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Use of "Poppers" among Adults in the United States, 2015-2017

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Abstract

We sought to estimate the prevalence as well as demographic and drug use-related correlates of poppers use among adults in the United States. Data were analyzed from adult participants (ages 18–64) in the 2015–2017 National Survey on Drug Use and Health (N = 115,744), a nationally representative survey of non-institutionalized adults in the US. An estimated 3.3% of adults have ever used poppers. Over a third (35.1%) of gay men are estimated as having ever used poppers. Estimates were lower for heterosexual (3.7%) and bisexual males (11.3%), and for heterosexual (1.8%), bisexual (4.8%), and lesbian women (6.3%). In the multivariable model, compared to male heterosexuals, gay men were at increased odds for reporting lifetime popper use (aOR = 24.64, $p<.001$), and bisexual men (aOR = 3.55, $p<.001$), lesbian women (aOR = 1.86, $p=.010$), and bisexual women (aOR = 1.33, $p=.049$) were at increased odds for lifetime use. Having a college degree was associated with increased odds for use, and lifetime use of marijuana, ecstasy/MDMA/Molly, cocaine, LSD, methamphetamine, tranquilizers, and/or opioids were associated with higher odds for use. Gay men in particular are at high risk for use. Results can help inform prevention efforts, particularly in sexual minority populations.

Keywords

Poppers; amyl nitrites; inhalants; sexual minorities; methamphetamine

Introduction

Known colloquially as "poppers", alkyl nitrites are potent vasodilators with a long history of recreational use, surging in popularity during the 1970s within the nightlife scene (Sharp and Stillman 1980). The slang term arose from the fact that nitrites were sold in glass vials that had squeezed or "popped" between one's fingers in order to release the vapor (French and Power 1997). Originally prescribed for the medical management of angina in the mid-nineteenth century (Lauder Brunton 1867), inhaling poppers became popular among the gay

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community in large part because of their relaxative effects on smooth muscles in the anal sphincter, thereby facilitating anal intercourse as well as enhancing sexual pleasure (Colfax et al. 2001; Vaccher et al. 2020; Zhao et al. 2017). Users also commonly reported short-lasting sensations of warmth and euphoria (Mathew, Wilson, and Tant 1989; Pepper, Zuniga, and Reed 2019). Among the most common types of inhaled poppers are amyl nitrites and butyl nitrites, which are currently legal in the United States (US) and widely available – often sold under the guise of air deodorizers and cleaners – at adult stores, bars, clubs, and online (Romanelli et al. 2004; Swartz and McCarty-Caplan 2018).

Recent epidemiological research on the use of poppers within the US is limited, with the majority of studies focusing on men who have sex with men (MSM) in other countries. For example, a recent Australian study on gay, bisexual, and other MSM individuals estimated that a nearly a quarter (24.3%) used poppers on a weekly basis or more frequently (Vaccher et al. 2020), while others found the prevalence of lifetime use to be 38% among young gay or bisexual Australian men (Demant and Oviedo-Trespalacios 2019). Indeed, the most commonly cited reasons for use included “to obtain a buzz” during sex and to facilitate receptive anal intercourse (Vaccher et al. 2020). A large study on the MSM population in China also found that nearly a quarter (24.1%) of participants had reported ever using poppers (Chen et al. 2018), corroborating similar estimates from several other studies investigating both lifetime and recent (within past six-month) use among sexual minorities across several major Chinese cities (Chen et al. 2015; Chu et al. 2018; Wang et al. 2017; Zhao et al. 2017). Likewise, researchers in Russia found that among the substance-using MSM community, the most commonly reported recreational drugs used were marijuana and poppers (Wirtz et al. 2016). In the United Kingdom, 1.1% of the general population was estimated to use poppers at least once a year, making them the fourth most common recreational drug after marijuana, cocaine, and ecstasy, respectively (Pebody 2011).

As it pertains to the US, researchers investigating drug use among MSM across three large cities (Atlanta, Chicago, and New York City) found that over one-fifth (20.7%) of respondents reported using poppers within the past three months, second only to marijuana use and more prevalent than cocaine and ecstasy use, though this study was limited to individuals in an HIV prevention trial (Feinstein et al. 2018). In a study of binational HIV-positive Latino individuals residing near the US–Mexico border region, one-quarter (25.6%) reported lifetime use of poppers (Pepper, Zuniga, and Reed 2019). Notably, participants recruited on the US side were more likely to report poppers use than those recruited on the Mexican side, and identifying as gay/bisexual, or having bought, sold, or traded sex for money or drugs were risk factors for poppers use.

Characterized by an onset within seconds and short-acting duration on the order of minutes, many users regard poppers use as innocuous (Demant and Oviedo-Trespalacios 2019). Nevertheless, adverse effects have been documented. For example, a recent survey of electronic dance music party attendees in New York City estimated that 14.5% have used poppers in the past year (Palamar et al. 2019). Of these, 8.7% reported having experienced an adverse effect from use, defined as experiencing a harmful or very unpleasant effect after use in which the individual is concerned about his or her immediate safety. Specific mild to moderate common side effects include headaches, light-headedness, hypotension, and

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ataxia, though the extent to which these adverse effects occur has not been rigorously investigated (French and Power 1997; Pepper, Zuniga, and Reed 2019; Romanelli et al. 2004). One study found no association between poppers use and mild adverse effects such anxiety, depression, or other drug-related harm (Vaccher et al. 2020), while others have suggested that poppers demonstrate a relatively low-risk profile for dependency or otherwise problematic use (Demant and Oviedo-Trespalacios 2019; Nutt et al. 2007). While uncommon, more severe adverse effects of poppers use include retinal toxicity, vision loss, methemoglobinemia, or severe hypotensive complications due to drug–drug interactions with phosphodiesterase-inhibitors such as erectile dysfunction medications (e.g., sildenafil), which could be fatal (Batista et al. 2019; Davies et al. 2017; Docherty, Eslami, and O'Donnell 2018; Lefevre, Nuzzo, and Mégarbane 2018; Schwartz and Kloner 2010; Vignal-Clermont et al. 2010). However, the majority of these findings were published in case reports and may reflect isolated events with limited generalizability to the overall population.

From a public health perspective, the greater concern may be that poppers use continues to be an independent risk factor for risky sexual behaviors (Colfax et al. 2001; Romanelli et al. 2004; Vandenbroucke and Pardoel 1989). For example, compared to non-users, MSM who use poppers within the past three months were at over twice the odds of having multiple male sexual partners, and at approximately 1.7 times the odds of engaging in unprotected receptive anal intercourse (Zhang et al. 2016). Other studies on the MSM population have also found poppers use to be associated with unprotected anal intercourse (Colfax et al. 2005; Daskalopoulou et al. 2014; Hambrick et al. 2018) as well as higher rates of group sex (Zhao et al. 2017).

Ultimately, there is a dearth of epidemiological studies relating to the use of poppers in the US. Insofar as health authorities continue to monitor the use of recreational drugs and seek to identify potentially at-risk groups within the general population, research on the prevalence and patterns of poppers use can serve to guide policies. To this end, our study examines the prevalence and correlates of poppers use among a nationally representative sample of American adults.

Methods

Study population

We analyzed aggregated data from the 2015–2017 National Survey on Drug Use and Health (NSDUH). NSDUH is an ongoing cross-sectional survey of non-institutionalized individuals in the 50 US states and the District of Columbia (Center for Behavioral Health Statistics and Quality [CBHSQ], 2019). Data are derived from nationally representative probability samples of individuals residing in households, noninstitutional group quarters, and shelters, obtained through four sampling stages. Adults of ages 18–25 are oversampled to produce more precise estimates for young adults. Surveys are administered via computer-assisted interviews which are conducted by an interviewer and through audio computer-assisted self-interviewing. Sample weights were provided by NSDUH to address non-response selection bias, unit- and individual-level non-response, and population distribution. Further details regarding survey methods and sampling can be found elsewhere (CBHSQ, 2018). The

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weighted interview response rates were 67.1–69.7%. This study focuses on adults of ages 18–64 with data on self-reported sexual identity (N = 115,744).

Demographic characteristics

Participants were asked their age, gender, race/ethnicity, education, annual family income, marital status, and sexual identity. Only participants of ages ≥18 were asked their sexual identity. Specifically, they were asked, “Which one of the following do you consider yourself to be?” Answer options were “heterosexual, that is, straight”, “lesbian or gay”, and “bisexual”. For the present study, we created six categories for sexual orientation: “male, heterosexual”, “female heterosexual”, “gay male”, “lesbian”, “male bisexual”, and “female bisexual”. Participants could also report that they were unsure, do not know, or refuse. We excluded the 1.9% (n = 2062) of participants that provided any of these responses.

Drug use

Participants were asked about lifetime use of various drugs. In these analyses, we considered self-reported use of poppers, marijuana, ecstasy (MDMA, Molly), cocaine, LSD, and methamphetamine. Use of poppers was defined as the use of “amyl nitrite, ‘poppers’, locker room odorizers, or ‘rush’ for kicks or to get high”. Misuse of prescription tranquilizers (e.g., benzodiaze-pines) and pain-relievers (prescription opioids) was also queried. Misuse was defined as “using without one’s own prescription; using in greater amounts, more often, or for longer than directed”, or “use in any way not directed by a doctor”. Participants were shown images of various pills to aid in their recall. As only lifetime use of poppers was queried, we focused on the lifetime use of each drug.

Analysis

First, we estimated the prevalence of lifetime use of poppers. We then examined demographic and drug use characteristics in relation to poppers use. Comparisons were made using Rao–Scott chi-square. After examining bivariable associations, we fit all covariates into a multivariable binary logistic regression to determine the associations of each variable with all else being equal. Data were analyzed using Stata SE 13 (StataCorp, 2013), and we used sample weights in all analyses to account for non-response selection probability, non-response, and population distribution (Heeringa, West, & Berglund, 2010). We used imputation-revised variables (provided by NSDUH) when available to limit missing data. Secondary analysis of these data was exempt from review by the New York University School of Medicine’s Institutional Review Board.

Results

An estimated 3.3% of individuals of ages 18–64 in the US have used poppers in their lifetime. As shown in Table 1, bivariable differences in poppers use according to age, sex/sexual orientation, race/ethnicity, education, marital status, and lifetime use of each drug examined were detected (all $ps < .01$). Of note, over a third (35.1%) of gay men are estimated as having ever used poppers. Estimates were lower for heterosexual (3.7%) and bisexual males (11.3%), and for heterosexual (1.8%), bisexual (4.8%), and lesbian women (6.3%). In addition, over a tenth of people who have ever used each of the other drugs

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examined (other than marijuana) reported lifetime poppers use, with nearly a fifth (19.4%) of people who have ever used methamphetamine reporting lifetime poppers use.

Results of the multivariable model (Table 1) suggest that as participant age increased, so too did odds for lifetime use of poppers. Compared to white individuals, black individuals were at lower odds for poppers use (aOR = 0.53, $p < .001$), and compared to those with less than a high school diploma, those with a college degree were at increased odds for use (aOR = 1.50, $p < .001$). Compared to male heterosexuals, gay men were at increased odds for reporting lifetime popper use (aOR = 24.64, $p < .001$), and bisexual men (aOR = 3.55, $p < .001$), lesbian women (aOR = 1.86, $p = .010$), and bisexual women (aOR = 1.33, $p = .049$) were at increased odds for use. Lifetime use of each drug examined was associated with increased odds of poppers use, particularly marijuana (aOR = 5.99, $p < .001$), cocaine (aOR = 2.21, $p < .001$), LSD (aOR = 2.83, $p < .001$) and methamphetamine (aOR = 1.99, $p < .001$). In addition, those reporting lifetime nonmedical use of opioids (aOR = 1.78, $p < .001$) and/or tranquilizers (aOR = 1.53, $p < .001$) were also at increased odds for use.

Discussion

To our knowledge, this study is the first to present findings estimating the prevalence and correlates of poppers use among a nationally representative sample of adults between the ages 18 and 64 in the US. Overall, our findings suggest that approximately 3.3% of US adults have used poppers during their lifetime. For rough comparisons, the most recent NSDUH findings from 2018 estimate that nearly half (49.2%) of American adults (aged 12 and older) had used marijuana in their lifetime, 14.7% for cocaine, 7.3% for ecstasy, 5.4% for methamphetamine, and 1.9% for heroin (Substance Abuse and Mental Health Services Administration 2019). Therefore, our findings may indicate that the prevalence of poppers use within the general population is relatively low, though additional research estimating more recent use is needed.

When focusing on sexual orientation, however, we found that those identifying as a sexual minority (e.g., lesbian, gay, or bisexual) of either gender were at significantly increased risk for lifetime poppers use when compared with heterosexual males. This appears to be particularly true for gay males, as over one-third of male respondents identifying as gay admitted to using poppers in their life, while multivariable analysis suggests that they are at nearly 25 times the odds of using poppers when compared to heterosexual males. Indeed, while previous studies focusing exclusively on MSM have reported high rates of poppers use (Colfax et al. 2005; Feinstein et al. 2018; Schmidt et al. 2016; Zhao et al. 2017), our findings substantiate the notion that certain groups of sexual minorities, especially gay males, are at higher risk for poppers use when compared with the general population.

In general, those identifying as lesbian, gay, or bisexual are more likely to use an array of drugs and have higher rates of substance use than the general population (Duncan et al. 2019; Ostrow and Stall 2008; Prestage et al. 2018; Substance Abuse and Mental Health Services Administration 2020). While overarching reasons tend to be socio-cultural in nature, for example, coping with societal stigmas, or peer pressure for social inclusion in a minority community historically centered around bars and nightlife (Green and Feinstein

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2012; Hawkins et al. 2019; Meyer 2003), we posit that higher rates of poppers use among gay males are largely attributable to their reported vasodilatory effects facilitating anal intercourse and sexual pleasure (Romanelli et al. 2004; Vaccher et al. 2020). Nevertheless, the role of socio-cultural factors should not be understated and can be framed using Zinberg's theory on drug, set, and setting. In short, Zinberg puts forth that the social setting plays a unique role in the development of substance use, often involving both social values and patterns of conduct that can shape the ideas of future patterns of behavior unknowingly. If the social surroundings consist of high popper use, individuals may be more likely to use poppers due to external influences in the setting.

Differences in poppers use also appear when considering race/ethnicity and education. For example, compared to white respondents, we found that black individuals were only at approximately half the odds of reporting lifetime poppers use. While other studies have reported that black MSM were less likely to use poppers compared to white individuals (Feinstein et al. 2018; Swartz and McCarty-Caplan 2018) or other races (Mutchler et al. 2011), our findings suggest that black individuals, irrespective of sexual orientation, may be at lower risk for poppers use in general. Additional research to better elucidate reasons for such racial differences in poppers use are welcome; however, one study found that compared to white MSM, black MSM had significantly lower numbers of male sexual partners as well as a lower number of unprotected receptive anal intercourse partners (Swartz and McCarty-Caplan 2018). Conversely, our findings suggest that higher levels of education may be associated with increased poppers use. Our findings echo similar findings from other studies on poppers use among MSM populations (Feinstein et al. 2018; Vaccher et al. 2020; Zhang et al. 2016).

Lifetime poppers use increased with age. This was not unexpected as older age is associated with a larger timespan for someone to engage in use. In the absence of data on recent use (e.g., past-year use), one potential reason for increasing poppers use with increasing age may be related to the reasons for using poppers. Indeed, in addition to facilitating anal intercourse, poppers have also been shown to heighten libido and reduce sexual inhibition akin to various other recreational drugs (Drumright, Patterson, and Strathdee 2006; Romanelli et al. 2004). Researchers in Australia have also reported that lifetime users of poppers tended to be significantly older than nonusers, though the data were limited to the MSM population (Vaccher et al. 2020).

Lastly, our findings demonstrate that lifetime use of each included drug (marijuana, ecstasy, cocaine, LSD, methamphetamine, tranquilizers, and opioids) was significantly associated with the use of poppers. This is not surprising given that poppers are considered to be party or club drugs, and the use of multiple drugs within the party scene is well established. While many MSM methamphetamine users are also users of poppers (Patterson et al. 2005; Plankey et al. 2007), no studies to date have examined other drug use among poppers users. Indeed, our findings suggest that the lifetime use of several other common drugs is correlated with the use of poppers among the general population as well. Of note, lifetime users of cocaine, LSD, and methamphetamine were at two-to-three times the odds of using poppers, while nearly one in every five lifetime methamphetamine users also reported the

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use of poppers. Lifetime marijuana use was associated with approximately six times greater odds of poppers use.

NSDUH data are based on self-report and subject to reporting bias and bias of recall. NSDUH surveys are limited to individuals living in households and non-institutionalized group quarters (e.g., dormitories, shelters) and civilians residing at military bases. Homeless individuals who do not use shelters are excluded, as are military personnel on active duty, and residents of institutional group quarters, such as hospitals and jails are excluded, which may limit generalizability. In addition, questions about popper use were limited to lifetime use. Data on recency of use (e.g., past-year use) may reveal other patterns of use and may improve the generalizability of findings. NSDUH also did not ask about the frequency of use or reasons for use.

Data on nationally representative samples of adults in the US suggest that 3.3% of adults in the US have ever used poppers. Significant differences in the prevalence of lifetime poppers use were detected based on age, race, sexual orientation, education, and lifetime use of other recreational drugs. Lifetime users of marijuana, ecstasy, cocaine, LSD, methamphetamine, opioids, and tranquilizers appear to be at high risk for poppers use, while gay males were at nearly 25 times the odds of using poppers compared to heterosexual males. These findings can help inform prevention, treatment, and harm reduction efforts.

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Table 1.

Sample characteristics and correlates of lifetime poppers use.

	Univariable	Bivariable Comparisons		Multivariable Model	
	Full Sample (n = 115,744) Weighted % (95% CI)	No Lifetime Poppers Use (n = 112,810) Weighted % (95% CI)	Lifetime Poppers Use (n = 2,934) Weighted % (95% CI)	aOR	(95% CI)
Survey Year					
2015	33.3 (32.8, 33.7)	96.6 (96.3, 96.9)	3.4 (3.1, 3.7)	1.00	
2016	33.3 (32.8, 33.7)	96.6 (96.4, 96.9)	3.4 (3.1, 3.7)	1.02	(0.89, 1.18)
2017	33.5 (33.1, 33.8)	96.9 (96.6, 97.2)	3.1 (2.8, 3.4)	0.88	(0.76, 1.02)
Age					
18–25	17.6 (17.3, 18.0)	98.6 (98.4, 98.7)	1.4 (1.3, 1.6)**	1.00	
26–34	19.7 (19.4, 20.1)	97.8 (97.5, 98.0)	2.2 (2.0, 2.5)	1.19*	(1.02, 1.40)
35–49	30.8 (30.4, 31.2)	96.8 (96.6, 97.1)	3.2 (2.9, 3.4)	2.11***	(1.81, 2.45)
50–64	31.8 (31.2, 32.4)	94.9 (94.4, 95.3)	5.1 (4.7, 5.6)	3.83***	(3.20, 4.58)
Sex and Sexual Orientation					
Male, Heterosexual	47.2 (46.8, 47.7)	96.3 (96.0, 96.6)	3.7 (3.4, 4.0)**	1.00	
Female, Heterosexual	47.4 (47.1, 47.8)	98.2 (98.0, 98.4)	1.8 (1.6, 2.0)	0.69***	(0.58, 0.82)
Male, Gay	1.2 (1.1, 1.3)	64.9 (60.2, 69.3)	35.1 (30.7, 39.8)	24.64***	(18.02, 33.68)
Female, Lesbian	0.9 (0.8, 1.0)	93.7 (91.2, 95.5)	6.3 (4.5, 8.8)	1.86*	(1.17, 2.95)
Male, Bisexual	0.9 (0.8, 0.9)	88.7 (85.3, 91.4)	11.3 (8.6, 14.7)	3.55***	(2.48, 5.09)
Female, Bisexual	2.4 (2.3, 2.5)	95.2 (94.2, 96.0)	4.8 (4.0, 5.8)	1.33*	(1.00, 1.77)
Race/Ethnicity					
White	61.7 (61.0, 62.3)	95.7 (95.4, 95.9)	4.4 (4.1, 4.6)**	1.00	
Black	12.5 (12.1, 12.9)	98.9 (98.6, 99.2)	1.1 (0.8, 1.4)	0.53***	(0.40, 0.71)
Hispanic	17.4 (16.9, 18.0)	98.1 (97.8, 98.4)	1.9 (1.6, 2.2)	0.94	(0.77, 1.15)
Asian	5.7 (5.5, 6.1)	99.0 (98.2, 99.4)	1.0 (0.6, 1.8)	0.81	(0.47, 1.39)
Other/Mixed	2.6 (2.5, 2.8)	96.6 (95.9, 97.3)	3.4 (2.8, 4.1)	0.86	(0.66, 1.11)
Education					
Less Than High School	12.0 (11.6, 12.4)	97.6 (97.3, 97.9)	2.4 (2.1, 2.7)**	1.00	
High School Diploma	24.3 (23.9, 24.6)	96.9 (96.7, 97.2)	3.1 (2.8, 3.3)	1.11	(0.92, 1.34)
Some College	32.4 (32.0, 32.8)	96.6 (96.3, 96.8)	3.4 (3.2, 3.7)	1.14	(0.94, 1.40)

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	Univariable	Bivariable Comparisons		Multivariable Model	
	Full Sample (n = 115,744) Weighted % (95% CI)	No Lifetime Poppers Use (n = 112,810) Weighted % (95% CI)	Lifetime Poppers Use (n = 2,934) Weighted % (95% CI)	aOR	(95% CI)
College Degree	31.3 (30.7, 32.0)	96.3 (96.0, 96.7)	3.7 (3.3, 4.0)	1.50***	(1.22, 1.84)
Annual Family Income					
<$20,000	16.8 (16.4, 17.2)	96.9 (96.4, 97.2)	3.1 (2.8, 3.6)	1.00	
$20,000–$49,999	27.9 (27.4, 28.4)	96.7 (96.4, 97.0)	3.3 (3.0, 3.6)	1.00	(0.83, 1.20)
$50,000–$74,999	15.9 (15.5, 16.2)	96.7 (96.2, 97.1)	3.3 (2.9, 3.8)	0.96	(0.74, 1.23)
≥$75,000	39.4 (38.7, 40.1)	96.6 (96.3, 96.9)	3.4 (3.1, 3.7)	0.91	(0.70, 1.17)
Relationship Status Not Married	49.9 (49.3, 50.5)	96.3 (96.1, 96.6)	3.7 (3.4, 3.9)**	1.00	
Married	50.1 (49.5, 50.7)	97.1 (96.9, 97.3)	2.9 (2.7, 3.1)	1.04	(0.92, 1.19)
Lifetime Drug Use Marijuana	53.5 (53.0, 53.9)	94.1 (93.8, 94.4)	5.9 (5.6, 6.2)**	5.99***	(4.41, 8.14)
Ecstasy	9.4 (9.1, 9.6)	87.1 (86.2, 87.9)	12.9 (12.1, 13.8)**	1.35**	(1.14, 1.60)
Cocaine	18.7 (18.3, 19.0)	87.1 (86.5, 87.8)	12.9 (12.2, 13.5)**	2.21***	(1.86, 2.62)
LSD	12.1 (11.8, 12.4)	83.0 (82.1, 83.9)	17.0 (16.1, 17.9)**	2.83***	(2.45, 3.26)
Methamphetamine	7.0 (6.8, 7.3)	80.6 (79.3, 81.7)	19.4 (18.3, 20.7)**	1.99***	(1.71, 2.30)
Tranquilizers (misuse)	5.3 (5.1, 5.5)	83.8 (82.3, 85.3)	16.2 (14.7, 17.7)**	1.53***	(1.27, 1.85)
Opioids (misuse)	12.3 (12.0, 12.5)	88.5 (87.7, 89.3)	11.5 (10.7, 12.3)**	1.78***	(1.56, 2.04)

Lifetime poppers use is the outcome variable (3.3%). CI = confidence interval, aOR = adjusted odds ratio (controlling for all covariates presented in table).