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台北都會區慣用菸酒之年輕成人的初次性經驗早晚  
與高危險性行為的關係

Early sexual initiation and risky sexual practices among alcohol-  
and tobacco-using young adults in the Taipei metropolitan area

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本論文係 胡達亮 君 (學號 R05849040) 在國立臺灣大學流行病學與預防醫學研究所完成之碩士學位論文，於民國 107 年 6 月 21 日承下列考試委員審查通過及口試及格，特此證明。

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## 誌謝



歲月匆匆，兩年的碩士生涯，轉眼間便已步入尾聲了。

這份論文得以順利完成，首先我要感謝陳為堅老師。每次的討論，老師總是耐心的與我一起解決難題，與我分享豐富的研究經驗，亦不斷啟發我思考問題的方式。從老師身上，我體會到對待學術一份難以比擬的熱誠。

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## 中文摘要



**背景：**早發性行為在過去的研究被指出與不良的健康後果相關，但目前大部分的研究均在西方族群進行，亦未有探討非法藥物在兩者之間的潛在效應。本研究旨在探討台灣人口的早發性行為與危險性行為的相關性，及性行為前用藥於兩者之間的中介效果。

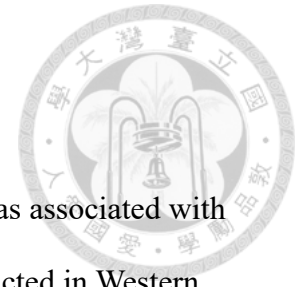
**方法：**透過「回應者引介抽樣法」於台北都會區，招募慣用菸酒的 1115 位年輕成人（18 至 50 歲）參與研究。每位參與者接受電腦輔助式訪談，內容涵蓋各種物質使用與性經驗，以及其他題項。其中有性經驗的 916 位參與者被用於本分析。多變項邏輯迴歸模型分析了早發性行為（16 歲前有初次性經驗）與四個危險性行為的相關性 – 分別為多重性伴侶（終生累積 8 個或以上）、一夜情、群交以及不規則保險套使用（有時候/很少/從來沒有）。此外，模型中早發性行為與性別的交互作用項探討了男性性別對早發性行為與危險性行為之相關性的調節作用。因果式中介分析則探討了性行為前用藥（終生有或沒有）是否能夠中介前述的相關性及其中介的程度。

**結果：**慣用菸酒的年輕成人中約 9% 有早發性行為的經驗，而危險性行為的盛行率為 7%（群交）至 47%（不規則保險套使用）。早發性行為與多重性伴侶、一夜情及群交皆呈現正向相關性；而與男性相比，女性早發性行為與多重性伴侶及一夜情的勝算比較高。上述的相關性均被性行為前用藥顯著地中介，中介的比率 17% 至 22% 不等。

**結論：**慣用菸酒的年輕成人中有早發性行為者，會比較傾向參與危險性行為，而性行為前用藥解釋了它們之間部分的關係。對於台灣及整個東亞而言，這部分人口的性健康需要更多的關注。

**關鍵字：**早發性行為、危險性行為、性行為前用藥、物質使用、性健康、回應者引介抽樣法

## ABSTRACT



**Background.** Previous studies showed that early sexual initiation was associated with negative sexual health outcomes. However, most studies were conducted in Western populations and did not examine the role of illicit drugs in the pathway. This study aims to (1) examine the associations between early sexual initiation and risky sexual practices in Taiwan and (2) the mediation effects through drugs before sex in the above associations.

**Methods.** Participants were recruited from regular alcohol- and tobacco-using young adults (aged 18-50) in the Taipei metropolitan area through respondent-driven sampling ( $N = 1115$ ). Respondents completed a computer-assisted self-interview covering a variety of questions on substance use and sexual experiences, among others. We analyzed a sexually experienced subsample of 916 participants. Multivariable logistic regression analyses examined the associations between early sexual initiation (before age 16) and four risky sexual practices, respectively – multiple sexual partners ( $\geq 8$  partners in lifetime), casual sex, group sex, and inconsistent condom use (sometimes/seldom/never). Interaction terms of early sexual initiation and gender were applied to the logistic regression models to examine moderation effects of being male on the associations between early sexual initiation and the four risky sexual practices. Causal mediation analyses examined if and to what extent drugs before sex (yes/no in lifetime) mediated these associations.

**Results.** Around 9% reported early sexual initiation and the prevalence of risky sexual practices ranged from 7% (group sex) to 47% (inconsistent condom use). Early sexual initiation was positively associated with multiple sexual partners, casual sex, and group sex. The odds ratio of early sexual initiation with multiple sexual partners or casual sex

was greater for females than males. Significant mediation effects through drugs before sex were found between early sexual initiation and the three risky sexual practices, with the proportions mediated ranging from 17% to 22%.

**Conclusions.** Early sexual initiators among alcohol- and tobacco-using young adults were more likely to engage in risky sexual practices and drugs before sex partially explained this relationship. Attention should be given to the sexual health of this population in Taiwan and more generally in East Asia.

**Keywords:** Early sexual initiation; risky sexual practices; drugs before sex; substance use; sexual health; respondent-driven sampling

# Contents



口試委員會審定書.....	i
誌謝.....	ii
中文摘要.....	iii
Abstract.....	iv
1. Introduction.....	1
2. Methods.....	4
2.1 Sample.....	4
2.2 Measures.....	5
2.3 RDS-based prevalence estimation.....	7
2.4 Weighted logistic regression analysis.....	8
2.5 Mediation analysis.....	8
3. Results.....	10
4. Discussion.....	13
References.....	18
Tables.....	25
Figures.....	30
Appendix.....	31

## List of Tables



Table 1. Demographic characteristics of sexually experienced alcohol- and tobacco-using young adults in Taiwan recruited using RDS during 2007-2010, by gender and sexual initiation ( $N = 916$ ) .....	25
Table 2. Sexual history among alcohol- and tobacco-using young adults in Taiwan recruited using RDS, by gender and sexual initiation ( $N = 916$ ) .....	26
Table 3. Substance use among sexually experienced alcohol- and tobacco-using young adults in Taiwan recruited using RDS, by gender and sexual initiation ( $N = 916$ ) .....	27
Table 4. Weighted multivariable logistic regression models of multiple sexual partners, casual sex, group sex, and inconsistent condom use on early sexual initiation among alcohol- and tobacco-using young adults in Taiwan ( $N = 916$ ) .....	28
Table 5. Causal mediation analysis examining drugs before sex as a potential mediator between early sexual initiation and risky sexual practices ( $N = 916$ ) .....	29



## List of Figures

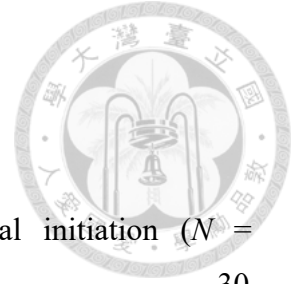


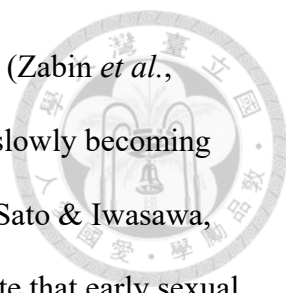
Figure 1. Prevalence of four risky sexual practices, by sexual initiation ( $N = 916$ ) .....	30
Figure A1. Interface of the audio-computer assisted self-interview (ACASI) questionnaire used in respondent-driven sampling among alcohol- and tobacco-using young adults in Taiwan .....	34

## 1. INTRODUCTION



Early sexual initiation has been an important theme of sexuality research in the past few decades and its links with various adverse health outcomes were well-documented in Western populations (Heywood *et al.*, 2015; Boislard *et al.*, 2016). There have been variations in how early sexual initiation is defined across studies, but one commonly used cutoff is age 16, which sometimes aligns with the legal age of consent in the populations under investigation (Cavazos-Rehg *et al.*, 2010; Madkour *et al.*, 2010; Mercer *et al.*, 2013; Chan *et al.*, 2015). In previous studies, early sexual initiation was shown to be associated with risky sexual practices, including multiple sexual partners, sex with non-regular partners, sex under the influence of alcohol or drugs, and condom non-use (Sandfort *et al.*, 2008; Ma *et al.*, 2009; Heywood *et al.*, 2015). These risky sexual practices are of public health concern because of their risks of adverse health outcomes, such as sexually transmitted infections, unintended pregnancy, and regret after sex (Wight *et al.*, 2000; Vaccarella *et al.*, 2006; Campbell, 2008; Scott *et al.*, 2011). However, given the importance of early sexual initiation on sexual health, the extant literature has been sparse (Heywood *et al.*, 2015).

In East Asia, where collectivist culture is a common tradition, early sexual behaviors tend to be disapproved (Chiao & Yi, 2012; Rodríguez-Arauz *et al.*, 2013; Van de Bongardt *et al.*, 2015). This is supported by the fact that prevalence of early sexual initiation in East Asian populations, such as Taiwan (Cernada *et al.*, 1986; Chan *et al.*, 2015), Hong Kong (The Family Planning Association of Hong Kong, 2016), and Japan (Sato & Iwasawa, 2015), was lower than that in Western populations, including the U.S. (Abma & Martinez, 2017), the U.K. (Mercer *et al.*, 2013), and Europe (Madkour *et al.*, 2014; Ramiro *et al.*, 2015). Since traditional culture might have been weakened owing to widespread education and increased exchange with Western societies, younger



generations might see a growing prevalence of early sexual initiation (Zabin *et al.*, 2009). Indeed, there have been signs that early sexual initiation was slowly becoming more common in East Asia (Cernada *et al.*, 1986; Chan *et al.*, 2015; Sato & Iwasawa, 2015; The Family Planning Association of Hong Kong, 2016). Despite that early sexual initiation is increasingly common in East Asian societies, it is unclear if and to what extent it is associated with risky sexual practices.

Another unresolved question pertaining to early sexual initiation is the dearth of empirical framework on why associations exist between early sexual initiation and risky sexual practices (Heywood *et al.*, 2015). One potential link that remains seldom investigated is the experience of using drugs before sex. Previous studies in Western and East Asian populations, respectively, found that early sexual initiators were more likely to report drugs before sex (Sneed, 2009; Ding *et al.*, 2015). This observation is consistent with Problem Behavior Theory (Jessor & Jessor, 1977; Vazsonyi *et al.*, 2010), which posits that socially undesired behaviors often cluster together. Meanwhile, studies found that drugs before sex was associated with risky sexual practices (Calsyn *et al.*, 2010; Ding *et al.*, 2013). Given that illicit drug users reported sexual use of drugs to enhance sensation and to reduce inhibition (Bellis *et al.*, 2008), it is worthwhile to examine whether drugs before sex acted as a potential mediator between early sexual initiation and risky sexual practices. A recent development of causal mediation analysis (Valeri & VanderWeele, 2013; VanderWeele, 2016), which is more flexible than traditional approach (Baron & Kenny, 1986) in allowing for binary mediating variable and outcome variable, can help clarify this role of drugs before sex.

A further challenge in studying early sexual initiation and illicit drug use in East Asian populations is the relatively uncommon occurrence of these events in the general population. To address these gaps, we turned to a special sample of alcohol- and

tobacco-using young adults in Taiwan that was recruited via social network (Ting *et al.*, 2015). By means of respondent-driven sampling (RDS) (Heckathorn, 2002), the sample consisted of people with much increased risk of using illicit drug as well as risky sexual practices that typically could not be accessed through traditional survey. Based on this RDS sample, this study aims (1) to examine the associations between early sexual initiation and four risky sexual practices (multiple sexual partners, casual sex, group sex, and inconsistent condom use, respectively); (2) to explore whether the associations between early sexual initiation and each of the risky sexual practices were mediated through drugs before sex using a causal mediation analysis.

## 2. METHODS

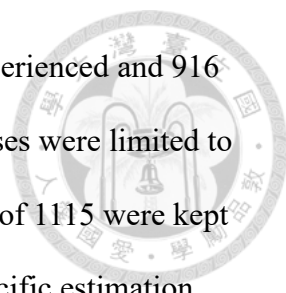


### 2.1 Sample

Participants of this study were recruited via RDS in the Taipei metropolitan area from 2007 to 2010. The data collection spanned four years due to annual funding limits and the data collected were pooled into a single dataset. Details of this RDS recruitment have been described elsewhere (Ting *et al.*, 2015). Briefly, two sampling criteria were set for the seeds and the recruiters of this RDS recruitment: participants should be (a) permanent residents aged 18 to 50 living in the Taipei metropolitan area (loosely defined as the area covering the capital city and the neighboring major cities in northern Taiwan); and (b) regular alcohol and tobacco users.

We recruited 47 seeds from a variety of sources. These included web forum users who shared information on nightlife and drinking activities, college students whose nightlife affected school performance and were referred by college counselors, substance misuse patients referred by physicians at rehabilitation centers, and personal connections known to the research team. Seeds and eligible participants could invite up to six peers who satisfied the sampling criteria to participate in the study. Our field experience during the pilot phase showed that this amount of peers allowed for each participant to recruit would provide the efficiency needed in this study.

Similar to the majority of other RDS studies, a double-incentive system was adopted in this study to encourage participation and recruitment by participants. Participants were compensated with NTD 300 (around USD 10) worth of convenience store vouchers for joining the study, and were further rewarded NTD 100 worth of vouchers for every peer they successfully recruited into the study. Participants were informed the nature of the study and were guaranteed confidentiality prior to the survey.

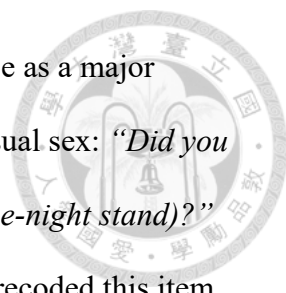


The total sample size was 1115, among whom 919 were sexually experienced and 916 of them had information on their age at first sex. Although our analyses were limited to those 916 individuals with sexual initiation data, the original sample of 1115 were kept in the process in order to derive complete referral chains in RDS-specific estimation, i.e., denoted as missing in the outcome variables. The institutional review board of the College of Public Health, National Taiwan University approved the study.

## 2.2 Measures

Participants completed the study survey through an audio computer-assisted self-interview (ACASI) implemented on notebook computers. To balance the assurance of anonymity in their participation in this study and the research team's communication on the recruitment process, all recruits were asked nicknames and mobile phone numbers of their recruiters and their relationships to verify and subsequently delineate their network structures. We were able to use this information to match recruits with their recruiters efficiently, similar to the use of coupons in the RDS literature but without compromising privacy. In addition, we asked all participants to estimate their number of peers in who satisfied the two sampling criteria, as in other RDS studies, for the purpose of weighting in RDS estimation.

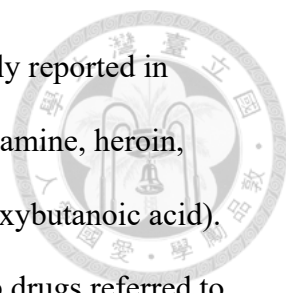
The questionnaire used in the ACASI included items on demographic characteristics (gender, age, highest education completed, and current employment status), sexual experience, and substance use, among others. The items on sexual behaviors include: (1) Past engagement and the age at first engagement in vaginal sex, anal sex, and oral sex, respectively. If the age reported for any one type of sexual behaviors was lower than 16, we categorized the respondent as an early sexual initiator. (2) Number of lifetime sexual partners measured in categorical form (*1, 2-3, 4-5, 6-7, 8-10, 11-14, 15 or above*). Based on this item, we created a variable "multiple sexual



partner” to reflect participants who had  $\geq 8$  partners in lifetime for use as a major outcome variable in subsequent analyses. (3) Past involvement in casual sex: “*Did you ever had sex with acquaintances, unfamiliar people, or strangers (one-night stand)?*” (never, once, 2-3 times, 4-5 times, 6-9 times, 10 times or above). We recoded this item into a binary variable to reflect any experience in casual sex for use as a major outcome variable in subsequent analyses. (4) Group sex: “*Did you ever have sex with two or more people at the same time or in a row (gang bang)?*” (never, once, 2-3 times, 4-5 times, 6-9 times, 10 times or above). We recoded this item into a binary variable to reflect any experience in group sex as a major outcome variable in subsequent analyses. (5) Condom use: “*In general, what is your frequency of using condoms throughout sex?*” (always, often, sometimes, seldom, never). We created a binary variable “inconsistent condom use” to reflect condom use frequency of sometimes or below as a major outcome variable in subsequent analyses. (6) Drugs before sex: “*The number of times you used drugs before sex?*” (never, once, 2-3 times, 4-5 times, 6-9 times, 10 times or above). This item was not presented if the respondent reported no lifetime use of any of the drugs listed in the study survey. We recoded this item into a binary variable to reflect any experience in drugs before sex in subsequent analyses. (7)

Homosexual/bisexual experience: “*What gender(s) of people have you had sex with so far?*” (male, female, both genders). We recoded the item based on the respondent’s gender and their response to this question to reflect homosexual/bisexual experience.

The items on substance use include: (1) Binge drinking: “*When you drink alcohol, how often do you drink 5 or more “alcohol units” in a row?*” (every time, almost every time, sometimes, once in a while, just once). This item was accompanied by pictures and text to explain the amount of one alcohol unit. We recoded the item in a binary variable by collapsing every time and almost every time into one category to reflect a general



tendency of binge drinking. (2) Illicit drugs including those commonly reported in previous studies in Taiwan: ketamine, ecstasy, cannabis, methamphetamine, heroin, FM2 (flunitrazepam), angel dust (phencyclidine), and GHB (4-hydroxybutanoic acid). Hard drugs here referred to methamphetamine and heroin, while club drugs referred to the rest of drugs listed above. Since hard drug and club drug users had different demographic and sexual partnership profiles (Chen *et al.*, 2017), we distinguished them using two additional variables. First, we created a variable “hard drug use” to represent participants who ever used hard drugs, regardless of involvement with other types of illicit drugs. Second, we also created a variable “exclusively club drug use” to represent participants who only used club drugs but not hard drugs. The two variables together represented all illicit drug users in this survey.

### **2.3 RDS-based prevalence estimation**

We computed RDS-weighted prevalence estimates using RDS Analysis Tool (RDSAT) version 7.1 (Volz *et al.*, 2012), the software developed by the original RDS authors. The 95% confidence intervals (CIs) were estimated with 15,000 bootstrap resamples following the recommendation of the software. Other estimation options remained default.

To examine the association of early sexual initiation with a variety of risky sexual practice in this RDS-derived sample, the analysis incorporated the recruitment patterns of this RDS by sampling weights. Currently, there is no best option for researchers to weigh an RDS sample for regression analysis, but one recommendation was to apply sampling weight of the dependent variable (i.e., risky sexual practice in this study, including multiple sexual partners, casual sex, group sex, and inconsistent condom use) to the regression model concerned (Wejnert & Heckathorn, 2011).



## 2.4 Weighted logistic regression analysis

Using the weights in the RDS network output by RDSAT, we built multivariable logistic models to regress each risky sexual practice on early sexual initiation while adjusting for age, educational attainment below college, and homosexual/bisexual experience. To examine whether gender would moderate early sexual initiation, we included an interaction between gender and early sexual initiation in each of the logistic regression models tested. Logistic regression analyses were done using Stata 14.0 (StataCorp, 2015).

## 2.5 Mediation analysis

We carried out mediation analysis following the formulation by Valeri and VanderWeele (2013) with a user-written package that was run in Stata 14.0 (Emsley & Liu, 2013). This package automates the whole analysis with a brief syntax and requires users to specify the outcome variable, the exposure variable, the mediating variable, covariates, what type of the link function to be used for the outcome regression model (i.e., both the exposure variable and the mediating variable predicting the outcome variable), what type of the link function to be used for the mediator regression model (i.e., the exposure variable predicting the mediating variable), and whether interaction is allowed for between the exposure and the mediating variable. Following the suggestion by VanderWeele (2016), Poisson regression was used as the outcome regression models for multiple sexual partners, casual sex, and inconsistent condom use because these outcomes were not rare (prevalence above 10%), while logistic regression was used as the outcome regression model for group sex (prevalence below 10%). When Poisson regression was used, the direct, indirect, and total effect estimated by the mediation analysis would be interpreted as risk ratio, rather than odds ratio when logistic regression was used. In addition, we did not allow for interaction between exposure and

mediating variable as their interaction was non-significant in all four outcome regression models. Without the interaction, the direct effect needs not be differentiated into controlled direct effect and natural direct effect (Valeri & VanderWeele, 2013). A total of 1000 bootstraps were implemented to obtain 95% confidence intervals in this study.

Four risky sexual practice outcomes were tested respectively with early sexual initiation as the exposure and drugs before sex as the mediator. We obtained the direct effect (effect of exposure on outcome) and indirect effect (effect of exposure on outcome that operated through mediator) while controlling for gender, age, participant's highest educational attainment, and homosexual/bisexual experience. The proportion of indirect effect out of total effect in each of the mediation models was obtained by dividing the natural log of indirect effect by the natural log of the total effect. Although interaction terms were included in our multivariable logistic regression analysis, these were not included in our mediation analysis to limit the complexity of models after considering our sample size.

### 3. RESULTS



In this sample of 916 alcohol- and tobacco-using young adults recruited in the Taipei metropolitan area, 109 (a weighted prevalence of 9.3%, 95% CI: 6.9-12.1) were early sexual initiators. The proportion of early sexual initiators among males (79 out of 578, 11.0%, 95% CI: 7.8-14.8) was higher than that among females (30 out of 338, 6.9%, 95% CI: 3.7-11.3).

As displayed in Table 1, participants with early sexual initiation had a much higher proportion of males (68.3%) than those with non-early sexual initiation (56.3%, with a 95% CI not including 68.3%). Hence, the remaining Table 1 displays the sociodemographic characteristics of the participants separately for males and females. Male early sexual initiators had similar age as male non-early sexual initiators. Judging from whether the point estimate of one group fell in the 95% CI of the other group, male early sexual initiators had lower educational attainment and higher proportion of being unemployed than male non-early sexual initiators. Meanwhile, female early sexual initiators had a younger median age, lower educational attainment, and higher proportion of being work-study/in school than female non-early sexual initiators.

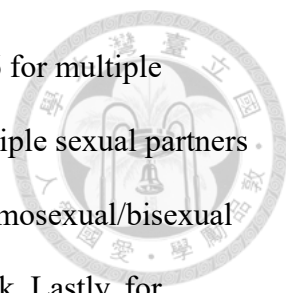
The weighted prevalence of individual risky sexual practices in this sample was 17.9% for multiple sexual partners ( $n = 194$ ; 95% CI: 14.8-22.2), 36.1% for casual sex ( $n = 334$ ; 95% CI: 31.5-41.0), 7.0% for group sex ( $n = 75$ ; 95% CI: 4.9-9.4), and 47.3% for inconsistent condom use ( $n = 413$ ; 95% CI: 41.9-52.5). Individuals with early sexual initiation had higher weighted prevalence than those with non-early sexual initiation across all four types of risky sexual practices, with the point estimate of one group not covered by the 95% CI of the other group (Figure 1). There were inter-correlations among these four risky sexual practices, with the tetra-choric correlation being 0.75 ( $P$

< 0.001) between multiple sexual partners and casual sex, 0.65 ( $P < 0.001$ ) between multiple sexual partners and group sex, 0.68 ( $P < 0.001$ ) between causal sex and group sex, and no correlation between inconsistent condom use and all the other three risky sexual practices.

Table 2 displays sexual history for male and female participants, respectively. For males, judging from their 95% CIs, early sexual initiators were more likely to have multiple sexual partners, casual sex, group sex, inconsistent condom use, drugs before sex, and homosexual/bisexual experience than non-early sexual initiators. For females, early sexual initiators were similarly more likely to have multiple sexual partners, casual sex, group sex, and inconsistent condom use than non-early sexual initiators, but not more likely to have drugs before sex and homosexual/bisexual experience.

In terms of substance use (Table 3), for males, early sexual initiators were more likely to report binge drinking and to have ever used illicit drugs (individual drugs, hard drugs, and exclusively club drugs) than non-early sexual initiators. For females, early sexual initiators were more likely to report binge drinking and to have ever used ketamine and exclusively club drug use than non-early sexual initiators. However, due to small sample size of the female early sexual initiation group ( $n = 30$ ), the number of users for ecstasy, cannabis, FM2/angel dusts/GHB, methamphetamine, heroin, and hard drug use were too small to allow for meaningful comparisons.

The results of weighted multivariable logistic regression for four risky sexual practice outcomes are displayed in Table 4. First, for multiple sexual partners, being older, male, having homosexual/bisexual experience and early sexual initiation were associated with a greater risk. Second, for casual sex, being male and having early sexual initiation were associated with a greater risk. Moreover, the interaction between gender and early sexual initiation was significant for multiple sexual partners and casual



sex, i.e., the corresponding odds ratios were greater for females (6.96 for multiple sexual partners and 9.91 for casual sex) than for males (1.53 for multiple sexual partners and 1.49 for casual sex). Third, for group sex, being male, having homosexual/bisexual experience and early sexual initiation were associated with higher risk. Lastly, for inconsistent condom use, having educational attainment below college was associated with higher risk, while being male was associated with lower risk.

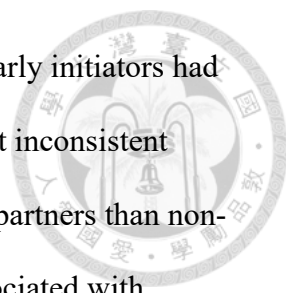
To examine whether the four risky sexual practice outcomes were mediated through drugs before sex in this sample, a series of causal mediation analyses was conducted (Table 5). The direct effects, indirect effects, and total effects were significant for three of the risky sexual practices tested, including multiple sexual partners, casual sex, and group sex. The percentages of indirect effect out of total effect on a log scale ranged from around 17% (multiple sexual partners) to 22% (casual sex), with a higher percentage implying that more of the total effect was mediated by drugs before sex.

#### 4. DISCUSSION



Among this RDS-recruited sample of alcohol- and tobacco-using young adults (aged 18-50) in the Taipei metropolitan area, around 9% were early sexual initiators and the prevalence was higher among males (11%) than females (7%). The four risky sexual practices ranged from relatively uncommon (7% for group sex) to relatively common (47% for inconsistent condom use). Compared with non-early sexual initiators, the prevalence of these practices was higher among early sexual initiators. After controlling for potential confounders, multivariable logistic regression analyses revealed that early sexual initiation was associated with higher risks of multiple sexual partners, casual sex, and group sex, in which gender moderated the associations of early sexual initiation with multiple sexual partners and casual sex. Furthermore, our mediation analyses found that drugs before sex was a significant mediator for these risky sexual practices, with the proportions mediated ranging from 17% to 22%. These findings imply that the promotion of informed decisions on sexual initiation and safe sex practices targeting substance-using young people is important to reduce sexual health risks.

As no studies have examined the prevalence of early sexual initiation in the Taiwan general population, we compared our prevalence with a representative study of 10th grade students in Taiwan, among whom the majority had no sexual experience (Chan *et al.*, 2015). After including those without sexual experience in our RDS sample in calculation, the prevalence of early sexual initiation was higher in our sample (8.9% for males and 5.5% for females) than in the student sample (3.3% for male and 3.1% for female students). The higher proportion of early sexual initiation in our alcohol- and tobacco-using participants is compatible with the prediction of Problem Behavior Theory (Jessor & Jessor, 1977).

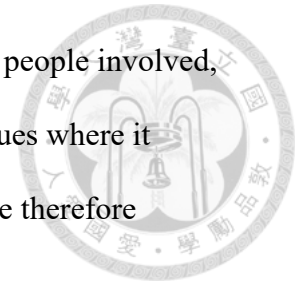


Among the four risky sexual practices examined in this study, early initiators had higher likelihood than non-early initiators to be involved in all except inconsistent condom use. First, early initiators were more likely to switch sexual partners than non-early initiators. Indeed, we found that early sexual initiation was associated with multiple sexual partners, an observation consistent with previous studies (Ma *et al.*, 2009; Heywood *et al.*, 2015; Kugler *et al.*, 2017). In addition, as early sexual initiation was associated with engagement in casual sex, early initiators seemed to be less committed in sexual relationships. This finding is consistent with a previous study (Ma *et al.*, 2009).

Moreover, through the moderation effects, we observed the strengths of associations between early sexual initiation and these two risky sexual practices (multiple sexual partners and casual sex) were different for the two genders. Regarding marginal effects of male gender on these two risky sexual practices, it is easy to attribute them to a sexual double standard - unequal acceptance of liberal sexual practices that traditionally favors males (Crawford & Popp, 2003; Bordini & Sperb, 2012). However, our results indicated that females who had early sexual initiation emerged as a particularly liberal group, with odds ratios of being involved in these risky sexual practices over those with non-early sexual initiation even greater than the male counterparts.

Regarding the experience of group sex, it is noteworthy that two thirds of our participants with group sex experience were presumably heterosexual (only had heterosexual sexual experience in life), which seems to exceed the expectation given the conservative East Asian collective culture (Chiao & Yi, 2012; Rodríguez-Arauz *et al.*, 2013; Van de Bongardt *et al.*, 2015). To date, heterosexual group sex has received relatively little investigation in the literature (Thompson & Byers, 2017). Group sex in

practice can take diverse forms as well, depending on the number of people involved, their relationships, the gender(s) of the people involved, and the venues where it happens. Future studies using more specific measure of group sex are therefore warranted.

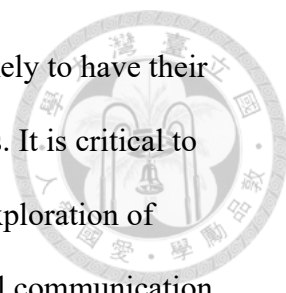


Surprisingly, early sexual initiation was not associated with inconsistent condom use. In fact, inconsistent condom use was common (prevalence 47.3%) in the whole study sample. Meanwhile, findings from the literature were inconsistent. One study found that early sexual initiation was associated with inconsistent condom use (Ma *et al.*, 2009), while another study found only a very small correlation ( $r = 0.06$ ) among women between early sexual initiation and negative condom attitudes (Sandfort *et al.*, 2008). Future studies to utilize more specific measures that differentiate condom use with regular partners from that with casual partners are needed to address the inconsistent condom use in this population.

Our mediation analyses further explored drugs before sex as a possible mechanism behind the associations between early sexual initiation and risky sexual practices. Drugs before sex best explained the relationship between early sexual initiation with casual sex. We speculate that a common venue for casual sex includes nightlife settings, where attendees might have opportunities to “get high” and solicit uncommitted sexual partners. Meanwhile, multiple sexual partners and group sex had relatively smaller proportions explained by drugs before sex. Both of these measures were less specific about the settings under which sex might take place and also could not specify whether regular or uncommitted partners were involved. A mix of these factors might have contributed to a lower explanatory power of drugs before sex.

The current findings have implications for enhancing sexual health of alcohol- and tobacco-using young adults. First, timely sexual health intervention should be tailored





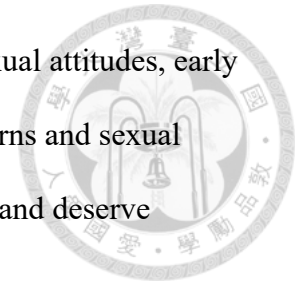
for this population (particularly among females), as they are more likely to have their first sex at a rather young age and to involve in risky sexual practices. It is critical to help them establish a healthy partnering pattern during their initial exploration of sexuality, one characterized by safe sex practices and effective sexual communication.

Second, public sexual health education should incorporate illicit drug use as an additional theme for the substance-using population. Drug use before sex can undermine the capacity to use protection and to refrain from unwanted sexual solicitation. In particular, as early initiators were likely to have casual sex, it is critical to inform them the potential sexual health risks brought by drugs before sex. An integrated educational effort that promote sexual health and discourage illicit drug use can be cost-effective as well, as illicit drug use was substantially more common among our study population (around 20%) (Ting *et al.*, 2015) than the general population (around 1%) (Chen *et al.*, 2017).

There are limitations in this study. First, we were not able to determine if illicit drugs were used before a particular instance of risky sexual practice, as both were only measured as lifetime experiences. The mediation effects were likely to be overestimated and should be interpreted as preliminary findings. Second, prescription drugs before sex might be misclassified as illicit drugs before sex as the questionnaire item only asked “drugs before sex” but did not specify illicit drugs. Nevertheless, this issue was minimized by recoding participants with no lifetime illicit drug use to be null in the drugs before sex variable. Third, causal mediation analysis requires assumptions of no unmeasured confounding. This is difficult to achieve with our data but we have included all relevant variables as potential confounders in the mediation models.

In sum, our study presented valuable evidence to demonstrate that early sexual initiation was consistently linked with various risky sexual practices in an East Asian

context. Under a traditionally conservative culture with evolving sexual attitudes, early sexual initiation has important implications on sexual behavior patterns and sexual health. In particular, the young substance-using population is at risk and deserve additional public health attention.



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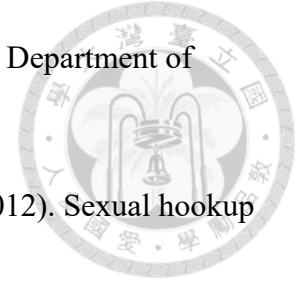
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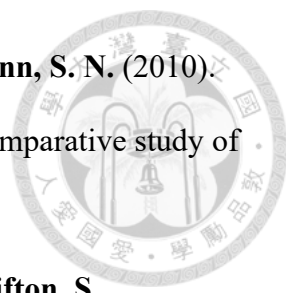
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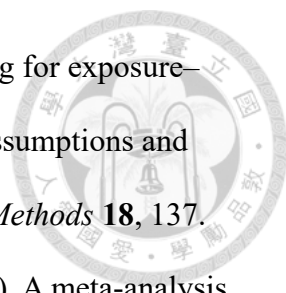
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**TABLES**



Table 1. Demographic characteristics of sexually experienced alcohol- and tobacco-using young adults in Taiwan recruited using RDS during 2007-2010, by gender and sexual initiation (*N* = 916)

	Non-early sexual initiation			Early sexual initiation			
	<i>N</i>	% <sub>wt</sub>	95% CI	<i>N</i>	% <sub>wt</sub>	95% CI	
<i>Total</i>		<i>N</i> = 807			<i>N</i> = 109		
<b>Gender</b>							
Male	499	56.3	(50.2-63.0)	79	68.3	(54.2-81.4)	
Female	308	43.7	(36.9-49.7)	30	31.7	(18.6-45.9)	
<i>Males</i>		<i>N</i> = 499			<i>N</i> = 79		
Age (in years), median (IQR) <sup>a</sup>	499	26.0	(23.0-33.0)	79	26.0	(22.0-32.0)	
Education level < college	291	59.9	(52.2-67.1)	62	83.5	(73.2 -92.5)	
<b>Employment</b>							
Full-time job	294	54.4	(46.9-62.4)	39	37.7	(22.7-53.1)	
Unemployed	26	7.9	(4.2-12.4)	16	23.0	(11.1-38.2)	
Work-study/in school	153	32.1	(24.8-39.3)	16	26.9	(12.2-45.5)	
Part-time job/military	26	5.5	(2.9-8.6)	8	12.4	(2.5-21.6)	
<i>Females</i>		<i>N</i> = 308			<i>N</i> = 30		
Age (in years), median (IQR) <sup>a</sup>	308	28.0	(23.0-34.0)	30	22.5	(20.0-26.0)	
Education level < college	202	75.5	(67.4-81.9)	25	88.6	(72.7-99.1)	
<b>Employment</b>							
Full-time job	204	67.7	(55.2-75.0)	17	49.9	(25.8-79.4)	
Unemployed	25	11.6	(6.6-23.7)	1	0.3	(0.0-4.5)	
Work-study/in school	72	16.0	(10.0-22.2)	10	43.9	(16.3-70.3)	
Part-time job/military	7	4.6	(1.2-8.6)	2	6.0	(0.0-19.1)	

<sup>a</sup>This estimate was unweighted due to limitation of RDS Analyst

Table 2. Sexual history among alcohol- and tobacco-using young adults in Taiwan recruited using RDS, by gender and sexual initiation ( $N = 916$ )

	Non-early sexual initiation			Early sexual initiation		
	<i>N</i>	% <sub>wt</sub>	95% CI	<i>N</i>	% <sub>wt</sub>	95% CI
<i>Males</i>	<i>N</i> = 499			<i>N</i> = 79		
No. of sexual partners						
1-3	249	47.4	(40.2-53.4)	24	29.4	(15.5-42.9)
4-7	120	26.7	(21.2-33.3)	21	31.6	(17.6-47.6)
≥ 8	130	25.9	(20.4-32.3)	34	39.0	(24.8-54.8)
Casual sex	206	44.7	(38.1-51.1)	42	53.4	(39.0-69.7)
Group sex	42	7.0	(4.1-10.6)	16	20.9	(10.1-33.6)
Inconsistent condom use <sup>a</sup>	194	38.9	(32.0-44.8)	39	51.2	(37.3-66.7)
Drugs before sex	42	6.7	(3.4-10.1)	21	27.5	(15.1-43.2)
Homosexual/bisexual experience	47	5.4	(2.8-9.1)	12	11.5	(2.0-27.1)
<i>Females</i>	<i>N</i> = 308			<i>N</i> = 30		
No. of sexual partners						
1-3	190	65.4	(55.3-71.7)	8	25.8	(5.2-51.9)
4-7	97	30.0	(24.0-39.5)	13	54.2	(27.0-80.0)
≥ 8	21	4.6	(2.3-7.9)	9	20.0	(3.9-39.1)
Casual sex	69	18.7	(13.5-26.0)	17	72.0	(48.8-90.3)
Group sex	13	2.9	(1.3-5.2)	4	16.6	(1.0-38.9)
Inconsistent condom use <sup>a</sup>	160	56.5	(46.9-64.4)	20	76.2	(52.5-92.2)
Drugs before sex	34	11.6	(6.5-18.1)	5	14.1	(1.5-30.7)
Homosexual/bisexual experience	33	8.0	(4.1-12.5)	1	5.1	(0.0-15.8)

<sup>a</sup>Condom use frequency “sometimes”, “seldom”, or “never”

Table 3. Substance use among sexually experienced alcohol- and tobacco-using young adults in Taiwan recruited using RDS, by gender and sexual initiation ( $N = 916$ )

	Non-early sexual initiation			Early sexual initiation		
	<i>N</i>	% <sub>wt</sub>	95% CI	<i>N</i>	% <sub>wt</sub>	95% CI
<i>Males</i>		<i>N</i> = 499			<i>N</i> = 79	
Binge drinking <sup>a</sup>	115	20.5	(15.9-26.3)	31	35.2	(21.0-49.2)
Illicit drugs						
Ketamine	70	12.1	(8.6-16.9)	34	41.6	(27.5-58.7)
Ecstasy	68	13.0	(9.1-18.2)	22	25.1	(13.4-40.6)
Cannabis	74	11.5	(7.8-16.5)	23	28.3	(16.2-43.9)
FM2/angel dust/GHB	14	2.2	(0.3-4.7)	11	11.8	(3.9-22.4)
Methamphetamine	39	6.6	(3.4-10.1)	20	24.9	(12.0-38.8)
Heroin	20	3.2	(0.7-6.4)	12	10.0	(1.7-19.4)
Hard drug use <sup>b</sup>	41	7.3	(3.7-11.1)	22	26.9	(13.0-40.7)
Exclusively club drug use <sup>c</sup>	75	14.8	(10.5-20.2)	21	25.0	(13.3-39.2)
<i>Females</i>		<i>N</i> = 308			<i>N</i> = 30	
Binge drinking <sup>a</sup>	46	11.1	(6.4-16.4)	8	18.3	(0.7-38.4)
Illicit drugs						
Ketamine	41	11.8	(6.9-17.7)	11	37.9	(15.0-67.0)
Ecstasy	39	12.5	(7.1-18.8)	7	14.7	(2.3-33.4)
Cannabis	45	12.0	(7.2-18.3)	3	7.4	(0.0-21.0)
FM2/angel dust/GHB	4	1.2	(0.0-3.0)	0	0.0	---
Methamphetamine	13	5.8	(1.8-11.1)	2	5.0	(0.0-16.0)
Heroin	8	3.3	(0.1-8.5)	0	0.0	---
Hard drug use <sup>b</sup>	15	6.5	(1.6-13.2)	2	5.0	(0.0-16.3)
Exclusively club drug use <sup>c</sup>	30	5.3	(3.0-8.8)	6	20.0	(1.4-46.7)

<sup>a</sup>Five or more units of alcohol in one sitting “almost every time”

<sup>b</sup>Hard drugs: methamphetamine and heroin

<sup>c</sup>Club drugs: ketamine, ecstasy, cannabis, and FM2/angel dust/GHB



Table 4. Weighted multivariable logistic regression models of multiple sexual partners, casual sex, group sex, and inconsistent condom use on early sexual initiation among alcohol- and tobacco-using young adults in Taiwan ( $N = 916$ )

Variable	Multiple sexual partners <sup>a</sup>		Casual sex		Group sex		Inconsistent condom use <sup>b</sup>	
	aOR	95% CI	aOR	95% CI	aOR	95% CI	aOR	95% CI
Age	<b>1.05</b>	<b>(1.02-1.07)</b>	1.00	(0.98-1.02)	1.02	(0.99-1.07)	1.01	(0.98-1.05)
Education level < college	1.09	(0.64-1.84)	1.10	(0.72-1.68)	1.02	(0.48-2.14)	<b>2.35</b>	<b>(1.53-3.59)</b>
Homosexual/bisexual experience	<b>3.00</b>	<b>(1.48-6.1)</b>	1.71	(0.93-3.14)	<b>2.77</b>	<b>(1.31-5.84)</b>	1.77	(0.99-3.17)
Male	<b>7.26</b>	<b>(3.67-14.37)</b>	<b>3.46</b>	<b>(2.17-5.54)</b>	<b>3.13</b>	<b>(1.23-7.96)</b>	<b>0.54</b>	<b>(0.34-0.83)</b>
Early sexual initiation	<b>6.96</b>	<b>(2.01-24.07)</b>	<b>9.91</b>	<b>(3.54-27.76)</b>	<b>7.51</b>	<b>(1.75-32.31)</b>	2.40	(0.81-7.11)
Male × early sexual initiation	<b>0.22</b>	<b>(0.05-0.94)</b>	<b>0.15</b>	<b>(0.04-0.49)</b>	0.42	(0.07-2.38)	0.59	(0.17-2.06)

<sup>a</sup>≥ 8 lifetime sexual partners

<sup>b</sup>Condom use frequency “seldom” or “never”

Note: Results in bold were statistically significant

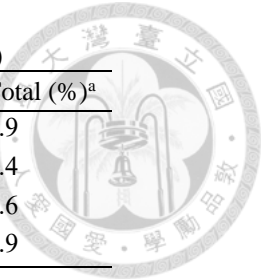


Table 5. Causal mediation analysis examining drugs before sex as a potential mediator between early sexual initiation and risky sexual practices ( $N = 916$ )

Exposure	Mediating variable	Outcome variable	Direct effect	Indirect effect	Total effect	Indirect/Total (%) <sup>a</sup>
Early sexual initiation	Drugs before sex	Multiple sexual partners	<b>1.60 (1.14-2.20)</b>	<b>1.10 (1.03-1.24)</b>	<b>1.76 (1.28-2.41)</b>	16.9
		Casual sex	<b>1.36 (1.08-1.67)</b>	<b>1.09 (1.04-1.17)</b>	<b>1.47 (1.18-1.79)</b>	22.4
		Group sex	<b>2.53 (1.23-4.63)</b>	<b>1.22 (1.05-1.62)</b>	<b>3.09 (1.54-5.57)</b>	17.6
		Inconsistent condom use	1.18 (0.97-1.42)	1.02 (0.99-1.07)	1.20 (0.99-1.44)	10.9

<sup>a</sup>Calculated on natural log-scale

Note: (1) Results in bold were statistically significant. Figures in parenthesis “( )” were bootstrap 95% confidence intervals.

(2) All models controlled for being male, age, education < college, and homosexual/bisexual experience

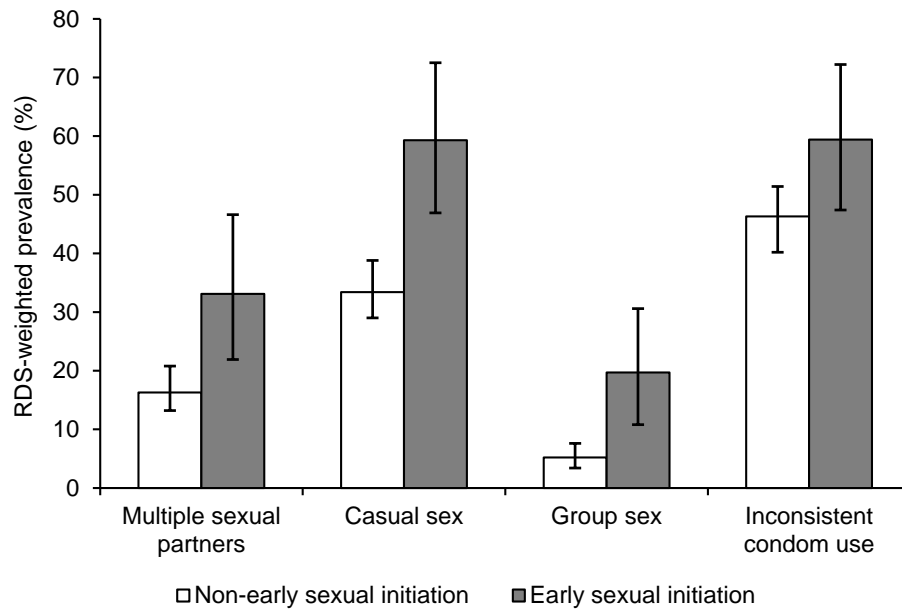
(3) Interaction between exposure variable and mediating variable was not allowed due to sample size

(4) Poisson regression was used for outcome regression model (E and M predicting Y) for multiple sexual partners, casual sex, and inconsistent condom use due to non-rare outcomes (prevalence > 10%). Logistic regression was used for group sex (prevalence < 10%)

## FIGURES



Figure 1. Prevalence of four risky sexual practices, by sexual initiation ( $N = 916$ )



APPENDIX



Panel A1. Original survey questionnaire items used in respondent-driven sampling among alcohol- and tobacco-using young adults in Taiwan (in Chinese)

基本資料：

您的生日在什麼時候？請告訴我您出生的民國年、月份、日期。	民國□□年□□月□□日		
您的性別？	1 <input type="checkbox"/> 男 2 <input type="checkbox"/> 女		
請問您父母親的教育程度為何？		父親	母親
	1 小學含以下	<input type="checkbox"/>	<input type="checkbox"/>
	2 國中	<input type="checkbox"/>	<input type="checkbox"/>
	3 高中職	<input type="checkbox"/>	<input type="checkbox"/>
	4 五專	<input type="checkbox"/>	<input type="checkbox"/>
	5 大學含以上	<input type="checkbox"/>	<input type="checkbox"/>
	6 不知道	<input type="checkbox"/>	<input type="checkbox"/>
您目前與誰同住？	1 <input type="checkbox"/> 父母 2 <input type="checkbox"/> 親戚 3 <input type="checkbox"/> 朋友 4 <input type="checkbox"/> 獨居 5 <input type="checkbox"/> 先生/妻子 6 <input type="checkbox"/> 男/女朋友 7 <input type="checkbox"/> 其他_____		
您完成的最高學歷為？	1 <input type="checkbox"/> 小學含以下 2 <input type="checkbox"/> 國中 3 <input type="checkbox"/> 高中職 4 <input type="checkbox"/> 五專 5 <input type="checkbox"/> 大學含以上		
您目前是否有就學或就業？	1 <input type="checkbox"/> 就學 – 跳至 7 2 <input type="checkbox"/> 就業 3 <input type="checkbox"/> 打工 4 <input type="checkbox"/> 半工半讀 5 <input type="checkbox"/> 服役 6 <input type="checkbox"/> 兩者皆無 – 跳至 7		

性行為：

您是否曾經發生過性行為？	陰道性交：1 <input type="checkbox"/> 是 2 <input type="checkbox"/> 否
	肛交：1 <input type="checkbox"/> 是 2 <input type="checkbox"/> 否
	口交：1 <input type="checkbox"/> 是



	2 <input type="checkbox"/> 否 若全部皆否，則結束此部分
您第一次發生性行為是幾歲時？	陰道性交：_____ 歲 肛交：_____ 歲 口交：_____ 歲
您第一次發生性行為時你的性伴侶是幾歲？（包括陰道性交、肛交及口交）	_____ 歲
到目前為止，與您發生過性行為的人的性別為何？	1 <input type="checkbox"/> 男性 2 <input type="checkbox"/> 女性 3 <input type="checkbox"/> 男女皆有
到目前為止，與您發生過性行為的人數有？	1 <input type="checkbox"/> 1 人 2 <input type="checkbox"/> 2-3 人 3 <input type="checkbox"/> 4-5 人 4 <input type="checkbox"/> 6-7 人 5 <input type="checkbox"/> 8-10 人 6 <input type="checkbox"/> 11-14 人 7 <input type="checkbox"/> 15 人以上
您是否曾經在同一時間或連續時間內與二人以上發生性行為(多 P、雜交)？	1 <input type="checkbox"/> 從來沒有 2 <input type="checkbox"/> 1 次 3 <input type="checkbox"/> 2-3 次 4 <input type="checkbox"/> 4-5 次 5 <input type="checkbox"/> 6-9 次 6 <input type="checkbox"/> 10 次以上
您是否曾經與認識不久、不熟識或者陌生人發生性行為(一夜情)？	1 <input type="checkbox"/> 從來沒有 2 <input type="checkbox"/> 1 次 3 <input type="checkbox"/> 2-3 次 4 <input type="checkbox"/> 4-5 次 5 <input type="checkbox"/> 6-9 次 6 <input type="checkbox"/> 10 次以上
您在發生性行為前有使用藥物的次數？	1 <input type="checkbox"/> 從來沒有 2 <input type="checkbox"/> 1 次 3 <input type="checkbox"/> 2-3 次 4 <input type="checkbox"/> 4-5 次 5 <input type="checkbox"/> 6-9 次 6 <input type="checkbox"/> 10 次以上
您在發生性行為前有飲酒的次數？	1 <input type="checkbox"/> 從來沒有 2 <input type="checkbox"/> 1 次 3 <input type="checkbox"/> 2-3 次 4 <input type="checkbox"/> 4-5 次 5 <input type="checkbox"/> 6-9 次 6 <input type="checkbox"/> 10 次以上
一般來說，您在發生性行為時全程使用保險套的頻率為？	1 <input type="checkbox"/> 每一次 - 跳至 101 2 <input type="checkbox"/> 經常 3 <input type="checkbox"/> 有時候

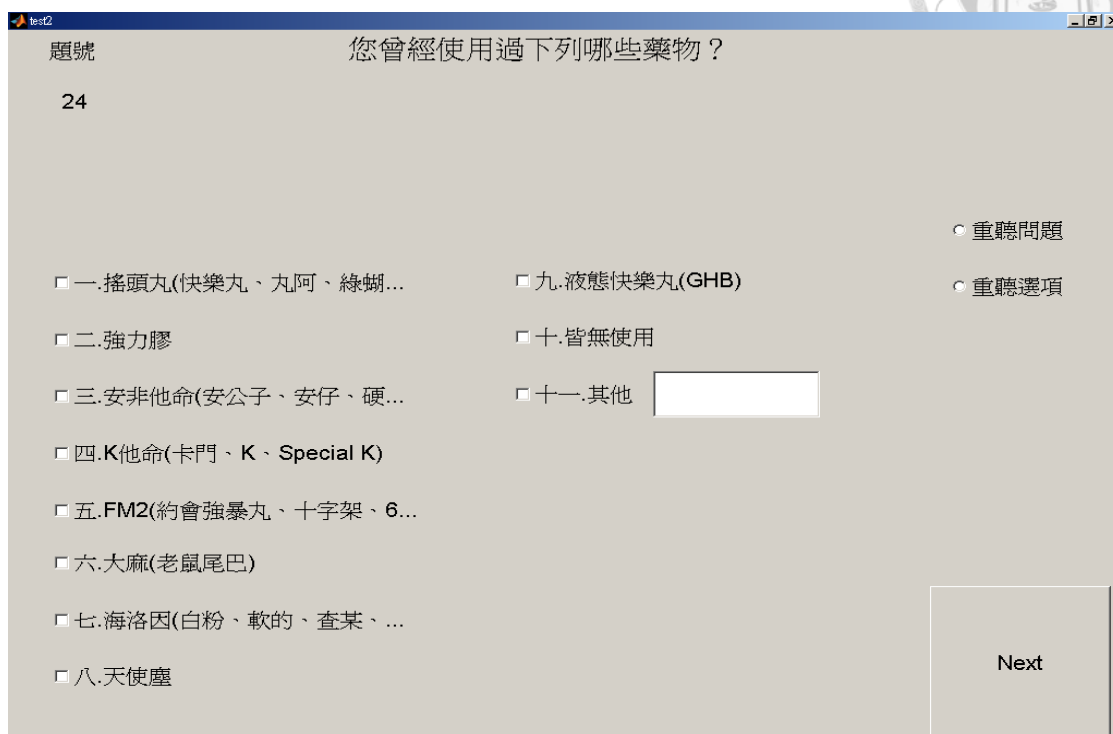


	4 <input type="checkbox"/> 很少 5 <input type="checkbox"/> 從來沒有
--	--

**物質使用：**

<p>當下列問題使用「飲酒單位」這個詞的時候，請先將您飲用的酒種及飲用量換算為我們所稱的「飲酒單位」，換算方式如下：</p> <p>1「飲酒單位」指：飲用酒精含量為5%的酒360c.c.。大約是1罐鋁罐裝的啤酒或半瓶0.6~0.7公升裝瓶裝的啤酒。</p> <p>飲用酒精含量為12%的酒150c.c.。大約是1杯高腳杯7分滿的梅酒、葡萄酒或紅酒。</p> <p>飲用酒精含量為40%的酒45c.c.。大約是45c.c.的威士忌、伏特加、琴酒或白蘭地。</p>	
<p>您是否曾經在一次的飲酒行為中，連續飲用5個或超過5個「飲酒單位」的酒？</p>	<p>1 <input type="checkbox"/> 是 2 <input type="checkbox"/> 否 - 跳至香菸使用部分</p>
<p>在您喝酒的時候，連續飲用5個或超過5個「飲酒單位」的酒的頻率為何？</p>	<p>1 <input type="checkbox"/> 每一次 2 <input type="checkbox"/> 幾乎每次 3 <input type="checkbox"/> 有時候 4 <input type="checkbox"/> 偶爾幾次 5 <input type="checkbox"/> 只有一次</p>
<p>您曾經使用過下列哪些藥物？（可複選）</p>	<p>1 <input type="checkbox"/> 搖頭丸（快樂丸、丸阿、綠蝴蝶、亞當、狂喜、忘我、ecstasy） 2 <input type="checkbox"/> 強力膠 3 <input type="checkbox"/> 安非他命（安公子、安仔、硬的、冰糖、冰塊、鹽、speed、查普） 4 <input type="checkbox"/> K他命（卡門、K、Special K） 5 <input type="checkbox"/> FM2（約會強暴丸、十字架、615、815） 6 <input type="checkbox"/> 大麻（老鼠尾巴） 7 <input type="checkbox"/> 海洛因（白粉、軟的、查某、四號）、嗎啡 8 <input type="checkbox"/> 天使塵 9 <input type="checkbox"/> 液態快樂丸(GHB) 10 <input type="checkbox"/> 鎮靜劑、安眠藥(非醫生處方) 11 <input type="checkbox"/> 減肥藥(非醫生處方) 12 <input type="checkbox"/> 類固醇(非醫生處方) 13 <input type="checkbox"/> 其他_____</p>
	<p>14 <input type="checkbox"/> 皆無使用</p>

Figure A1. Interface of the audio-computer assisted self-interview (ACASI) questionnaire used in respondent-driven sampling among alcohol- and tobacco-using young adults in Taiwan



The screenshot shows a software window titled 'test2' with a question in Chinese: '您曾經使用過下列哪些藥物?' (Have you ever used any of the following drugs?). The question number '24' is displayed in the top left. The list of substances includes: 一.搖頭丸(快樂丸、丸阿、綠蠟...), 二.強力膠, 三.安非他命(安公子、安仔、硬...), 四.K他命(卡門、K、Special K), 五.FM2(約會強暴丸、十字架、6...), 六.大麻(老鼠尾巴), 七.海洛因(白粉、軟的、查某、...), 八.天使塵, 九.液態快樂丸(GHB), 十.皆無使用, and 十一.其他 (with an adjacent text input field). On the right side, there are two radio buttons labeled '重聽問題' and '重聽選項'. A 'Next' button is located in the bottom right corner.