

Association of heated tobacco product use with tobacco use cessation in a Japanese workplace: a prospective study

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ABSTRACT

We investigated how use of heated tobacco products (HTPs) affects tobacco cessation in a Japanese workplace. We offered cessation programmes for 158 tobacco users from November 2018 to April 2019 and surveyed the quitting rate in August 2019. Successful quitting was defined as stopping use of all kinds of nicotine-containing tobacco products. A Poisson regression analysis adjusted with inverse probability weighting showed that HTP users (either exclusive HTP users or dual users) were less likely than exclusive cigarette users to quit tobacco (risk ratio, 0.77; 95% CIs 0.61 to 0.97, $p=0.024$). The use of HTPs should not be recommended to assist in smoking cessation. Trial registration UMIN000034719.

INTRODUCTION

The use of heated tobacco products (HTPs) has increased in Japan since 2014. Tobacco industries promoted HTPs as a less harmful alternative to cigarettes. Lenient national tobacco control measures and the prohibition of nicotine-containing e-cigarettes made Japan a fertile market for HTPs.^{1,2} However, their health impact and effectiveness for quitting tobacco are not well known. This study aimed to investigate how HTP use affects tobacco cessation.

METHODS

This prospective study included tobacco users at a manufacturing company in Japan. Tobacco users were defined as users of any nicotine-containing tobacco products in the past 30 days. The products used were investigated using a free-form questionnaire, and they included conventional cigarettes and HTPs. Tobacco users voluntarily participated in tobacco cessation support programmes, including support email distribution, counselling and pharmacological support, from November 2018 to April 2019. All study participants provided written informed consent. Pharmacological support consisted of either nicotine replacement therapy or varenicline and was provided by a specialised physician according to the standard procedures for smoking cessation treatment.³ Whether or not to receive pharmacological support was a participant's choice. We surveyed the tobacco use status of all participants in August 2019 and defined those who quit all types of nicotine-containing product use at that time as successful quitters.

We conducted Propensity Score (PS) analyses to evaluate the association between HTP use and

successful quitting. Because HTP use was not randomly assigned, PS weightings were used to account for differences. After PS weighting created an acceptable balance, Poisson regressions with PS weighting were used to calculate the risk ratios (RRs) and 95% CIs for successful quitting because the outcome was more than 10%.

The details of the surveyed information and statistical analyses are provided in the online supplemental file 1.

RESULTS

Complete data of 158 current tobacco users were available for the final analysis. The intervention protocol for tobacco cessation and its outcomes are shown in figure 1. After the tobacco cessation programme, 45 (28.4%) successfully quit tobacco products. We analysed predictive factors for successful quitting (table 1). There was no significant difference in the use of HTPs at baseline between the two groups (35.6% vs 42.5%; $p=0.48$). The use of pharmacological support and the consultation rate of the in-office tobacco cessation clinic showed significant differences between successful quitters and non-quitters (66.7% vs 10.6%; $p<0.0001$, 68.9% vs 20.4%; $p<0.0001$, respectively).

We conducted PS analyses to minimise the effects of covariates in the evaluation of the association between HTP use and tobacco cessation. The details are shown in online supplemental file 2. A Poisson regression analysis adjusted with inverse probability

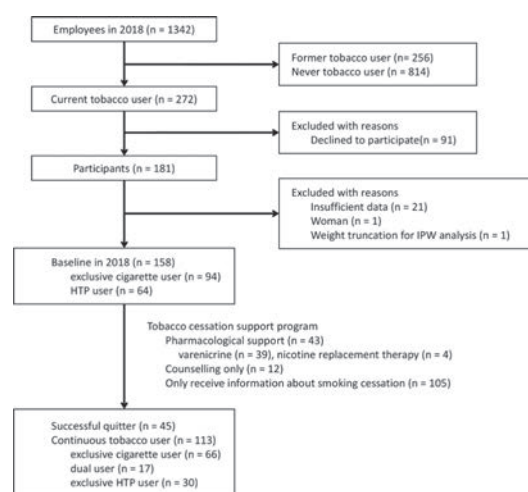


Figure 1 The intervention protocol for tobacco cessation and its outcomes. HTP, heated tobacco product; IPW, inverse probability weighting.

Brief communication

Table 1 Univariate analyses of predictive factors for successful quitting

Tobacco use status 2019	Overall	Non-quitter	Successful quitter	P value
n	158	113	45	
Age, years, mean (SD)	46.1 (10.6)	47.1 (10.5)	43.7 (10.5)	0.073
Body mass index, kg/m ² , mean (SD)	23.7 (3.3)	23.7 (3.5)	23.4 (2.8)	0.6
Living environment, n (%)				
Live with cohabitants	121 (76.6)	89 (78.8)	32 (71.1)	0.31
Live alone	37 (23.4)	24 (21.2)	13 (28.9)	
Comorbidities				
Diabetes mellitus, n (%)	11 (7.0)	10 (8.8)	1 (2.2)	0.18
Hyperlipidaemia, n (%)	61 (38.6)	44 (38.9)	17 (37.8)	>0.99
Hypertension, n (%)	23 (14.6)	18 (15.9)	5 (11.1)	0.62
Hyperuricaemia, n (%)	30 (19.0)	22 (19.5)	8 (17.8)	>0.99
Tobacco use profiles at baseline				
Brinkman Index (SD)	414.8 (283.0)	433.7 (289.2)	367.4 (264.0)	0.19
Interest in tobacco cessation, n (%)	64 (40.5)	42 (37.2)	22 (48.9)	0.21
Previous quit attempts, n (%)	61 (38.6)	39 (34.5)	22 (48.9)	0.11
HTP use in 2018, n (%)	64 (40.5)	48 (42.5)	16 (35.6)	0.48
Consider HTPs less harmful, n (%)	40 (25.3)	24 (21.2)	16 (35.6)	0.07
Consider HTPs useful for smoking cessation, n (%)	5 (3.2)	2 (1.8)	3 (6.7)	0.14
Questionnaire				
Tobacco Dependence Screener (SD)	4.2 (2.9)	3.9 (2.8)	4.8 (3.2)	0.09
COPD Assessment Score (SD)	6.2 (4.4)	6 (4.5)	6.8 (4.1)	0.33
Patient Health Questionnaire-9 (SD)	2.6 (3.1)	2.5 (3.2)	2.6 (2.7)	0.85
Tobacco cessation support				
Consult in-office tobacco cessation clinic, n (%)	54 (34.2)	23 (20.4)	31 (68.9)	<0.0001
Pharmacological support, n (%)	42 (26.6)	12 (10.6)	30 (66.7)	<0.0001
Lifestyle questionnaire				
Daily drinking, n (%)	38 (24.1)	28 (24.8)	10 (22.2)	0.84
Readiness to modify lifestyle, n (%)	90 (57.0)	65 (57.5)	25 (55.6)	0.86
Weight gain more than 10 kg from weight at 20 years, n (%)	68 (43.0)	49 (43.4)	19 (42.2)	>0.99
Sleep duration, hours (SD)	5.9 (0.9)	5.8 (0.8)	6 (0.9)	0.36

Comparisons between groups were examined using Fisher's exact tests for categorical values and t-tests for continuous values.

CAT, Chronic obstructive pulmonary disease assessment test; HTP, heated tobacco product.

weighting (IPW) showed that HTP users were less likely to quit tobacco (RR 0.77, 95%CI 0.61 to 0.97, $p=0.0013$). The use of pharmacological support was associated with higher rate of successful quitting (RR3.13, 95%CI 2.29 to 4.40, $p<0.0001$) (table 2).

DISCUSSION

In this prospective study, we showed for the first time that HTP users were less likely to quit tobacco than exclusive cigarette users. HTP use was negatively associated with successful quitting after adjusting for age, logarithm Tobacco Dependence Screener, previous quit attempts and pharmacological support. In contrast, pharmacological support was significantly associated with successful quitting in the same model.

HTPs were marketed around the world with claims that they were less harmful than cigarettes.⁴ In the present study, those who considered HTPs less harmful than cigarettes and who lived with cohabitants were more likely to use HTPs. However, there are already some reports of adverse events, including fatal cases, which required extracorporeal membrane oxygenation due to rapid and severe respiratory failure.^{5 6} Although HTPs are misunderstood to be less harmful, they expose users and bystanders to toxicants, and the evidence does not show that HTPs will reduce tobacco-related diseases.^{4 7 8}

There is no evidence that HTPs are useful for smoking cessation, although some smokers are reported to start using HTP to stop smoking.⁹ In the present study, we showed for the first time that HTP users were less likely to quit tobacco. It is possible that the rhetorical phrases by tobacco industries attract and make consumers misunderstand that changing from cigarettes to HTPs can provide a healthier environment for themselves and their surroundings. These misunderstandings on HTPs may have misled smokers to consider that switching from cigarettes to HTPs eliminates the need to quit tobacco, resulting in the negative impact of HTP use on successful quitting.

The present study has some limitations. First, the participants are limited to healthy male workers in a single institution, are biased by gender and age, and the number of participants is small. The findings of this study may have limited generalisability. However, the prevalence of HTP use within tobacco uses in this study was similar to that in the Japanese National Health Survey in 2018 (42.1% of men in their 20–50s).¹⁰ Second, the IPW analysis ensured a balance between HTP users and non-HTP users based on most but not all variables. Potential bias remains due to unmeasured confounders. Although a randomised controlled study may resolve the potential bias, we cannot ethically conduct such a study assigning subjects to use HTPs because of the harmfulness of HTPs. Third, the influence of cigarette use cannot be excluded because HTP users contain both exclusive HTP users and dual users. Fourth, smoking status was self-reported and assessed at a single point, and the length of cessation was not considered. Despite these limitations, this study's strength was the standard smoking cessation programme, which has suitable evidence for all participants and prospectively tracked the use of all tobacco products.

In conclusion, HTP users were less likely to quit tobacco than

Table 2 Risk ratio of factors independently affecting successful quitting by Poisson regression analysis adjusted with IPW

	Unweighted			Weighted with IPW		
	RR	95% CI	P value	RR	95% CI	P value
Age (per 1 year)	0.98	0.95 to 1.01	0.23	0.98	0.96 to 1.00	0.09
Logarithm TDS	0.54	0.31 to 0.91	0.024	0.5	0.32 to 0.76	0.0013
Previous quit attempt (reference no attempt)	1.2	0.88 to 1.62	0.26	1.24	0.99 to 1.55	0.065
HTP use (reference non-HTP user)	0.89	0.65 to 1.19	0.44	0.77	0.61 to 0.97	0.024
Pharmacological support (reference no pharmacological support)	2.97	2.00 to 4.61	<0.0001	3.13	2.29 to 4.40	<0.0001

HTP, heated tobacco product; IPW, inverse probability weighting; RR, risk ratio; TDS, Tobacco Dependence Screener.

exclusive cigarette users. Given that HTPs undermine cessation among smokers without providing health benefits, the use of HTPs should not be recommended for any purpose.

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