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Disparities in co-payments for influenza vaccine among the elderly, during the COVID-19 pandemic in Japan

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ABSTRACT

Introduction: Seasonal influenza vaccination for the elderly is highly recommended during the COVID-19 pandemic. In Japan, the amount of subsidy for influenza differs among municipalities. Thus, we investigated the amount of and variation in subsidy for influenza vaccination for the elderly in 2020.

Methods: This was an ecological study of 1,922 municipalities in Japan. The amount of subsidy for influenza vaccines for the elderly in each municipality was surveyed through websites or via telephone. Geographic and financial data for municipalities and prefectures were obtained from the open data. The amount of co-payment for the influenza vaccine and the geographical and financial status of each municipality were compared, according to the aging rate. Univariate logistic regression analysis was performed to explore factors related to the free influenza vaccine.

Results: Municipalities with higher aging rates tended to have higher median co-payments for vaccines in 2020. (0 yen vs 1000 yen, \( p < 0.001 \)) In addition, they tended to have worse financial conditions and lower per capita incomes. A similar trend was observed in the analysis by prefecture, i.e., a higher influenza mortality rate in prefectures with a higher aging rate. Despite having lower incomes, municipalities and prefectures with higher aging populations had higher mortality rates from influenza and higher co-payments for influenza vaccination.

Conclusions: In Japan, there is a disparity among elderly people; areas with an aging population have higher co-payments for influenza vaccines despite lower incomes, suggesting that the government needs to implement corrective measures to reduce this disparity.

1. Introduction

The coronavirus disease of 2019 (COVID-19) outbreak was first identified in Wuhan, China, at the end of December 2019, and rapidly spread to the rest of the world. In January 2020, the first case of COVID-19 was confirmed in Japan, and the infection spread gradually. The risks of severe illness with seasonal influenza and COVID-19 are similar, and it has been suggested that co-infection with influenza and COVID-19 is associated with worse prognosis [1]. Influenza vaccination was considered as an important strategy to avoid increased burden on healthcare facilities due to co-morbidity of influenza and COVID-19 [2, 3]. In August 2020, the World Health Organization (WHO) recommended influenza vaccination for the elderly during the COVID-19 pandemic [4].

In Japan and globally, reports have showed that influenza vaccination reduces the risk of influenza, pneumonia, hospitalization, and death in people aged 65 and older [5,6]. Hence, the cost of seasonal influenza vaccination for the elderly (over 65 years) was subsidized in Japan since 2001. However, the amount of subsidy for the vaccination depends on each municipality, and there are regional disparities [7]. The vaccine subsidy program of each municipality is financed by the tax revenue of each municipality as well as the local allocation tax distributed by the national government to reduce the financial imbalance among municipalities (Fig. 1). In 2020, in order to avoid a simultaneous COVID-19 and influenza pandemic in Japan, the government ordered priority influenza vaccination for the elderly. Accordingly, some municipalities increased
the subsidies for influenza vaccination for the elderly to reduce the co-payment or make it completely free. The response however yielded regional differences. While there are many high-risk residents in areas with a high aging population, there was a concern that local governments in rural areas with a high aging population might not be able to subsidize influenza vaccination due to their limited financial capacity. Therefore, the purpose of this study was to examine whether there is a disparity in the co-payment of influenza vaccine among the elderly in areas with high and low aging rates. We also explored other factors associated with influenza subsidies.

2. Material and methods

2.1. Data collection

This was an ecological study of 1,922 municipalities in Japan. Administrative wards of government-designated cities (n = 175) and the Northern territories were excluded (n = 6) because they have different vaccine subsidy systems. In the 1,741 municipalities excluding the above, we searched each municipality’s website and archived public relations magazines to investigate the amount of influenza vaccines subsidy for older people aged ≥65 years in the 2019/2020 and 2020/2021 season. In case of municipalities for which we could not find the information on their website, we telephoned the municipal office and asked for the subsidy amount. As a result, we were unable to obtain data from 175 municipalities, which reduced our sample size to 1,566 municipalities. Some municipalities indicated the amount of the vaccine subsidy, while others indicated the amount of the co-payment. The data on the unsubsidized cost of the influenza vaccine for the elderly in medical care facilities in each municipality was not available. Therefore, for those municipalities that only specified the subsidy amount, we estimated the co-payment amount using a vaccine price of 3,500 yen from a previous report that investigated average unsubsidized vaccine price in Japan [8]. With regard to the average unsubsidized vaccine cost in each prefecture, we used data for the 2019/2020 season published on the website by a private research company [9].

2.2. Municipal statistical data

Statistical data published by the government and each ministry and agency were used. From the statistical indicators for municipalities and prefectures, we obtained the aging rate, population, area, population density, financial capability index, ordinary balance ratio, real debt service ratio, local allocation tax, Laspyres index, and taxable income. The Laspyres index is a measure used to compare the level of salaries of public employees in different regions. For population and area, data as of January 2020 were used [10,11]. For financial indices and taxable income of each municipality and prefecture, data as of 2019 were used [12–14]. Data on the number of influenza deaths and the cumulative number of COVID-19 cases were only available for each prefecture. The number of influenza deaths in 2019 and the cumulative number of COVID-19 cases by September 1, 2020, were used.

2.3. Statistical analysis

We dichotomized the aging rate using the median and compared vaccine co-payments, population, area, population density, financial capability index, ordinary balance ratio, real debt service ratio, Laspyres index, local allocation tax, and taxable income in the municipality subgroups with high and low aging rates. Vaccine co-payments for each prefecture were calculated as a weighted average using the number of elderly people. Prefectures were also divided into two subgroups, high and low aging rates, and were compared between groups with respect to cumulative COVID-19 infection rates (per 100,000), influenza mortality rates (per 100,000), and geographic and economic data. We performed t-test for parametric variables and Wilcoxon’s rank sum test for non-parametric variables.

Univariate logistic regression analysis was used to calculate the odds ratios for free influenza vaccine co-payments by municipality and by prefecture, and 95% confidence intervals and p-values for crude odds ratios for each variable were calculated. All analyses were conducted using R studio Version 1.4.1717, and the results were considered statistically significant at a two-sided P-value of <0.05.

2.4. Ethical statement

This study used the open data from municipalities and prefectures and does not include any personal information.

3. Results

The basic characteristics of the 1,566 municipalities included in the analysis are shown in Table 1. For 217 municipalities that stipulated the amount of subsidy rather than the co-payment, we used an estimated value for the co-payment. The number of municipalities that provided free influenza vaccines for the elderly increased from 4.1% in the 2019/2020 season to 46.3% in the 2020/2021 season. The median co-payment for the vaccine also dropped from 1,500 yen to 660 yen, with 51.1% of municipalities reducing their co-payments compared to the 2019/2020 season. Comparing municipalities with low and high aging rates revealed that there was no difference in vaccine co-payments in the 2019/2020 season (1500 yen vs 1490 yen, p = 0.298), but co-payments were significantly higher in municipalities with high aging rates in the 2020/2021 season. (0 yen vs 1000 yen, p < 0.001). The percentage of municipalities that reduced co-payments in the 2020/2021 season was also significantly lower in regions with a higher aging rate (55.6% vs 45.9%, p = 0.001). Municipalities with higher aging rates had significantly smaller populations, larger areas, and lower population densities. Municipalities with high aging rates also had significantly poorer financial conditions, lower financial capability index, and higher real debt service ratio than municipalities with low aging rates. Local allocation tax to compensate for financial disparities was significantly higher in municipalities with high aging rate. The higher the aging rate, the lower the Laspyres index, and the taxable income per capita.

The results of the analysis for each prefecture are shown in Table 2. The amount of co-payment was higher in prefectures with higher aging rates (median = 30.1%) than those with lower aging rates, but was not statistically significant (822.31 yen vs 1195.24 yen, p = 0.069). Compared to the 2019/2020 season, the median difference in co-payments was significantly lower in municipalities with a higher aging rate. The average cost of unsubsidized vaccines in all prefectures in Japan was 3580.74 yen, with a standard deviation of 141.24 yen. In comparison with high and low aging rates, the cost of unsubsidized vaccines was significantly lower in municipalities with higher aging
index, and higher taxable incomes per capita. There was no significant ratio were significantly associated with the introduction of free co-

using data for each municipality, all factors except the ordinary balance

dependent variable. In the analysis

rates (3536.26 yen vs 3623.38 yen, p = 0.033). Prefectures with higher aging rates had lower financial capability index, lower Laspeyres index, and significantly lower total taxable income. In addition, prefectures with higher aging rates had lower cumulative COVID-19 infection rates but higher influenza mortality rates.

Table 3 shows the odds ratios for each variable with the free influenza vaccine co-payment as the dependent variable. In the analysis using data for each municipality, all factors except the ordinary balance ratio were significantly associated with the introduction of free co-payments. Free influenza vaccines tended to be more common in municipalities with lower aging rates, higher population densities, higher financial capability index, lower real debt service ratio, lower Laspeyres index, and higher taxable incomes per capita. There was no significant association between free vaccine and the number of COVID-19 cases, but influenza mortality rate showed an inverse correlation with free

| Table 1 | Comparison of co-payment of influenza vaccine and characteristic of each municipality. |
|---------|----------------------------------------------------------|
|         | Overall | Low aging rate | High aging rate | p-value |
| n       | 1566    | 783            | 783             |         |
| Co-payment of flu vaccine in 2020/2021 (yen, median [IQR]) | 6660 (1500) | 0 (0, 1300) | 1000 (0, 1500) | <0.001 |
| Free flu vaccine in 2020/2021 (%)(n) | 725 (46.3) | 414 (52.9) | 311 (39.7) | <0.001 |
| Co-payment of flu vaccine in 2019/2020 (yen, median [IQR]) | 1500 (1000, 1600) | 1500 (1000, 1600) | 1490 (1000, 1600) | 0.298 |
| Free flu vaccine in 2019/2020 (%) | 51 (4.1) | 25 (3.8) | 26 (4.5) | 0.609 |
| Reduced co-payments from the 2019/2020 season (n (%) | 636 (51.1) | 370 (55.6) | 266 (45.9) | 0.001 |

| Table 2 | Comparison of co-payment of influenza vaccine and characteristic of each prefecture. |
|---------|----------------------------------------------------------|
|         | Overall | Low Aging Rate | High Aging Rate | p-value |
| n       | 47      | 24             | 23              |         |
| Free flu vaccine (%) | 11 (23.4) | 8 (33.3) | 3 (13.0) | 0.194 |
| Co-payment of flu vaccine in 2020/2021 (yen, median [IQR]) | 1077.77 | 822.31 | 1195.24 | 0.069 |
| Co-payment of flu vaccine in 2019/2020 (yen, median [IQR]) | 1306.35 | 1194.19 | 1345.12 | |
| Increase in subsidy amount (yen, median [IQR]) | 1442.53 | 1453.29 | 1393.72 | 0.469 |
| Unsubsidized vaccine cost in 2019/2020 (yen, mean [SD]) | 1593.23 | 1654.59 | 1556.15 | |
| Laspeyres index (mean (SD)) | 1442.53 | 1453.29 | 1393.72 | 0.469 |
| Real debt service ratio (mean SD) | 110.6 (1.8) | 90.29 (6.43) | 90.93 (5.91) | 0.042 |
| Total taxable income (yen, mean [SD]) | 7.28 (4.50) | 6.03 (4.28) | 8.53 (4.37) | 0.001 |
| Laspeyres index (mean (SD)) | 97.9 (2.95) | 98.34 (2.77) | 96.45 (2.83) | <0.001 |
| Local allocation tax (Million yen, median [IQR]) | 2989.00 | 2534.98 | 3190.81 | <0.001 |
| Total taxable (Million yen, median [IQR]) | 3124.59 | 38077.80 | 13605.70 | <0.001 |
| Taxable income per capita (Thousand yen, median [IQR]) | 1228.68 | 1409.99 | 1071.86 | <0.001 |
| Mortality rate of seasonal flu (%) | 2.96 (2.54) | 2.57 (2.33) | 2.36 (2.92) | <0.001 |

IQR = Interquartile range, SD = Standard Deviation.

influenza vaccine for elderly (OR = 0.16, 95% CI: 0.03–0.84, p = 0.03).

Eleven prefectures have made the decision to offer free flu vaccines to all municipalities in their prefecture. The basic characteristics of these 11 prefectures compared to the others are shown in Table 4. These prefectures did not differ from others in the 2019/2020 season in the weighted average of co-payments for influenza vaccines. Prefectures that decided to subsidize on a prefectural basis and provide free influenza vaccine to residents of all municipalities in the prefecture tended to have lower aging rates, larger populations, higher population densities, higher financial capability indices, a higher ordinary balance ratio, and higher taxable incomes per capita. These prefectures also tended to have a higher number of COVID-19 cases, but a lower mortality rate due to influenza. Table 5 shows the results of the analysis conducted in 1114
municipalities, excluding those municipalities wherein the vaccinations were made free of charge on a prefectural basis. In this group, there was no significant difference in the co-payment of influenza vaccine between municipalities with high and low aging rates for both the 2019/2020 and 2020/2021 seasons.

4. Discussion

Disparities in co-payments for influenza vaccine among the elderly due to high and low municipal aging rates were observed in the 2020/2021 season. At the prefectural level, those with higher aging rates tended to have higher co-payments for influenza vaccines among the elderly, and the increased subsidies compared to the 2019/2020 season tended to be significantly lower. In municipalities and prefectures with higher aging rates, residents’ incomes tended to be lower, as indicated by the lower Laspeyres index and taxable income per capita. Nonetheless, the fact that municipalities and prefectures with a higher proportion of elderly residents have higher co-payments for influenza vaccines indicates that there is an additional disparity in terms of the burden. One reason for this is that both the total and the working-age population are smaller in regions with higher aging rates, which means that these municipalities or prefectures receive less tax revenue and are in worse financial conditions. In fact, this study also revealed that regions with higher aging rates tend to have worse financial conditions in terms of the financial capability index, ordinary balance ratio, and real debt service ratio. To correct these financial imbalances at the municipal level, the government introduced a local allocation tax in Japan as shown in Fig. 1.

 Moreover, in Italy, it has been reported that COVID-19 infections and hospitalizations and deaths due to influenza among the elderly [20, 21]. Influenza vaccination is known to be a cost-effective way to reduce hospitalization and deaths due to influenza among the elderly [22]. Further to this, the government should make provisions for the financial stability of municipalities and prefectures. On the other hand, the influenza vaccine is known to be a cost-effective way to reduce regional disparities. For instance, the UK has allocated a budget to eliminate regional price disparities for COVID-19 vaccine [15]. In Japan, the government provides COVID-19 vaccine free of charge, but it is necessary for the government to distribute more financial resources toward influenza vaccine as well.

In this study, more densely populated areas were found to be more likely to have free co-payments for influenza vaccines. In fact, population density has been reported to play a major role in the occurrence of influenza and COVID-19 [16–19]. Increased risk of healthcare collapse due to the simultaneous outbreak of COVID-19 and influenza in densely populated areas may have led to increased subsidies for influenza vaccines. Despite lower population densities in areas with higher aging rates, this study showed that influenza mortality was higher in areas with higher aging rates. There are two possible reasons for this: first, a high number of elderly people at high risk of complications and serious illness could lead to an increase in mortality even if the risk of infection is low; second, medical resources are likely to be scarce in depopulated areas with an aging population.

Although the mortality rate of influenza is high in areas with a high aging rate, the co-payment for influenza vaccines tended to be high during the COVID-19 pandemic disaster due to the low financial capacity of municipalities and prefectures. On the other hand, the influenza vaccine is known to be a cost-effective way to reduce hospitalization and deaths due to influenza among the elderly [20, 21]. Furthermore, in Italy, it has been reported that COVID-19 infections and mortality tended to be lower in areas with higher influenza vaccination rates among the elderly [22]. The government should make provisions for the financial stability of municipalities and prefectures. On the other hand, the influenza vaccine is known to be a cost-effective way to reduce regional disparities. For instance, the UK has allocated a budget to eliminate regional price disparities for COVID-19 vaccine [15]. In Japan, the government provides COVID-19 vaccine free of charge, but it is necessary for the government to distribute more financial resources toward influenza vaccine as well.

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influenza and pneumonia. With regard to the price elasticity of influenza
vaccines, there are reports that vaccination rates increase when co-

understanding whether influenza co-payments are
approximately 140 yen; thus, considering the unsubsidized price of the

Table 5
Overall Low aging rate High aging rate p-value

Co-payment of flu vaccine in 2020/2021 (yen, median [IQR])
1200.00 [500.00, 1500.00]
273 (24.5) 135 (24.2) 138 (24.8) 0.889

Free flu vaccine in 2020/2021 (%)
1500.00 [1000.00, 1500.00]
45 (5.2) 26 (5.7) 19 (4.8) 0.667

Increase in subsidy amount (%)
256 (29.8) 125 (27.2) 131 (32.8) 0.083

Aging rate (mean (SD))
34.65 (6.86) 29.22 (3.71) 40.07 (4.63) <0.001

Population (median [IQR])
21256 [7987.25, 52009.50]

Area (km2, median [IQR])
162.36 [69.62, 341.86]

Density (km2, median [IQR])
149.91 [54.27, 396.96]

Financial capability index (mean (SD))
0.42 [0.27, 0.63] 0.61 (0.45) 0.30 (0.21) 0.39 <0.001

Ordinary balance ratio (mean (SD))
96.03 (5.72) 90.43 (5.63) 90.83 (5.80) 0.251

Real debt service ratio (mean (SD))
8.22 (4.16) 7.52 (3.75) 8.91 (4.42) <0.001

Lasepyes index (mean (SD))
97.07 (2.92) 97.83 (2.75) 96.31 (2.89) <0.001

Local allocation tax (Million yen, median [IQR])
3663.74 [1886.37, 6263.59]

Total taxable income (Million yen, median [IQR])
25370.08 [8600.06, 66264.62]

Taxable income per capita (Thousand yen, median [IQR])
1179.09 [1022.69, 1358.18]

IQR = Interquartile range, SD = Standard Deviation.

to ensure that vaccinations are actively provided even in areas with
aging populations, in order that regional disparities can be reduced.

This study had some limitations. First, this study did not consider
regional differences in vaccination costs, for which data on vaccination
costs for each municipality were not available. The standard deviation of
the unsubsidized vaccine cost at the prefectural level was also small,
approximately 140 yen; thus, considering the unsubsidized price of the
vaccine to be uniform across Japan would not significantly affect the
results. Second, we did not analyze the association with health out-
comes. It is necessary to examine whether influenza co-payments are
associated with actual vaccination rates and the number of deaths from
influenza and pneumonia. With regard to the price elasticity of influenza
vaccines, there are reports that vaccination rates increase when co-
payments are reduced [23,24]. Future studies on vaccination rates and
influenza mortality rates should examine how each municipality’s pol-
icies affect patient mortality and other health outcomes.

Availability of data and materials

The datasets analyzed in the current study are available upon request.

Authors’ contributions

T.A., T.M., A.T., T. Murakami, Y.K., T.I., and H.T. conceptualized and
designed the study. T.A., T.M., A.T., T. Murakami, Y.K., and T.I.
participated in the data collection. T.A., T.M., J.H., and D.S. participated in
the data analysis. T.A. performed the final statistical analysis. T.A.,
and J.H wrote the initial draft. T.A., J.H., D.S., and S.F. provided critical
revision of the draft. All authors approved the final version of the
manuscript.

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Authorship statement

All authors meet the ICMJE authorship criteria.

Declaration of competing interest

None.

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