



## Short Communication

# Adolescent Internet use and its relationship to cigarette smoking and alcohol use: A prospective cohort study

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## HIGHLIGHTS

- Explores the longitudinal impact of adolescent Internet use.
- Social Learning Theory guides predictions of cigarette smoking and alcohol use.
- The more time spent on the Internet, the greater the odds of future alcohol use.
- Teen girls who use an Internet café are more likely to begin smoking and drinking.
- Internet searches for non-school uses increase the odds of smoking initiation.

## ARTICLE INFO

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## ABSTRACT

The present study aims to investigate the longitudinal impact of situational Internet use on future cigarette smoking and alcohol use among male and female adolescents. A Northern Taiwanese cohort sample of adolescents with no prior use of cigarettes ( $n = 1445$ ) or alcohol ( $n = 1468$ ) was surveyed at age 16 and again 4 years later. Information regarding where, why, and length of time spent using the Internet was gathered from the 16-year-old participants. Outcome information regarding cigarette/alcohol use was gathered via a follow-up questionnaire at age 20. Multivariate regressions were used to incorporate peer, individual and family characteristics as measured at age 16 and create models of future cigarette and alcohol use at age 20. The analyses demonstrated that adolescent Internet use, particularly *where* such use took place, has a significant impact on future cigarette smoking and alcohol use, adjusted for conventional factors, and its relationship differs significantly by gender. Female adolescents with Internet café use appear to be especially likely to develop these two risky behaviors. The *why* of Internet use is also a predictor of future cigarette smoking. Finally, *time spent* using the Internet is significantly related to alcohol use; greater use of the Internet is associated with higher levels of drinking. The results revealed that different risky behaviors are differentially influenced by separate components of adolescent Internet use. These findings suggest that programs aimed at promoting adolescent health could potentially benefit Taiwanese adolescents by including components related to situational Internet use and taking gender into consideration.

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## 1. Introduction

## 1.1. Adolescent smoking and drinking

Cigarette smoking and alcohol misuse are associated with an increased likelihood of subsequent mental and physical health problems to some degree (Jessor, 1991; Newcomb & Bentler, 1998; Pickett et al., 2006; Simpson, Janssen, Boyce, & Pickett, 2006) and these two risky behaviors contribute 8.7% and 3.8% to global deaths, respectively (WHO, 2009). Despite international efforts for tobacco control and alcohol

misuse prevention over the past few decades, cigarette smoking and alcohol use in adolescents are even more prevalent in East Asian countries such as Taiwan (Bureau of Health Promotion, 2010).

## 1.2. Adolescent Internet use and smoking/drinking behaviors

Over the years, research on cigarette smoking and alcohol use in adolescents has often focused on their relationship to three groups: adolescents, peers, and families (Jessor, 1991; Jessor & Jessor, 1977). Emerging studies have begun to underscore media exposure as an important contributing factor leading to an increased likelihood of risky behaviors such as smoking and drinking at adolescence (Baranowski, Cheryl, & Guy, 2002; Fischer, Greitemeyer, Kastenmüller, & Vogrincic, 2011). Given Internet access has increased from 28% to 70% over the

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past decade for Taiwanese adolescents, social cognitive theory would suggest adolescents' use of electronic media might serve as a frequent channel to observe, learn about and imitate risky behaviors like cigarette smoking and alcohol use (Bandura, 2004; Fischer et al., 2011). Research findings show that greater time spent on the Internet contributed to both problematic Internet use (Liu, Desai, Krishnan-Sarin, Cavallo, & Potenza, 2011) and higher likelihoods of cigarette (Carson, Pickett, & Janssen, 2011; Huang et al., 2012) and alcohol use (Denniston, Swahn, Hertz, & Romero, 2011; Epstein, 2011). These studies, however, do not establish whether Internet use actually influences adolescent smoking and drinking. Answering this question needs either experimental studies, which are not possible for ethical reasons, or longitudinal studies with the relevant adolescent population.

### 1.3. Study aims

The purpose of this study is to assess the temporal association between adolescent Internet use and subsequent cigarette and alcohol use in later adolescence via a cohort sample. According to the aforementioned theoretical assumption, we investigate Internet use measured by *where*, *why*, and *length of time spent* using the Internet in mid-adolescence and its relationship to future cigarette smoking and alcohol use. Given the distinct pattern of cigarette smoking and alcohol use in a particular social context such as Taiwan, we hypothesize that the type of adolescent Internet use may well be associated with these two behavioral outcomes. Furthermore, this study investigates the extent to which gender differences are observed in the relationship between Internet use and future cigarette/alcohol behaviors in adolescents (Byrnes, Miller, & Schaefer, 1999; Fischer et al., 2011), even after controlling for biological, peer, individual and family characteristics at earlier ages as proposed in the bio-psycho-social frameworks (Bandura, 2004; Jessor, 1991; Jessor & Jessor, 1977; Udry, 1988). Since the majority of cigarette- and alcohol-related risky behaviors in Taiwan occur in adolescents between 18 and 20 years of age (Cheng, Wen, Tsai, & Tsai, 2002), the present longitudinal study focuses on adolescents between the ages of 16 and 20.

## 2. Materials and methods

### 2.1. Participants

This study utilized data from the Taiwan Youth Project (TYP). The TYP datasets are publicly available and can be downloaded from the Taiwan Academia Sinica website: [www.typ.sinica.edu.tw](http://www.typ.sinica.edu.tw). The five waves of TYP data over the period of 4 years (2000–2004) provided longitudinal data on the academic, peer, and behavioral well-being of a large sample of adolescents who were 16 years of age in 2000. Our analytical samples included Internet users at age 16 (10th graders). This adolescent sample consisted of 1445 individuals who did not have prior cigarette smoking experience and 1468 who did not report prior alcohol use. This cohort was followed through its high school years and assessed again in 2004. The study protocol was approved by the Ethical Committee of Taiwan Academia Sinica.

### 2.2. Measures

#### 2.2.1. Cigarette smoking and alcohol use

Cigarette smoking and alcohol use were assessed by whether 20-year-old youth self-reported cigarette and/or alcohol use. Smoking and cigarette smoking information was obtained directly from the TYP questionnaire items, "Have you smoked [cigarettes] in the past week?" and, "Have you drunk [alcohol] in the past month?" Respondents were dichotomized as "smokers" and "non-smokers." For the alcohol use item, students were categorized into one of three groups: "abstainer" (no alcohol use), "light drinker" (1–2 times per month) and "heavy drinker" (3+ times per month) (Chiao, Yi, & Ksobiech, 2012).

#### 2.2.2. Adolescent Internet use

Adolescent Internet use was the major explanatory variable measured at age 16, the first year of high school in Taiwan. Three specific self-reported items were included: *where*, *why*, and *length of time spent* using the Internet. *Where* the Internet was used was coded into "Internet café visit" versus "other." The present study focuses on visiting Internet café due to three reasons. First is that Internet café provides an affordable place to access the internet. Second, it is a social place in which adolescents stay away from parental supervision, gathering with peers (Liu, 2009; Wu & Cheng, 2007). Third, research has demonstrated that adolescents who visit an internet café in Taiwan characterize themselves as "bad students" who pay little attention to academic performance (Liu, 2009). *Why* was categorized as "use for non-school work" versus "other." We specifically paid attention to adolescents who used the Internet to search for new information unrelated to school work. Lastly, *length of time spent* was calculated by 2 items: frequency and average length of time per usage. With multiplication of two items, we obtained a measure of *length of time daily spent* on the Internet, which was then categorized into "less than one-half hour," "one-half hour to less than one hour," and "one hour or more."

#### 2.2.3. Covariates

Peer influence was assessed via a survey item related to perceived cigarette/alcohol use of close friends in middle school. Respondents were asked whether their close friends smoked or drank; responses were placed into 1 of 3 categories ("yes," "no," and "do not know").

Several individual and family covariates were included as potential confounding variables that influence the relationships between the main explanatory variables and cigarette/alcohol use. Individual characteristics included were: pubertal onset ("early," "on-time," and "late"), first sex at age 15 or younger ("yes" or "no"), level of self-esteem measured by 9 of 10 items of Rosenberg Self-Esteem Scale (Rosenberg, 1986), and class ranking during middle school ("top 10% ranked" vs. "not"). Pubertal onset is constructed by self-reported pubertal status, separately for girls and boys. Girls' pubertal development is measured by grade at menarche. Boys' pubertal development is assessed by four items that included self-reports of amount of body hair, voice change, facial hair, and acne appearance observed. Each item was measured with a 4-point scale and higher score indicated more complete maturation. Because of differences in response formats for girls and boys, pubertal development was standardized and categorized as "early maturation" [more than one standard deviation (SD) above], "late maturation" (more than one SD below), or "on-time" (within one SD either way). Family background variables included parental education (2 categories: "parental college degree" versus "no parental college degree") and family cohesion, measured by a 4-item scale asking adolescents to report their family cohesive behaviors such as inclusion in making family decisions, participation in family activities, and support or advice for family members in need (Yi, Wu, Chang, & Chang, 2009) with scores being divided into quartiles.

### 2.3. Statistical analysis

To examine the longitudinal association between adolescent Internet use and future cigarette/alcohol behaviors by age 20, we began with descriptive analyses that characterized the distributions of 2 sample cohorts separately for cigarette smoking and alcohol use. We then used multivariate logistic regression models for cigarette smoking and multivariate multinomial logit models for alcohol use that elaborated and progressively adjusted the significance of participant Internet use on future cigarette/alcohol use. Model 1 explored adolescent Internet use and gender to investigate our primary research interest. As mentioned above, gender differences were expected; we tested for interactions between gender and adolescent Internet use to examine whether adolescent Internet use varied by

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