Non-financial social determinants of diabetes among public assistance recipients in Japan: A cohort study

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Keywords

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ABSTRACT

Aims/Introduction: Poverty is an important social determinant of diabetes. Poverty is a multidimensional concept including non-financial difficulties, such as social isolation and exclusion from communities. Many countries provide financial social assistance programs for those in need. This study aimed to explore non-financial social determinants of diabetes among public assistance recipients in Japan, by using linkage data of two municipal public assistance databases and medical assistance claim data.

Materials and Methods: We carried out a retrospective cohort study. Public assistance is provided to households below the poverty line to ensure their income security. We extracted recipients' sociodemographic factors of January 2016 (household number and employment status as non-financial social determinants of diabetes) and identified the incidence of diabetes diagnosis until December 2016 as the outcome.

Results: We included the data of 2,698 younger individuals (aged <65 years) and 3,019 older individuals (aged >65 years). A multivariable Poisson regression, with a robust standard error estimator, showed that among 2,144 younger recipients at risk, unemployment and living alone were slightly associated with 1-year cumulative incidence of diabetes diagnosis (adjusted incidence ratio 1.20, 95% confidence interval 0.93–1.54 and adjusted incidence ratio 1.15, 95% confidence interval 0.89–1.48, respectively). Among 2,181 older recipients at risk, there was no strong association between their sociodemographic factors and incidence of diabetes diagnosis.

Conclusions: Unemployment and living alone might be additional risk factors for diabetes among younger public assistance recipients. Multidimensional supports assuring financial and non-financial securities are required to prevent diabetes among people living in poverty.

INTRODUCTION

Poverty is known to be a major social determinant of health^{1,2}. People living in poverty tend to endure a higher prevalence of chronic diseases; specifically, diabetes is a chronic disease that is more prevalent in a socioeconomically vulnerable population³⁻⁶. Therefore, advocating for the maintenance of a healthy life among people living in poverty is an important role in society. Conventionally, the concept of poverty has been associated with an economic problem, such as lack of income; governments in

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many countries have aided people in poverty by ensuring income and financial healthcare access with social assistance entitlement⁷. The Japanese government, likewise, offers a public assistance program that ensures monthly minimum income protection for the recipients, and that exempts payments for their medical care utilization⁸.

Recently, poverty has been reconceptualized to include multidimensional livelihood difficulties that affect fundamental areas of human life and well-being, such as health, education, and standards of living⁹. However, social relationships have been overlooked as an aspect of multidimensional poverty¹⁰, even though social isolation and exclusions from the labor market or

approximately 2% of the population receives public assistance. Households availing public assistance obtain monthly minimum income protection and are fully exempted from payment on their medical care utilization⁸. We excluded the data of patients who stopped receiving public assistance during the study. This occurs mainly when their income has increased or on the death of recipients (Figure 1). **Data sources** For baseline data, we used the public assistance recipients' database of the welfare offices of the municipalities. This database

included information on age, sex, number of family members, household composition, nationality, working status, income including working income, pension and disability pension. These data were collected by the staff members at the municipality welfare offices to determine the receipt of public assistance and the amount of monthly minimum income protection, thus, we did not have any missing data. To obtain the outcome data, we used medical assistance claims data from January 2016 to December 2016, which included the month of the recipients' medical consultation, total cost of medical receipts, total numbers of visits each month, and their diagnosis.

Each municipality individually linked the two databases, using individual identification codes. The welfare offices of the two municipalities agreed to provide anonymized data to the authors through a system company that had provided the management software of the public assistance database for municipalities. This study protocol was approved by the ethics committee of the Graduate School of Medicine of the University of Tokyo (Approval No: 11503).



To balance the increasing medical care costs of diabetes, the Japanese government has started a special secondary and tertiary prevention of diabetes program for those under the public assistance program. However, there has been some difficulty in identifying and prioritizing targets owing to a dearth of studies that ascertain the non-financial sociodemographic factors associated with diabetes among the recipients of public assistance. Hence, the objective of the present study was to explore the association between individual non-financial sociodemographic factors, such as working status and living arrangement, and diabetes, among people who receive minimum income protection as public assistance, using the individual linkage data of public assistance recipients' database and their medical assistance claim data, administered by the municipalities in Japan.

METHODS

Study participants

The present retrospective cohort study included adults who received public assistance in two suburban municipalities, Osaka and Tokyo, in January 2016. Public assistance is the governmental welfare program availed by households who are living below the poverty line without any assets. In Japan,



Figure 1 | Flowchart of study participants.

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Measurement and variables

Outcome variables

From the medical assistance claims data, we identified the cumulative incidence of diabetes diagnosis, defined as those who visited medical care institutions for diabetes care once or more during the observation period. Diabetes was determined according to International Classification of Disease, Tenth Edition code¹⁵ E10-14.

Explanatory variables

We extracted information of household composition (living alone or not) and the employment status (working or not) from the database.

Covariates

Based on data availability, we used the age (continuous), sex (women/men) and nationality (Japanese or others), as of January 2016, as demographic factors. We coded the municipality as a dummy variable to adjust for unmeasured cultural and environmental characteristics of the two municipalities (A/B). We also considered psychological, intellectual and physical disabilities as potential confounding factors, noting the information on the qualifications for welfare benefits for disabled persons. The municipality officials certify them with the diagnosis of designated physicians and agency. The recipients of disability assistance can have the benefit of additional income and social care. We also considered the levels of long-term care needs based on the information in the public long-term care insurance system. In the system, there are seven nationally standardized levels of long-term care need (support required levels 1 and 2 and care need levels 1-5)8. People aged >65 years who are potentially in need of long-term care, and people aged \geq 40 years with the designated diseases can apply for the insurance benefit. Based on the definition of the level, insurers (in most cases municipality governments) assess and certify the use of insurance benefits. The amount of benefit is determined based on the certified level. In the present study, we dichotomized the levels into support required level and care need level.

Statistical analysis

First, we described the characteristics of participants and recipients of public assistance in the cohort who were assigned to have diabetes. Second, we carried out univariable Poisson regression analysis, and calculated the crude cumulative incidence ratio (IR) and 95% confidence interval (CI) of each explanatory variable. Third, we carried out a multiple Poisson regression analysis to calculate the multivariable-adjusted IR of each explanatory variable (analysis 1). To eliminate the potential reverse causation between non-financial poverty and diabetes diagnosis, we carried out additional analysis, not counting new cases of diabetes diagnoses in the first 3 months (analysis 2). We chose to exclude the first 3 months because medical consultations of diabetes patients usually occur at intervals of a

maximum of 3 months¹⁶. The robust standard error estimator was adopted for all statistical analysis to calculate 95% CIs. All analyses were stratified by age group (<65 years and \geq 65 years), because the policy approach of the Japanese government is differentiated based on age, for people receiving public assistance. We carried out three sensitivity analyses to identify individuals at risk for the incidence of diabetes diagnoses, by excluding the cases of individuals who visited medical institutions for diabetes care in the first 2 months (analysis S1) and the first 4 months (Analysis S2). Furthermore, we carried out analysis 2 stratified by both sex and age group to identify the difference between sexes and between age groups. Statistical analyses were carried out using Stata SE version 16.2 (StataCorp, College Station, TX, USA).

RESULTS

We obtained the data of 2,851 younger (aged <65 years) people and 3,165 older (\geq 65 years) people receiving public assistance. Among them, 2,698 younger people and 3,019 older people were eligible (Figure 1). Among the younger recipients, 1,385 (51.3%) were men, 1,623 (60.2%) were living alone and 838 (31.1%) were employed (Table 1). Among the older recipients, 1,405 (46.5%) were men, 2,139 (70.9%) were living alone and 250 (8.3%) were employed (Table 1). After diabetes patients were excluded in the first 3 months, we identified 2,144 younger and 2,181 older recipients at risk. During the study period, 269 younger diabetes patients (12.5%) and 329 older diabetes patients (15.1%) were identified (Table 2).

Among younger recipients, univariable Poisson regression analysis showed that living alone and unemployment were associated with a higher incidence of diabetes diagnosis (Table S1). The results of analysis 1 showed that adjusted IR of unemployment was 1.26 (95% CI 1.10-1.45), when compared with being employed. Compared with living with someone, adjusted IR of living alone was 1.12 (95% CI 0.99-1.28; Table 3). The results of analysis 2, which excluded diabetes patients in the first 3 months, showed that both unemployment and living alone were seen to have a slight association with incidence of diabetes diagnosis (IR 1.20, 95% CI 0.93-1.54 and IR 1.15, 95% CI 0.89-1.48, respectively). Compared with employment, the adjusted IR of unemployment was 1.07 (95% CI 0.86-1.34) in analysis S1 and 1.13 (95% CI 0.84-1.51) in analysis S2 (Table S2). Living alone was seen to have a slight association with the incidence of diabetes diagnosis in both analyses (Table S2). Furthermore, sex-stratified analysis showed that, among younger men, both unemployment and living alone had a higher incidence of diabetes diagnosis (IR 1.28, 95% CI 0.85-1.91 and IR 1.48, 95% CI 0.96-2.29, respectively), whereas no strong association was seen among women (Table S3). Among older recipients, the results of analysis 1 showed that unemployment was slightly associated with a higher incidence of diabetes diagnosis (IR 1.18, 95% CI 0.98-1.41) when compared with being employed; however, no association was found in analysis 2 (Table 3).

Character	Category	20–64 years old		≥65 years old		
		Total participants (n = 2,698) n (%)	Diabetes patients (n = 823) n, % for total	Total participants (n = 3,019) n (%)	Diabetes patients ($n = 1,167$) n, % for total	
Age	Mean (SD)	48.7 (11.1)	52.0 (9.5)	74.9 (6.9)	74.4 (6.4)	
Sex	Male	1,385 (51.3)	451, 32.6%	1,405 (46.5)	571, 40.6%	
	Female	1,313 (48.7)	372, 28.3%	1,614 (53.5)	596, 36.9%	
Living alone	Yes	1,623 (60.2)	560, 34.5%	2,139 (70.9)	815, 38.1%	
0	No	1,075 (39.8)	263, 24.5%	patients Total participants Diabetes p. $(n = 3,019)$ $(n = 1,167)$ total n (%) $n, \%$ for to n n (%) 74.4 (6.4) n n (%) $571, 40.6\%$ n $1,405$ (46.5) $571, 40.6\%$ n $2,139$ (70.9) $815, 38.1\%$ n 880 (29.1) $352, 40.0\%$ n $2,769$ (91.7) $1,082, 39.16$ n $2,769$ (91.7) $1,082, 39.16$ n $2,968$ (98.3) $1,151, 38.89$ n 51 (1.7) $16, 31.4\%$ n $2,257$ (74.8) $857, 38.0\%$ 192 (6.4) $95, 49.5\%$ n $2,645$ (87.6) $1,023, 38.79$ n $2,645$ (87.6) $1,023, 38.79$ n 6 (0.2) $2, 33.$	352, 40.0%	
Working status	Yes	838 (31.1)	201, 24.0%	250 (8.3)	85, 34.0%	
0	No	1,860 (68.9)	622, 33.4%	2,769 (91.7)	1,082, 39.1%	
Nationality	Japanese	2,590 (96.0)	801, 30.9%	2,968 (98.3)	1,151, 38.8%	
	Other	108 (4.0)	22, 20.4%	retes patientsTotal participantsDiabe823) $(n = 3,019)$ $(n = 1,09)$ for total n (%) $n, \%$ 9.5)74.9 (6.9)74.4 (32.6%1,405 (46.5)571, 428.3%1,614 (53.5)596, 334.5%2,139 (70.9)815, 324.5%880 (29.1)352, 424.0%250 (8.3)85, 3433.4%2,769 (91.7)1,082, 330.9%2,968 (98.3)1,151, 320.4%51 (1.7)16, 3'30.4%2,257 (74.8)857, 329.1%2,645 (87.6)1,023, 334.4%115 (3.8)39, 3320.8%6 (0.2)2, 3340.0%253 (8.4)103, 429.4%2,181 (72.2)826, 333.9%838 (27.8)341, 4	16, 31.4%	
Long-term care status	None	2,639 (97.8)	801, 30.4%	2,257 (74.8)	857, 38.0%	
Age Sex Living alone Working status Nationality Long-term care status Disabilities certificate Municipality	Support required	10 (0.4)	4, 40.0%	192 (6.4)	95, 49.5%	
	Care needs	49 (1.8)	18, 36.7%	570 (18.9)	215, 37.7%	
Disabilities certificate	None	2,000 (74.1)	582, 29.1%	2,645 (87.6)	1,023, 38.7%	
	Psychological disability	421 (15.6)	145, 34.4%	115 (3.8)	39, 33.9%	
	Intellectual disability	77 (2.9)	16, 20.8%	6 (0.2)	2, 33.3%	
	Physical disability	200 (7.4)	80, 40.0%	253 (8.4)	103, 40.7%	
Municipality	A	2,032 (75.3)	597, 29.4%	2,181 (72.2)	826, 37.9%	
	В	666 (24.7)	226, 33.9%	838 (27.8)	341, 40.7%	

Table 1 | Characteristics of public assistance recipients and diabetes patients in the cohort

SD, standard deviation.

Table 2	Characteristics	of public assistance	recipients and d	iabetes patients	among participants	after diabetes	patients were	excluded at t	he first
3 months	5								

Character	Category	20-64 years		≥65 years		
		Population at risk (n = 2,144) n (%)	Diabetes patients (n = 269) n, % for total	Population at risk (n = 2,181) n (%)	Diabetes patients ($n = 329$) n, % for total	
Age	Mean (SD)	47.7 (11.3)	50.3 (9.9)	75.2 (7.0)	74.5 (6.4)	
Sex	Male	1,060 (49.4)	126, 11.9%	995 (45.6)	161, 16.2%	
	Female	1,084 (50.6)	143, 13.2%	1,186 (54.4)	168, 14.2%	
Living alone	Yes	1,238 (57.7)	175, 14.1%	1,554 (71.3)	230, 14.8%	
0	No	906 (42.3)	94, 10.4%	627 (28.7)	99, 15.8%	
Working status	Yes	713 (33.3)	76, 10.7%	194 (8.9)	29, 14.9%	
5	No	1,431 (66.7)	193, 13.5%	1,987 (91.1)	300, 15.1%	
Nationality	Japanese	2,049 (95.6)	260, 12.7%	2,142 (98.2)	325, 15.2%	
	Other	95 (4.4)	9, 9.5%	39 (1.8)	4, 10.3%	
Long-term care status	None	2,099 (97.9)	261, 12.4%	1,637 (75.1)	237, 14.5%	
0	Support required	7 (0.3)	1, 14.3%	13.2%1,186 (54.4)168, 14.2%14.1%1,554 (71.3)230, 14.8%10.4%627 (28.7)99, 15.8%10.7%194 (8.9)29, 14.9%13.5%1,987 (91.1)300, 15.1%12.7%2,142 (98.2)325, 15.2%5%39 (1.8)4, 10.3%12.4%1,637 (75.1)237, 14.5%4.3%127 (5.8)30, 23.6%8.4%417 (19.1)62, 14.9%12.0%1,912 (87.7)290, 15.2%16.4%90 (4.1)14, 15.6%6%4 (0.2)0, 0%	30, 23.6%	
	Care needs	38 (1.8)	7, 18.4%		62, 14.9%	
Disabilities certificate	None	1,611 (75.1)	193, 12.0%	1,912 (87.7)	290, 15.2%	
	Psychological disability	330 (15.4)	54, 16.4%	90 (4.1)	14, 15.6%	
	Intellectual disability	66 (3.1)	5, 7.6%	4 (0.2)	0, 0%	
	Physical disability	137 (6.4)	17, 12.4%	175 (8.0)	25, 14.3%	
Municipality	A	1,629 (76.0)	194, 11.9%	1,583 (72.6)	228, 14.4%	
	В	515 (24.0)	75, 14.6%	598 (27.4)	101, 16.9%	

SD, standard deviation.

	2064 years		≥65 years		
	Analysis 1 (<i>n</i> = 2,698) IR (95% Cl)	Analysis 2 (<i>n</i> = 2,144) IR (95% Cl)	Analysis 1 (<i>n</i> = 3,019) IR (95% Cl)	Analysis 2 (<i>n</i> = 2,181) IR (95% CI)	
Explanatory variables					
Working status					
Yes	Ref	Ref	Ref	Ref	
No	1.26 (1.10–1.45)	1.20 (0.93–1.54)	1.18 (0.98–1.41)	0.93 (0.75-1.15)	
Living alone					
No	Ref	Ref	Ref	Ref	
Yes	1.12 (0.99–1.28)	1.15 (0.89–1.48)	0.95 (0.86–1.04)	1.03 (0.72–1.47)	
Covariates					
Age					
By 1 year	1.03 (1.02–1.04)	1.02 (1.01–1.03)	0.99 (0.98–0.99)	0.98 (0.97-1.00)	
Sex					
Female	Ref	Ref	Ref	Ref	
Male	0.99 (0.89–1.12)	0.80 (0.64–1.01)	1.08 (0.99–1.18)	1.13 (0.92–1.39)	
Nationality					
Japanese	Ref	Ref	Ref	Ref	
Other	0.72 (0.50–1.04)	0.77 (0.41–1.43)	0.82 (0.55–1.22)	0.71 (0.28–1.78)	
Long-term care status					
None	Ref	Ref	Ref	Ref	
Support required	0.99 (0.47–2.10)	1.05 (0.18–5.98)	1.37 (1.18–1.60)	1.76 (1.26–2.46)	
Care needs	0.81 (0.55–1.20)	1.24 (0.62–2.51)	1.06 (0.94–1.21)	1.15 (0.88–1.52)	
Disabilities certificate					
None	Ref	Ref	Ref	Ref	
Psychological disability	1.16 (1.00–1.35)	1.37 (1.03–1.80)	0.79 (0.61–1.03)	1.03 (0.63–1.68)	
Intellectual disability	0.87 (0.57–1.34)	0.63 (0.27–1.48)	0.80 (0.26–2.52)	_	
Physical disability	1.19 (0.98–1.44)	1.04 (0.65–1.65)	1.00 (0.85–1.17)	0.94 (0.65-1.37)	
Municipality					
A	Ref	Ref	Ref	Ref	
В	1.10 (0.98–1.25)	1.17 (0.91–1.51)	1.09 (0.98–1.20)	1.22 (0.98–1.52)	

Table 3 | Adjusted incidence ratios and 95% confidence intervals for incidence of diabetes diagnosis among public assistance recipients

Analysis 1 included all eligible participants, and analysis 2 included the population at risk after excluding diabetes patients at the first 3 months. Cl, confidence interval; IR, adjusted incidence ratio; Ref, reference.

DISCUSSION

Among younger people availing public assistance in Japan, the incidence of diabetes diagnosis was greater among those who were unemployed and living alone, especially among men. There was also a slight association between unemployment and diabetes among older recipients. This was the first study to have identified the incidence of diabetes diagnosis, and showed its association with non-financial aspects of poverty and health conditions among adult public assistance recipients in Japan. An important strength of this study was that, using existing standardized databases without missing data, we could examine the association between individual sociodemographic statuses and the incidence of diabetes diagnosis among socially vulnerable populations who were usually difficult to reach in standard social surveys.

The association between unemployment and higher incidence of diabetes was consistent with other recent studies. For example, Varanka-Ruuska *et al.*¹⁷ reviewed 12 studies and reported

that unemployment status was associated with diabetes in the general population. Toge¹⁸ reported that the association between unemployment and health was mediated by patients' financial strain. Furthermore, the association between living alone and diabetes, in the general population, has been reported in Japan^{19,20}. Living with someone was strongly associated with the prevention of the development of diabetes, which was explained by availabilities of social resources and social engagement²⁰. The present study added to the evidence that unemployment and living alone remained associated with a higher incidence of diabetes diagnosis among younger public assistance recipients in Japan, even if their minimum income and health-care access were ensured by governmental welfare.

Possible explanations for the present findings include the postulations that unemployed recipients might experience psychosocial stress from income reduction and joblessness, and furthermore, might suffer from social isolation. The Japanese public assistance program has strengthened the non-financial self-reliance support program since 2015, and started providing extra support for those losing jobs, including consultation opportunities, additional housing rent support and job skill training. However, given the findings of the present study, these programs should be further strengthened. Furthermore, although this is just a speculation, the stronger association between unemployment and the incidence of diabetes diagnosis among the younger generation might be explained by a stronger pressure to participate in the labor market, whereas older people have additional healthcare opportunities, including free long-term care, and formal and informal social supports from the community-based integrated care system, which is currently only promoted for older persons (aged >65 years)^{21,22}. Preventing diabetes, known as ambulatory care sensitive conditions, through additional individual support, might help avoid unplanned hospitalization $^{23-26}$. For example, the government has launched a health management program for people availing public assistance, which will be mandated for municipality governments in 2021²⁷. Given the findings of the present study, those activities might be geared to provide special care for vounger male recipients who live alone and those who are unemployed.

There were several limitations to the present study. First, as aforementioned, there is a possibility for reverse causation. Some people might develop severe diabetes and other illness, and thus lose their ability to work; this might have resulted in financial difficulties, thus the need for public assistance²⁸. In 2015, among the reasons for receiving public assistance, health issues accounted for 25% of the population²⁷. Nevertheless, analyses removing the incidence of our outcomes in the first 3 months showed almost the same results, supporting that the reverse causation does not alter our conclusion. When excluding the diabetes patients only for 2 months from baseline, unemployment did not predict the incidence of diabetes diagnosis. This result might have occurred by misclassification of diabetes morbidity between employment statuses. Employed people usually have longer outpatient intervals. Thus, the morbidity of diabetes among employed recipients might be underestimated in the first 2 months of the cohort. Excluding the cases in the first \geq 3 months could sufficiently identify the population at risk among recipients, regardless of their employment status. Second, because we used medical assistance claim data, we might have overestimated or underestimated hospital/clinic visits and disease incidence. The incidence of diabetes diagnosis only happens when recipients visit the facilities. For example, people who were working might not have enough time to consult a physician. If public assistance recipients were also assisted by other welfare programs, their consultations were not shown in the medical assistance claim data. Furthermore, these claim data can also code diabetes, even though it is not clinically confirmed. In Japan, to claim insurance payments, physicians need to write down the name of a disease diagnosis including "suspected" diseases

on the medical record. The medical record differentiates the disease names of suspected and confirmed diagnoses. However, this process is not perfect, and could potentially result in overestimation of the incidence of diabetes diagnosis. The diagnosis can also be influenced by their clinical subspecialty and patients' consultation behaviors^{29,30}. In contrast, in the present study, the 1-year cumulative incidence of diabetes diagnosis was approximately 12-15% among the study participants, which was higher than the general population in Japan³¹. This might be attributable to the characteristics of the study population, who were older and with more socioeconomic challenges³⁻⁶. Third, there are important non-financial factors that were not evaluated in the present study, including educational attainments and social relationships. In addition, other unmeasured factors, such as the severity of diseases and the degree of medical treatment, potentially bias our findings. Fourth, the generalizability is limited, because this study used the data from just two municipalities.

To conclude, public assistance programs should go beyond financial protection, and comprehensively include additional social care to prevent social isolation and exclusion due to nonfinancial reasons. Although further in-depth studies are necessary, the present study suggests that younger male recipients who are unemployed and living alone should be prioritized in the program providing social care.

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DISCLOSURE

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Table S1 | Crude incidence ratios and 95% confidence intervals for the incidence of diabetes diagnosis among public assistance recipients.

Table $S2 \mid$ Adjusted incidence ratios and 95% confidence intervals for the incidence of diabetes diagnosis after excluding diabetes patients at the first 2 and 4 months.

Table S3 | Adjusted incidence ratios and 95% confidence intervals for the incidence of diabetes diagnosis among public assistance recipients in Japan, stratified by age and sex.