

Mask-Wearing Behavior Among Individuals Newly Diagnosed With Type 2 Diabetes: Insights From Community Health Screenings During the COVID-19 Pandemic in Indonesia

Fumihiko Yokota^{1*}, Akane Anai¹, Lutfan Lazuardi², Nurholis Majid², Hanifah Wulandari², Mariko Nishikitani³, Kimiyo Kikuchi⁴, Yoko Sato⁴, Subaru Ikeda⁴, Ashir Ahmed⁵, Rafiqul Islam Maruf³, Naoki Nakashima³

¹Institute for Asian and Oceanian Studies, Kyushu University, Fukuoka, Japan

²Department of Health Policy and Management, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia

³Medical Information Center, Kyushu University Hospital, Fukuoka, Japan

⁴Department of Health Sciences, Graduate School of Medical Sciences, Kyushu University, Fukuoka, Japan

⁵Faculty of Information Science and Electrical Engineering, Kyushu University, Fukuoka, Japan

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Abstract The coronavirus disease 2019 (COVID-19) pandemic has had a severe impact on people with type 2 diabetes (T2D) and their health behaviors. This study investigated the associations between T2D status and mask-wearing behaviors in public settings during the first wave of COVID-19 among community residents in Yogyakarta, Indonesia. Outreach health checkups and self-report questionnaires were cross-sectionally conducted to measure mask-wearing behavior, T2D status, and sociodemographic characteristics. Chi-square tests and bivariate and multivariate logistic regression were performed for data analysis. Out of 254 participants, nearly one-fourth (24%) were newly diagnosed with T2D, while 15% reported that they had never been diagnosed with T2D before. Bivariate and multivariate logistic regression models had no statistically significant associations between mask-wearing behavior and T2D status. However, Chi-square test results showed significant differences ($P=0.02$) in percentages of inconsistent mask-wearing behavior among those who were newly diagnosed with T2D (19%), those who had known as T2D (8%), and those who had no T2D (7%). Early diagnostic services and awareness education for T2D are imperative to reduce the disease severity and mortality for future pandemics, particularly among undiagnosed individuals who are unaware of their T2D status.

1. INTRODUCTION

The International Diabetes Federation reported that 10.8% of approximately 19.5 million adults in Indonesia suffered from diabetes in 2021, and the prevalence has been increasing over time (International Diabetes Federation, 2021). However, 73.7% of the adult population in Indonesia are undiagnosed and do not know their T2D status (International Diabetes Federation, 2021). Undiagnosed and/or delayed diagnosis of T2D can lead to an increased

risk of cardiovascular diseases and complications (Einarson et al., 2018). Recent studies revealed that COVID-19 patients who were undiagnosed with T2D had higher risk of severity and death than the patients with known T2D because of their weaker immune system and impaired physical abilities to fight infections (Li et al., 2020; Wang et al., 2021). Thus, mask-wearing, combined with other COVID-19 preventive behaviors, is especially important for

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*Corresponding author: Fumihiko Yokota

Institute for Asian and Oceanian Studies, Kyushu University, 744 Motoooka, Nishi, Fukuoka, 819-0395, Japan

Email: yokota.fumihiko.785@m.kyushu-u.ac.jp

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undiagnosed individuals with T2D as they are likely to lack awareness regarding the importance of COVID-19 preventive measures and are likely to have less access to healthcare information (Hasyim et al., 2022).

The Indonesian government and WHO recommend health behavior guidelines such as physical distancing, hand washing, and mask-wearing to minimize the risk of contracting COVID-19 (Hartono & Nurhasana, 2022; World Health Organization, 2020). Despite some studies that do not support the effectiveness of face mask-wearing in preventing COVID-19 transmissions, major systematic reviews suggest that consistent face mask use in public settings is effective in reducing the risk of COVID-19 infection as well as seasonal influenza and protecting oneself and others from the community transmission (Abboah-Offei et al., 2021; Howard et al., 2021; Li et al., 2021; Liao et al., 2021).

However, existing research on mask-wearing behaviors remains hampered in a number of ways. First, most recent studies examining factors associated with mask-wearing behaviors focused mainly on psychosocial and/or demographic factors (Chen & Lei, 2022; Cunningham & Nite, 2021; Liang et al., 2022; Magoc et al., 2023; Pengpid et al., 2022). but not focused on health factors such as T2D. Second, the majority of existing research on mask-wearing behaviors during the COVID-19 pandemic was conducted using online surveys targeting participants only who can access internet services (Kaewpan et al., 2022; Kilic et al., 2022; Pengpid et al., 2022; Warnock-Parkes et al., 2021; Xu et al., 2022). During the pandemic, few studies collected data using face-to-face surveys and health checkups targeting high-risk community residents who needed access to essential healthcare services. Third, although there is little existing literature investigating relationships between T2D and mask-wearing behaviors (Franco et al., 2023), they did not investigate mask-wearing behaviors before COVID-19 vaccination in the early stage of the pandemic. As such, the possible associations between mask-wearing behaviors and T2D status during the early pandemic remain vague and largely unknown.

We address this knowledge gap by investigating the association of mask-wearing behaviors with T2D status during the first wave of COVID-19 before the first mass vaccination program was administered in Indonesia. To do this, outreach health checkup services along with a questionnaire survey were implemented for adult community residents in Yogyakarta, Indonesia, with assistance from local primary health centers and community health volunteers. The findings are useful for understanding preventive health behaviors and reducing disease severity and mortality among people with chronic illnesses, including T2D, during potential future pandemics.

2. METHOD

2.1 Data source and data collection procedures

Data were collected cross-sectionally through a health and behavioral survey during outreach checkup services in Yogyakarta, Indonesia, during the first wave of COVID-

19 in February 2021. Study participants were community residents who voluntarily participated in a health checkup service that is routinely provided by Puskesmas (Indonesian community health centers at the district level) in three regencies: Kulon Progo, Sleman, and Klaten, which are located near Yogyakarta. The participants included but were not limited to those with T2D who attended the Indonesian Chronic Disease Management Program called "PROLANIS". We included the PROLANIS-registered patients mainly because these patients with T2D had difficulties accessing healthcare services during the first wave of the pandemic (Ambarita & Nurwahyuni, 2022). Eligible participants were 20 years or older, provided written consent, and had a body temperature lower than 37 degrees Celsius. Prior to the survey and health checkup implementation, prior notification was provided to all potential community participants. The outreach health checkups were scheduled and arranged by trained community health volunteers called "Cadre" to avoid crowded situations at community health posts called "Posyandu". The health checkups and surveys were carried out by nurses from a primary health center (Puskesmas) and local research staff from Universitas Gadjah Mada (UGM). The trained field research team members acted as research coordinators, field supervisors, healthcare workers, survey interviewers, and information technology data managers. The survey and health checkup were administered in the local language (Bahasa Indonesia). Interviewers explained the study purpose and obtained informed consent. Using a semi-structured questionnaire, Participants were asked about their sociodemographic background, and health, and behavioral status including mask-wearing behaviors. Body Mass Index (BMI) and T2D data were obtained through the health checkup. The medical and health research ethics committee of the UGM Institutional Review Board approved the study in December 2020. The approval reference number is KE/FK/1387/EC/2020.

2.2 Outcome, explanatory, and control variables and the measurements

The dependent variable, mask-wearing behavior, was measured by a question asking, "How often did you wear a face mask when going out in public in the past 30 days?". The response options for the frequency were (1) always, (2) often, (3) sometimes, and (4) never. Those who often answered, sometimes, or never were classified as "not always", thus forming two categories: "always" and "not always".

The explanatory variable was the participant's T2D status, which was classified into three groups: (1) no T2D, (2) known T2D, and (3) newly diagnosed T2D. The participants who were classified as "newly diagnosed T2D" had a blood glucose level of ≥ 126 mg/dL at the time of the health checkups and also reported "no" in response to, "In your lifetime, have you ever been diagnosed with T2D by a doctor at health facilities?". Most participants were under non-fasting conditions at the time of their health checkups. Fasting blood glucose (FBG) or oral glucose tolerance test (OGTT) was not conducted for T2D diagnosis

because participants had difficulty fasting 8 hours before the health checkups and implementing FBG and OGTT in outreach settings during the pandemic. The blood glucose level was measured using the Easy-Mate GCU ET-311 (Biotek Technology Inc., Taiwan, China). A drop of blood was taken from each participant's middle fingertip. T2D was defined according to WHO's definitions. Participants who were classified as "known T2D" were those who self-reported "yes" in response to, "In your lifetime, have you ever been diagnosed with T2D by a doctor at health facilities?". Participants who were classified as "no T2D" were those who self-reported that they had never been diagnosed with T2D and those who had a blood glucose level of ≤ 126 mg/dL at the time of the health checkups.

The following control variables were selected based on theoretical and empirical literature related to factors associated with mask-wearing behaviors: (1) age, (2) sex, (3) education, (4) occupation, (5) smoking, and (6) BMI (Cunningham & Nite, 2021; Kaewpan et al., 2022; Liu & Arledge, 2022; Xu et al., 2022). Smoking was measured by asking, "Are you currently smoking or chewing tobacco products (including betel nut or even one cigarette per day)?" Participants were given the following three response options: (1) no (never smoked or chewed before), (2) not now but used to smoke or chew, and (3) yes (current smoker). BMI was calculated as weight (kg)/height (m)² and was categorized into two groups: underweight, normal or overweight: <30 kg/m², and obese: ≥ 30 kg/m² based on

WHO definitions (World Health Organization, 2006).

2.3 Data analysis

Chi-square tests were performed to determine statistically significant differences between the outcome and explanatory/control variables. Bivariate and multivariate logistic regression analyses were conducted separately for each variable to explore unadjusted and adjusted associations between the outcome and explanatory variables after adjusting for the controlling variables. Odds ratios (OR) and 95% confidence intervals (CI) were calculated. All statistical analyses were performed using SPSS version 24 (IBM Corp., Armonk, NY, USA). $P < 0.05$ was considered statistically significant.

3. RESULT AND DISCUSSION

Overall, 254 participants who completed both the health checkup and the survey questionnaire were analyzed. The majority of participants were 50 years of age or older (66%), with a mean age of 54.2 years, female (68%), identified themselves as housewives (43%), and half (50%) had elementary or middle school education (Table 1). Most participants were non-smokers (80%) and <30 kg/m² (84%), with a mean BMI of 25.2 kg/m². Only 15% of participants reported that they had known T2D, and 24% were newly diagnosed with T2D with a mean blood glucose of 127.7 mg/dL. Ten percent of participants reported "not always wearing a face mask when going out in public in the past 30 days".

Table 1. Participant's sociodemographic, behavioral and health-related characteristics (N=254)

	N	%	Mean	SD (Range)
Age groups			54.2	13.5 (20-88)
20–39 years	35	13.8		
40–49 years	51	20.1		
50–59 years	78	30.7		
60–69 years	59	23.2		
70+ years	31	12.2		
Sex				
Male	82	32.3		
Female	172	67.7		
Education				
Elementary or middle school	128	50.4		
High school, college, university or higher	126	49.6		
Occupation				
Private or self-employees	29	11.4		
Housewife	109	42.9		
Farmers	34	13.4		
Laborers	32	12.6		
Civil servants	30	11.8		
Retired, unemployed, or students	20	7.9		
Smoking				
Not currently smoking	203	79.9		
Currently smoking	51	20.1		
BMI			25.2	5.3 (14-47)
<30 kg/m ²	214	84.3		
≥ 30 kg/m ² (Obese)	40	15.7		

Continuation of Table 1

	N	%	Mean	SD (Range)
T2D Status (Blood Glucose)			127.7	61.4 (43-509)
Known as T2D* ¹	38	15.0		
No T2D* ²	154	60.6		
Newly Diagnosed as T2D* ³	62	24.4		
How often do you usually wear a mask when going out to public?				
Always	228	89.8		
Not always (Often, Sometimes, Never)	26	10.2		

*¹ Those who have ever been diagnosed as T2D before

*² Those who never been diagnosed as T2D before and also no T2D at this time health-checkup

*³ Those who did not know their T2D status until the health-checkup

Table 2. Proportional distribution of inconsistent mask-wearing behavior by participant’s sociodemographic, behavioral and health-related characteristics (N=254)

Items	Inconsistent mask-wearing at a public place		
	n/N	%	P for differ
Age groups			0.31
20–39 years	3/35	8.6	
40–49 years	4/51	7.8	
50–59 years	5/78	6.4	
60–69 years	10/59	16.9	
70+ years	4/31	12.9	
Sex			0.79
Male	9/82	11.0	
Female	17/172	9.9	
Education			<0.01
Elementary or middle school	21/128	16.4	
High school, college, university, or higher	5/126	4.0	
Occupation			0.13
Private or self-employees	1/29	3.4	
Housewife	10/109	9.2	
Farmers	4/34	11.8	
Laborers	7/32	21.9	
Civil servants	1/30	3.3	
Retired, unemployed, or students	3/20	15.0	
Smoking			0.36
Not currently smoking	19/203	9.4	
Currently smoking	7/51	13.7	
BMI			0.96
<30 kg/m ²	22/214	10.3	
≥30 kg/m ² (Obese)	4/40	10.0	
T2D Status			0.02
Known as T2D* ¹	3/38	7.9	
No T2D* ²	11/154	7.1	
Newly Diagnosed as T2D* ³	12/62	19.4	

*¹ Those who have ever been diagnosed as T2D before

*² Those who never been diagnosed as T2D before and also no T2D at this time health-checkup

*³ Those who did not know their T2D status until the health-checkup

Table 2 uses the chi-square test to compare the proportional distribution of inconsistent mask-wearing behavior and the participants’ sociodemographic, behavioral, and health-related factors. Education was significantly associated with inconsistent mask-wearing behavior (P<0.01). For instance, the proportion of participants who reported “not always wearing a face mask when going out in public” was significantly higher among those who attended elementary or middle school

(16%) compared with those who attended high school or higher education (4%). T2D status was also significantly associated with mask-wearing behavior (P=0.02). For example, the proportion of participants who reported “not always wearing a face mask when going out in public” was significantly different such that those who were newly diagnosed with T2D (19%), those who knew they had T2D (8%) and those who had no T2D (7%).

Table 3 . Bivariate and multivariate logistic regression on T2D status and other factors associated with inconsistent mask-wearing behaviors (N=254)

	Bivariate logistic regression			Multivariate logistic regression		
	Unadjusted OR	95% CI	P	Adjusted OR	95% CI	P
Age groups						
20–39 years	1			1		
40–49 years	0.91	0.19-4.33	0.90	0.56	0.10-3.09	0.50
50–59 years	0.73	0.17-3.24	0.68	0.37	0.07-2.10	0.26
60–69 years	2.18	0.56-8.52	0.26	0.53	0.10-2.90	0.47
70+ years	1.58	0.33-7.69	0.57	0.40	0.06-2.60	0.34
Sex						
Male	1			1		
Female	0.89	0.38-2.09	0.79	1.96	0.40-9.65	0.41
Education						
Elementary or middle school	1			1		
High school, college, university or higher	0.21	0.08-0.58	<0.01	0.20	0.06-0.68	0.01
Occupation						
Private or self-employees	1			1		
Housewife	2.83	0.35-23.1	0.33	2.89	0.28-29.72	0.37
Farmers	3.73	0.39-35.5	0.25	4.28	0.36-50.33	0.25
Laborers	7.84	0.90-68.2	0.06	9.96	0.97-102.40	0.05
Civil servants	0.97	0.06-16.2	0.98	2.86	0.14-57.13	0.49
Retired, unemployed, or students	4.94	0.48-51.4	0.18	3.89	0.30-50.83	0.30
Smoking						
Not currently smoking	1			1		
Currently smoking	1.54	0.61-3.89	0.36	2.47	0.44-13.91	0.31
BMI						
<30 kg/m ²	1			1		
≥30 kg/m ² (Obese)	0.97	0.32-2.98	0.96	1.17	0.33-4.17	0.81
T2D Status						
Known T2D* ¹	1			1		
No T2D* ²	0.90	0.24-3.39	0.87	0.58	0.12-2.71	0.48
Newly Diagnosed T2D* ³	2.80	0.74-10.66	0.13	2.14	0.48-9.53	0.32

The multivariate logistic regression model includes following variables; (1) age, (2) sex, (3) education, (4) occupation, (5) smoking, (6) BMI

*¹ Those who have ever been diagnosed as T2D before

*² Those who never been diagnosed as T2D before and also no T2D at this time health-checkup

*³ Those who did not know their T2D status until the health-checkup

Table 3 shows the bivariate and multivariate logistic regression results presenting the unadjusted and adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for factors associated with inconsistent mask-wearing behavior. There were no statistically significant associations between T2D status and inconsistent mask-wearing behaviors in both bivariate and multivariate regression models. However, we found some tendencies, such as that participants newly diagnosed with T2D were more likely to have inconsistent mask-wearing than those who had known T2D and those who had no T2D in both models. Participants who completed high school or higher education were significantly more likely to have consistent mask-wearing than those who completed elementary or middle school in both bivariate and multivariate models (OR=0.21, P<0.01, 95% CI=0.08-0.58; OR=0.20, P=0.01, 95% CI=0.06-0.68, respectively).

This is the first study to investigate the associations between T2D status and an individual's mask-wearing behaviors during the first wave of the COVID-19 pandemic.

Our logistic regression results did not show statistically significant associations between T2D status and mask-wearing behaviors. However, there was a tendency to suggest that people who were newly diagnosed with T2D were less likely to always wear masks compared with people already known as T2D and no T2D. Indeed, chi-square test results showed significant differences in inconsistent mask-wearing behavior, with a higher percentage among those newly diagnosed as T2D compared with those who had known as T2D and those with no T2D. This discrepancy in the results suggests the need for further investigations using a larger sample size and more representative community samples to examine the associations between mask-wearing behaviors and T2D status.

These results need to be interpreted carefully. Possible reasons for a higher percentage of inconsistent mask-wearing behavior among those who were newly diagnosed with T2D may be that these undiagnosed people were previously unaware and uncontrolled of their T2D status.

In addition, these undiagnosed, unaware, and uncontrolled individuals may be likely to lower risk perception and fears of severity and death from COVID-19 infection than those who knew they had T2D. Thus, people who were newly diagnosed with T2D had lower adherence to mask-wearing. This contention is supported by recent studies reporting that COVID-19 patients who were unaware, undiagnosed, and uncontrolled of T2D had indeed increased risks of severity and mortality than patients with known T2D and healthy individuals (Li et al., 2020; Sathish et al., 2020; Wang et al., 2021). Other research reported that people with T2D showed higher COVID-19-related fear, increased risk perception, and increased safety behavior changes than generally healthy individuals (Kohler et al., 2021; Musche et al., 2021).

During the first wave of the pandemic in Indonesia, vaccines were not yet available to the general population (Nugraha et al., 2021). The unavailability of effective vaccines and disruptions to health services increased people's fear and anxiety about contracting COVID-19, especially among T2D patients (Mahendradhata et al., 2021; Nugraha et al., 2021). In addition, the Indonesian Society of Endocrinology (ISE/PERKENI) has issued policy recommendations especially for T2D patients to stay at home and maintain physical distance to reduce exposure to viral carriers in early 2020 (Kshanti et al., 2021). Our findings suggest the importance of promoting early diagnosis, treatment, and awareness of T2D and preventive behaviors, including consistent mask-wearing, especially during the pandemic, to minimize the disease severity and mortality.

This study had some limitations. First, the study sample recruited from outreach health checkup services is unlikely to be representative of all adults in Indonesia. Participants were likely less likely to be as healthy as the general population. Indeed, the sample mostly included PROLANIS patients and older adults who had limited access to healthcare services. Second, the questionnaire did not ask about the duration of T2D, the age at first diagnosis of T2D, any complications or co-morbidities, and COVID-19-related symptoms, all of which may also influence mask-wearing behaviors. Finally, this was a cross-sectional survey and thus does not allow us to investigate causality between T2D status and mask-wearing behaviors. A strength of this study is that the data were collected during the first wave of the pandemic when access to healthcare services was limited. The collaborative effort among the research team consisting of community health volunteers and primary health center staff made it possible to conduct outreach health checkups to measure health and behavioral factors during the first wave of the pandemic in Indonesia.

4. CONCLUSION

This study provides insights into the associations between T2D status and mask-wearing behaviors during the early stage of the pandemic. The results imply that newly diagnosed T2D status may have an association with inconsistent mask-wearing in the early pandemic phase. To

reduce disease severity and mortality among undiagnosed T2D patients while mitigating future waves of COVID-19, early diagnosis and the awareness of T2D to increase mask-wearing and other preventive behaviors will be important in low- and middle-income countries where regular screening services are insufficient. The provision of mobile community health checkups, online health education, and teleconsultation services for people with undiagnosed T2D would be helpful in the case of future pandemics.

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

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