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Differences in exposure environments of coronavirus disease 2019 under no-mask conditions: a confirmatory study

Razlike u okruženjima izloženosti koronavirusnoj bolesti 2019 u uvjetima bez maske: potvrdna studija

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Summary

We aimed to identify the locations of coronavirus disease 2019 (COVID-19) infections in Fukui prefecture due to lack of mask usage and to determine infection status in older people without mask wearing. Of 286 COVID-19-positive individuals, 242 were likely infected through "talking, eating, or drinking without wearing a mask." We conducted an ordinal logistic regression to determine the relationship between age and SARS-CoV-2 infection factors during a non-Omicron outbreak. Odds ratios (ORs) indicated high risk among older patients in hospitals and nursing facilities (OR: 15.2, confidence interval [CI]: 1.980–118.000) and low risk among students in schools (OR: 0.09, CI: 0.012–0.632). The Cochran–Armitage test demonstrated a decreasing trend in age for "school/college" and an increasing trend in age for "hospitals/nursing facilities". Infections occurred most at home, where masks were not used; hospitals/nursing care facilities were the most common places of infection for people ≥60 years old.

Sažetak

Cilj ovog istraživanja bio je identificirati mjesta infekcije koronavirusnom bolešću 2019 (COVID-19) u prefekturi Fukui povezana s neupotrebom maski te utvrditi status infekcije kod starijih osoba koje nisu nosile masku. Od ukupno 286 COVID-19-pozitivnih osoba, kod 242 se vjerojatno infekcija dogodila tijekom „razgovora, jela ili pića bez nošenja maske". Provedena je ordinalna logistička regresija radi utvrđivanja odnosa između dobi i čimbenika infekcije virusom SARS-CoV-2 tijekom razdoblja bez prisutnosti Omicron varijante.

Omjeri izgleda (OR) pokazali su visoki rizik među starijim bolesnicima u bolnicama i ustanovama za njegu (OR: 15,2; interval pouzdanosti [CI]: 1,980–118,000) te nizak rizik među učenicima u školama (OR: 0,09; CI: 0,012–0,632). test Cochran-Armitage pokazao je silazni trend dobi za kategoriju „škola/fakultet" te uzlazni trend dobi za kategoriju „bolnice/ustanove za njegu". Najveći broj infekcija zabilježen je u kućanstvima, gdje se maske nisu koristile, dok su bolnice i ustanove za njegu bile najčešća mjesta infekcije kod osoba ≥60 godina.

Background

In Fukui prefecture the designation of coronavirus disease 2019 (COVID-19) has been changed from a category equivalent to Class 2 infectious disease to Class 5, effective May 8, 2023.[1] Further, the responsibility for implementing infection control measures now lies with individuals and companies; thus, some effective preventive measures, such as ventilation, hand washing, hand sanitizing, and wearing masks, remain in practice. Specifically, masks are recommended for use in hospitals, facilities for older adults, and crowded trains to prevent infection among those at high risk of severe illness.[1]

In April 2021, Fukui prefecture conducted an analysis of the infection status of 286 COVID-19-positive individuals in the prefecture. In 84.6% of cases, transmission occurred through "talking, eating, or drinking without wearing a mask".[2] Mask-wearing has

been reported to be effective in reducing COVID-19 transmission, even in settings where social distancing measures were insufficient.[3]

This study aimed to identify the locations in Fukui prefecture where people, especially older persons, were likely to be infected due to the lack of mask usage.

Methods

A COVID-19 survey was conducted in Fukui prefecture, Japan, as part of an outbreak investigation under the Act on the Prevention of Infectious Diseases and Medical Care for Patients with Infectious Diseases. In April 2021, an additional survey was carried out in Fukui prefecture to determine whether COVID-19-positive individuals had removed their masks when talking or eating.[2] The results revealed that out of 286 COVID-19-positive individuals, 242 were likely infected through "talking, eating, or drinking without wearing a mask," whereas the remaining 44 either wore masks or their mask usage details were unknown.[2]

We analyzed the survey data of these 286 individuals. The data were anonymized before analysis, and only researchers appointed by the Fukui Prefectural Government were authorized to access, analyze, and use the data. We compared COVID-19 transmission factors due to mask non-use during the non-Omicron epidemic across three age categories: 0–19, 20–59, and ≥60 years. We also determined the impact of age and contributing factors on infection risk in the absence of mask wearing.

All statistical data were analyzed using EZR ver.1.54 (Saitama Medical Center, Jichi Medical University, Saitama, Japan).[4] Age was reported as the mean and standard deviation. Categorical variables were presented as frequencies and percentages. Fisher's exact test using the Bonferroni adjustment was employed for multiple comparisons, and the Kruskal–Wallis test using the Bonferroni adjustment for multiple comparisons and post-hoc analysis were used for three-group comparisons. Furthermore, we conducted a multiple logistic regression analysis (ordinal logistic regression analysis) to identify factors associated with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and to analyze the relationship between age category and infection factors during the non-Omicron outbreak. The Cochran–Armitage test, a test of trend, was used to evaluate trends of the infection factors of "school/college" and "hospitals/nursing facility" in the different age categories. Statistical significance was set at p <0.05.

Results

Table 1 presents the factors of SARS-CoV-2 infection across the three age categories in the absence of mask wearing. Univariate analysis revealed significant differences in mean age among the three age groups. Significant differences were observed among the three age groups in the transmission factors of mealtime, restaurants/barbeque, school/college, workplace, and hospitals/nursing facilities.

The odds ratios (ORs) obtained by ordinal logistic regression analysis indicated a high risk with increasing age in hospitals and nursing facilities (OR: 15.2, confidence interval[CI]:1.980–118.000) and low risk in schools (OR: 0.09, CI: 0.012–0.632). Furthermore, the Cochran–Armitage test demonstrated a decreasing trend in age for the "school/college" infection factor (p <0.0001) and an increasing trend in the age for the "hospitals/nursing facilities" factor (p <0.0001).

Discussion

This study analyzed the impact of age on the infection status of 242 of 286 COVID-19-positive individuals suspected to have been infected because of non-use of masks in Fukui prefecture in April 2021. Ordinal logistic regression analysis revealed that the ORs for hospitals/nursing homes increased with age when masks were not used, whereas the ORs for schools decreased. Older age groups were likely to be infected in "hospitals or nursing homes." The survey results reconfirmed that the environment of "family living/communal living" was the main factor for infection in each age group. Furthermore, the infection factors reflect the respective environments in which the different age groups reside. The survey period was marked by an influx of alpha mutant strains and an increase in infections within schools, which had been rarely observed in the past.[5] It is possible that the infection spread among siblings at home, resulting in clusters of infection in multiple grades and classes.[5] This information is crucial for formulating effective quarantine policies against clusters in the fight against COVID-19 because clusters can lead to rapid infection spread within a short period of time. In Japan, contact tracing focuses on cluster measures.[6] A Korean study reported that clusters were more common in medical facilities, workplaces, and nursing homes.[7] Further, a Japanese study found that the number and size of clusters in long-term care hospitals and institutions were independently associated with high COVID-19 mortality rates in prefectures.[8]

Mandatory masking among schoolchildren did not lead to a reduced incidence or transmission of SARS-CoV-2, meaning this intervention was ineffective.[9] Age is the most important factor explaining the risk of infection among school-aged children.[9] A study in Massachusetts, USA, reported that masking during

Table 1. Age and coronavirus 2019 disease transmission factors in the absence of mask wearing

Tablica 1. Dob i čimbenici prijenosa bolesti uzrokovane koronavirusom 2019 pri izostanku nošenja maske

	Univariate analysis					Multivariate analysis (ordinal logistic regression analysis)		
	Total n = 242	0–19 years[a] n = 60	20–59 years[b] n = 139	Over 60 years[c] n = 43	*p*-value	Odds ratio	95% Confidence interval Lower–upper	*p*-value
Age (years)	38.7 ± 23.2	11.2 ± 3.8	39.0 ± 11.5	76.4 ± 10.9	<0.0001[d]	-	-	-
Sex (male/female)	129/113	30/30	78/61	21/22	0.601	-	-	-
Mealtime, n (%)	164 (67.8)	32 (53.3)	103 (74.1)	29 (67.4)	0.018[e]	1.34	0.230–7.370	0.743
Infection location								
Family Living/ Communal living	98 (40.5)	25 (41.7)	56 (40.3)	17 (39.5)	0.967	-	-	-
Restaurants/ Barbeque	60 (24.8)	7 (11.7)	42 (30.2)	11 (25.6)	0.0159[f]	1.74	0.884–3.460	0.112
School/College	34 (14.0)	27 (45.0)	7 (5.0)	0 (0)	<0.0001[g]	0.09	0.012–0.632	0.017
Workplace	32 (13.2)	1 (1.7)	27 (19.4)	4 (9.3)	0.001[h]	2.35	0.455–11.600	0.300
Hospitals/ Nursing facilities	18 (7.4)	0 (0)	7 (5.0)	11 (25.6)	<0.0001[i]	15.20	1.980–118.000	0.008

Mean ± standard deviation, number of cases (% or unit). The *p*-values for categorical variables were calculated using Fisher's exact test (two-group comparisons: Bonferroni multiple comparison). The *p*-values for continuous variables were calculated using the Kruskal–Wallis test (two-group comparisons: Bonferroni multiple comparison).

d: a vs. b, p<0.0001; a vs. c, p<0.0001; b vs. c, p<0.0001.

e: a vs. b, p=0.015. f: a vs. b, p=0.02. g: a vs. b, p<0.0001; a vs. c p<0.0001.

h: a vs. b, p=0.001. i: a vs. c, p<0.0001; b vs. c p=0.0011.

Without mask use: 242 of 286 (85%); other than without mask use (wearing mask, details unknown): 44 of 286 (15.4%).

periods of high transmission in the community was an important strategy for minimizing the spread of SARS-CoV-2 and the loss of face-to-face school time.[10] Despite the lifting of the mask mandate in Japan, we believe masks should be recommended based on age, infection prevalence period, and location. Specifically, the results of this analysis support the government's recommendation of mask use by high-risk patients, such as older adults, in medical institutions and care facilities.

This study had some limitations. First, we used questionnaire survey data and did not capture the duration of mask usage or distance of contact. Second, the mask survey targeted COVID-19-positive individuals and the infection status related to mask use was not confirmed. Finally, owing to the cross-sectional design, it was not possible to infer a causal relationship between mask use and infection factors. These factors should be considered in future studies.

In conclusion, the most common place of infection where masks were not used were homes, whereas hospitals/nursing care facilities were the common places of infection for those aged ≥60 years.

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Conflicts of Interest

The authors declare no conflicts of interest.

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Ethics Approval

This study was approved by the University of Fukui Medical Research Ethics Review Committee (approval number: 20210037). The requirement for informed consent was waived because the study was based on a retrospective analysis of anonymized data.

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