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Asthma inhaler misuse and substance abuse: A random survey of secondary school students[★]

Carol J. Boyd^{a,*}, Sean Esteban McCabe^a, and Christian J. Teter^{b,c}

^a*Substance Abuse Research Center, 2025 Traverwood, Suite C, University of Michigan, Ann Arbor, MI 48105-2194, United States*

^b*Northeastern University School of Pharmacy, Boston, MA, United States*

^c*McLean Hospital Alcohol and Drug Abuse Treatment Program Belmont, USA*

Abstract

Purpose—To assess the relationship between prescription asthma inhaler misuse and other substance abuse.

Methods—The study included a random sample of 5th through 10th grade students attending one, ethnically diverse school district in metropolitan Detroit ($N=1017$). A cross-sectional, web-based survey design was used. The survey included questions about the use and misuse of prescribed asthma inhalers (among other medications) as well as the use of alcohol, cigarettes, marijuana, and other drugs. We investigated four types of interaction with prescribed asthma inhalers: non-use, prescribed use, prescribed use and misuse, and misuse.

Results—Students who misused asthma inhaler medication during their lifetimes were more likely to smoke cigarettes and marijuana as well as more likely to drink alcohol, binge drink and have used other illicit drugs. Students who used asthma inhaler medication solely as prescribed were no more likely to abuse drugs or alcohol than non-users of prescription asthma inhalers.

Conclusions—Our findings are of interest to clinicians who provide health care to adolescents. The present study also has implications for adults managing prescription asthma medication in households and schools.

Keywords

Asthma inhaler abuse and diversion; Drug abuse; Prescription drug abuse

Using another person's asthma inhaler not prescribed to you represents the nonmedical use—or misuse—of the medication and thus, is a form of medication abuse. While generally an under-investigated topic (Boyd, Teter, & McCabe, 2004; Brennan, 1983; Edwards & Holgate, 1979; Pratt, 1982; Thompson, Dhillon, & Cole, 1983), there is preliminary evidence that middle school students are more likely than other students to misuse someone else's asthma inhaler (Boyd et al., 2004). Reasons for this type of misuse are not clear although they may be related to the effect of the fluorocarbon propellants such as mild stimulation, euphoria and intoxication (Pratt, 1982; Thompson et al., 1983) or the perceived benefits of sympathetic stimulation such as racing heart, increased alertness and expanded lung capacity. And despite preliminary evidence of asthma inhaler misuse (Boyd et al., 2004; Brennan, 1983; Pratt, 1982), the most well known national surveys of adolescent drug use fail to assess the prevalence

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* Corresponding author. Tel.: +1 734 998 6500; fax: +1 734 998 6508. E-mail address: caroboyd@umich.edu (C.J. Boyd).

of non-prescribed asthma inhaler use in adolescents (Johnston, O'Malley, & Bachman, 2002; National Center for Chronic Disease Prevention and Health Promotion, 2002).

Using a school-based survey of middle and high school students ($n = 1536$) Boyd et al. (2004) reported on the non-prescribed, lifetime use of asthma inhalers in an exploratory pilot study. They found that approximately 15% of 8th and 9th graders reported using non-prescribed asthma inhalers; the odds ratios were significantly higher for these students (2.25 and 2.30, respectively) and the use of non-prescribed asthma inhalers was significantly associated with higher rates of drug and alcohol use. However, this preliminary study was limited by several factors including the lack of information regarding the rates of prescribed inhaler use in the sample.

Given the dearth of research pertaining to asthma inhaler misuse and abuse, the purpose of this descriptive, cross-sectional study was to build on an earlier pilot study and examine the misuse of prescription asthma inhalers in a sample of 5th through 10th graders attending an ethnically diverse, school district in metropolitan Detroit. To gain a better understanding of the problem, we asked the following questions: 1) What is the lifetime and past year prevalence of use and misuse of prescribed asthma inhalers? 2) Are there group differences in cigarette smoking, binge drinking, marijuana use and other illicit drug use between non-users of prescription asthma inhalers, prescribed users of prescription asthma inhalers and those who misuse prescription asthma inhalers? 3) Does gender, race, grade level in school and/or prescribed use of asthma inhalers predict lifetime and past year misuse of prescription asthma inhalers? And finally, 4) How do students obtain prescribed asthma inhalers for misuse? In this study, the misuse or nonmedical use of prescription asthma inhalers refers to the non-prescribed use of an prescribed asthma inhaler.

1. Methods

The present study occurred during a 1-week period in May 2003 and included a sample of 1017 students; the sample was drawn from a population of 1155 students in 5th through 10th grades who attended one public school district in the Detroit metropolitan area. This study was conducted as part of a larger web-based study on student behaviors and attitudes. The University of Michigan's Human Subject Review Board approved this study and informed parental consent was obtained by sending consent forms home with the students. The survey was conducted over the Internet from computer labs in the students' schools. The web-based survey method was used in part because similar computer-based approaches have been shown to be effective for collecting sensitive information in secondary (Boyd et al., 2004; McCabe, Teter & Boyd, 2004) and postsecondary student populations (McCabe, Boyd, Couper and d'Arcy, 2002). The web survey was maintained on a hosted secure Internet site running under the secure sockets layer (SSL) protocol; students were given a unique pre-assigned PIN number (on a piece of paper) as they sat down at the computer terminal. The PIN allowed them to confidentially access the web survey and to anonymously process the data. An 88.0% response rate was achieved and this rate compares favorably with national school-based alcohol and other drug studies (Johnston, O'Malley, & Bachman, 2003).

2. Instruments

The survey took approximately 25 min to complete and included questions about the use and misuse of prescribed asthma inhalers (among other medications) as well as student use of alcohol, cigarettes, marijuana, and other illicit drugs.

Alcohol, tobacco and drug use was assessed by asking respondents about alcohol and other drug use through a series of questions adapted from national studies of substance use among

8th, 10th and 12th grade students (Johnston et al., 2003) and of college alcohol use (Wechsler, Dowdall, Davenport, & Rimm, 1995).

Alcohol use was measured using the following question: “On how many occasions (if any) have you had alcohol to drink more than just a few sips during...(a) the past 30 days...(b) the past 12 months...(c) in your lifetime? The response scale was: (1) no occasions, (2) 1–2 occasions, (3) 3–5 occasions, (4) 6–9 occasions, (5) 10–19 occasions, (6) 20–39 occasions, (7) 40 or more occasions.

Binge drinking was measured using the following single item question: “Over the past two weeks, how many occasions have you had five or more drinks in a row (four or more for women)?” A drink was defined as a glass of wine, a bottle of beer or wine cooler, a shot glass of liquor or a mixed drink. The response scale was (1) none, (2) once, (3) twice, (4) 3–5 occasions, (5) 6–9 occasions, and (6) 10 or more occasions.

Monthly cigarette smoking was measured using the following question: “How many cigarettes did you smoke during the past 30 days”? The response scale was: (1) none, (2) less than 1 cigarette per day, (3) 1–5 cigarettes per day, (4) about 1/2 pack per day, (5) about 1 pack per day, (6) about 1 1/2 packs per day, and (7) 2 or more packs per day.

Monthly marijuana use was assessed using the following question: “Have you ever used marijuana in the past 30 days”? The response scale was: (1) Yes, (2) No, and (3) Don’t know/Rather not say.

Annual illicit drug use was assessed by summing the total number of illicit drugs used in the past year (other than marijuana). The index was based on a “Yes” response for the following illicit drugs: cocaine, LSD, other psychedelics, inhalants and ecstasy.

Misuse and diversion of prescription asthma inhalers was assessed using the following items adapted from previous research (Boyd et al., 2004; Johnston et al., 2002; Poulin, 2001).

Question

Sometimes people use prescription drugs that were meant for other people, even when their own doctor has not prescribed it for them. Please indicate if you have EVER used an asthma inhaler NOT prescribed to you. (e.g., Albuterol), 1) Yes, 2) No, 3) Don’t know/Rather not say. Using skip logic via the web-based survey, follow-up questions were asked to students who reported lifetime misuse: *Follow-up Question 1*) “On how many occasions have you used an asthma inhaler (e.g., Albuterol) that was NOT prescribed to you in the past 12 months”? The response scale was (a) never, (b) 1–2 occasions, (c) 3–5 occasions, (d) 6–9 occasions, (e) 10–19 occasions, (f) 20–39 occasions, and (g) 40 or more occasions. *Follow-up Question 2*) “Please indicate how you obtained the asthma inhaler not prescribed to you by a doctor”. Since such little information is available regarding the sources for diversion, an open-ended text box was provided to respondents. *Follow-up Questions 3*). Motivations for misuse of asthma inhaler medications were assessed by using the following item: Please indicate the REASON(S) why you used asthma inhalers not prescribed to you (check all that apply): 1) Because it helps me concentrate; 2) Because it helps increase my alertness; 3) Because it helps me breathe; 4) Because it gives me a high; 5) Because it helps me when I exercise; 6) Other (SPECIFY); 7) Don’t know/Rather not say.

Medically prescribed use of prescription asthma inhalers was assessed using the following item: Many people are prescribed drugs by their doctor. *Question*: Has your doctor ever prescribed an asthma inhaler for you (e.g., Albuterol)? Respondents were given three choices: 1) Yes; 2) No or 3) Don’t know/Rather not say.

3. Sample

Our random sample included 1017 middle and high school students in grades 5th through 10th from a Detroit-metropolitan public school district; 54% were White while 43% were African American and 3% were from other racial and ethnic groups. Gender was equally distributed in the student sample. Approximately 22% of the sample were in 5th grade, 27% in 6th grade, 11% in 7th grade, 14% in 8th grade, 12% in 9th grade and 14% in 10th grade. As illustrated in Table 1, there were a greater number of students in 5th and 6th grades (when compared to the upper grades) because one-half of the students in 7th through 10th grade were randomly assigned to a different web-based survey and were not included in the present study.

4. Results

Ninety-eight students reported the lifetime nonmedical use of prescription asthma inhalers and there were no significant gender or racial differences in the reporting of the misuse of asthma inhaler medication. Ten percent of girls and 9% of boys reported lifetime, misuse of a prescription asthma inhaler; in the previous year, 6% of girls and 7% of boys reported misuse. As grade level increased, so too did prevalence rates of all substances including lifetime misuse of asthma inhalers; these differences were statistically significant. Approximately 6% of 5th graders reported lifetime misuse of asthma inhalers as contrasted with 15% of 8th graders and approximately 14% of 9th and 10th graders (see Table 1). There were two peaks in lifetime prescribed asthma inhaler use; students in the 6th and 7th grades were twice as likely as 5th graders to report lifetime prescribed use of asthma inhalers and 26% of 10th graders had been prescribed an asthma inhaler as contrasted to 17% of 9th graders. Although there were no gender differences in lifetime prescribed asthma inhaler use, boys were more likely to be approached to divert their asthma inhalers than girls (21% vs. 8%). In fact, more than one in every five boys prescribed an asthma inhaler had been approached to sell, trade or give away his asthma inhaler (see Table 1).

When we compared four groups of respondents based on their use and/or misuse of asthma inhaler medications we found differences relative to other forms of substance abuse. Using logistic regression analyses, we examined other substance use among mutually exclusive groups of asthma inhaler users: Group 1) non-use of asthma inhaler medications (never had a prescription and never misused); Group 2) legitimate use of asthma inhaler medications (had a prescription and never misused); Group 3) legitimate use but also misuse of prescription asthma medications (had a prescription and also misused asthma inhalers); and Group 4) misuse of asthma inhaler medications (never had a prescription for asthma inhalers but used them). Using Group 1 as the reference group, we found that compared to non-users of asthma inhalers, students who misused them were six times more likely to smoke cigarettes and marijuana; eight times more likely to drink alcohol; three times more likely to binge drink and 10 times more likely to have used several other drugs (see Table 2). Respondents who both used and misused asthma inhalers were also more likely, when compared to non-users, to use cigarettes, alcohol, marijuana and other illicit drugs although this group was not at the same risk as the group who only misused the inhalers. It is notable that students who used asthma inhaler medication solely as prescribed were no more likely to abuse substances than the reference group (non-users of prescription asthma inhalers). The use and misuse of asthma inhalers—along with the control variables (gender, race, and grade level)—explained 12% of variance in the outcome (for other illicit drug use) and 34% of the variance (for marijuana use), according to the Nagelkerke pseudo R^2 .

In order to determine the risk associated with demographic and age related characteristics, we also examined respondents based on gender, race and grade using a logistic regression model. We found no gender or racial differences and very few differences among grade levels. One

notable finding was related to having a previous prescription for asthma inhaler medications. When controlling for other factors (e.g. gender, race, etc.) we observed an eightfold increase ($OR=8.0$; $p<0.001$) in lifetime, misuse and a sevenfold increase ($OR=7.2$, $p<0.001$) in previous 12 month misuse among students who had been previously given a prescription for asthma inhalers (see Table 3).

We queried respondents regarding their motivations for non-prescribed use of asthma inhalers and asked respondents to endorse one (or more) response choices regarding their reasons. Most respondents (55%) stated that they used the non-prescribed asthma inhaler because “it helps me breathe” and/or “it helps me when I exercise” (13%). Eight percent of the students reported misusing an asthma inhaler in order to help them concentrate and 4% stated that they used a non-prescribed asthma inhaler to increase their alertness. Only one student stated s/he used the asthma inhaler to get high.

Of the ninety-eight students reporting the lifetime, misuse of asthma inhalers, 46 students (47%) provided a response to our open-ended question regarding how they obtained the non-prescribed asthma inhalers. Seventeen (37%) of these students gave responses indicating they got the inhaler from a family member. Responses included, “It was my sisters she got from the doctor”; “I borrowed it from my aunt”; “I ask my cousin for hers”; and “it was prescribed to my dad”. Only six students (13%) obtained use of the asthma inhaler from a friend and of these six students, only one student solely obtained the inhaler from a friend, the other five respondents obtained the inhalers from both family and friends. Another seventeen of the respondents (37%) provided answers that did not appropriately correspond to the question although some of these 17 responses provided additional insight into the reason the students used someone else’s inhaler. For instance, several of these 17 students indicated that they “borrowed” or shared another’s inhaler when they really needed it (e.g. “I use them when I really need them;” “I used it when I was short of breath” or “I just take a puff”, etc.). One student indicated that s/he got the asthma inhaler from “people who have the drug” and two others got it by stealing. No students reported getting their drugs on the Internet. There were no statistical differences in the likelihood of providing an open-ended response by race, gender, or grade-level differences.

5. Discussion

According to national data, when compared to other age groups, adolescents and young adults reported the highest prevalence of non-medical use of prescription drugs (Office of Applied Studies, 2003) with approximately 9.2% of adolescents aged 12–17 years having used prescription drugs for nonmedical purposes in the past year, although data specific to asthma inhaler misuse were not reported. These national prevalence rates correspond to our data; we found that 10% ($n=98$) of our respondents had engaged in lifetime misuse of prescription asthma inhalers and approximately 6% reported misuse in the previous year. It was not surprising that the misuse paralleled legitimate prescription use. The higher the grade, the more likely the students were to have been given a prescription for asthma inhalers and the more likely they were to engage in lifetime misuse.

Given gender and racial differences in rates of most forms of substance abuse among adolescents and young adults (Johnston et al., 2003; Simoni-Wastila, Ritter, & Strickler, 2004; Wallace et al., 2003) we expected some gender and racial differences in the misuse of asthma inhalers; however, we found no such differences. However, national studies have not examined the misuse of asthma inhalers and it is likely that this form of medication abuse is different from other forms of prescription drug abuse (e.g. the illicit use of stimulant or pain medications). While there was neither a gender nor a racial difference in students’ reports of misuse rates did differ by grade level. Based on the present findings, the misuse of asthma

inhalers appears to be most prevalent in 8th and 9th grade students; however, additional longitudinal research is needed in order to establish any developmental trends in the prevalence of asthma inhaler misuse.

Students who had been given a prescription for asthma inhaler medication were eight times more likely to use an inhaler NOT prescribed to them. It appears that in this population, when prescribed use increased there was a corresponding increase in the misuse of inhalers. Thus, while these data are enlightening and increase our awareness, the data also lead to more questions: To what extent are prescribed asthma inhalers being diverted to other children and to what extent do children self-medicate for asthma symptoms? These are two questions that beg for a greater number of well designed research studies.

It is of great interest that students who use another person's asthma inhaler were significantly more likely smoke cigarettes and marijuana, other drugs that require inhalation. However, as noted in Table 2, these students also were significantly more likely to use all drugs. It is possible that using others' medications represents part of a cluster of risky behaviors that includes cigarette smoking, binge drinking, and other illicit drug use (Jessor, Donovan, & Costa, 1991). Despite evidence of high rates of substance abuse among those who misused prescription asthma inhalers, the present study provided equally compelling evidence that the proper use of asthma inhalers is not associated with increased risk for substance abuse. Indeed, students who used asthma inhaler medication solely as prescribed by their doctor were no more likely to abuse substances than non-users of prescription asthma inhalers. We are also cautious about drawing conclusions regarding the motivations for the abuse. It appeared from students' motivations for misuse that many respondents used someone else's inhaler as a form of self-medication. Although the misuse of asthma inhalers may represent a problem behavior, it is certainly plausible that students experiencing shortness of breath may simply "borrow" family members' prescription medications—not to get high but rather, to breathe better. And while our data provide some preliminary insights into this issue, ways to reduce this form of diversion needs to be further explored. Clearly, using someone's prescription asthma inhaler—regardless of the reason—is a risky health behavior that should be prevented. Asthma inhalers remain a highly effective and safe medication for the majority of patients suffering from asthma. Therefore, despite the evidence for asthma inhaler misuse among secondary students, it is critical to strike a balance between the medical necessity to treat patients with asthma inhalers and the need to reduce misuse of asthma inhalers.

Our findings offer direction for future prevention efforts and therefore, should be of interest to clinicians who work with minors. It is apparent that children and adolescents who are prescribed asthma inhalers are also at increased risk for using someone else's asthma inhaler. Students who had been prescribed inhalers were eight times more likely to misuse asthma inhalers and young boys were at increased risk for being approached to divert their asthma inhalers. Clinicians who prescribe inhalers to youth should consider discussing the appropriate use of the medication with their young patients and families. It may also be important for clinicians to assess whether their treatment regimens are adequate and whether young patients are supplementing the treatment regimens with others' medications. The students' responses to our open-ended question provided preliminary evidence that family members divert their own prescription medications to children, probably in an effort to relieve a child's discomfort. Thus, the families' motivations for diverting inhalers are not nefarious but, parallels the students'—to help with breathing. In either case, prescription asthma inhalers should only be used under the appropriate medical supervision to allow for proper therapeutic monitoring and adjustments in medication use as needed.

The results of the present study also have important implications for parents and educators regarding the management of prescription asthma medication in households and schools. The

two leading sources specified by respondents were family and friends. Family members and students need to be educated about the potential dangers associated with providing prescription medications to their children and peers. For instance, it is important for families to realize that children who receive prescription medications, including asthma inhalers, from non-clinical sources are unlikely to receive the appropriate information about possible contraindications or negative interactions with other drugs. For example, adolescents with unknown cardiovascular disorders may be at increased risk for serious medical complications if they use asthma inhalers (without a prescription); this is even more likely if these adolescents exceed the recommended dose. High dose short-acting beta2-agonists, in fact, have been associated with cardiovascular adverse effects such as palpitations, blood pressure changes and ECG abnormalities (Chervinsky et al., 1999). In addition, there is a need to educate family members regarding the degree to which prescription medications, particularly asthma inhalers, are available in their households. Finally, schools can play an important role in deterring the availability of asthma inhalers for misuse by implementing effective management policies and procedures so that these medications are properly stored and dispensed to students.

We believe that the findings from this descriptive study are timely; however, our conclusions are constrained by several factors. Generalizations are limited because the sample was drawn from one school district. This web-based study relied on the self-report of students that were in school and thus, may have resulted in underestimates. In fact, previous research has shown that students who are absent or drop out from school tend to report higher rates of illicit substance use (Johnston & O'Malley, 1985). It is also possible that some of the questions adapted from Johnston and colleagues were less reliable for younger students (5th and 6th grade students) since these questions were originally designed for middle and high school students. Next, due to the cross-sectional nature of the data, we cannot make causal assumption regarding many of the relationships found in the present study. Finally, this study represents an analysis of survey data collected for a larger study, and thus, the items in the original questionnaire present some limitations. For instance, we never assessed the quantity and frequency of the prescribed use of asthma medication. We also recognize that the present study would have benefited from having physical diagnoses that provided medical indications for the asthma inhalers.

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Table 1
Demographic characteristics and prevalence of use and misuse of prescription asthma medication

	Total student sample (n =1017)		Lifetime alcohol use (n =950)		Past year alcohol use (n =966)		Lifetime misuse asthma inhaler (n =961)		Past year misuse asthma inhaler (n =955)		Lifetime use asthma inhaler (prescribed) (n =967)		Diversion of asthma inhaler (n =191)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Gender														
Female	506	49.8	39.0		29.7		10.0		6.1		20.7		8.1	
Male	511	50.2	40.4		26.4		9.2		6.9		18.8		20.9	
Race														
White	553	54.4	39.1		28.2		9.3		5.8		19.8		11.7	
Black	438	43.1	40.8		28.0		9.6		7.0		18.7		16.7	
Other	26	2.6	34.6	***	26.9	***	16.0	***	12.0	*	34.6	*	22.2	
Grade level														
5th grade	228	22.4	18.1		8.3		5.6		3.8		11.8		8.0	
6th grade	272	26.7	28.2		16.6		6.2		4.7		22.9		11.7	
7th grade	112	11.0	33.7		22.4		8.9		6.9		22.3		13.6	
8th grade	138	13.6	50.0		33.6		15.0		9.8		19.3		19.2	
9th grade	122	12.0	58.6		50.9		13.9		12.4		17.2		20.0	
10th grade	145	14.3	75.0		61.7		13.5		5.8		26.4		16.2	

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$.

Table 2

Prevalence of substance use by use and misuse of prescription asthma inhaler

Prescription asthma inhaler use status	Monthly cigarette smoking (n =917)		Monthly alcohol use (n =925)		2-week binge drinking (n =918)		Monthly marijuana use (n =923)		Annual illicit drug use ^d (n =942)	
	%	OR ^b	%	OR ^b	%	OR ^b	%	OR ^b	%	OR ^b
Lifetime prescription asthma inhaler use status										
Non-use (n =722)	5.4	—	13.7	—	5.8	—	4.9	—	2.4	—
Prescribed use only (n =136)	6.8	1.2	16.4	1.2	6.7	1.0	4.6	0.8	5.1	2.3
Prescribed use and misuse (n =52)	25.5	4.6***	35.3	2.7**	16.3	2.3	27.5	6.2***	16.0	7.2***
Misuse only (n =36)	26.5	5.8***	50.0	7.8***	18.2	3.4*	21.9	6.1**	20.0	10.0***
Nagelkerke R ²		0.21		0.25		0.16		0.34		0.12

—Reference group.

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$.

^aThe annual drug index was created by summing cocaine, LSD, other psychedelics, inhalants and ecstasy.

^bOdds ratios are adjusted for all other predictors in the model and the reference group for each model was students who did not report use or misuse of prescription asthma medication in their lifetime. All of the models also included gender, race, and grade level. The odds ratios for these variables were not shown.

Table 3

Logistic regression for misuse of prescription asthma medication, adjusted odd ratios

	Lifetime misuse asthma inhaler (<i>n</i> =946)		Past year misuse asthma inhaler (<i>n</i> =944)	
	Odds ratio	95% CI	Odds ratio	95% CI
Gender				
Male	1.00	Reference	1.00	Reference
Female	0.98	0.61–1.56	0.80	0.46–1.37
Race				
White	1.00	Reference	1.00	Reference
African American	1.07	0.66–1.74	1.24	0.71–2.16
Other	1.07	0.32–3.60	1.15	0.29–4.53
Grade level				
5th grade	1.00	Reference	1.00	Reference
6th grade	0.75	0.33–1.68	0.88	0.34–2.25
7th grade	1.17	0.45–3.04	1.35	0.45–4.01
8th grade	2.31 *	1.04–5.17	2.28	0.89–5.87
9th grade	2.19	0.94–5.09	3.18 *	1.24–8.16
10th grade	1.53	0.68–3.48	1.05	0.37–2.98
Lifetime prescribed use of asthma inhalers				
No	1.00	Reference	1.00	Reference
Yes	8.02 ***	4.97–12.93	7.2 ***	4.14–12.51
Nagelkerke R^2		0.19		0.17

*
 $p < 0.05$,**
 $p < 0.01$,***
 $p < 0.001$.