhesion molecule-1), cytokines (e.g. interleukin-1β, -6, -8, and -10 and tumor necrosis factor-α), acute phase reactants (e.g. fibrinogen, serum amyloid A protein and hs-CRP) and WBC count, favor CRP from the clinical chemistry perspective [27]. Although the detection of elevated levels of CRP in the serum is not specific for any particular disease, it is a useful indicator of inflammatory processes [42]. High-sensitivity CRP is the term applied to a test that detects serum CRP concentration at lower levels than previous generations of laboratory tests. The lower limit of detection is substantially lower and can therefore detect lower levels of inflammation. In Western countries, the concentrations of CRP are proposed to be <1.0 mg/l as low risk, 1.0–3.0 mg/l as intermediate risk, and >3.0 mg/l as high risk for CHD [27]. Nonetheless, the current results suggested that high CRP also is independently related to poorer physical performance in elderly populations who have a serum CRP concentration <1.0 mg/l.

Several epidemiological studies assessed the relationship between CRP and physical performance [9, 16–19].

Most of these studies reported an inverse relation between CRP and physical performance or disability. However, the level of serum CRP was remarkably higher in these studies compared to the present study. In three of these studies, hsCRP was not used [9, 16, 17]. Only two studies used hsCRP to assess the relationship between CRP and physical performance [18, 19]. McDermott et al. [18] reported that higher CRP levels were associated with lower physical performance among subjects with PAD but not among those without non-PAD. Another cross-sectional study used hsCRP to assess that the relationship between CRP and physical performance in a community-based elderly population aged ≥60 years, but in their study, several confounding factors such as use of NSAIDs [43], statin drugs [38], and PAD [18, 35] associated with CRP were not considered [19]. Moreover, although multiple linear regression was conducted to assess the natural-log-transformed CRP and physical performance in their study, it was not shown whether the CRP also is associated with physical performance even within a very low rang (CRP <1.0 mg/l). Compared with these studies, hsCRP was used in this study, and the median CRP value of 0.55 mg/l of our participants was lower. This population with low CRP and hsCRP measure gave us an opportunity to examine the relationship between a very low range of CRP and physical performance. In the current study, we found that the serum CRP concentration is inversely associated with physical performance, even within a very low range (CRP <1.0 mg/l). Therefore, maintaining lower CRP levels may be important in clinical or subclinical practice. However, whether reducing inflammatory status by use of a drug will lead to a reduced risk of dependency in old age remains to be an important research question.

Since the concentrations of CRP are proposed to be <1.0 mg/l as low risk, 1.0–3.0 mg/l as intermediate risk, and >3.0 mg/l as high risk for CHD [27], the current results have also shown that levels associated with risk of coronary artery disease may be less sensitive than muscular performance for those participants with CRP <1.0 mg/l.

Although the association of CRP and disability or mortality has been proven by a large number of studies [9, 16–19], a direct mechanistic impact of CRP on mortality or disability has to be regarded as still doubtful. The underlying processes may have certainly more impact on risk factors and functionality than CRP. For example, the BMI is known to relate to the length of life with disability before death or severity of disability [44]. Because the BMI has been strongly associated with the serum CRP levels [45], the present study suggests that one possible pathway by which the control of BMI may reduce these risks is through decreasing serum CRP levels. Further study is required to explore the mechanisms that are involved in the associations.

We did not find significant associations between CRP and TUGT. Since TUGT [31] was not a test concerning peak physical performance as compared to 10-meter maximum walk test and leg extension power, CRP may be sensitively associated with peak physical performance within a very low range.

This study had several limitations. First, since all assessment was carried out in a public facility, participants were sufficiently active and healthy. Therefore, our results may not represent an elderly general population. Second, since this study was a cross-sectional study, we were not able to infer causality from our results. Still, several prospective studies suggested that CRP was associated with a decline in physical performance [9, 16, 17]. Therefore, the current results may be reliable. Further, although compared to those without fractures, individuals with a hip, arm, or clinical spinal fracture have shown similar global declines in physical performance [46], the results were not adjusted for fracture status because of a lack of information.

In summary, a lower serum CRP concentration is favorably related to physical performance, even within a very low range. The findings suggest that maintaining CRP levels as low as possible may potentially maintain better physical performance.

Acknowledgments

This study was supported by a Grant-in-Aid for Scientific Research (13557031) and by a Grant for Research Conducted by the Japanese Society for Promotion of Science (14010301) from the Ministry of Education, Culture, Sports, Science and Technology of Japan, by Research Grants (2002, 2003) from the Japan Atherosclerosis Prevention Fund, and by a Health Science Grant on Health Services (H16-seisaku-023) and a Grant for Comprehensive Research on Aging and Health (H16-choju-016) from the Ministry of Health, Labor and Welfare of Japan.

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A. Touati[a,*]
L. Brasme[b]
S. Benallaoua[a]
J. Madoux[b]
A. Gharout[a]
C. de Champs[b]
[a]*Laboratoire de microbiologie appliquée, FSNV, Université A/MIRA de Béjaia, Algérie*
[b]*Laboratoire de Bactériologie-Virologie-Hygiène Hospitalière, CHU Reims, Hôpital Robert Debre, Reims, France*
E-mail address: ziz1999@yahoo.fr

Available online 14 January 2008

* Corresponding author. Address: Laboratoire de microbiologie appliquée, FSNV, Université A/MIRA de Béjaia, 06000, Algérie. Tel./fax: +213 34 21 47 62.

doi:10.1016/j.jhin.2007.11.001

Infection and its control in group homes for the elderly in Japan

Madam,

Following the implementation in Japan of a new, long-term care insurance system in April 2000, the number of small-scale facilities known as group homes has risen rapidly to more than 6000. These homes, which provide an alternative to traditional, larger-scale long-term care facilities for elderly demented people, are regulated by the municipality. The municipality is responsible for assigning, supervising and instructing all group home employers. Compared with care at traditional, larger-scale facilities, care at small-scale group homes is believed to treat patients better primarily in terms of dementia symptom management and minimizing functional decline.

Recently, mass outbreaks of influenza and norovirus in senior care facilities have been reported in many regions.[1–3] Small-scale facilities have paid less attention to infection control than large-scale ones and were unequipped with manuals outlining policies for the prevention of infectious diseases. Therefore, we examined the actual conditions of infection and the systems of infection control in small-scale care facilities in Japan.

Questionnaires were sent to 1899 care facilities registered with the National Association of Dementia Group Homes throughout Japan to investigate infection control measures at each facility. Discussions were held with community-based service representatives, including municipal supervisors and instructors as well as infection control specialists; and inspections of small-scale multifunctional group homes, dementia group homes, and group homes for fewer than 29 people needing heavy care were conducted to examine the current situation from multiple perspectives.

In all, 684 facilities (36%) completed the questionnaires. As shown in Figure 1, 26% of facilities had residents who had been infected with influenza, 14.5% with scabies, 12% with norovirus and 8.2% with meticillin-resistant *Staphylococcus aureus* (MRSA). These four communicable diseases were frequently found in residents. The mass outbreaks

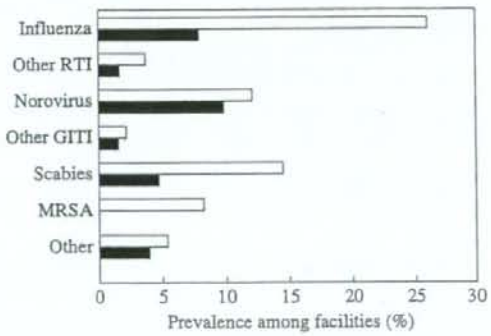

Figure 1 Prevalence of infections and outbreaks among the facilities. Open bars show the prevalence of facilities which had residents who suffered from the infection indicated. Closed bars show the prevalence of facilities which experienced mass outbreaks of infection indicated. 'Other RTI' denotes respiratory tract infections other than influenza and meticillin-resistant *Staphylococcus aureus* (MRSA). 'Other GITI' denotes gastrointestinal tract infections other than norovirus and MRSA. 'Other' denotes infection in organs other than the respiratory tract and the gastrointestinal tract.

reported in these facilities were norovirus (9.8%), influenza (7.9%) and scabies (4.7%) (Figure 1). Influenza vaccination was provided to all employees and residents upon request, in most facilities. Although facilities did not experience any mass outbreaks of MRSA, the procedures to cope with MRSA differed among facilities; 10.1% failed to address MRSA, 3.9% isolated infected/colonised individuals in a room while 3.5% used gowns and pre-prepared disinfectant. Regarding the response following norovirus infection, 90.1% of facilities used gloves but only 60.1% used masks when disposing of vomit. In all, 26.9% of facilities kept pets, 11.6% kept dogs, 4.7% kept cats and 0.3% kept reptiles that are known to be carriers of *Salmonella* spp. Although most facilities reported policies addressing the collection of bodily fluids, blood and faeces for disposal, no standardized policies outlining final disposal methods were reported; 60% of facilities disposed of them as general refuse. Oral care, which is considered to have an effect in preventing pneumonia, was done regularly by dentists or hygienists in 22.4% of facilities. It was also revealed that even though many facilities implemented response measures to stop the spread of influenza, they experienced mass outbreaks of norovirus, influenza and scabies. Improvement is needed especially in the disposal of infectious waste since many facilities did not use masks when disposing of norovirus vomit.

We conclude that improvement in the management of infectious disease in small-scale facilities for elderly people in Japan is needed. The problems highlighted in this research show the need for developing standardized infectious disease control strategies and for creating a manual that outlines detailed measures designed to specifically meet the needs of small-scale group homes in Japan.

Conflict of interest statement
None declared.

Funding sources
Grant from the Ministry of Health, Labor and Welfare.

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S. Ebihara[a,b,*]
J. Aida[a]
S. Freeman[b]
K. Osaka[a]
[a]*Department of International Oral Health, Tohoku University School of Dentistry, Sendai, Japan*
[b]*Department of Geriatrics and Gerontology, Tohoku University School of Medicine, Sendai, Japan*
E-mail address: s_ebihara@geriat.med.tohoku.ac.jp

Available online 16 January 2008

* Corresponding author. Address: Department of Geriatrics and Gerontology, Tohoku University School of Medicine, Seiryo-machi 1-1, Aoba-ku, Sendai 980-8574, Japan. Tel: +81 22 717 7182; fax: +81 22 717 7186.

doi:10.1016/j.jhin.2007.11.009

Meticillin-resistant *Staphylococcus aureus* in the community: homeless are also at risk

Madam,

Thomas *et al.* recently identified the district nurse population as a significant reservoir for meticillin-resistant *Staphylococcus aureus* (MRSA) in the community, with 21.1% [confidence interval (CI): 11.6–30.4] of the study population found to be MRSA positive.[1] Other population groups known to be at risk of community MRSA colonisation or infection include military recruits, sports teams players, men who have sex with men, people in jail, injecting drug users (IDUs) and the homeless. Current or past IDUs and a history of skin abscess is associated with a higher prevalence of meticillin resistance in those who are *S. aureus*-colonised.[2–5] Studies from the USA have shown that the homeless are at a significantly increased risk (odds ratio: 3.35; 95% confidence interval: 1.22–9.22) of community-acquired MRSA skin and soft tissue infections compared with the non-homeless.[3,4] To our knowledge, we present the first assessment of skin and soft tissue infections due to MRSA in people who are homeless or at risk of homelessness in the UK.

We identified all wound swabs routinely submitted to the Health Protection Agency Regional Microbiology Laboratory in Cambridge over a period of four years (3 August 2003 to 3 August 2007) from

Original Article

Home Blood Pressure Is Associated with Depressive Symptoms in an Elderly Population Aged 70 Years and Over: A Population-Based, Cross-Sectional Analysis

Kaijun NIU[1], Atsushi HOZAWA[2),3)], Shuichi AWATA[4], Hui GUO[1], Shinichi KURIYAMA[2], Toru SEKI[4], Kaori OHMORI-MATSUDA[2], Naoki NAKAYA[2], Satoru EBIHARA[5], Yun WANG[1], Ichiro TSUJI[2], and Ryoichi NAGATOMI[1]

Although several epidemiologic studies have assessed the relationship between low blood pressure and depressive symptoms in geriatric populations, the results have been inconsistent. Because the white-coat phenomenon is observed frequently in patients with depressive symptoms, we have considered that blood pressure measured in nonmedical settings is important in assessing the relationship between blood pressure and depressive symptoms among the geriatric population. The aim of this study was to investigate the relationships between home blood pressure and depressive symptoms in a community-based elderly population aged 70 years and over. We analyzed a cross-sectional survey comprised of 888 community-dwelling Japanese aged 70 years and older. Blood pressure was self-measured at home, and depressive symptoms were evaluated using the 30-item Geriatric Depression Scale (GDS 30) with a cutoff point of 11. The prevalence of depressive symptoms was 34.8%. For all subjects, after adjustments for potentially confounding factors, the odds ratios of having depressive symptoms by increasing quartiles of systolic blood pressure of subjects not taking antihypertensive drugs to subjects taking them were 1.00, 0.97, 0.88, 0.59, and 0.70. Statistically significant inverse relationships were observed in subjects not taking antihypertensive drugs. No apparent association between diastolic blood pressure and depressive symptoms was observed in any subjects or in a stratified analysis of antihypertensive drug use. In this study, a higher home systolic blood pressure was independently and continuously related to a lower prevalence of depressive symptoms in participants not using antihypertensive medication. Further study is required to clarify the causality of this relationship. (*Hypertens Res* 2008; 31: 409–416)

Key Words: home blood pressure, depressive symptoms, Japanese, community-dwelling population

From the [1]Department of Medicine and Science in Sports and Exercise, [2]Department of Public Health and Forensic Medicine, [4]Department of Psychiatry, [5]Department of Geriatrics and Gerontology, Tohoku University Graduate School of Medicine, Sendai, Japan; and [3]Department of Health Science, Shiga University of Medical Science, Otsu, Japan.

This study was supported by a Grant-in-Aid for Scientific Research (13557031) and by a Grant for Research Conducted by the Japanese Society for the Promotion of Science (JSPS) (14010301) from the Ministry of Education, Culture, Sports, Science and Technology of Japan; by Research Grants (2002, 2003) from the Japan Atherosclerosis Prevention Fund; and by a Health Science Grant on Health Services (H16-seisaku-023) and a Grant for Comprehensive Research on Aging and Health (H16-choju-016) from the Ministry of Health, Labour and Welfare of Japan.

Address for Reprints: Kaijun Niu, M.D, Ph.D., Ryoichi Nagatomi, M.D, Ph.D., Department of Medicine and Science in Sports and Exercise, Tohoku University Graduate School of Medicine, 2–1 Seiryo-machi, Aoba-ku, Sendai 980–8575, Japan. E-mail: ggg@mail.tains.tohoku.ac.jp; nagatomi@mail.tains.tohoku.ac.jp

Received July 11, 2007; Accepted in revised form September 24, 2007.

Introduction

Depression in late life is a recognized public health problem. Population-based estimates of the prevalence of mild and severe depression (using cutoffs of 5/6 on the Geriatric Depression Scale [GDS]-15) among older women in Japan range from 34.2% to 37.0% and among older men range from 29.7% to 35.4% (*1*).

The global burden of hypertension is a leading risk factor for cardiovascular and kidney disease and for mortality (*2–4*). It has overshadowed possible health problems associated with chronic low blood pressure (BP). Hypotension also is common in the general population and is associated with a distinct body habitus (*5*). Low BP was associated with the development of idiopathic chronic fatigue in women (*6*) and with neurasthenic symptoms such as weakness, fatigue, crying, psychological dysfunction, dizziness, and headache (*7–9*). Recent studies also have indicated that low BP reduced cortical activity (*10*), cerebral perfusion, and maladaption of blood flow to cognitive demands (*11*). Since these chronic psychological dysfunctions and/or body symptoms may be associated with depressive symptoms (*9*), it was hypothesized that low BP may be a potential risk factor for depressive symptoms (*12*).

However, in epidemiological studies, observations of the relationship between BP and depression have been inconsistent (*12–20*). Because the white-coat phenomenon has been observed frequently in all psychological types but especially in types having depressive symptoms (*21*, *22*), we have considered that BP measured in nonmedical settings is important in assessing the relationship between BP and depressive symptoms among the geriatric population. BP measurements at home (home blood pressure, HBP) are known to avoid the white-coat phenomenon (*23–25*). However, to our knowledge, no previous study used HBP to examine the association between BP and depressive symptoms among a geriatric population.

Thus, we used HBP to investigate the relationship between BP (including systolic BP [SBP] and diastolic BP [DBP]) and depressive symptoms among community-dwelling elderly aged 70 years and over.

Methods

Study Participants

Our study population was comprised of subjects aged 70 years and older who were living in the Tsurugaya area of Sendai, one of the major cities in the Tohoku area of Japan. At the time of the study in 2002, there were 2,730 individuals aged 70 years and older living in Tsurugaya. All of these individuals were invited to participate in a comprehensive geriatric assessment, which included medical status, physical function, cognitive function, and dental status. Among them, 1,178 did so, giving their informed consent for data analysis. The protocol of this study was approved by the Institutional Review Board of the Tohoku University Graduate School of Medicine.

In this study, the depressive symptoms were assessed with the aid of the GDS (*26*). Out of the 1,178 subjects, 1,169 completed the GDS. Since BP was assessed using data from self-measured BP at home, subjects who did not measure HBP data for more than 3 days during the 4-week study period were excluded (n=184; GDS≥11: 41.0%). This criterion was based on a previous observation that average BP values for the first 3 days did not differ significantly from those obtained during the entire study period (*27*, *28*). We also excluded all potential subjects with notable comorbidities, those who were using drugs that could influence the degree of depressive symptoms, those who reported a history of cancer (*29*) (n=68), those who were using anti-depressants (n=16), and 13 subjects with cognitive dysfunction (Mini Mental State Examination, MMSE, Score (*30*) <18). As a result of these exclusions, the final study population was comprised of 888 subjects (mean±SD age 75.7±4.6 yeras, men: 44.0%).

Assessment of Depressive Symptoms

Depressive symptoms were assessed according to the Japanese version (*31*) of the 30-item GDS using a cutoff point (GDS score ≥11) indicating relatively mild to severe depressive symptoms (*26*).

Assessment of HBP

HBP was self-measured with an HEM747IC device (Omron Life Science, Tokyo, Japan), which uses the cuff oscillometric method to generate a digital display of SBP and DBP. This device has been validated previously, and satisfies the criteria of the Association for the Advancement of Medical Instrumentation (*32*). The following procedure was used to ascertain the accuracy of the HBP measurement. First, physicians informed the subjects about HBP recording and taught them how to measure their own BP. The daily measurement was made within 1 h after waking up and before breakfast, with the subject seated and having rested for at least 2 min. Subjects taking antihypertensive drugs measured their HBP before taking the drugs. An individual's HBP was defined as the mean of all measurements obtained for that person. The mean (±SD) number of HBP measurements was 15.7±10.5 (range, 3–49).

Assessment of Other Variables

Anthropometrics (height, body weight) were recorded by a standardized protocol. Body mass index (BMI) was calculated as weight (kg)/height^2 (m^2).

Sociodemographic variables including gender, age, educational level, and perceived social supports were also assessed.

Table 1. Baseline Characteristics According to Blood Pressure Status

	Subjects non-taking antihypertensive drugs (quartile)				Subjects taking antihypertensive drugs
	SBP				SBP
	81.4–123.6 mmHg	123.7–134.7 mmHg	134.9–147.0 mmHg	147.2–203.3 mmHg	105.7–224.7 mmHg
No. of participants	128	127	129	128	376
Age (years)	74.2 (73.5–75.0)	75.4 (74.6–76.2)	76.3 (75.5–77.1)	76.4 (75.6–77.2)	75.9 (75.5–76.4)
Sex (female)	43.8	63.0	55.8	58.6	56.9
BMI	22.3 (21.8–22.9)	23.3 (22.8–23.9)	23.8 (23.2–24.3)	24.6 (24.0–25.2)	24.4 (24.1–24.8)
Total number of physical illness					
≥4	12.5	15.0	17.1	21.9	39.1
2–3	42.2	43.3	46.5	38.3	43.4
Lack of perceived social support (total score=0)	18.8	22.8	20.2	19.5	18.7
Cognitive ability					
Normal (28≤MMSE≤30)	63.3	63.8	55.0	60.9	59.3
Slightly impaired (24≤MMSE≤27)	31.3	32.3	39.5	33.6	33.8
Smoking status					
Current smoker	14.8	11.8	16.3	11.7	10.9
Ex-smoker	31.3	23.6	24.0	33.6	32.5
Driking status					
Current drinker	38.3	38.6	45.0	37.5	41.2
Ex-drinker	16.4	11.8	7.8	7.8	13.0
PA (≥ level 4)	39.8	33.1	30.2	28.1	31.9
Educational level (≤12 years)	33.6	45.7	45.0	39.1	44.4
Pain	26.6	15.0	24.0	20.3	23.9
Impaired IADL	17.2	18.9	20.2	13.3	20.5

	Subjects non-taking antihypertensive drugs (quartile)				Subjects taking antihypertensive drugs
	DBP				DBP
	49.6–69.0 mmHg	69.3–74.9 mmHg	75.0–82.1 mmHg	82.1–105.4 mmHg	49.3–123.8 mmHg
No. of participants	128	128	128	128	376
Age (years)	75.8 (75.0–76.6)	75.8 (75.0–76.6)	75.4 (74.6–76.2)	75.3 (74.5–76.1)	75.9 (75.5–76.4)
Sex (female)	54.7	53.9	57.8	54.7	56.9
BMI	22.4 (21.8–22.9)	23.7 (23.1–24.2)	23.8 (23.2–24.3)	24.2 (23.6–24.8)	24.4 (24.1–24.8)
Total number of physical illness					
≥4	14.1	17.2	15.6	19.5	39.1
2–3	49.2	41.4	42.2	37.5	43.4
Lack of perceived social support (total score=0)	22.7	23.4	20.3	14.8	22.3
Cognitive ability					
Normal (28≤MMSE≤30)	63.3	56.3	57.8	65.6	59.3
Slightly impaired (24≤MMSE≤27)	30.5	38.3	37.5	30.5	33.8
Smoking status					
Current smoker	14.8	10.2	14.8	14.8	10.9
Ex-smoker	25.0	31.3	25.0	31.3	32.5
Driking status					
Current drinker	36.7	35.2	43.0	44.5	41.2
Ex-drinker	14.8	14.1	7.8	7.0	13.0
PA (≥ level 4)	41.4	35.2	28.9	25.8	31.9
Educational level (≤12 years)	39.1	46.1	43.0	35.2	44.4
Pain	22.7	21.1	24.2	18.0	23.9
Impaired IADL	20.3	20.3	17.2	11.7	20.5

Variables are presented as mean (95% CI) or %. CI, confidence interval; SBP, systolic blood pressure; DBP, diastolic blood pressure; BMI, body mass index; MMSE, Mini Mental State Examination; PA, physical activity; IADL, instrumental activities of daily living.

Educational level was assessed by determining age at completion of schooling and was divided into two categories: ≤12 or >12 years. Perceived social support (PSS) was evaluated on the basis of responses (yes or no) to five questions: "Do you have someone to talk to when you are in trouble?" (PSS 1); "Do you have someone to talk to when you're not feeling well?" (PSS 2); "Do you have someone who can help you with daily housework?" (PSS 3); "Do you have someone who can take you to the hospital when you don't feel well?" (PSS 4); and "Do you have someone who can take care of you when you are ill in bed?" (PSS 5). These questions were extracted from a previous study regarding social support and elderly depression in a rural community (*33*). A strong association between negative answers to these items and depression has been confirmed in two Japanese community studies of elderly populations (*33*, *34*). A single summed score was calculated based on the PSS 1–5. No PSS was defined as a score of 0.

Health-related variables assessed included history of physical illness, pain, cognitive function, instrumental activities of daily living (IADL), and current use of medication. History of physical illness was evaluated on the basis of responses (yes or no) to questions concerning history of a stroke, ischemic heart disease, diabetes mellitus, hyperuricemia, hyperlipidemia, renal disease, liver disease, cholelithiasis or cholecystitis, a gastric or duodenal ulcer, tuberculosis, pneumonia, asthma, a hearing disturbance, cataracts, glaucoma, arthritis, and osteoporosis. Subjects were classified into three categories according to the total number of these conditions in the subject's history: 0–1, 2–3, or ≥4. Pain within the previous 4 weeks was assessed by the question, "Have you had any pain recently? If so, how intensely do you feel such pain?" Possible answers were "no pain," "very mild pain," "mild pain," "moderate pain," and "severe pain." A subject who reported mild to severe pain was considered to have pain. Cognitive function was assessed on the basis of the MMSE and was classified into three categories: 18–23, 24–27, and 28–30. IADLs were assessed using the Rouken-Shiki scale (*35*), and a cutoff point of 10/11 was used to determine impairment in IADL. Information about antihypertensive drugs was confirmed by a well-trained pharmacist.

Information on smoking status and drinking status was obtained from the questionnaire survey. Physical activity (PA) was assessed first by a self-reported single-item question on whether or not the participant obtained any PA in the past year. If yes, questions were asked about the frequency and duration of walking, brisk walking, and sports. PA was then classified into three categories, based on frequency and duration in the participant: 1) High: at least 3–4 times per week for at least 30 min each time; 2) Low: reporting some activity in the past year, but not enough to meet high levels; and 3) None: no PA. Furthermore, PA was classified into six levels based on these three categories and each PA such as walking, brisk walking, and sports: 1) Level 1: no walking, no brisk walking, no sports; 2) Level 2: low walking, no brisk walking, no sports; 3) Level 3: high walking, no brisk walking, no sports; 4) Level 4: any walking, low brisk walking, no sports; 5) Level 5: any walking, high brisk walking, no sports; 6) Level 6: any walking, any brisk walking, low or high sports. Detailed information was provided in previous reports (*36*). Finally, subjects were divided into two categories: ≤level 3 or >level 3.

Statistical Analysis

Descriptive data are presented as means (95% confidence interval [CI]) or percentages. Depressive symptoms (GDS scores ≥11) were used as the dependent variables and the HBP level as the independent variable. Multiple logistic regression analysis was used to examine the relationship between HBP and depressive symptoms after adjustment for age, sex, BMI, self-reported medical conditions, lack of PSS, smoking and drinking habits/history, educational level, impaired physical functioning, cognitive status, pain, PA, and the number of HBP measurements. p values for linear trends were calculated using the median (mmHg) of HBP groups. The odds ratios (ORs) and 95% CI of depressive symptoms for increasing HBP levels, with the lowest level as the reference, were also calculated using multiple logistic regression analysis. A significant difference was defined as $p<0.05$. All statistical analyses were performed using the Statistical Analysis System 9.1 edition for Windows (SAS Institute, Cary, USA).

Results

In this study, 34.8% (407/1,169) of the subjects were classified as having depressive symptoms. Among the 888 subjects who were available for analysis, 285 (32.1%) were classified as having depressive symptoms.

Baseline characteristics according to BP status are presented in Table 1.

Table 2 shows the adjusted association between the HBP quartile of subjects not taking antihypertensive drugs, subjects taking antihypertensive drugs, and depressive symptoms. Although not statistically significant, ORs adjusted for potentially confounding factors for depressive symptoms were lowest in the highest tertiles of subjects not taking antihypertensive drugs (OR: 0.59; 95% CI: 0.32–1.08) in SBP. Similarly, we observed lower ORs of having depression in participants taking antihypertensive medication compared with the lowest SBP quartile of participants not taking antihypertensive medication. In contrast, there was no apparent association between DBP and depressive symptoms.

Table 3 shows separately the adjusted association between HBP quartiles and depressive symptoms in subjects not taking antihypertensive drugs and those taking antihypertensive drugs. In subjects not taking antihypertensive drugs, the ORs of depressive symptoms decreased across the levels of SBP. The age- and sex-adjusted ORs for depressive symptoms

Table 2. Adjusted Relationships of Blood Pressure to Depressive Symptoms

	Subjects non-taking antihypertensive drugs (quartile)				Subjects taking antihypertensive drugs
	SBP				SBP
	81.4–123.6 mmHg	123.7–134.7 mmHg	134.9–147.0 mmHg	147.2–203.3 mmHg	105.7–224.7 mmHg
No. of participants	128	127	129	128	376
No. of depressive symptoms	43	44	43	32	123
Odds ratio (95% CI)					
Age- and sex-adjusted	1.00	0.92 (0.54–1.56)	0.87 (0.51–1.47)	0.57 (0.32–0.98)	0.85 (0.55–1.32)
Multiple adjusted*	1.00	0.97 (0.55–1.69)	0.88 (0.50–1.55)	0.59 (0.32–1.08)	0.70 (0.43–1.15)

	Subjects non-taking antihypertensive drugs (quartile)				Subjects taking antihypertensive drugs
	DBP				DBP
	49.6–69.0 mmHg	69.3–74.9 mmHg	75.0–82.1 mmHg	82.1–105.4 mmHg	49.3–123.8 mmHg
No. of participants	128	128	128	128	376
No. of depressive symptoms	38	49	42	33	123
Odds ratio (95% CI)					
Age- and sex-adjusted	1.00	1.48 (0.88–2.52)	1.16 (0.68–1.98)	0.83 (0.48–1.45)	1.14 (0.74–1.78)
Multiple adjusted*	1.00	1.51 (0.87–2.64)	1.20 (0.68–2.12)	0.94 (0.52–1.69)	0.96 (0.59–1.57)

*Adjusted for age, sex, BMI, self-reported medical conditions, lack of perceived social support, respectively, smoking and drinking habits/history, educational level, cognitive status, pain, physical activity, impaired instrumental activities of daily living and the number of HBP measurements. CI, confidence interval; SBP, systolic blood pressure; DBP, diastolic blood pressure; BMI, body mass index; HBP, home blood pressure.

across SBP were 1.00, 0.86, 0.82, and 0.53 (p for trend=0.03), and ORs across DBP were 1.00, 1.50, 1.16, and 0.83 (p for trend=0.31), respectively. These results were unchanged when adjusted for multiple confounding factors. In contrast, no apparent association was observed in subjects taking antihypertensive drugs.

Discussion

In this cross-sectional study, we examined the relationship between HBP and depressive symptoms in a community-dwelling elderly population aged 70 years and over. Our results suggested that lower SBP, but not lower DBP, was related to depressive symptoms independently of potential confounding factors in subjects not taking antihypertensive drugs.

Several studies used office BP to investigate the relationship between BP and depressive symptoms, but the results were inconsistent. Four cross-sectional (*12–15*) studies and a prospective study (*16*) showed inverse associations between BP and depressive symptoms. Another prospective study found no association (*17*). In contrast, three cross-sectional studies found a positive association between hypertension and depression (*18–20*). Only one previous study (*37*) using HBP reported no significant relationship between BP levels, and psychological dysfunction/fatigue was demonstrated among younger subjects (mean age±SD: 48.7±16 years). However, they did not assess the depressive symptoms. Because some studies reported that the white-coat phenomenon was frequently observed in depressive symptoms (*21, 22*), it might be interesting to investigate the relationship between BP measured in nonmedical settings and depressive symptoms. Therefore, HBP was used to assess the relationships between BP and depressive symptoms in this study. The present results suggested that SBP, but not DBP, is inversely related to depressive symptoms among an elderly population not taking hypertensive drugs.

An important finding in the current study was the inverse relationship between HBP and depressive symptoms in subjects who were not taking antihypertensive drugs. Moreover, the ORs of having depression were lower, although not significantly, in subjects taking antihypertensive drugs than among the lowest SBP quartile of subjects not taking antihypertensive drugs. This result can be interpreted in several ways. First, because antihypertensive medication lowered BP, weaken BP's influence on depressive symptoms. Second, one

Table 3. Adjusted Relationships of Blood Pressure (Quartile) to Depressive Symptoms

a. Subjects non-taking antihypertensive drugs (n=512)

	Systolic blood pressure (mmHg)				p for trend
	81.4–123.6	123.7–134.7	134.9–147.0	147.2–203.3	
No. of participants	128	127	129	128	—
No. of depressive symptoms	43	44	43	32	—
Odds ratio (95% CI)					
Age- and sex-adjusted	1.00	0.86 (0.50–1.47)	0.82 (0.48–1.40)	0.53 (0.30–0.92)	0.03
Multiple adjusted*	1.00	0.81 (0.46–1.47)	0.72 (0.39–1.33)	0.46 (0.23–0.88)	0.02
	Diastolic blood pressure (mmHg)				p for trend
	49.6–69.0	69.3–74.9	75.0–82.1	82.1–105.4	
No. of participants	128	128	128	128	—
No. of depressive symptoms	38	49	42	33	—
Odds ratio (95% CI)					
Age- and sex-adjusted	1.00	1.50 (0.88–2.55)	1.16 (0.67–1.98)	0.83 (0.48–1.45)	0.31
Multiple adjusted*	1.00	1.47 (0.82–2.64)	1.15 (0.64–2.09)	0.90 (0.48–1.69)	0.52

b. Subjects taking antihypertensive drugs (n=376)

	Systolic blood pressure (mmHg)				p for trend
	105.7–134.3	134.5–144.3	144.7–156.4	156.5–224.7	
No. of participants	94	94	94	94	—
No. of depressive symptoms	33	29	30	31	—
Odds ratio (95% CI)					
Age- and sex-adjusted	1.00	0.82 (0.44–1.51)	0.86 (0.46–1.58)	0.84 (0.45–1.57)	0.64
Multiple adjusted*	1.00	0.84 (0.44–1.62)	1.03 (0.53–1.99)	0.80 (0.41–1.59)	0.64
	Diastolic blood pressure (mmHg)				p for trend
	49.3–72.0	72.0–77.9	77.9–84.0	84.0–123.8	
No. of participants	94	94	94	94	—
No. of depressive symptoms	32	38	23	30	—
Odds ratio (95% CI)					
Age- and sex-adjusted	1.00	1.34 (0.74–2.43)	0.64 (0.34–1.21)	0.93 (0.51–1.72)	0.39
Multiple adjusted*	1.00	1.70 (0.89–3.29)	0.85 (0.43–1.70)	0.95 (0.49–1.84)	0.43

*Adjusted for age, sex, BMI, self-reported medical conditions, lack of perceived social support, respectively, smoking and drinking habits/history, educational level, cognitive status, pain, physical activity and impaired instrumental activities of daily living and the number of HBP measurements. CI, confidence interval; BMI, body mass index; HBP, home blood pressure.

more possibility that might explain the inverse relationship between SBP and depressive symptoms was the issue of measurement timing. HBP was measured in the early morning, and a question on the GDS (Question 27: "Do you enjoy getting up in the morning?") was in harmony with symptoms of hypotension in the morning. Therefore, participants with morning hypotension tended to score higher on the GDS scale. This also makes it possible to explain the inverse association of BP with depression symptoms. To understand the causal relation of BP in nonmedical settings with depressive symptoms, prospective studies using ambulatory BP measurements that can assess not only morning BP but also daytime BP are required.

The biological mechanisms involved in the relationship between HBP and depression are not well known. Recent findings have indicated that many neuropeptides play a major role in mediating the response to stress-related diseases, including depression and anxiety disorders (*38*). The overexpression of endogenous neuropeptide Y in transgenic rats has been associated with lower BP at baseline and during stress (*39*). Thus, these findings suggested that neuropeptide Y may be a possible link between low BP and depressive symptoms. Further study is required to clarify the biological mechanism underlying the association between lower BP and depressive symptoms.

A previous study reported that chronic hypotensives have a female preponderance (*40*). In contrast, the current results show that the proportion of males was higher in the lowest SBP group than in the other SBP groups (Table 1). Differences in participant population may partly explain the incon-

sistencies. Further study is required for clarification.

This study had several limitations. First, the participants were sufficiently active and healthy to participate in the survey; therefore, it is possible that our results do not apply to subjects at higher risk. Second, because this study was cross-sectional, we could not conclude that lower HBP increases the occurrence of depressive symptoms or that depressive symptoms lead to the decline of HBP among subjects aged 70 years and over. Therefore, a prospective study or trial should be undertaken to confirm the relationship between HBP and depressive symptoms. Third, since screening BP was not measured, we could not infer the influence of screening BP on depressive symptoms in this study population. Finally, the GDS scale was designed for measuring the intensity of depressive symptoms and not for making a clinical diagnosis of depressive episodes. Therefore, a larger sample population using a standardized comprehensive structured diagnostic interview should be undertaken to confirm the relation between HBP and depressive episodes.

In conclusion, home SBP, but not home DBP, was independently related to a lower prevalence of depressive symptoms in a community-dwelling elderly population not taking antihypertensive drugs. A prospective study or randomized trials are required to clarify the causality in this relationship.

Acknowledgements

We are grateful to Shannon Freeman for correcting the English in the manuscript.

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SEX DIFFERENCES IN THE PREFERENCE FOR PLACE OF DEATH IN COMMUNITY-DWELLING ELDERLY PEOPLE IN JAPAN

To the Editor: The Ministry of Health, Labor, and Welfare in Japan is strongly promoting "death at home."[1] Research indicates that honoring the treatment preferences of terminally ill patients is critical for the provision of high-quality care at the end of life,[2,3] but few studies have investigated the preference for place of death in elderly people in Japan. In this study, we found that only half of community-dwelling elderly people studied wanted to die at home when they become terminally ill. Especially in elderly women, there is a strong desire for not wanting to inconvenience others, and therefore many of them prefer "hospital deaths."

The survey was conducted from November 2006 to April 2007. Face-to-face questionnaires were given to all members aged 70 and older who belonged to four nonreligious affiliated seniors clubs. Two of the seniors clubs were rurally located in Iwanuma village, Miyagi prefecture, northern Japan (n = 55 and 71), whereas the other two were located in Kawasaki city, an urban area in central Japan (n = 84 and 76). Subjects were aged 70 to 102, with a mean age ± standard deviation of 77.0 ± 6.1. Questionnaires focused on the place where the subjects want to be cared for when they die and demographic factors (housing status, personal medical history, degree of physical and mental independence). One hundred fifty men (aged 75.9 ± 5.3) and 136 women (aged 78.2 ± 6.6) responded.

Results showed that 50% of respondents preferred to die at home, 33.6% in a hospital, and 5.2% in a nursing facility. There were more multigenerational households in rural areas than in urban areas, and many of them were two- and three-generation families. No significant differences were found in the preferences of place to die according to the number of family members living together or age, but 60% of men preferred to die at home, whereas 40% each of women wanted to die at home and in the hospital.

In addition, for the following question "What is the most important thing when you are on your deathbed?" in which respondents were asked to choose two answers, approximately 110 men and 110 women chose the answer "dying without pain (or suffering)," followed by "dying at home" (n = 77) for men and "not bothering family and friends" (n = 58) for women. This highlighted the differences between the sexes regarding feelings toward life and death. Women, who did not want to bother others, significantly preferred hospital deaths.

The study revealed that individuals who have a higher degree of physical and mental independence tend to desire to die in a hospital. Women showed a marked tendency toward this. In contrast, many men are mentally and physically dependent on their spouse.

More than 80% of men and women are independent in terms of fundamental activities of daily living, but fewer than 50% of men did any housework, whereas nearly 70% of females did all the housework. More than 70% of men wanted to be cared for by their spouses when needed, whereas women wanted to be cared for by their daughters, daughter-in-laws, and spouses and in hospitals.

These results suggest that, although an individual's personal values and the degree of physical and mental dependence can affect the desire of death at home or in a hospital, sex differences need to be taken into account. The Ministry of Health, Labor and Welfare in Japan has been promoting home-based medical care after the medical service fee system was revised in 2006, but only half of elderly people want to die at home. This revision may not meet all of the needs of elderly people in Japan. End-of-life care for elderly people should not be only home-based medical care but also other types of care. More surveys on the actual conditions will be needed in the future.

Miyako Yamasaki, MD
Satoru Ebihara, MD
Shannon Freeman, BA
Takae Ebihara, MD
Masanori Asada, MD
Shinsuke Yamanda, MD
Hiroyuki Arai, MD
Department of Geriatrics and Gerontology
School of Medicine
Tohoku University
Sendai, Japan

ACKNOWLEDGMENTS

Conflict of Interest: The editor in chief has reviewed the personal and financial checklist provided by the authors and has determined that none have any conflicts related to this letter.

Author Contributions: Miyako Yamasaki and Satoru Ebihara: study concept and design, acquisition of subjects and data, preparation of manuscript. Shannon Freeman, Takae Ebihara, Masanori Asada, and Shinsuke Yamanda: acquisition of data and analysis. Hiroyuki Arai: analysis and interpretation of data.

Sponsor's Role: None.

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DIAGNOSTIC ACCURACY OF CRITERIA FOR URINARY TRACT INFECTION IN A COHORT OF NURSING HOME RESIDENTS

To the Editor: We are commenting on "Diagnostic Accuracy of Criteria for Urinary Tract Infection in a Cohort of Nursing Home Residents."[1] Table 1 in the article infers that 54 of 100 cases of suspected urinary tract infection (UTI) had neither fever nor urinary signs or symptoms. The discussion includes the unproven hypothesis that residents with UTI frequently exhibit nonspecific "geriatric manifestations" of acute disease such as confusion, falls, or functional decline *without* fever or urinary symptoms such as frequency, dysuria, or suprapubic tenderness. This is a widespread belief that is not supported by data or expert