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Multiple Logistic Regression Analysis on the Health Checkup Data and the Lifestyle Habits of Medicated Residents: A Population-Based Cohort Study

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Abstract

Background: The residents currently taking prescribed medication have been exempted from the special public health guidance conducted in the act in Japan. This study analyzed blood pressure taken during the special health checks from 2008 to 2011 in light of resident lifestyle, focusing on comparisons between medicated and non-medicated residents.

Methods: Health checkup data in retrospective cohort of 4,734 residents undergoing special health checks in B-City from 2008 to 2011 were analyzed. The participants were categorized as taking medication (medicated residents, n=1,083) and others (non-medicated residents, n=3,651). The multiple logistic regression analysis provided odds ratios (ORs) and 95% confidence intervals (95% CI).

Results: The medicated residents had higher systolic and diastolic blood pressure than the non-medicated in both 2008 and 2011. Factors on which the OR was significantly higher for the hypertension group (normal blood pressure group=1) were alcohol consumption (OR: 1.30 (95% CI: 1.12-1.50)), and weight gain (OR: 1.45 (95% CI: 1.26-1.67)). Factors on which the OR was significantly higher for the diabetes mellitus group (normal blood glucose group=1) were smoking (OR: 3.14 (95% CI:1.69-5.80)). Factors on which the OR was significantly higher for the neutral fat high-flying group (normal neutral fat group=1) were alcohol consumption (OR: 1.30 (95% CI: 1.12-1.50)) and weight gain (OR: 1.45 (95% CI: 1.26-1.67)). Compared to the group with hypertension only, the group with multiple conditions who consumed alcohol in both 2008 and 2011 had an OR of 1.49 (95% CI: 1.29-1.72), and those who had weight gain of 10 kg had an OR of 1.74 (95% CI: 1.50-2.02).

Conclusion: No improvement was found in the lifestyle habits of medicated residents. This study suggested that an appropriate health guidance will be needed to improve the lifestyle habits in medicated residents.

Keywords: Medicated residents; Lifestyle habits; Public health guidance

Background

Public health management to improve lifestyle habits is the most important strategy. Residents can be classified into medicated and non-medicated people. The medicated residents are supposed to be medically managed under family doctors. However, there has been no actual condition survey. In order to reduce lifestyle diseases, we need to seek how to conduct the public health management to improve lifestyle habits.

Medicated residents are exempted from the special public health checks and special public health guidance under the 2008 Act on Assurance of Medical Care for Elderly People in Japan. The aim of the special health checks is, as evident from the alternative name "metabolism checks", to prevent and early detect lifestyle diseases that account for over 60% of deaths in Japan. Improving the lifestyle habits of every individual concerned is essential to prevent lifestyle diseases, improve symptoms, and prevent deterioration. However, people with hyperlipidemia are unlikely to understand their condition correctly, and they may not take the disease seriously, either. It also seems that there is a lack of associated fear of the disease. Thus, those who have the disease may not take care of themselves properly. Therefore, it is important to encourage people with lifestyle diseases who are taking medication to change their own behavior through an appropriate health guidance. It has been indicated that it is necessary to include people taking medication in the special health guidance [1]. In the initial revisions of the special health checks and special health guidance that were implemented since 2012 [2], people taking medication remained excluded from the special health guidance on the ground that "initiatives aimed at improvement or prevention of deterioration of symptoms are already progressing under the direction of doctors".

This study used health checkup data of the residents collected in B-City from 2008 to 2011 to carry out a comparative analysis of medicated residents who were excluded from the special health guidance with non-medicated. Our previous study [3] indicated that 56.6% residents were medicated in B-city and 41.1% residents followed no appropriate medication. This study aimed to clarify the relationship between changes in the health checkup data and the lifestyle habits in the residents with lifestyle diseases. This population-based cohort study would serve as some evidence for effective implementation of the special public health guidance in the future.

Methods

Health checkup data from 85,636 residents in B-City was continuously collected and collated from 2008 to 2011. This study focused on longitudinal population-based health checkup data from

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4,734 residents who had undergone special health checks in both 2008 and 2011, among 11,054 residents from the age of 40 or more to the age of less than 65. Analysis was conducted as described below. The statistics package SPSS J for Windows 20.0 (IBM Japan) was used for all analyses and the significance level was set at 5%.

Study participants

Classification by medication was conducted among 4,734 residents. Residents taking medication for hypertension/diabetes mellitus/ hyperlipemia were classified as the medicated residents, while others were classified as non-medicated residents.

Focusing on blood pressure levels in health checkup data, those with a systolic blood pressure of 139 mmHg or less and a diastolic pressure of 89 mmHg or less were classified as the normal blood pressure group, while others were classified as the hypertension group. Focusing on fasting blood glucose levels in health checkup data, those with fasting blood glucose of 125 mg/dl or less were classified as the normal fasting blood glucose group, while others were classified as the fasting blood glucose group.

Focusing on neutral fat levels in health checkup data, those with a neutral fat of 150 mg/dl or less were classified as the normal neutral fat group, while others were classified as the neutral fat group (Table 1). The focus was on items related to lifestyle habits from the 22 item "Standard Questionnaire" used in the "Standard Health Check/Health Guidance Program" for special health checks in B-City, namely, smoking, alcohol consumption, exercise, and weight. These items were collected and analyzed. The study investigated the changes in condition and lifestyle habits over the 3 year study period from 2008 to 2011. The systolic and diastolic pressures of the medicated and non-medicated residents were focused on. Analysis of lifestyle habits involved calculating the percentages of residents, who smoked, drank alcohol, did not exercise for at least 30 min daily and had gained 10 kg for three years.

Data analysis

Correlation between the health checkup data and the lifestyle habits in the medicated and non-medicated residents was investigated using a multiple logistic regression analysis. For each year, the correlation between each lifestyle habit and hypertension diabetes mellitus/ hyperlipemia symptoms was analyzed. The multiple logistic regression analysis provided odds ratios (ORs) and 95% confidence intervals (95% CI). Using the hypertension group and the normal blood pressure group/ fasting blood glucose group and normal fasting blood glucose/ neutral fat group and the normal neutral fat as the criterion variable, and sex, age, hypertension medication, smoking, alcohol consumption, 30 min of daily exercise and 10 kg weight gain as explanatory variables, ORs were calculated. Correlation between conditions related to hypertension and lifestyle habits was also investigated in order to ascertain which lifestyle habit factors influenced the prognosis of hypertension using the logistic regression analysis. In the data analyses, the likelihood ratio statistics was used to evaluate improvement by adding a new parameter [4]. The significance level was set at 5%.

Ethical clearance

This study was approved by the Research Ethics Safety Committee in Oita University of Nursing and Health Sciences before implementation (registration number 636). The study fell under the category, "ethical guidance related to epidemiological surveys" since it used health data. The health checkup data received from B-City did not include any information that could identify the participating individuals. There was no negative impact on the participants due to agreeing or declining to participate in the study and there were no issues concerning the protection of human rights.

Results

Correlation between medication status and lifestyle parameters

Table 2 shows the correlation between medication status and lifestyle parameters.

Significant relationships were observed for alcohol consumption, exercise, and weight in the hypertension medication group; exercise and weight in the diabetes mellitus medication group; and smoking, alcohol consumption, exercise and weight in the hyperlipidemia medication group.

Multiple logistic regression analysis of lifestyle test values between the medicated group and the non-medicated group

Hypertension: Using the hypertension group and the normal blood pressure group as the criterion variable, ORs were calculated

Attribute		Number of people
Residents		4,734
Non-medicated residents		3,651
The medicated residents		1,083
Hypertension		765
Blood pressure	Normal Systolic blood pressure of 139 mmHg or less and a diastolic pressure of 89 mmHg or less	211
	Hypertension group Above values or more	554
Diabetes mellitus		110
Fasting blood glucose	Normal Fasting blood glucose of 125 mg/dl or less	55
	Fasting blood glucose group Fasting blood glucose of 125 mg/dl or over	55
Hyperlipemia		367
Neutral fat	Normal Neutral fat of 150 mg/dl or less	288
	Neutral fat group Neutral fat of 150 mg/dl or over	79

Table 1: Study population by hypertension, diabetes mellitus and hyperlipemia.

(Table 3). In both 2008 and 2011, hypertension medication, alcohol consumption and 10 kg weight gain compared with at aged 20 were each independently significantly correlated with hypertension. Comparing between the medicated group and the non-medicated group, the OR in 2011 was 2.10 (95% CI: 1.81-2.44). Factors for which the OR was significantly high for the hypertension group (normal blood pressure group=1) were alcohol consumption (OR: 1.30 (95% CI: 1.12-1.50)) and weight gain (OR: 1.45 (95% CI: 1.26-1.67)).

Diabetes mellitus: Using the fasting blood glucose group and the normal fasting blood glucose group as the criterion variable, ORs were calculated (Table 4). Comparing the medicated group with the not medicated group, the OR in 2011 was 42.70 (95% CI: 26.64-68.44). Factors on which the OR was significantly higher for the diabetes mellitus group (normal blood glucose group=1) were smoking (OR: 3.14 (95% CI: 1.69-5.80)).

Hyperlipemia: Using the neutral fat group and the normal neutral fat group as the criterion variable, ORs were calculated (Table 5). In both 2008 and 2011, smoking, alcohol consumption and 10 kg weight gain were each independently significantly correlated with neutral fat. Comparing the medicated group with the non-medicated group, the OR in 2011 was1.60 (95% CI: 1.81-2.07).

Factors on which the OR was significantly higher for the neutral fat high-flying group (normal neutral fat group=1) were alcohol consumption (OR: 1.30 (95% CI: 1.12-1.50)), and weight gain (OR: 1.45 (95% CI: 1.26-1.67)).

Multiple logistic regression analysis of lifestyle factors related with progression of diseases

We analyzed lifestyle factors on which the group with multiple conditions had progressed during 2008 and 2011 compared to the group with hypertension only. Adjusted odd ratios are shown in Table 6 for each change in lifestyle. A significant correlation with alcohol consumption was apparent, with the OR for drinkers in both 2008 and 2011 and non-drinkers in both 2008 and 2011 at 1.49 (95% CI: 1.29-1.72). A significant correlation with 10 kg weight gain was evident, with the OR for those gaining 10 kg and those not gaining 10 kg at 1.74 (95% CI: 1.50-2.02).

Discussion

In this study, the results of comparative analysis between the medicated group and the non-medicated group did not show any differences in test values and lifestyle habits between the two groups, despite the fact that the medicated group was receiving treatment, medication control, and health guidance on lifestyle habits from family doctors.

Medicated people for hypertension

This study suggested that, compared to non-medicated people,

Medication	Hypertension medication		Diabetes mellitus medication		Hyperlipidemia medication	
	2008	2011	2008	2011	2008	2011
Smoking	-0.025 ns	-0.027 ns	0.019 ns	0.03**	-0.053**	-0.063**
Alcohol consumption	0.030*	0.005 ns	-0.010 ns	0.001ns	-0.076**	-0.105**
30 min of daily exercise	-0.040**	-0.036*	-0.056**	-0.047**	-0.039**	-0.046**
10 kg of weight gain compared with aged 20	0.115**	0.144**	0.065**	0.082**	0.053**	0.053**

Lifestyle	Smoking		Alcohol consumption		30 min of daily exercise	
	2008	2011	2008	2011	2008	2011
Smoking						
Alcohol consumption	0.202**	0.171**				
30 min of daily exercise	0.049**	0.043**	-0.032*	-0.036*		
10 kg of weight gain compared with aged 20	0.038**	0.038**	0.038**	0.053**	0.022 ns	0.030*

Pearson Correlation coefficient: *p<0.05, **p<0.01

Table 2: Correlation between medication status and lifestyle parameters.

Explanatory Variables		2008		2011	
		OR (95% CI)	p	OR (95% CI)	p
Hypertension medication	No	1.0	0.000***	1.0	0.000***
	Yes	2.61 (2.19-3.12)		2.10 (1.81-2.44)	
Sex	Men	1.0	0.000***	1.0	0.002**
	Women	1.84 (1.53-2.22)		0.77 (0.66-0.91)	
Age		1.0	0.000***	1.0	0.000***
		1.05 (1.03-1.07)		1.05 (1.04-1.07)	
Smoking	No	1.0	0.079	1.0	0.923
	Yes	0.79 (0.61-1.03)		0.99 (0.77-1.27)	
Alcohol consumption	No	1.0	0.013*	1.0	0.001**
	Yes	1.25 (1.05-1.48)		1.30 (1.12-1.50)	
10 kg of weight gain compared with aged 20	No	1.0	0.000***	1.0	0.000**
	yes	1.35 (1.15-1.59)		1.45 (1.26-1.67)	
30 min of daily exercise	Yes	1.0	0.947	1.0	0.708
	No	0.10 (0.85-1.16)		1.03 (0.90-1.17)	

n=4,734
*p<0.05, **p<0.01, ***p<0.001

Table 3: Adjusted odd ratios of hypertension group to the normal group in logistic regression analyses for each observation year.

Explanatory Variables		2008		2011	
		OR (95% CI)	p	OR (95% CI)	p
Hypertension medication	No	1.0	0.000***	1.0	0.000***
	Yes	33.42 (21.86-51.09)		42.70 (26.64-68.44)	
Sex	Men	1.0	0.000***	1.0	0.095
	Women	2.07 (1.38-3.11)		0.66 (0.40-1.08)	
Age		1.0	0.030*	1.0	0.054
		1.04 (1.00-1.08)		1.04 (1.00-1.09)	
Smoking	No	1.0	0.194	1.0	0.000***
	Yes	0.72 (0.44-1.18)		3.14 (1.69-5.80)	
Alcohol consumption	No	1.0	0.084	1.0	0.708
	Yes	0.71 (0.48-1.05)		0.91 (0.56-1.48)	
10 kg of weight gain compared with aged 20	No	1.0	0.813	1.0	0250
	yes	0.81 (0.56-1.18)		1.29 (0.83-2.01)	
30 min of daily exercise	Yes	1.0	0.964	1.0	0.433
	No	0.99 (0.69-1.42)		0.85 (0.55-1.29)	

n=4,734
*p<0.05, **p<0.01, ***p<0.001

Table 4: Adjusted odd ratios of fasting blood glucose group to normal group in logistic regression analyses for each observation year.

Explanatory Variables		2008		2011	
		OR (95% CI)	p	OR (95% CI)	p
Hypertension medication	No	1.0	0.083	1.0	0.000***
	Yes	1.28 (0.97-1.68)		1.60 (1.24-2.07)	
Sex	Men	1.0	0.000***	1.0	0.000***
	Women	2.13 (1.75-2.60)		0.51 (0.42-0.63)	
Age		1.0	0.572	1.0	0.350
		1.00 (0.99-1.02)		1.01 (0.99-1.02)	
Smoking	No	1.0	0.000***	1.0	0.015*
	Yes	0.59 (0.46-0.75)		1.42 (1.07-1.88)	
Alcohol consumption	No	1.0	0.139	1.0	0.021*
	Yes	1.15 (0.96-1.39)		0.80 (0.66-0.97)	
10 kg of weight gain compared with aged 20	No	1.0	0.000***	1.0	0.000***
	yes	0.44 (0.37-0.52)		2.02 (1.71-2.39)	
30 min of daily exercise	Yes	1.0	0.469	1.0	0.039
	No	1.07 (0.90-1.26)		1.19 (1.01-1.40)	

n=4,734
*p<0.05, **p<0.01, ***p<0.001

Table 5: Adjusted odd ratios of neutral fat group to normal group in logistic regression analyses for each observation year.

Explanatory Variables	Lifestyle habits in 2008	Lifestyle habits in 2011	OR (95% CI)	p
Smoking	Yes	Yes	0.98 (0.77-1.25)	0.869
	Yes	No	0.91 (0.64-1.30)	0.608
	No	Yes	0.17 (0.02-1.47)	0.111
	No	No	1.0	
Alcohol consumption	Yes	Yes	1.49 (1.29-1.72)	0.000***
	Yes	No	1.10 (0.84-1.44)	0.474
	No	Yes	0.84 (0.60-1.18)	0.304
	No	No	1.0	
10 kg of weight gain	Yes	Yes	1.74 (1.50-2.02)	0.000***
	Yes	No	1.38 (1.10-1.73)	0.005**
	No	Yes	1.52 (1.19-1.94)	0.001**
	No	No	1.0	
30 min of daily exercise	No	No	0.86 (0.75-0.10)	0.046*
	No	Yes	0.88 (0.72-1.07)	0.205
	Yes	No	0.90 (0.71-1.13)	0.346
	Yes	Yes	1.0	

*p<0.05, **p<0.01, ***p<0.001

Table 6: Adjusted odd ratios obtained by multiple logistic regression analyses of lifestyle factors related with progression of diseases. The outcome measures were multiple diseases in 2011 that progressed among medicated residents with hypertension only in 2008 (n=571).

most of the medicated people for hypertension drank more alcohol, weighed at least 10 kg more than they did when they were 20 years old, and do not exercise for at least 30 min daily, thus showing no improvement in lifestyle habits. Many cross-sectional studies [5-11], cohort studies [12-15] and intervention studies [16,17] have proven a link between alcohol consumption and blood pressure, clearly showing that limiting alcohol consumption reduces blood pressure. The correlation between weight gain and blood pressure is clear and the importance of weight control has been emphasized in JNC7 and ESH/ESC2007, as well as in JSH2009. It seems that guidance on drinking in moderation is important from the perspective of blood pressure management. Eni et al. reported that the blood pressure of 50% of patients with hypertension can be controlled through reducing lack of interest in treatment [18] and emphasizing the importance of health guidance for people taking medication [19]. All of this seems to prove the importance of health guidance related to lifestyle habits for people taking medication for hypertension. In order to further promote the health of community residents, it is necessary not only to focus on hypertension, but also to improve other risk factors such as hypoglycemia, lack of exercise, alcohol consumption, overweight or obesity, and high salt consumption.

Medicated people for diabetes mellitus

Compared to the non-medicated group, the diabetes mellitus medication group included more residents who smoked, had experienced weight gain of 10 kg or more since the age of 20 and did not engage in regular exercise of 30 min or longer, indicating no improvements in lifestyle habits among these residents.

Previous studies [20-30] investigating the relationship between smoking and diabetes mellitus clarified the importance of smoking cessation for risk management of cardiovascular disease.

Compared to the non-medicated group, the medicated group included more residents who had experienced weight gain of 10 kg or more since the age of 20. This weight gain was reported by approximately 40% of the diabetes mellitus medication group, suggesting the importance of reviewing or being aware of improving lifestyle habits, eating a healthy diet, and exercising during adulthood. Residents who participated in exercise therapy under medical management in conjunction with appropriate diet therapy lost weight and had improved insulin sensitivity and lipid metabolism, decreased blood pressure, and good blood glucose control [31-33]. Thus, increasing physical activity during daily life appears to be an important part of health guidance for residents taking diabetes mellitus medication.

Blood pressure control is required to prevent the onset of concomitant diseases [34], while hyperlipidemia in patients with diabetes mellitus is a risk factor for cardiovascular problems [35,36]. With the revisions to medical law in 2006, construction of a diabetes-related cooperative medical care system was mandated and prefectural governments established medical care plans for diabetes. Prefectural governments have also established promotion councils for diabetes prevention. In practical terms, forming interdisciplinary medical teams, developing educational programs, and providing individual and group guidance, such as diabetes classes, are important approaches to tackling diabetes. Improving interdisciplinary medicine [37,38] and thorough ongoing self-management to improve lifestyle habits under interdisciplinary medical team guidance are also important from the perspective of preventing exacerbation. Various interdisciplinary approaches from primary through to tertiary prevention must be used to implement community-based interdisciplinary medicine for diabetes and reduce medical costs [39,40].

Medicated people for hyperlipidemia

Compared to the non-medicated group, the hyperlipidemia medication group included more residents who smoked, consumed alcohol, and had experienced weight gain of 10 kg or more since the age of 20, indicating no improvements in lifestyle habits among these residents.

While treatment protocols should be based on the type of hyperlipidemia, improving lifestyle habits is of paramount importance regardless of which drug therapy is selected. Many studies have found that smoking directly affects lipid metabolism [41–47]. The Hisayama study found that the risk of coronary artery disease was 2.8 times greater in the smoking group compared to the non-smoking and non-hypertensive groups [48]. Therefore, smokers should receive guidance for smoking cessation and lifestyle improvement, including health guidance regarding daily lifestyle habits such as diet and exercise.

Previous studies [49,50] have suggested that appropriate management of both blood pressure and serum lipid levels is important for preventing cerebro- and cardiovascular diseases. However, according to the National Health and Nutrition Survey in Japan, increasing numbers of people have abnormal levels of neutral fats, which is one of the diagnostic criteria for hyperlipidemia. For example, the incidence of hyperlipidemia among men in their 30s to 50s is increasing, affecting around 1 in 2 men in their 50s. The incidence is also increasing in women from their 50s onwards, affecting around 1 in 3 women in their 60s [51]. However, only 30% of people with hyperlipidemia are aware of their condition [52]. Furthermore, hyperlipidemia tends to be taken less seriously than hypertension and diabetes mellitus; there is a lack of associated fear, and most patients responded, “Don’t know” [53]. In addition to “experience of the disease”, presence or absence of subjective symptoms of disease is closely linked with behavior. Health guidance should therefore be based on an understanding of patients’ lifestyle characteristics. In addition to drug therapy, improving lifestyle habits is essential to prevent exacerbation of the symptoms of lifestyle disease. In a study by Akahoshi et al., 83.8% of patients were initially taking medication for one condition. After 3 years, this figure had dropped to 68.6% while the number of patients taking medication for multiple conditions had increased [3]. As is also clear from the changes in diseases for which patients were taking medication, improved healthcare guidance is necessary to prevent the onset of concomitant diseases.

Conclusion

Public residents were classified into a medicated group and a non-medicated group to analyze the changes in test values and lifestyle habits over a 3 year study period. Analysis of the health checkup data shed light on the health issues of the residents undergoing the health guidance from family doctors. No improvement was found in the lifestyle habits of medicated residents. This study suggested that appropriate health guidance will be needed to improve the lifestyle habits in medicated residents.

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Author’s Contribution

KA designed and oversaw the study, performed the statistical analysis and wrote the manuscript. MK proposed suggestions to improve the study and revised the manuscript. All authors read and approved the final manuscript.

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