High blood pressure in middle age is associated with a future decline in activities of daily living. NIPPON DATA80.

Short running head: Blood pressure and future ADL decline
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Abstract

Although several studies have reported on the relation between high blood pressure (BP) and impaired activities of daily living (ADL), only a few studies have reported on the relation of high BP in middle-aged subjects with future impaired ADL. Furthermore, no studies reported an excess impaired ADL due to non-normal BP. Using ADL 1999 data, we compared data from NIPPON DATA80 survivors without impaired ADL (N=1816) with those with impaired ADL (N=75) using baseline BP information collected in 1980. We analyzed participants who were aged 47-59 years at baseline. Multiple adjusted logistic regression analyses were used to estimate the risk of impaired ADL according to baseline BP categories using Joint National Committee 7 guidelines (normal BP, prehypertension, stage 1 hypertension (HT), and stage 2 HT). Subjects who used antihypertensive medications were classified as having stage 2 HT. We calculated excess impaired ADL due to non-normal BP. Compared with normal BP categories, the adjusted odds ratio (OR) and 95% confidence interval (CI) of having impaired ADL was higher in subjects with prehypertension (OR=1.50, 95% CI: 0.55-4.09), stage 1 HT (OR=1.56, 95% CI: 0.56-4.32), and stage 2 HT (OR=2.96, 95% CI: 1.09-8.05). Non-normal BP explained 45% (33.7/75) of impaired ADL. A positive relation of BP categories with the composite endpoint of mortality and impaired ADL was also observed. In conclusion, controlling BP in middle age may prevent deaths and future ADL decline.

Key words: blood pressure, activities of daily living, mortality, population attributable fraction

INTRODUCTION

Hypertension (HT) is one of the strongest risk factors for cardiovascular disease mortality and all-cause mortality (1-3). Thus, control of blood pressure (BP) can increase lifespan. As the proportion of elderly people increases, the importance of preventing physical dysfunction, that is, impaired ability to perform activities of daily living (ADL), becomes a major public health concern for older people (4).

We previously reported that the main cause of impaired ADL in Japan was stroke (4). Other studies have shown that participants who died from stroke had a longer period of disability before death compared with participants who died of other causes (5). It is well known that HT is a strong risk factor for stroke (1-3). Therefore, HT may also be strongly associated with impaired ADL. However, only a few studies have reported the relation of HT with physical dysfunction or impaired ADL (6-12). Furthermore, these studies primarily included elderly participants (6-9). Only a few studies have examined the relation of BP measured at middle age and future disability (11,12), and no studies have reported on the contribution of BP to impaired ADL. Furthermore, if we combined impaired ADL and deaths together, we can calculate the relation of BP with alive without impaired ADL.

The objective of this study was to investigate the relation between ability to perform ADL in 1999 and baseline BP measured in 1980 among a general population of Japanese subjects aged 47-59 years taken from NIPPON DATA80. NIPPON DATA80 is a cohort study that consisted of a representative Japanese sample who were surveyed in 1980.

METHODS

Participants and follow-up

Two cohort studies of the National Survey on Circulatory Disorders comprise the National Integrated Project for Prospective Observation of Non-communicable Disease and Its Trends in the Aged (NIPPON DATA). Baseline surveys were performed in 1980 (NIPPON DATA80) (13-18) and in 1990 (19-21). Detailed methods of NIPPON DATA have been described previously (13, 17, 19). We analyzed the 19-year follow-up data from NIPPON DATA80 in this study.

Baseline surveys were carried out at local public health centers, and all participants had to be capable of reaching the examination center without assistance.

Biochemical and physical examinations

Baseline BP was measured by trained observers using a standard mercury sphygmomanometer on the right arm of seated participants after at least 5 min of rest. We defined BP categories as follows: Stage 2 HT, systolic BP ≥ 160 mmHg and/or diastolic BP ≥ 100 mmHg; Stage 1 HT, systolic BP 140-159 mmHg and/or diastolic BP 90-99 mmHg; prehypertension, systolic BP 120-139 mmHg and/or diastolic BP 80-89 mmHg; normal BP, systolic BP < 120 mmHg and diastolic BP < 80 mmHg. If participants were taking antihypertensive medication, they were categorized into Stage 2 HT irrespective of their BP level. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). Public health nurses obtained data including smoking habits, as well as current health status and medical history. Non-fasting blood samples were separated by centrifugation within 60 min of collection in 1980 and stored at −70°C. Blood glucose levels were measured using the cupric-neocuproine method, and the values were adjusted by using the formula ([0.047 × (glucose concentration in mg/dl)] − 0.541) to obtain the approximate value measured by the hexokinase method, which gives levels in mmol/L (18). Diabetes was defined as casual blood glucose level of 11.1 mmol/L or self-reported diabetes (18). Serum albumin and total cholesterol levels were measured using a sequential autoanalyzer (SMA12/60; Technicon, Tarrytown, USA) using bromocresol-green staining for albumin and the Lieberman-Burchard direct method for total cholesterol at a specific laboratory (presently the Osaka Medical Center for Health Science and Promotion).

ADL survey

The NIPPON DATA studies performed follow-up ADL surveys in 1994 (4) and 1999. In this study, we analyzed 1999 data because we wanted to examine the effect of high BP in middle-aged subjects on future ADL decline. The 1999 ADL survey was done in subjects aged ≥ 65 years at that time. Participants aged 45 and younger were not surveyed and some of participants aged 46 were not surveyed. Furthermore, because we wanted to study the effect of high BP in middle-aged subjects, we limited the upper age of subjects in this study to those younger than 60 years at baseline.

We asked 300 Public Health Centers to participate in the 1999 ADL survey, and 249 of them agreed. In these areas, 2724 participants were between the ages of 47 and 59 at baseline. Among them, 75 were excluded because of a history of cardiovascular disease (i.e., acute myocardial infarction [AMI] or stroke), and because of lack of information on serum total cholesterol levels, blood glucose levels, height, weight, and serum albumin levels. The remaining 2649 participants were surveyed; however, 385 died and 84 moved before the ADL survey. Thus, 2180 participants were asked to respond to the ADL survey and 1891 did so (87%) (Figure 1). No significant differences were seen between responders and non-responders for baseline age, BP values, use of antihypertensive medications, body mass index, smoking status, and albumin levels (Table 1). Non-responders had a significantly higher total cholesterol level than responders ($P < 0.01$)

Participants were asked about five basic ADL items (feeding, dressing, bathing, toileting, and transfer [walking indoors]), as modified from Katz et al. (22) and whether each of these items could be accomplished without help, with partial help, or with full help. Participants were also asked whether they had a history of stroke, lower limb fracture, and AMI (4). This survey was conducted through telephone

interviews (10.5%), face-to-face interviews at home (80.0%), and other methods (9.5%). Impaired ADLs were defined as partial or full support needed to perform any of the five basic ADL items. As previously reported (13, 17, 19), we identified participants who had died by computer matching data from Japanese National Vital Statistics records, using area, gender, birth date, and death as key codes. We obtained permission to use the National Vital Statistics records from the Management and Coordination Agency of the Government of Japan. The Institutional Review Board of Shiga University of Medical Science (NO.12-18, 2000) approved the study.

Statistical analysis

Analysis of variance for continuous variables or chi-square tests for proportions were used to compare baseline characteristics. The relationship between BP categories and impaired ADL was calculated using multiple adjusted logistic regression models. The multivariable-adjusted odds ratio (OR) for impaired ADL was adjusted for age, sex, BMI (<18.5 kg/m^2, 18.5-24.9 kg/m^2, ≥25 kg/m^2), cigarette smoking (current, ex-smoker, never smoked), drinking (everyday, sometimes, ex-drinker, never), diabetes, total cholesterol levels, and albumin levels. We also added a history of stroke and AMI at the ADL survey as covariates in an additional model to determine the role of stroke or AMI on the relation between high BP and impaired ADL. The normal BP group was used as the reference group. The OR for having impaired ADL was calculated using multiple logistic regression analysis. To identify the effect of BP on being alive without impaired ADL, we also analyzed the OR for the composite outcome of impaired ADL and death before the ADL survey (N=385) using multiple logistic regression analysis. Trend tests were performed by allocating scores 1, 2, 3, and 4 to all participants with normal BP, prehypertension, stage 1 HT, and stage 2 HT, respectively.

The percentage of excess impaired ADL due to non-normal BP was calculated as follows: $p * \{OR - 1\}/OR$ where p = proportion of cases exposed to the risk factor (23). All probability values were two-tailed and all confidence interval (CIs) were estimated at the 95% level. SAS software (version 9.1, SAS Institute, Cary, NC, USA) was used for analyses.

RESULTS

Table 2 shows the baseline characteristics of the 1891 study participants. According to the BP categories, participants in the higher BP categories were older, and had a higher BMI, albumin level, and total cholesterol level than those in the lower BP categories. The proportion of women was higher in the lower BP categories.

Table 3 shows the relation of baseline BP categories to impaired ADL. The age and sex-adjusted OR of having impaired ADL was higher in the higher BP categories. The age and sex-adjusted OR (CIs) of prehypertension, stage 1 HT, and stage 2 HT were 1.38 (0.51-3.71), 1.49 (0.55-4.06), and 2.92 (1.11-7.67), respectively. This trend was unchanged when we adjusted for BMI, smoking status, drinking status, diabetes, total cholesterol levels, and albumin levels. No sex differences were observed for the relation of BP categories and impaired ADL (P for interaction = 0.38).

When we further adjusted for the history of stroke at the end of follow-up, the relation between high BP and impaired ADL was largely attenuated. The adjusted ORs for prehypertension, stage 1 HT, and stage 2 HT were 1.59 (0.56-4.53), 1.75 (0.60-5.12), and 2.10 (0.73-6.05), respectively. This suggests that stroke plays an important causal role in the relation between high BP and impaired ADL. On the other hand, adjustment for history of AMI at the end of follow-up did not change the findings (data not shown).

From the adjusted OR, we calculated the proportion of impaired ADL due to non-normal BP and 7.0, 6.8, and 19.9 of excess impaired ADL were due to prehypertension, stage 1 HT, and stage 2 HT, respectively. Thus, among 75 survivors with impaired ADL, non-normal BP, that is, prehypertension, stage 1 HT, and stage 2 HT, explained 33.7 (44.9%) of impaired ADL.

To assess the relation between BP and being alive without impaired ADL, we calculated the risk of baseline BP categories using the composite endpoint of impaired ADL and all-cause death. Of 385 participants who died before the ADL survey, 191 (50%), 46 (12%), 50 (13%), 7 (2%), and 91 (24%) died of cancer, stroke, heart disease, other CVD, and other causes, respectively. The ORs of the composite endpoints were 1.22 (0.83-1.78), 1.13 (0.76-1.69), and 1.78 (1.20-2.66) for prehypertension, stage 1 HT, and stage 2 HT, respectively (Table 4).

DISCUSSION

This study revealed a positive correlation between high BP at middle age and impaired ADL in the future, as well as the composite endpoint of impaired ADL and death. We found that 45% of impaired ADL could be explained by non-normal BP in Japanese subjects. This suggests that, among Japanese subjects, non-normal BP in middle age is an important determinant of future impaired ADL.

There are several prospective studies reporting the relation of BP to physical performance (6-12). However, most of these studies investigated elderly populations (6-9). Studies focusing on the relation between BP measured at middle age and future disability are scarce (11,12). Although Pinsky et al. investigated 2021 participants whose baseline age range was 28 to 62 years and found long-term hypertension related to disability (10), they used "ever hypertensive," that is, whether participants were diagnosed with hypertension during follow-up, as a risk factor. Thus, their study could not conclude whether BP measured at middle age could predict future disability. Reed et al. investigated physical function among 3263 subjects with Japanese ancestry who had information from 28 years before the survey. The baseline age of these participants ranged from 45 to 68 years (11). They found that the most consistent predictor of healthy aging was low BP. Guralnik et al also studied participants of Alameda County Study who were aged 46-70 years at baseline and investigated the relation of high BP with physical function after 19 years (12). They found high BP predicted future lower levels of physical function. These latter 2 findings were mostly consistent with our results showing that high BP at ages 47-59 predicts impaired ADL after 19 years.

It is well known that high BP is associated with a higher risk of stroke (1-3). We previously reported the prevalence of impaired ADL and the magnitude of the association with stroke (4). Similarly, another study in Japan showed that the duration of disability before death was longer in participants who died of stroke than in participants who died of other reasons (5). In that study, 45% of patients who died from stroke had more than 6 months of disability (5). These findings are consistent with our results, that is, BP was strongly related with impaired ADL. Our results that adjustment for stroke history at the end of the follow-up largely attenuated the relation between high BP and impaired ADL also support the idea that stroke plays an important role in the relation between high BP and impaired ADL. Although Ohmori, et al. also showed the risk of long-term disability was lower in participants who died from ischemic heart diseases, which is strongly affected by BP, than in those who died from other causes (5), our study revealed that, overall, higher BP levels at middle age were strongly associated with a future decline in ADL.

We found 45% of impaired ADL was explained by non-normal BP in our study. This suggests that preventing progression of non-normal BP might yield a lower incidence of ADL decline. Because participants of NIPPON DATA80 included a representative Japanese general population, and the response rate of the ADL survey was high, we believe that these rates are applicable to a general Japanese population. However, this rate may not be applicable to other populations where mortality or incidence rates of stroke are lower. Further studies conducted in other countries that assess the impact of BP on impaired ADL would be of interest.

We also found that high BP was strongly associated with the composite endpoint of death and impaired ADL. This supports the idea that preventing high BP is important not only for preventing impaired ADL but also preventing death; that is, controlling or managing BP in middle-aged subjects may have the potential to prolong the duration of lives without impaired ADL, thus increasing so called healthy life expectancies (24).

There are several limitations to this study. First, we did not assess baseline ADL conditions. Thus, we could not determine whether participants had been independent at baseline. However, because participants arrived at the baseline exam on foot and because we also excluded participants who had a history of stroke, we considered the effect of the lack of information on baseline ADL on our results to be neglible. Second, we assessed ADL only in 1999, and, some participants progressed to impaired ADL before the ADL survey. However, many participants with impaired ADL before the ADL survey died before the ADL survey. Thus, we believe we adequately addressed this limitation by exploring the composite endpoint of death and impaired ADL. Finally, because we focused on the relation between BP at middle age (<60 years) and future ADL decline, the oldest participants in 1999 were younger than 80. In Japan, in 1980, life expectancy at 40 years was 35.5 years for men and 40.2 years for women (25). Thus, our participants might be too young to assess the impact of BP at middle age on lifetime disability. However, we believe that our information is important to assess the impact of high BP on premature

impaired ADL and death.

In conclusion, non-normal BP in middle age is a strong predictor of impaired ADL 19 years later. Nearly half of the impaired ADL in 1999 was shown to be related to non-normal BP in 1980. Non-normal BP also predicted the composite outcome of death and impaired ADL; that is, lower BP in middle age can yield longer healthy life expectancies.

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There are no conflicts of interest.

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APPENDIX

List of the NIPPON DATA80 Research group.

NIPPON DATA: "National Integrated Project for Prospective Observation of Non-communicable Disease And its Trends in the Aged."

Chairman: Hirotsugu Ueshima (Department of Health Science, Shiga University of Medical Science, Otsu, Shiga).

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Table 1. Difference between responder of survey for activity of daily living and non-responder.

		Responder	Non-Responder	P
		1891	289	
Age	years	52.9 (3.6)	52.7 (3.8)	0.33
Sex	(% female)	59%	64%	0.09
Systolic blood pressure	mmHg	138.4 (19.8)	136.5 (19.9)	0.14
Diastolic blood pressure	mmHg	83.3 (11.9)	82.1 (11.6)	0.11
Antihypertensive medication	Yes %	10%	8%	0.31
Body mass index	kg/m^2	23.0 (3.1)	23.1 (3.1)	0.89
Current smoking	%	30%	29%	0.63
Daily drinker	%	22%	20%	0.41
Total cholesterol	mmol/L	5.00 (0.85)	5.18 (0.90)	<0.01
Albumin	g/L	43.9 (2.3)	44.0 (2.3)	0.43

Values are expressed as means (standard deviation) or %.
SD: standard deviation
P-values were tested by t-test or chi-squared test

Table 2. Baseline characteristics according to BP categories, NIPPON DATA80 1980.

		Normal BP	Prehypertension	Stage1 HT	Stage2 HT	P-value
N		230	682	541	438	
Age	years	52.3 (3.7)	52.6 (3.6)	53.1 (3.6)	53.4 (3.6)	<0.01
Sex	(% female)	63%	62%	55%	57%	0.03
Systolic BP	mmHg	110.3 (6.3)	127.5 (6.5)	144.7 (7.3)	162.2 (18.0)	<0.01
Diastolic BP	mmHg	68.2 (6.0)	77.8 (6.5)	86.5 (7.2)	95.9 (11.1)	<0.01
Antihypertensive medication	Yes %	0%	0%	0%	44%	<0.01
Body mass index	kg/m^2	21.8 (3.0)	22.5 (3.0)	23.3 (3.0)	24.1 (3.2)	<0.01
Current smoking	%	35%	28%	33%	28%	0.10
Daily drinker	%	17%	17%	27%	27%	<0.01
Diabetes	%	4%	3%	4%	4%	0.44
Total cholesterol	mmol/L	43.1 (2.2)	43.7 (2.3)	44.0 (2.4)	44.3 (2.3)	<0.01
Albumin	g/L	4.8 (0.9)	5.0 (0.8)	5.1 (0.9)	5.1 (0.9)	<0.01

Values are expressed as means (standard deviation) or %.
BP: blood pressure; N: numbers of participants; HT: hypertension
Stage 2 HT: systolic BP ≥ 160 mmHg and/or diastolic BP ≥ 100 mmHg
Stage 1 HT: not satisfied with stage 2 HT and systolic BP 140-159 mmHg and/or diastolic BP 90-99 mmHg
Prehypertension: Satisfied with neither stage2 nor stage 1 HT criteria and systolic BP 120-139 mmHg and/or diastolic BP 80-89
Normal BP: systolic BP < 120 mmHg and diastolic BP < 80 mmHg
User of antihypertensive medications were included in Stage 2 HT categories.
P-values were tested by t-test or chi-squared test

Table 3. Relation of baseline BP category with impaired ADL assessed at 19 year after baseline among participants aged 47-59 at baseline. NIPPON DATA80, 1980-1999.

BP category at baseline*	Normal BP	Prehypertension	Stage1 HT	Stage2 HT	P for trend
Participants alive at the end of follow-up without impaired A	225	661	522	408	
Participants alived with impaired ADL	5	21	19	30	
Age,sex-adjusted OR (95%CI)	1	1.38 (0.51-3.71)	1.49 (0.55-4.06)	2.92 (1.11-7.67)	<0.01
Multivariate adjusted OR (95%CI)†	1	1.50 (0.55-4.09)	1.56 (0.56-4.32)	2.96 (1.09-8.05)	<0.01
Excess impaired ADL due to non-normal BP	0	7.0	6.8	19.9	
Population Attributable Fraction		9.3%	9.0%	26.5%	

BP: blood pressure, ADL: activity of daily living; OR: odds ratio; CI: confidence interval

*: Definition of BP categories are described in Table 2.

†: adjusted for age, sex, body mass index (<18.5, 18.5-24.9, 25-), and smoking (current, ex-smoker), drinking (daily, occasional,ex-drinker), diabetes, total cholesterol, and albumin.

Table 4. Relation of baseline blood pressure (BP) category with composite outcome (impaired ADL and all cause mortality) assessed at 19 year after baseline among participants aged 47-59 at baseline. NIPPON DATA80, 1980-1999.

BP category at baseline*	Normal BP	Prehypertension	Stage1 HT	Stage2 HT	P for trend
Overall N	271	809	641	555	
Number of composite outcome‡	46	148	119	147	
Age,sex-adjusted OR (95%CI)	1	1.10 (0.76-1.60)	1.00 (0.68-1.47)	1.57 (1.07-2.29)	<0.01
Multivariate adjusted OR (95%CI)†	1	1.23 (0.84-1.81)	1.14 (0.77-1.70)	1.79 (1.20-2.67)	<0.01

BP: blood pressure, ADL: activity of daily living; OR: odds ratio; CI: confidence interval

*: Definition of BP categories are described in Table 2.

†: Adjusted for age, sex, body mass index (<18.5, 18.5-24.9, 25- kg/m^2), smoking (current, ex-smoker),drinking (daily, occasional, ex-drinker), diabetes, total cholesterol, and albumin.

‡: Deceased participants and participants alive with impaired ADL at the end of follow-up

Table 5
Summary

What is known about topic

- Although several studies have reported on the relation between high blood pressure (BP) and impaired activities of daily living (ADL), only a few studies have reported on the relation of high BP in middle age with future impaired ADL.
- No studies have reported an excess incidence of impaired ADL due to non-normal BP levels.

What this study adds

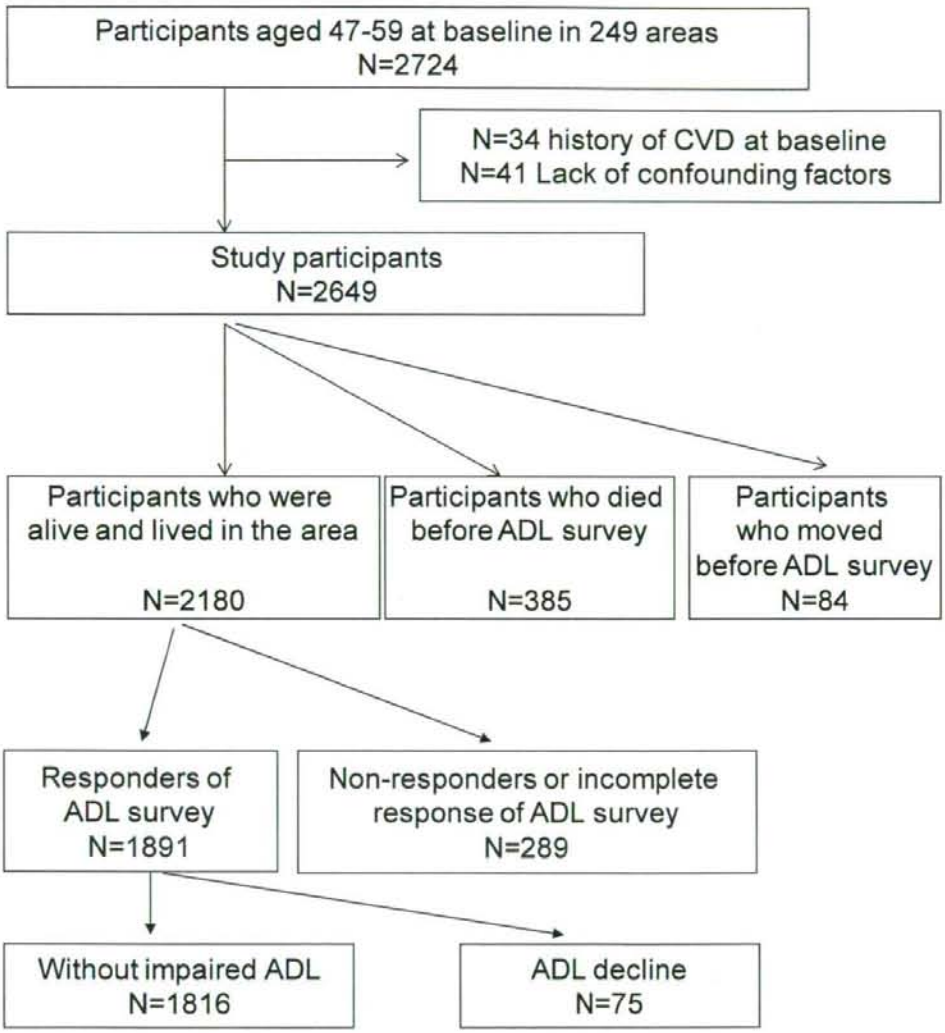
- BP categories measured at middle age could predict future impaired ADL and the composite endpoint of impaired ADL and death.
- We found that 45% of impaired ADL could be explained by non-normal BP in Japanese subjects.

Figure legend

Figure 1

Flow chart of the study participants.
N: numbers of participants.
ADL: Activities of daily living

Figure 1


Participants aged 47-59 at baseline in 249 areas
N=2724
N=34 history of CVD at baseline
N=41 Lack of confounding factors
Study participants
N=2649
Participants who were alive and lived in the area
N=2180
Participants who died before ADL survey
N=385
Participants who moved before ADL survey
N=84
Responders of ADL survey
N=1891
Non-responders or incomplete response of ADL survey
N=289
Without impaired ADL
N=1816
ADL decline
N=75

中年期の喫煙と将来のADL、IADLの低下とのリスクについて

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目的

これまで喫煙は循環器疾患やがんなどの危険因子であることが報告されている。一方で、循環器疾患、特に脳卒中は日常生活動作（ADL）や手段的ADL（IADL）が障害されるもっとも大きな要因であることが報告されている。ADL/IADLなどの将来の機能的な障害と高齢者の喫煙との関係についてはこれまでに報告されている。西欧諸国のこれらの調査によると高齢者の喫煙は日常生活機能低下の危険因子であることが報告されている。喫煙率はアジアでは西欧諸国と比べて高いことが知られており、高齢者においては喫煙と日常生活機能低下との関連について報告されている。しかしこれらのアジアでの調査は横断研究であったり追跡期間が短く高齢者の喫煙についての影響を評価している。中年期における喫煙習慣が高齢期における日常生活機能低下にアジア人でも関係しうるかについてはよくわかっていない。

アジア諸国の喫煙率は高く、日本では2005年時点で男性が39.3%、女性が11.3%で、中年期の男性の喫煙率はさらに高く50%に達する。喫煙率が高いアジア諸国での喫煙と日常生活機能低下との関係を明らかにすることが重要である。

本研究では中年期の喫煙が将来のADL/IADLの低下、あるいは総死亡を含めたリスクを増加させるかについて日本人を代表するコホート研究であるNIPPON DATA80を用いて検討した。

方法

1980年に全国から無作為に選ばれた300地区の住民のうち、1999年のADL/IADL調査が実施できた249地区に1980年当時、居住していた中壮年期(47歳から61歳)の住民2902名を対象に検討した。(図1)　75名が循環器疾患の既往歴が、49名はベースライン調査時の調査項目に欠損値があり除外した。2778名のうちADL調査時に転居していた89名とそ

れまでに死亡していた411名を除いた2278名を対象にADL調査を行い、85.3%（1944名）から協力を得た。解析はこの1944名あるいは死亡者を含めた2355名を対象に行った。

食事、着替え、入浴、排泄、屋内歩行のいずれかが自立していない場合をADL低下とした。また都老研式調査票の手段的ADLについて5点を下回るものをIADL低下とした。1980年当時の喫煙者、禁煙者(過去喫煙者)、非喫煙者の3群に分けて、非喫煙者に対するADLおよびIADLの低下のオッズ比を年齢、BMI、血圧、アルブミン値、総コレステロール値、飲酒を調整したロジステック回帰解析で求めた。解析はADL低下に死亡を含めた場合／含めない場合の両方を実施し、各々について非喫煙者を1としたオッズ比を求めた。

結果

表1に解析対象者の基本特性を示している。男性では喫煙者は非喫煙者と比較してBMI、総コレステロールレベルが低い傾向がみられた。男女ともに喫煙者は非喫煙者と比較して飲酒者の割合が高かった。

1999年の調査で、男性32名および女性48名でADLの低下を認めた。IADL低下者は男性204名、女性169名であった。1999年時に同時に行った自己申告による調査では、ADL/IADL低下のない男性28名(ADL/IADL低下のない男性の4.8%)、ADL/IADL低下のある男性38 名(ADL/IADL低下のある男性の18.5%) 、ADL/IADL低下のない女性20 名(ADL/IADL低下のない女性の2.0%)、ADL/IADL低下のある女性 27名(ADL/IADL低下のある女性の15.9%)が1980年以降に脳卒中の発症を認めた。

表2には喫煙歴とADL/IADL低下との関係を示した。喫煙者のADL低下に達するオッズ比は非喫煙者を1とすると男性 1.52 [95% CI: 0.50, 4.63]、女性1.74 [95% CI: 0.65, 4.69]であった。IADL低下に達するオッズ比は喫煙男性で1.83 [95% CI: 1.10, 3.05]と有意に高かったが、女性では有意な関連は認めなかった。表3は喫煙歴と、ADL/IADL低下あるいは死亡との関連について示した。ADL/IADL低下あるいは死亡のオッズ比は喫煙男性で2.04 [95% CI: 1.38, 3.01]、喫煙女性で1.25 [95% CI: 0.77, 2.03] であった。

考察

日本人を代表する集団の長期にわたる追跡において、中壮年期喫煙者の将来のADL/IADL低下のリスクは非喫煙者に比べて特に男性で高かった。死亡を含めたリスクも同様の傾向を認めた。

これまでの追跡研究において喫煙は高齢者の将来の日常生活機能の低下をもたらすことが報告されている。しかし多くの研究は西欧諸国で行われている。この西欧諸国での結果は疾病構造が大きく異なっている日本においても同様の結果を示した。アジア諸国ではこれまでに高齢者の喫煙は日常生活機能低下に関連することが報告されている。しかし、これらの調査と比較して本研究は大規模でより若い世代の喫煙の影響について長期にわたる追跡を行っている。このことから本研究は世界で初めてアジア人で中年期の喫煙が将来の

ADL/IADL 低下のリスクになることを示したと考えている。喫煙が ADL/IADL 低下に及ぼすメカニズムについては脳卒中や COPD などを介すると考えている。これまでの報告より喫煙は脳卒中や COPD のリスクであることが報告されている。他のメカニズムとして骨折によるものが考えられる。確かに骨粗鬆症は高齢者における骨折の大きな要因であり、喫煙が骨粗鬆症のリスクであることが報告されている。1994 年の ADL 調査データを用いてすでに我々は男性の 54%、女性の 22%の ADL 低下は脳卒中に起因し、女性の 30% の ADL 低下は下肢の骨折によることを報告している。本研究の男性対象者では ADL 低下者の 53.1%が 1980 年以降に脳卒中の既往を持っていた。

女性においては喫煙と ADL/IADL 低下について有意な関連を認めることができなかった。ADL 低下と喫煙との関係については男性と同様の傾向を示したにもかかわらず IADL 低下にかんしては喫煙の影響を見出すことはできなかった。考えられる一つの要因として喫煙率が女性は低いことがあげられる。さらなる女性の大規模な調査が必要と考えられる。この研究にはいくつかの限界がある。ひとつはベースライン時に ADL/IADL について調査をしていないことである。しかし、この研究においてはベースライン調査時に自力で保健所に来ており、低下はしていなかったと考えられる。また ADL/IADL の調査を 1999 年にしか行っていない。他には ADL/IADL 低下の一つの要因である関節炎などの評価のための炎症指標等を調査していないことがあげられる。

われわれの結果から中壮年期の喫煙が将来の死亡を含めた ADL/IADL 低下、あるいは ADL/IADL 低下の危険性を増加させることが示唆された。循環器疾患やがんの死亡だけでなく、将来の生活機能の低下を防ぐためにも禁煙が重要であると考えられる。

Figure 1

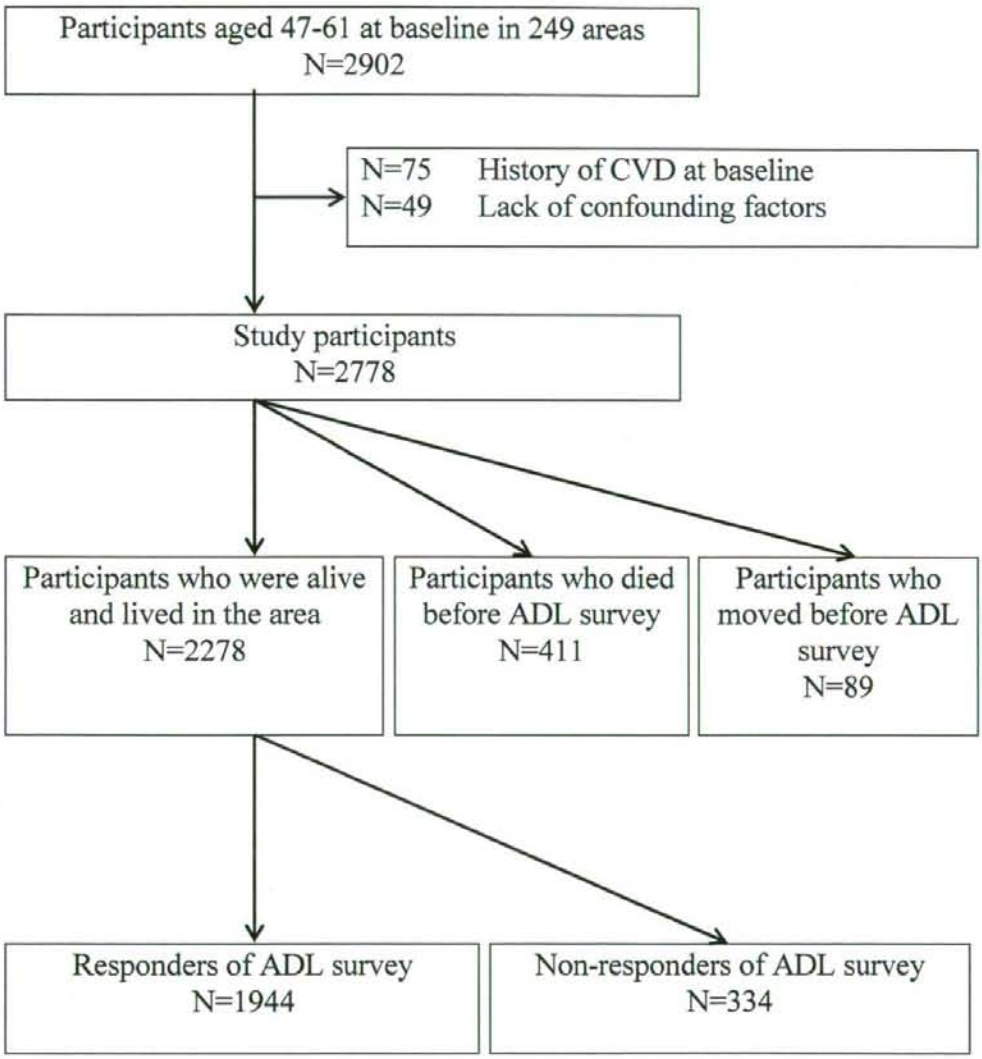
Participants aged 47-61 at baseline in 249 areas
N=2902
N=75 History of CVD at baseline
N=49 Lack of confounding factors
Study participants
N=2778
Participants who were alive and lived in the area
N=2278
Participants who died before ADL survey
N=411
Participants who moved before ADL survey
N=89
Responders of ADL survey
N=1944
Non-responders of ADL survey
N=334

Table 1. Baseline Characteristics of Study Population in 1980. NIPPON DATA80, 1074 Men and 1332 Women aged 47 to 61

	Non smoker	Former smoker	Current smoker	*P* value*
Men				
Number of participants	152	199	696	
Age (year)	52.97 ±3.9	53.43 ±3.8	53.44 ±3.8	0.37
BMI (kg/m^2)	23.74 ±2.8	22.64 ±2.8	22.29 ±2.7	<0.001
Serum albumin (g/dl)	4.4 ±0.3	4.41 ±0.2	4.37 ±0.3	0.08
Serum total cholesterol (mg/dl)	191.34 ±30.4	193.64 ±33.7	184.28 ±33.9	<0.001
SBP (mmHg)	140.65 ±19.6	140.85 ±22.1	140.47 ±20.3	0.97
DBP (mmHg)	87.05 ±11.0	86.18 ±13.1	84.67 ±12.4	0.05
Prevalence of hypertension† (%)	61.2	54.3	55.8	0.38
Current drinking (%)	71.1	70.4	77.9	0.04
Women				
Number of participants	1181	28	99	
Age (year)	53.66 ±4.1	54.46 ±4.6	54.16 ±4.1	0.31
BMI (kg/m^2)	23.3 ±3.4	23.58 ±3.6	22.95 ±3.4	0.55
Serum albumin (g/dl)	4.37 ±0.2	4.34 ±0.2	4.36 ±0.2	0.81
Serum total cholesterol (mg/dl)	198.16 ±33.6	198.89 ±30.1	198.01 ±32.5	0.99
SBP (mmHg)	138.46 ±20.7	140.82 ±17.1	133.37 ±21.0	0.05
DBP (mmHg)	82.45 ±11.4	83 ±11.6	79.61 ±13.0	0.06
Prevalence of hypertension† (%)	51.0	57.1	42.4	0.20
Current drinking (%)	14.6	21.4	36.4	<0.001

SBP,収縮期血圧; DBP,拡張期血圧.

* 連続変量には ANOVA 検定を、名義変数にはカイの二乗検定を用いた.

†高血圧は 140/90mmHg 以上または降圧薬治療中のもの

Table 2. Relationship between Baseline Smoking Category in 1980 and Impaired ADL/IADL Assessed 19 years later. NIPPON DATA80, Japan, 1980-1999.

	Non smoker	Former smoker		Current smoker	
Men					
Number of participants alive at the end of follow-up	127	160		503	
Number of participants who developed impaired ADL	4	5		23	
Age-adjusted OR (95%CI)	1	0.96	(0.25, 3.66)	1.42	(0.48, 4.18)
Multivariate-adjusted OR (95%CI)*	1	1.15	(0.30, 4.48)	1.52	(0.50, 4.63)
Number of participants who developed impaired IADL	22	37		145	
Age-adjusted OR (95%CI)	1	1.40	(0.78, 2.54)	1.89	(1.14, 3.12)
Multivariate-adjusted OR (95%CI)*	1	1.42	(0.78, 2.58)	1.83	(1.10, 3.05)
Women					
Number of participants alive at the end of follow-up	1047	24		83	
Number of participants who developed impaired ADL	41	2		5	
Age-adjusted OR (95%CI)	1	1.93	(0.43, 8.62)	1.51	(0.58, 3.95)
Multivariate-adjusted OR (95%CI)*	1	1.64	(0.35, 7.69)	1.74	(0.65, 4.69)
Number of participants who developed impaired IADL	155	2		12	
Age-adjusted OR (95%CI)	1	0.40	(0.09, 1.78)	0.91	(0.47, 1.75)
Multivariate-adjusted OR (95%CI)*	1	0.36	(0.08, 1.61)	0.98	(0.50, 1.92)

ADL: 日常生活動作, IADL: 手段的 ADL, OR: オッズ比, CI:信頼区間.

*調整変数には年齢、BMI、血清アルブミン、血中総コレステロール、高血圧、飲酒歴を用いた

Table 3. Relationship between Baseline Smoking Category in 1980 and Composite Outcomes (Death or Impaired ADL/IADL) Assessed 19 years later. NIPPON DATA80, Japan, 1980-1999.

	Non smoker	Former smoker		Current smoker	
Men					
Number of participants	152	199		696	
Number of composite outcomes	47	76		340	
Age-adjusted OR (95%CI)	1	1.33	(0.84, 2.10)	2.09	(1.43, 3.07)
Multivariate-adjusted OR (95%CI)*	1	1.33	(0.84, 2.11)	2.04	(1.38, 3.01)
Women					
Number of participants	1181	28		99	
Number of composite outcomes	290	6		28	
Age-adjusted OR (95%CI)	1	0.72	(0.28, 1.85)	1.14	(0.71, 1.83)
Multivariate-adjusted OR (95%CI)*	1	0.69	(0.27, 1.81)	1.25	(0.77, 2.03)

ADL: 日常生活動作, IADL: 手段的 ADL, OR: オッズ比, CI:信頼区間.

*調整変数には年齢、BMI、血清アルブミン、血中総コレステロール、高血圧、飲酒歴を用いた