Tobacco Retailers and Adolescent Smoking in South Korea

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Abstract

Background: Smoking leads to various harmful effects on health. Most adult smokers initiate smoking during adolescence. Once smoking is established, it is difficult quit. Adolescents are impressionable and more receptive to tobacco marketing in tobacco retailers.

Purpose: The purpose of this study was to describe various licensed tobacco retailer factors and determine predictors of adolescent smoking outcomes including receptivity to tobacco marketing, lifetime smoking, and current smoking in South Korea.

Methods: This study used a cross-sectional descriptive correlational design. The survey was conducted with 740 adolescents aged 13 to 15 attending middle schools in Seoul, South Korea. Addresses of 3,488 licensed tobacco retailers were obtained from borough offices of Seoul. Geographic Information Systems were used to measure factors of licensed tobacco retailer and multilevel modeling was used to determine predictors of adolescent smoking outcomes.

Results: Predictors of receptivity to tobacco marketing were peer smoking and number of licensed tobacco retailer passed when traveling to school or home. Predictors of lifetime smoking were gender, perceived economy, weekly allowance, sibling smoking, peer smoking, and number of licensed tobacco retailer passed. Predictors of current smoking were gender, weekly allowance, sibling smoking, and peer smoking.

Conclusions: Predictors found in this study need to be considered in adolescent tobacco prevention programs and policies. There is a need for the regulation of zoning and licensing of licensed tobacco retailers in areas frequented by adolescents.

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CHAPTER 1. Introduction

Smoking is a primary risk factor for cancer, heart disease and stroke, and respiratory disease; these three conditions constitute the first, second, and third leading causes of death in the United States (Centers for Disease Control and Prevention, 2013; U.S. Department of Health and Human Services, 2010b; World Health Organization, 2013). Smoking costs the United States $170 billion in direct medical costs and $156 billion in lost productivity annually (U.S. Department of Health and Human Services, 2014; Xu, Bishop, Kennedy, Simpson, & Pechacek, 2014).

Adolescents who initiated smoking may be more exposed to harmful substances of tobacco leading to various diseases during lifetime. Because most smokers begin smoking during their teen years and established smoking is difficult to quit because of nicotine effect (U.S. Department of Health & Human Services, 2016), adolescent smoking prevention is an important issue in health care.

Youths purchase tobacco products primarily from licensed tobacco retailers (LTRs). Even those who enter an LTR without the intention of purchasing tobacco products may be exposed to the tobacco companies' marketing materials; thus, the LTR is an important source of tobacco control (McCarthy et al., 2009). South Korea has 160,142 LTRs across the country (Kim, 2013), which indicates that there is one LTR for every 21 Korean adolescents between 15 and 19 years of age. These LTR-related factors need to be considered in tentative predictors of South Korean adolescent smoking. However, fewer studies have included these LTR factors in the analytic models determining predictors of adolescent smoking outcomes.

Adolescence is an impressionable time (Kinder & Sears, 1985). Adolescents tend to

imitate the behaviors of others and are susceptible to their environment, which may result in a higher potential for change. Adolescents, who live in an area with a higher density of LTRs, or shorter proximity to LTRs from school or home may, are more likely to observe adults purchasing tobacco products and smoking, than those who do not. Ashe, Jernigan, Kline, & Galaz (2003) stated that zoning regulations of tobacco stores may be needed to prevent adolescents from exposure to tobacco advertising and increased availability of tobacco products.

There have been no studies in South Korea using Geographic Information Systems (GIS) to identify LTR factors such as the geographic distribution of LTRs or mean distance from LTRs to schools. GIS is a system designed to manage, analyze and present all kinds of geographically referenced data (Law & Collins, 2013). GIS makes it possible to measure LTR factors more accurately and to present these factors spatially.

The purpose of this study was to determine predictors of smoking among South Korean adolescents aged 13 to 15 years old who attend middle schools in South Korea using Multilevel Modeling (MLM) and GIS. The dissertation consists of the dissertation proposal, and three manuscripts. The first manuscript is a systematic literature review on the association between the density and proximity of licensed tobacco retailers, and adolescent smoking, to provide an in-depth understanding of the relation between geographic distribution of LTRs and adolescent smoking. The second manuscript is about predictors of adolescent smoking in South Korea. Various factors including LTR density and proximity were mapped using GIS and examined to determine predictors of adolescent smoking outcomes. The third manuscript applies the Theory of Planned Behavior (TPB) to intention to smoke and lifetime smoking in South Korean

adolescents. Major constructs of the TPB including attitude, subjective norm, and perceived behavioral control were used to explain adolescent smoking intention and lifetime smoking.

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CHAPTER 2. Dissertation Proposal – PHS 398 Form

SPECIFIC AIMS

Smoking has a detrimental effect on nearly every organ in the body. Each year six million people die worldwide because of smoking, and this figure will increase to more than seven million by the year of 2020 (World Health Organization [WHO], 2011). Among current adult smokers, half began smoking at the age of 19 or younger and 90% started smoking at the age of 24 or younger in South Korea (Ko & Jung, 2013). In South Korea, the average age of smoking initiation among current adolescent smokers was 12.6, which is the age of entering middle school (Ministry of Education, Ministry of Health and Welfare, & Korea Centers for Disease Control and Prevention, 2014). Cho (2013) reported that smokers who initiated smoking before 19 years old were 2.4 times more likely to become heavy smokers than those who started smoking after 26 years old. Ko and Jung (2013) reported that 28.2% of current 18 year olds in South Korea would die because of diseases caused by smoking before they reach the age of 85. The smoking rate among South Korean high school students has held steady between 11 and 12 % for the last decade (Ministry of Education et al., 2014).

Youths purchase tobacco products primarily from licensed tobacco retailers (LTRs); thus, LTRs are an important source of tobacco control (McCarthy et al., 2009). South Korea has 160,142 LTRs across the country (J. H. Kim, personal communication, November 7, 2013), which indicates that there is one LTR for every 300 Korean and every 21 Korean adolescent between 15 and 19 years of age. More than 90% of Korean adolescents reported that they observed tobacco advertising in LTRs (Shin, Jeong, & Lee, 2012). Previous studies reported that

advertising of tobacco products in LTRs affected adolescent smoking (Feighery, Henriksen, Wang, Schleicher, & Fortmann, 2006; Henriksen, Feighery, Wang, & Fortmann, 2004; Slater, Chaloupka, Wakefield, Johnston, & O'Malley, 2007). More than 90% of convenience stores in South Korea displayed and advertised tobacco products around the checkout counter (The Seoul Young Men's Christian Association, 2013). Also, a number of studies found that the density of LTRs and proximity to LTRs were associated with adolescent smoking (Adams, Jason, Pokorny, & Hunt, 2013; Lipperman-Kreda, Grube, & Friend, 2012; McCarthy et al., 2009; West et al., 2010). However, the influence of tobacco marketing and geographic distribution of LTRs on Asian or South Korean adolescents still remains unclear.

The research question for the proposed study is "Does the density of LTRs near middle schools and the proximity of LTRs to middle schools, and perception of tobacco marketing in LTRs influence South Korean adolescent smoking?" This descriptive correlational study will use the ecological model (McLeroy, Bibeau, Steckler, & Glanz, 1988; Sallis et al., 2006) in combination with constructs from the Theory of Planned Behavior (TPB) (Ajzen, 1991). Geographic Information Systems (GIS) will be used to examine the geographic location of LTRs and analyze the associations between the density of LTRs near and proximity of LTRs to middle schools, and adolescent smoking-related outcomes. **The major hypotheses** are:

1. Adolescents who perceive tobacco marketing in LTRs are more likely to smoke and have higher smoking intention compared to those who do not perceive tobacco marketing in LTRs;
2. Adolescents who attend schools with a higher density of LTRs are more likely to smoke and have higher smoking intention compared to those who attend schools with a lower density of

LTRs; and

3. Adolescents who attend schools with a closer mean proximity to LTRs are more likely to smoke and have higher smoking intention compared to those who attend schools with a further mean proximity to LTRs.

The specific aims of this study are:

1. To describe LTR factors (frequencies of LTR visits, perception of tobacco marketing in LTRs, location of LTRs and schools, density of LTRs around a school, and proximity of LTRs to schools);
2. To examine smoking-related outcomes (receptivity to tobacco marketing in LTRs, attitude, subjective norm, perceived behavioral control, intention, lifetime smoking, and current smoking);
3. To analyze associations between LTR factors and smoking-related outcomes of 13 to 15 year old adolescents; and
4. To determine predictors of the smoking-related outcomes of the participants.

RESEARCH STRATEGY

Background and Significance

Smoking accounts for around 30% of all cancer deaths, 87% of men's lung cancer deaths, and 70% of women's lung cancer deaths (Centers for Disease Control and Prevention, 2008). Smoking increases the risk of cancer such as nasopharynx, nasal cavity and paranasal sinuses, lip, oral cavity, pharynx, larynx, lung, esophagus, pancreas, uterine cervix, ovary, kidney, bladder, stomach, colorectum, and acute myeloid leukemia (Secretan et al., 2009; US

Department of Health and Human Services, 2004). Smoking is a primary cause of heart disease, cerebrovascular disease, chronic bronchitis, and emphysema (Centers for Disease Control and Prevention, 1989; Secretan et al., 2009).

The National Health Insurance Service (2014) in South Korea filed a lawsuit claiming damages caused by smoking against tobacco companies in 2014. They insisted that annually one billion and five hundred million dollars were disbursed from the National Health Insurance for medical costs related to smoking (this court case is still in progress as of May 14, 2015). Most adult smokers initiate smoking during their adolescence (Khuder, Dayal, & Mutgi, 1999).

The 1998 Master Settlement Agreement restricted active tobacco marketing including cigarette billboards and transit advertising, print advertising targeting youths, and brand sponsorship in the United States (U.S.) (National Association of Attorneys General, 2014). Subsequently, tobacco companies began to focus their marketing efforts on the point-of-sale in LTRs to promote tobacco product sales and continue advertising their products while still following the technical requirements of the agreement (Center for Tobacco-Free Kids, 2013).

In South Korea, the National Health Promotion Act was established in 1995 with a purpose of improvement of health of the people by providing knowledge about health and by creating environment for healthy life (National Museum of Korean Contemporary History, 2015). This was the first trial that stressed Korean government's active responsibilities for smoking prevention including restriction of tobacco advertisement, designation of non-smoking areas, and operation of the National Health Promotion Fund. This act prohibits advertisement of tobacco products in a variety of ways. For example, tobacco advertisement that is visible from

the exterior of the tobacco stores, brand sponsorship targeting women or adolescents, tobacco advertisement in international airplanes or cruises, publishing tobacco advertisement more than ten times a year in a magazine are prohibited. Also, tobacco manufacturers should inscribe warning phrases indicating maleficence of tobacco use on the tobacco products.

Because of these regulations, tobacco companies tend to utilize tobacco marketing within the law such as beautiful tobacco packs or using attractive pictures around the tobacco display stands. Understanding the influence that LTRs have on adolescent smoking is important because even those youths who enter an LTR without the intention of purchasing tobacco products may be exposed to the tobacco companies' marketing materials; thus the presence and availability of LTRs may influence visitors' smoking motivation.

There are 24,859 convenience stores in metropolitan cities of South Korea (Korea Associations of Convenience Stores, 2015). The Seoul Young Men's Christian Association (merged) reported results of examination of displaying and advertising of tobacco products in convenience stores in South Korea. Their findings indicated that more than 90% of convenience stores displayed and advertised tobacco products around the checkout counter. They reported that 11% of retailers in South Korea were located in the school absolute cleanup zone, an area designated for securing the students' health and academic atmosphere. This area is 164 feet from the school's front gate in South Korea (Korea Ministry of Government Legislation, 2013).

The Adolescent Period

The adolescent period has distinctive characteristics differing from other human developmental stages. Adolescents experience not only rapid physical growth, but also

significant developments of cognition and self.

Cognitive Development. According to Piaget (1965), the developmental period after the age of 12 is a stage of formal or propositional operations, which enables thoughts about all possibilities including reversibility, propositions, and reasoning. This adolescent period has distinguishing characteristics of more complex and higher dimensional thinking, which differs from previous developmental stages. This is a period of high impressionability and vulnerability which means being highly influenced by the social environment and/or significant others. Also, this developmental stage includes characteristics of imaginary audience, which means that adolescents believe everyone pays attention to them; and personal fable, which means they believe that their experiences or feelings are unique and different from others (Elkind, 1978). Because cognitive development is not complete, adolescents may not be able to understand abstract information (Orr & Ingersoll, 1991) and may show immature impulsivity or decision-making skills (U.S. Department of Health and Human Services, 2012). Because of these characteristics, adolescents may do not care about their health (Levenson, Morrow, & Pfefferbaum, 1984) and overlook health-compromising behaviors (Millstein, 1991).

Self-concept and Self-esteem. Self-concept, which means awareness and evaluation of self, develops more during the period of adolescence than in the previous developmental stages (Harter, 1990). While adolescents may experience unpleasant feelings such as disappointment, dissatisfaction, or fear in the early stage of adolescence because self-concept fluctuates significantly and self-concept tends to be negative in the middle stage of adolescence; self-concept is stabilized when adolescents reach the ages of 17 to 18 (Han, 2014; Higgins, 1987). Negative self-concept in adolescence may cause emotional disturbance or problematic behavior

influencing lifestyle immensely after the adolescent period (Han, 2014).

Self-esteem, which is defined as positive feelings about self-capabilities and self-belief, develops more in the adolescent period than other developmental stages and it plays a big role to both mental health and ego-identity establishment in adolescents (Dusek, Flaherty, & Hill, 1981; Han, 2014). Self-esteem improves or is stabilized during the adolescent period (Han, 2004).

Ego-identity. Establishment of ego-identity is a developmental task that needs to be essentially acquired throughout the whole life and the adolescent period is a critical time for founding of ego-identity (Erikson, 1959; 1968). Ego-identity includes concepts of integrity of roles perceived, permanence of self-cognition, harmony between subjective ego and objective ego, and self-consciousness of existence (Han, 2014). According to Erikson (1968), human beings realize themselves by questioning, "Who am I?" They recognize their possibilities and limits simultaneously in this process. He added that, if their limits exceed their possibilities, individuals are frustrated and encounter identity crisis caused by role diffusion, but this crisis can be overcome by accepting the current self.

Establishing self-concept, self-esteem, and ego-identity, adolescents attempt to imitate adult behaviors and roles (Steinberg & Morris, 2001; Tanti, Stukas, Halloran, & Foddy, 2011). A number of adolescent studies reported that this population is psychologically vulnerable (Konopka, 1991), self-critical (Rosenberg, 1985), self-conscious or concerned about social issues (Elkind & Bowen, 1979), and susceptible to political attitude change (Krosnick & Alwin, 1989). This may be because adolescents face confusion about self such as "Who am I? Who do I want to be? Who should I be?" (Higgins, 1987; Tanti et al., 2011). It is important to prevent unhealthy

behavior during the impressionable and vulnerable adolescent period, because established health behaviors may last the rest of their life.

Particularly, middle school years between 13 to 15 years of ages are important in establishing adolescent health behavior because the mean age of smoking initiation was 12.6, alcohol use initiation was 12.9, and sexual intercourse initiation was 13.1 among adolescents in South Korea (Ministry of Education et al., 2014). South Korean adolescents experience earlier puberty given that the mean ages of nocturnal emission and menarche have been earlier in the recent decade (Ministry of Education et al., 2014),. Therefore, the middle school period between 13 to 15 years of ages is important in health behavior control including smoking prevention.

Multi-level Determinants of Adolescent Smoking

According to the ecological perspectives of human behavior (Bronfenbrenner, 1979; McLeroy et al., 1988; Sallis et al., 2006), individual behavior or potential intervention outcomes are not influenced by only one dimension such as individual factors, but rather by multi-level dimensions including intrapersonal, interpersonal and community environmental factors. Researchers believe that considering all of the levels of social determinants would result in better outcomes for behavior change. This comprehensive perspective of viewing individual and environment levels of influence was used in various fields of study (McLeroy et al., 1988; Sallis et al., 2006).

Intrapersonal Factors. Worldwide, men smoke approximately five times as much as women (Guindon & Boisclair, 2003). The 2000-2007 Global Youth Tobacco Surveys reported that the smoking prevalence among male adolescents was significantly higher than among

female adolescents in Africa, the Eastern Mediterranean, Southeast Asia, and the Western Pacific, but not in the Americas and Europe. Some studies reported that smoking behavior is evaluated as inappropriate for girls among Vietnamese, Korean American and Indonesian youngsters (S. S. Kim, Son, & Nam, 2005; Morrow, Hoang, & Trinh, 2002; Ng, Weinehall, & Ohman, 2007). In South Korea, in contrast to a current smoking rate of 14.0% of among male adolescents, only 7.6% of the female adolescents reported current smoking (Ministry of Education et al., 2014). In adolescence, as one's age increases, smoking rates tend to increase. As they get older, adolescents may get bolder about new things. Along with study reports that age was a predictor of other unhealthy behavior such as alcohol or drug use or sexual intercourse, as adolescents get older, they are more likely to have higher lifetime and current smoking rates in South Korea (Ministry of Education et al., 2014).

Genetic factors were also reported as contributors to adolescent smoking initiation. In the U.S., heritability for "ever" smoking was reported between 36% and 56% (Han, McGue, & Iacono, 1999; McGue, Elkins, & Iacono, 2000; Rhee et al., 2003). Heritability for regular smoking ranged between 27% and 52% (Rende, Slomkowski, McCaffery, Lloyd-Richardson, & Niaura, 2005; Slomkowski, Rende, Novak, Lloyd-Richardson, & Niaura, 2005; Young, Rhee, Stallings, Corley, & Hewitt, 2006). The estimate of heritability for smoking initiation among 12 to 24 year old young people was 39% (Boomsma, Koopmans, DOORNEN, & Orlebeke, 1994; Koopmans, Slutske, Heath, Neale, & Boomsma, 1999).

In the U.S., psychosocial factors including attitude, subjective norm, and perceived behavioral control were found to be associated with adolescent smoking. All of these constructs

influenced the forming of intention to smoke and this intention predicted smoking initiation (Hanson, 2005; Noonan, Kulbok, & Yan, 2011; Primack et al., 2008).

Interpersonal Factors. Peers and family are the most significant factors influencing adolescent smoking. A substantial number of studies reported that peers' smoking and adolescents perception of peers' smoking were associated with adolescents' smoking behavior (Alesci, Forster, & Blaine, 2003; Ali & Dwyer, 2009; Conrad, Flay, & Hill, 1992; Jackson, 1997; Kobus, 2003; McVicar, 2011; Villanti, Boulay, & Juon, 2011). Adolescents tend to learn about smoking by observing people around them (Bandura & McClelland, 1977). Studies reported that adolescents with smoking friends tended to be more likely to initiate smoking (Flay et al., 1994; Jackson, 1997; Scal, Ireland, & Borowsky, 2003) and to smoke more (Audrain-McGovern, Rodriguez, Wileyto, Schmitz, & Shields, 2006; Dierker, Avenevoli, Goldberg, & Glantz, 2004; Wang, 2001). This peer influence on smoking was found to be significant in both genders (Killen et al., 1997; Urberg, Değirmencioğlu, & Pilgrim, 1997), and in girls only (Flay, Phil, Hu, & Richardson, 1998; F. Hu, Flay, Hedeker, Siddiqui, & Day, 1995). Adolescents may recognize that their parents dominate them and their friends are less coercive, less critical, and less scolding, rather than their parents (Laursen, Hartup, & Koplas, 1996). Most adolescents prefer spending time with their peers than with family members (Larson, Richards, Moneta, Holmbeck, & Duckett, 1996), and the potential influence of peers may be greater.

Family context is another important factor influencing adolescent smoking. The parents' smoking status was a predictor of smoking initiation and progression among young people (Biglan, Duncan, Ary, & Smolkowski, 1995; Chassin et al., 2008; den Exter Blokland, Endy AW, Engels, Hale, Meeus, & Willemsen, 2004; Gilman et al., 2009; Hill, Hawkins, Catalano,

Abbott, & Guo, 2005; Peterson et al., 2006). The effects of parental smoking factors lasted into young adulthood (Chassin, Presson, Pitts, & Sherman, 2000; M. Hu, Davies, & Kandel, 2006; Øygard, KLEPP, Tell, & Vellar, 1995; Patton, Coffey, Carlin, Sawyer, & Wakefield, 2006). Also, a meta-analysis indicated that parental smoking was strongly associated with adolescent smoking (Leonardi-Bee, Jere, & Britton, 2011). However, in a few studies, parental smoking did not have an impact on adolescent smoking (Distefan, Gilpin, Choi, & Pierce, 1998; Flay et al., 1994). In addition, some studies reported that older siblings influenced adolescent smoking (Butterfield, Hill, Postma, Butterfield, & Odom-Maryon, 2011; Conrad et al., 1992; Peterson et al., 2006).

Community Environmental Factors. Ecological perspectives include environmental factors that extend beyond individual and social factors. Sallis et al. (2006) proposed "behavior settings" to refer to places where health behavior may happen including access to these places and their specific characteristics. Thus, the behavior settings for smoking initiation will include aspects of the built environment related to smoking such as access to LTRs, community campaigns about youth smoking prevention, tobacco vending machines, or billboards of tobacco products. Built environment in the community may play a bigger role in adolescent residents than adult residents in that adolescents tend to stay in the community throughout the day. In particular, LTRs are important built environment factors related to adolescent smoking because adolescents primarily obtain tobacco products in LTRs. More than 90% of South Korean adolescents reported that they observed smoking advertising in convenience stores (Shin et al., 2012). More tobacco products were sold in convenience stores than other stores (Dipasquale, 2002). Also, many studies found that the LTR factors such as the number of LTRs or distance to

LTRs were associated with the likelihood of experiencing smoking among adolescents (Adams et al., 2013; Lipperman-Kreda et al., 2012; West et al., 2010).

Tobacco Marketing in LTRs. A number of studies using various designs including experimental, cohort, and cross-sectional methods reported an association between tobacco marketing in LTRs and adolescent smoking. For example, Wakerfield, Germain, Durkin, and Henriksen (2006) implemented a between-subjects experimental study among 14- to 15-year-old adolescents in Australia to examine effects of cigarette advertising and pack displays on schoolchildren. They found that adolescents exposed to tobacco advertising were significantly more likely to have future intention to smoke compared with those who saw the display of tobacco products only. Also, participants exposed to tobacco displays and advertising were significantly more likely to perceive it would be easy to buy tobacco products in the retailers.

Similarly, Henriksen, Flora, Feighery, and Fortmann (2002) conducted a quasi-experimental study on tobacco advertising and smoking outcomes among 385 students in eighth and ninth grade in California. They reported that, compared with controls, adolescents exposed to tobacco advertising in LTRs perceived easier access to tobacco products, more peer smoking, and less support for tobacco control policies.

A longitudinal study by Weiss et al. (2006) tested whether exposure to smoking marketing on TV and/or in stores influenced susceptibility to smoking among the sample of 2,292 adolescents in sixth to eighth grade in Los Angeles. Their findings showed that exposure to smoking marketing on TV and/or in stores at baseline predicted smoking susceptibility at two or three years later. In addition, several cross-sectional studies reported that adolescents exposed

to tobacco marketing in stores were more likely to become ever, occasional, or daily smokers compared to those without such exposure. Also the adolescent participants were more likely to be susceptible to smoking in the future (Braverman & Aaro, 2004; Feighery et al., 2006; Henriksen, Feighery, Schleicher, Haladjian, & Fortmann, 2004; C. Y. Lovato, Hsu, Sabiston, Hadd, & Nykiforuk, 2007; Slater et al., 2007).

Overall, there were limitations in the literature regarding tobacco marketing in LTRs and adolescent smoking. There were a relatively small number of studies using other than cross-sectional designs that examined this issue. Cross-sectional studies collect data only once and may not sufficient to measure long-term effects of LTRs among adolescents living in the community. Also, because of the use of correlational designs in much of the literature, it is difficult to verify causal relationships between tobacco marketing of LTRs and adolescent smoking outcomes. Furthermore, most of the studies were conducted in Western countries.

Despite of these limitations, most of the studies reported statistically significant associations between tobacco marketing in LTRs and adolescent smoking. These results supported the evidence of the increasing expenditure of the tobacco companies for tobacco marketing in LTRs (Feighery, Ribisl, Schleicher, & Clark, 2004; Loomis, Farrelly, Nonnemaker, & Mann, 2006) and of the increased focus on point-of-sale marketing inside LTRs by tobacco companies (Lavack & Toth, 2006; Pollay, 2007). As a result, efforts to market tobacco in LTRs by tobacco companies may influence adolescent smoking in the community.

Density of and Proximity to LTRs. A great deal of literature focused on the associations between the density of LTRs or proximity to LTRs and adolescent smoking using a cross-

sectional correlation design. Adams et al. (2013) and Liperman-Kreda et al. (2012) evaluated the association between the density of LTRs and adolescent lifetime smoking in their cross-sectional studies among adolescents in the United States. These studies found a statistical significance between these two outcomes. Lipperman-Kreda et al. subsequently reported analysis of the density of LTRs, which was statistically associated with participants who smoked within the past 12 months.

A number of studies examined the influence of the LTR density on smoking among adolescents within the past 30 days (Adams et al., 2013; Chan & Leatherdale, 2011; Henriksen et al., 2008; Leatherdale & Strath, 2007; Lipperman-Kreda et al., 2012; McCarthy et al., 2009; Novak, Reardon, Raudenbush, & Buka, 2006). However, only three studies of McCarthy et al. (2009), Leatherdale & Strath (2007), and Novak, Reardon, Raudenbush, & Buka (2006) found a significant association between LTR density and adolescent past 30-day smoking. While Loomis et al. (2012) and Chan & Leatherdale (Chan & Leatherdale, 2011) explored the relation between the density of LTRs and susceptibility to smoking in their cross-sectional studies using secondary data among adolescents, only Loomis et al. reported a significant association between these two outcomes.

Similar results were found in a small number of studies examining the association between the proximity to LTRs and adolescent smoking. West et al. (2010) examined the relation of the distance from home to alcohol and tobacco (A&T) retailers with lifetime smoking in 14- to 19-year-old adolescents from California. They demonstrated that the distance from home to the nearest A&T stores was associated with A&T use (OR = 0.90, $p < 0.01$). Henriksen et al. (2008) examined the distance to the nearest LTR from a school and smoking prevalence in a study

among 24,875 10th- to 12th-grade adolescents in California. They found that there was no significant relation of the LTR proximity with adolescent current smoking.

All of the studies regarding the density of and proximity to LTRs used a cross-sectional correlation design, which makes it difficult to identify long-term effects and causal relationships. In addition, most studies measured smoking behavior only instead of psychosocial outcomes such as attitude, subjective norm, perceived behavioral control, or intention. Moreover, most of the studies were conducted in the United States or Canada.

Overall, LTR density and proximity factors are more highly correlated with adolescent lifetime smoking and past 12-month smoking, and less correlated with past 30-day smoking and susceptibility to smoking. However, some of studies reported that the LTR density and proximity influence adolescent past 30-day smoking, and susceptibility to smoking. Adolescent smoking behavior may influence established smoking in adulthood (Paavola, Vartiainen, & Haukkala, 2004). Therefore, nursing and health researchers need to pay attention to the impact of the LTR density and proximity for adolescent smoking issue.

Smoking Prevention Programs

Because adolescents spend a lot of time in school during the day, the school-based smoking prevention program was the major type of intervention for adolescent smoking prevention. From the 1960s to 1970s, school-based smoking prevention programs using informational and affective approaches were ineffective (Beattie, 1984; Thompson, 1978). Goodstadt (1978) documented that knowledge change is not enough to real behavior change. Some social-psychological approaches were reported that were modestly effective in various

settings for adolescent smoking prevention (Glynn, 1989). After 1990, a considerable number of studies and reviews on adolescent smoking prevention programs concluded that informational and affective methods were not effective. However, some psychosocial methods such as role playing, practice of new social skills, skills for resisting social pressure were found to be effective to prevent adolescent smoking initiation (Davis, Nonnemaker, & Farrelly, 2007; Dobbins, DeCorby, Manske, & Goldblatt, 2008; Hwang, Yeagley, & Petosa, 2004; Krowchuk, 2005; La Torre, Chiaradia, & Ricciardi, 2005; E. Park, 2006; Thomas & Perera, 2006; Tingle, DeSimone, & Covington, 2003; Wiehe, Garrison, Christakis, Ebel, & Rivara, 2005).

A few couple of community-based programs including family, schools, media, and public policy were implemented for adolescent smoking prevention. Biglan et al. (2000) conducted a randomized controlled trial of a community-based smoking prevention program and tested its effectiveness. Their program included family communication, media advocacy, youth anti-smoking modules, and youth campaigns. This program showed significant effectiveness of decreased smokeless tobacco use among male adolescents one year after the program compared with the school-based intervention. Chaloupka et al. (1997) demonstrated that using tobacco control policies such as an increase in smokeless tobacco product taxes, higher minimum ages for the legal purchase of tobacco products, stronger restrictions of access to smokeless tobacco products, strong provisions for tobacco licensing, restrictions of the distribution of free tobacco, and posing signs of legal ages to purchase were effective in reducing the purchase of smokeless tobacco products among boys.

There is a range of variance in effectiveness of adolescent smoking prevention programs depending on types of interventions, settings, characteristics of sample, etc. Nevertheless, it is

clear that utilizing various levels of influence including individual, social, and community environmental factors is more effective than using limited factors only. There is a need for more smoking prevention interventions manipulating community environmental factors.

Gaps in Literature

Although there are a number of research articles about LTR built environment and adolescent smoking, more evidence is needed. Most of the studies of LTR influences on adolescent smoking were conducted in Western countries. South Korea differs from the United States in the way that adolescents commute to school. For example, whereas only 5% of children in South Carolina of the U.S. commute to school by foot or bicycle (Sirard, Ainsworth, McIver, & Pate, 2005), 89% of elementary school students, 72% of middle school students and 36% of high school students in major cities of South Korea commute to school by foot (Statistics Korea, 2015). Rates of student commuting to school by foot in non-major cities including rural areas were lower than in major cities. A total of 76% of elementary school students, 55% of middle school students and 28% of high school students were reported to commute to school by walking (Statistics Korea, 2015). In light of the large number of LTRs across the country, South Korean students' manner of commuting to school indicates that a considerable number of middle school students may be exposed to LTRs every weekday. To date, information on the influence of LTR factors such as tobacco marketing in LTRs and geographic distribution of LTRs in a community on Korean adolescent smoking outcomes remains unclear. Also, there were a small number of studies about associations between LTR factors and youth smoking using psychosocial constructs of the TPB as the measures.

Impact

Adolescent Health Promotion. The proposed study will use a cross-sectional descriptive research design to assess the built environment of LTRs and adolescent smoking-related outcomes. Expected results of the study are descriptions of LTR factors and adolescent smoking-related outcomes, associations between the LTR factors and adolescent smoking, and predictors of adolescent smoking-related outcomes. While existing literature mostly measures smoking prevalence influenced by LTR factors, the proposed study will examine not only smoking prevalence, but also key constructs of the TPB including attitude, subjective norm, perceived behavior control, and intention, which may affect actual smoking behavior. Thus, the results of this study will provide more fruitful information on smoking-related psychosocial outcomes among adolescents influenced by LTRs.

In spite of the substantial number of LTRs given the population, there is little research studying LTR factors influencing adolescent smoking in South Korea. This proposed study will provide information on how LTR factors, as predictors, contribute to adolescents smoking in Seoul, one of the largest cities worldwide. The proposed study results will be helpful in developing policies including regulations of tobacco advertising in LTRs or stricter licensing of the LTRs in areas frequented by adolescents.

Smoking prevention is a concerning health issue in adolescent health promotion research and practice. The proposed study results about the influence of LTR built environment on adolescent smoking will help many nursing researchers and practicing nurses to take an interest in built environment for adolescent health promotion. It may motive them to consider the built

environment in future adolescent health promotion research and practice.

Future Intervention Studies. The proposed study will provide useful information to develop adolescent smoking prevention programs addressing tobacco marketing of LTRs and the density of and proximity to LTRs. LTRs built environment factors may not be easily manipulated because of various laws and regulations, *i.e.*, Tobacco Business Act, Health Promotion Law, and School Health Law (Korea Ministry of Government Legislation, 2015), and the pursuit of profits between tobacco companies and LTR owners. No studies were found that have attempted adolescent smoking interventions including LTR factors of South Korea. The reason may be that there were few studies regarding the influence of LTRs on South Korean adolescent smoking problem or that people in charge of public health, policy makers, or even nursing researchers do not recognize the need for changing LTR factors. Considering the results of the proposed study and growing evidence on this issue, a variety of built environment factors can be included in adolescent smoking prevention programs such as adding signs showing the minimum age for tobacco purchase in LTRs, educating adolescents about the marketing strategies of tobacco companies in LTRs, or conducting youth campaigns in the community. Moreover, the results of this study results will provide officials related to LTR built environment in South Korea with an opportunity to restructure their thoughts on youth tobacco control.

Expected Outcomes

Through this study, three outcomes will be described.

1. Reliability and validity of the Korean Fishbein/Ajzen-Hanson Questionnaire (KFAHQ);
2. The current smoking prevalence among 13- to 15-year-old students in target middle schools

in Seoul;

3. The current state of LTR factors in two boroughs in Seoul; and
4. Predictors of adolescent smoking-related outcomes.

Expected Effect on Costs

In South Korea, one billion and five hundred million dollars were disbursed annually from the National Health Insurance for medical costs related to smoking (National Health Insurance Service, 2014). Most smokers in South Korea initiate smoking during adolescence. If more adolescents do not start smoking, a considerable amount of money treating the diseases caused by smoking will be saved.

Theoretical Framework

While the Health Belief Model, Social Cognitive Theory, Theory of Planned Behavior, and Transtheoretical Model contributed to explaining how individuals establish or change health behavior, these theories do not include the physical environment of a community setting.

Ecological Perspectives. The ecological model of health behavior places an emphasis on both individual and various social environmental factors as determinants of health behavior or interventions (McLeroy et al., 1988; Sallis et al., 2006). Bronfenbrenner introduced an ecological model to explain human behavior (1979). This ecological model included four levels of influence which were micro, meso, exo, and macrosystem dimensions. However, this ecological model does not focus on health behavior.

McLeroy et al. (1988) suggested an ecological model for health promotion interventions with five levels of influence including intrapersonal factors, interpersonal processes,

organizational factors, community factors, and public policy. The intrapersonal factors refer to individual characteristics such as knowledge, attitude, behavior, self-concept, and skills. The interpersonal processes refer to influence of social relationships of family, colleague at work, or friends. The organizational factors refer to institutions' characteristics or goals supporting behavior change of members. The community factors refer to the influence of organizations, institutions, or informal networks in the community. Community is viewed as a geospatial unit that residents belong to. The public policy factors refer to influence of national laws and public policy in a local or state perspective. MeLeroy and his colleagues demonstrated that interventions for health behavior would be most effective when operating these multiple levels of influence. Their ecological framework was the first model presenting five systematic levels of influence on individual health behavior for health promotion intervention studies. However, this ecological model does not specify the built environment factors.

Sallis et al. (2006) created the ecological model consisting of four levels of determinants of physical activity which were intrapersonal factors, perceived environment, behavior settings, and policy environment. The behavior settings referred to characteristics of places where health behavior occurs. Sallis et al. included comprehensive built environment factors such as walkability, bike facilities, parking, transit, traffic, etc. in the behavior settings of the ecological model for physical activity. As such, built environment factors such as tobacco marketing in LTRs and geographic distribution of LTRs can be included in the community level in the ecological model for adolescent smoking initiation.

A large number of previous studies found that ecological perspectives were useful in predicting continued smoking or smoking initiation amongst youths (Otsuki, Tinsley, Chao, &

Unger, 2008; Pokorny, Jason, & Schoeny, 2003; Wen, Van Duker, & Olson, 2009; Wilcox, 2003). Choi, Ha, & Park (2012) demonstrated effectiveness of school-based interventions for adolescent smoking prevention applying an ecological model in South Korea.

Theory of Planned Behavior (TPB). Fishbein and Ajzen (1975) developed the Theory of Reasoned Action (TRA), which described how personal motivational factors determine a specific action. They stated that beliefs about attributes or outcomes of implementing a behavior form an attitude toward the behavior, and normative beliefs meaning the level of approval of significant others about the behavior form a subjective norm. The TRA assumed that attitude toward a behavior and subjective norm influence the forming of a behavioral intention which is defined as "indication of a person's readiness to perform a given behavior" (Ajzen, 2015). Then, behavior is determined by intention. The TRA assumed that the strongest determinant of behavior is behavioral intention. However, this theory did not explain the effects of factors that an individual could not control, so Ajzen and Icek added the concept of perceived behavioral control to the TRA and created the TPB (Ajzen, 1985; Ajzen, 1991). Perceived behavioral control refers to "people's perceptions of their ability to perform a given behavior" (Ajzen, 2015). Several intervention studies reported that the TPB was effective in changing behaviors (Albarracin et al., 2005; Jemmott, Jemmott, & Fong, 1992; Kamb et al., 1998; Rhodes, Stein, Fishbein, Goldstein, & Rotheram-Borus, 2007). Also the TPB was verified in a range of studies of health behavior (Albarracin, Fishbein, & Muchinik, 1997; Albarracin, Johnson, Fishbein, & Muellerleile, 2001; Bogart, Cecil, & Pinkerton, 2000; Bosompra, 2001) including adolescent smoking initiation (Hanson, 1997, 1999, 2005; Hemchayat, 2003; Godin, Valois, Lepage, & Desharnais, 1992). As such, it is clear that individual attitude, subjective norm, perceived

behavioral control, and intention influence health behavior. However, the TPB did not include various environmental effects because the model covers individual psychosocial constructs.

The proposed study will use the ecological model of McLeroy et al. (1988) and Sallis et al. (2006) in combination with constructs from the TPB (Ajzen, 1991) as a theoretical framework (Figure 1). The ecological perspective emphasizes both individual factors and social, community environmental contexts for behavior change. The theoretical model will include three levels of influence which are intrapersonal, interpersonal, and community factors. The intrapersonal level will have demographics and psychological constructs related to smoking such as attitude, subjective norm, perceived behavioral control and intention. The interpersonal level will have social data of the participants such as parents' education, cohabitation with family, conversation time with parents, parents' economic activity, household economic status, and family current smoking status. The community factors will have LTR factors such as the density of and proximity to LTRs, tobacco marketing inside LTRs, and frequency of visits to LTRs. One assumption of this theoretical framework is that smoking behavior is influenced by multiple levels of factors. Intention to smoke will be measured as an outcome among non-smoking adolescents given that intention is a strong determinant of behavior (Fishbein & Ajzen, 1975).

This theoretical model shows how each level influences smoking behavior, receptivity to tobacco marketing, and the constructs (attitude, subjective norm, perceived behavioral control and intention) of the Theory of Planned Behavior.

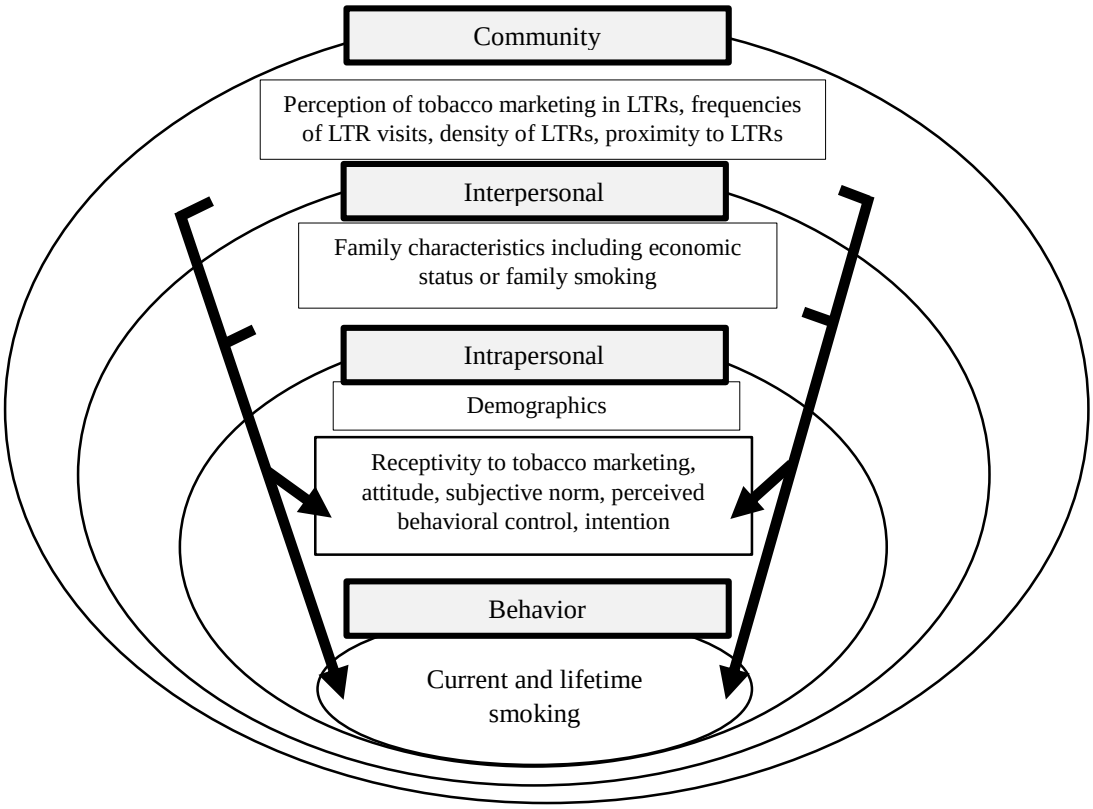

Figure 1. Theoretical framework from the ecological model from McLeroy et al. (1988) and Sallis et al. (2006) in combination with constructs of the TPB (Ajzen, 1991)

Design

This proposed study will examine LTR factors and smoking-related outcomes of the adolescents using a survey method, analyze associations between the LTR factors and smoking-related outcomes, and determine predictors of smoking-related outcomes. Thus, this study will use a cross-sectional descriptive correlational design (Table 1). The descriptive correlational design is appropriate for studies that aim at describing relationships between variables (Polit & Beck, 2012).

Table 1. Design, setting, sample, measures by study aim

Specific Aims	Design, Setting, and Sample	Measures
1. Describe LTR factors	· Design: cross-sectional descriptive study design · Setting: neighborhoods of 12 target middle schools in Seoul, South Korea · Sample: 720 of adolescents	Address data of LTRs and schools, density of LTRs around schools, proximity of LTRs to schools, frequencies of LTR visits, and perception of tobacco marketing in LTRs
2. Examine the smoking-related outcomes	· Design: same with no. 1 · Setting: same with no. 1 · Sample: same with no. 1	Receptivity to tobacco marketing, attitude toward smoking, subjective norm about smoking, perceived behavioral control about smoking, smoking intention, lifetime smoking rates, and current smoking rates
3. Analyze the associations between LTR factors and smoking-related outcomes	· Design: same with no. 1 · Setting: same with no. 1 · Sample: same with no. 1	N/A
4. Determine predictors of smoking-related outcomes	· Design: same with no. 1 · Setting: same with no. 1 · Sample: same with no. 1	N/A

Sample / Sampling Plan

The target population of this study will be 13- to 15-year-old adolescents who attend middle schools in the Seoul metropolitan city, South Korea. The study sample will be 720 students attending 12 target middle schools of two boroughs, Eunpyeong-gu and Seodaemun-gu, in Seoul. Inclusion criteria will be adolescents who (1) can speak Korean; (2) are between 13 to 15 years of ages; (3) have attended the target middle schools more than six months; and (4) submitted the parental consent and assent forms for the study participation. Greater than 95 % of

the participants who submitted the parental consent and assent forms will meet the inclusion criteria, given a report that three to four percent of students transfer annually in South Korea (Korean Educational Development Institute, 2014). Exclusion criteria will be adolescents who are challenged in reading and thinking because the surveys need basic abilities to read and understand the questionnaire to respond. However, none of the sample will be included in the exclusion criteria because challenged adolescents to respond questionnaires tend to be distributed to special classes in South Korea and the investigator will not recruit special classes. Also, the investigator will contact home room teachers beforehand to ask if there are students who are challenged in reading and thinking in the classes before the recruiting. The proportion between male and female will not differ more than 10 percent. A recent cross-sectional descriptive study on tobacco marketing and adolescent smoking intention reported that the survey response rate was 94.5% (Shin, Jeong, & Lee, 2012). Based on this response rate, the expected refusal and attrition rate is smaller than 10%. In conclusion, whereas the expected numbers of cases in total will be 720, the final study samples will be greater than 648.

Given budget and time limitations (Lee et al., 2009), a convenience sampling method will be applied to select the 12 target middle schools in two boroughs (six schools in Eunpyeong-gu and six schools in Seodaemun-gu) of Seoul. The distribution ratio of teen population and mean perceived level of income (out of 10) in Seoul were 10.20% and 5.05 respectively. These figures of Eunpyeong-gu and Seodaemun-gu were 10.26% and 4.97, and 9.77% and 5.02, which were very similar to the means of Seoul. In addition, these two boroughs showed adult smoking rates as 22.3% and 24.2% with a range of 17.8% to 26.2% indicating similar level of adult smoking rates (22.2%) of Seoul (Seoul Metropolitan Government, 2015) (There were no data

about adolescent smoking rates in these two boroughs.). Thus, these two boroughs may be representative for a study about predictors of adolescent smoking controlling for the perceived economic status.

In the target middle schools selected, one class will be randomly chosen in the second (primarily consisting of 13- and 14-year-olds) and third grades (primarily consisting of 14- and 15-year-olds) using an Excel formula. Of those classes, the all class students will be informed about the study. The participants who bring the signed Parental Consent form will have an opportunity to sign the Minor Assent Form. Then, they will participate in the survey. The expected sample number of students is approximately 30 for each class (Siminilbo, 2014), 60 for each school, and 720 for the 12 target schools.

Sample Size

There is no definite guideline for estimation of sample size of multilevel modeling. Since there is not preliminary data to guide the accurate sample size estimation, the Harrell (2001)'s rule of thumb for estimation of sample size in regression models will be used. A logistic regression model is likely to be reliable if, in the less frequent outcome category, there are at least 10 events per predictor. South Korean government statistics report rates of lifetime smoking and current smoking were 19.2% and 7.9% (Ministry of Education et al., 2014), so with the sample of 648, the investigator would expect 124 lifetime smokers and 51 current smokers in the study. The inclusion of 12 predictors for lifetime smoking and 5 predictors for current smoking in regression models meets this requirement.

Instruments

Korean Fishbein/Ajzen-Hanson Questionnaire (KFAHQ). Hanson (1997) developed the Fishbein/Ajzen-Hanson Questionnaire to measure all constructs—attitude, subjective norm, perceived behavioral control, and intention— of the TPB (Ajzen, 1991) in a research study for examining predictors of smoking intention in female adolescents. The instrument includes 52 items with 7-point semantic scales. The Cronbach's α of each measure (construct) in this instrument ranged from 0.96 to 0.66 (Hanson, 1997).

Because written in English, this instrument was translated to Korean by the investigator. The investigator followed the Brislin's translation model to translate (Brislin, 1986). First, the investigator translated the instrument to Korean and this draft was validated by back-translation by a person who was good at both English and Korean. Then, a language expert in an English major validated the Korean version with the original instrument. If the expert disagreed, the investigator revised the Korean version and asked a person who had conducted back-translation one more time. An English expert again compared the original version with the re-translated version. This process repeated until the English expert confirmed both English and Korean versions convey the same meaning.

Before conducting a survey, the KFAHQ will be verified for content validity by two experts in health behavior and adolescent health who are native Koreans. They will be asked if each question is appropriate to be included in the instrument, all questions cover the domain in Korean, and additional aspects are required. After the survey of 648 adolescents, internal consistency will be evaluated to check if coefficient (Cronbach's α) reaches 0.70 or greater (Frost, Reeve, Liepa, Stauffer, & Hays, 2007). The time expected to answer this instrument is 20 minutes.

Korean Receptivity to Tobacco Marketing Instrument (KRTMI). Evan, Farkas, Gilpin, Berry, & Pierce (1995) developed the Index of Receptivity to Tobacco Marketing (IRTM), which consisted of five sets of dimensions. For this proposed study, the investigator will use the first dimension assessing how adolescents attend and interpret the messages of tobacco advertising. This instrument included nine items whose answers are dichotomous (yes or now). The answer of yes will be counted as one point, so the range of the total score will be zero to nine. Shin et al. (2012) translated this English instrument to the Korean Receptivity to Tobacco Marketing Instrument (KRTMI). They reported that Cronbach's α of this Korean instrument was 0.86 in their descriptive study assessing 1,053 adolescents aged from 13 to 18 in South Korea. The time expected to complete this instrument is 5 minutes.

Questions about Lifetime Smoking and Current Smoking. The questions asking lifetime smoking and current smoking will be from questions of the Korea Youth Risk Behavior Web-based Survey (KYRBWS) (Ministry of Education et al., 2014). The KYRBWS is the sole national health survey conducted every year among approximately 70,000 adolescents across the whole South Korea. The KYRBWS has 15 categories about health behavior of Korean adolescents. Smoking which is one of those categories includes questions asking, "Have you ever smoked in your lifetime?" for a measure of lifetime smoking and "How many days did you smoke in the last month?" for a measure of current smoking. The Kappa values for the reliability of the lifetime smoking and current smoking evaluated by the test-retest method among all adolescents were 0.81 (95% CI: 0.78 – 0.85, p = < 0.001) and 0.75 (95% CI: 0.68 – 0.82, p = 0.01) respectively (Korea Centers for Disease Control and Prevention [KCDC], 2009). The Kappa values of these items among middle school students were 0.78 (95% CI: 0.73 – 0.84, p =

0.09) and 0.52 (95% CI: 0.38 – 0.66, $p = 0.002$) (KCDC, 2009) respectively. The Kappa value for the validity of the current smoking among all adolescents evaluated by the test-retest (a self-reported survey and urine cotinine test) was 0.80 (95% CI: 0.71-0.89) (KCDC, 2009). The sensitivity and specificity of the current smoking were 78.0% and 92.0% respectively (KCDC, 2009).

Operationalization of Study Constructs

According to Ajzen (2015), attitude toward the behavior was defined as "degree to which performance of the behavior is positively or negatively valued," subjective norm as "perceived social pressure to engage or not to engage in a behavior," perceived behavioral control as "people's perceptions of their ability to perform a given behavior," and intention as "person's readiness to perform a given behavior." In this proposed study, attitude will be defined as "degree to which smoking behavior is positively or negatively evaluated," subjective norm as "perceived social pressure to smoke or not to smoke," perceived behavioral control as "perceived ability to smoke," and intention as "readiness to smoke (Appendix 1). "

Variables and Measures

With each specific aim, different measures will be assessed (Table 1). Through the survey and secondary data, the investigator will examine addresses of LTRs and schools, frequencies of LTR visits, and perception of tobacco marketing in LTRs for LTR factors (Appendix 2). Also, the investigator will examine receptivity to tobacco marketing in LTRs, attitude toward smoking, subjective norm about smoking, perceived behavioral control about smoking, smoking intention, lifetime smoking rates, and current smoking rates for smoking-

related outcomes (Appendix 2). The LTR factors will be the independent variables and the smoking-related outcomes will be the dependent variables (Table 3).

Data Collection Protocol

The proposed study will be submitted for review of the institutional review board (IRB) from the University of Virginia after approval from the investigator's proposal committee. LTR address data in the Eunpyeong-gu and Seodaemun-gu boroughs of Seoul will be obtained from those borough offices.

The investigator will contact the school health teachers in cooperation with the Korean Health Teachers Association. As survey assistants, school health teachers who agree to participate in the study will be informed about the whole process of data collection and their responsibilities, which will be to obtain assent and parental consent forms. Among the participants recruited by the sampling plan, the survey will be conducted under supervision of the investigator.

Using a questionnaire (Appendix 2), the survey of 720 adolescents will be conducted in a classroom or health service room of the 12 target middle schools in both Eunpyeong-gu Seodaemun-gu boroughs in Seoul. The tentative date of the survey will be October 15, 2015. The time expected to complete the questionnaire is 30 minutes. After the survey, the investigator will collect all questionnaires completed.

Data Analysis

After the survey, reliability of the KFHAQ will be computed using Cronbach's α to

confirm internal consistency. The goal level of Cronbach's α is greater than 0.70. For the first aim in describing LTR factors, the locations of LTRs and schools will be geocoded and shown as points or symbols in the Seoul map using ArcGIS v.10.2. The density of LTRs will be calculated by a buffer function of the ArcGIS v.10.2. Round buffers from the schools will be created to show a half-mile radius since this distance is primarily used to see physical environmental influences to health behaviors such as smoking (Chuang, Cubbin, Ahn, & Winkleby, 2005; Henriksen et al., 2004). Then, the number of LTRs will be counted in these prescribed areas. The mean proximity to LTRs within a half-mile radius from the schools will be calculated by a point distance function of the ArcGIS v.10.2. However, this half-mile radius may be adjustable in the analysis stage, depending on sufficient number of LTRs in the radius for optimal analysis. And spatial statistics will be conducted to analyze patterns of LTR locations on the map. Also, descriptive statistics will be conducted to describe participants' demographics, frequencies of LTR visits, and perception of tobacco marketing in LTRs using SPSS v.22. The second aim will be examination of smoking-related outcomes; descriptive statistics will also be conducted to describe attitude, subjective norm, perceived behavioral control, intention, lifetime smoking, and current smoking using SPSS. All descriptive statistics will include frequencies, means, standard deviations, and percentages (Table 2).

Table 2. Specific aims and methods

Specific Aims	Analytic Methods
1. Describe LTR factors	Using ArcGIS v.10.2, addresses of LTRs and schools will be presented in points or symbols in a shapefile of Seoul. The density of LTRs will be calculated using a buffer function in a half-mile radius from the school. The mean proximity (Cartesian distance) to LTRs within a half-mile to schools will be calculated using a point distance function. Spatial statistics will be conducted. Using SPSS v.22, descriptive

		statistics will be conducted to describe participants' demographics, frequencies of LTR visits, and perception of tobacco marketing in LTRs. They will have the frequencies, means, standard deviations, and percent.
2.	Examine smoking-related outcomes	Using SPSS v.22, descriptive statistics will be conducted to compute the scores of receptivity to tobacco marketing in LTRs, attitude toward smoking, subjective norm about smoking, perceived behavioral control about smoking, smoking intention, lifetime smoking, and current smoking. They will have the frequencies, means, standard deviations, and percent.
3.	Analyze associations between LTR factors and smoking-related outcomes	Using HLM v.7.0, relationships between LTR factors and smoking-related outcomes will be analyzed.
4.	Determine predictors of smoking-related outcomes	Using HLM v.7.0, multilevel modeling will be conducted to determine predictors of smoking-related outcomes.

Table 3. Independent variables (IVs) and dependent variables (DVs) for inferential statistics

Specific Aims	IVs	DVs
3. Analyze associations between LTR factors and smoking-related outcomes 4. Determine predictors of smoking-related outcomes	Demographics (year of birth, sex, grade in school, parents' education, conversation time with parents, economic activity of parents, household economic status, weekly allowance, family smoking, and peer smoking), LTR factors (density of and proximity to LTRs around schools, frequencies of LTR visits, and perception of tobacco marketing in LTRs)	Smoking-related outcomes (receptivity to tobacco marketing in LTRs, attitude, subjective norm, perceived behavioral control, intention, lifetime smoking, and current smoking)

For the third aim, analysis of associations between LTR factors and smoking-related outcomes, relationships between LTR factors and smoking-related outcomes will be analyzed using HLM v.7.0. For the fourth aim determining predictors of smoking-related outcomes, multilevel regression will be used to determine predictors of smoking-related outcomes using

HLM v.7.0 with multiple levels of influence including intrapersonal, interpersonal, and community LTR factors. Candidate independent variables to include in the multilevel regression will be selected among the significant factors determined by the analysis of the third specific aim. In Seoul, South Korea, middle school schools are randomly assigned to students-to-be regardless of academic performance or preference. However, there might be a possibility that characteristics of the participants are different depending on school and that participants at the same school are more similar to each other than other schools. Multilevel regression will adjust for differences of characteristics of each school. Also, this regression will provide information about how much the within-person (within participants) variation and between-group (between schools) variation are. Furthermore, this multilevel regression will enable to compare the effect of each level of influence predicting the adolescent smoking outcomes (Table 2).

Limitations and Strategies to Overcome

There are a few limitations of the proposed study. The first limitation involves using the convenience sampling method in selecting target schools. Convenience sampling may entail bias because the sample selected may be atypical compared with the total population regarding critical variables (Polit & Beck, 2012). To minimize the bias, the investigator is planning to select two classes in the second and third grades randomly and to recruit all class students in those classes of the school. The investigator will also compare demographic characteristics of the participants with demographic data from the target boroughs. And the investigator will use multilevel modeling to adjust for differences of characteristics between schools.

Another limitation is the possibility of confounding or mediating variables in the analysis. In cross-sectional research, there may be confounding variables or mediators influencing the results (Lee et al., 2009). To overcome this limitation, the investigator will include a number of questions asking demographic information to assess potential confounding variables or mediators influencing the smoking outcomes such as age, sex, family smoking and peer smoking. These variables will be included as covariates of the multilevel regression.

Major rivers or spatial barriers may make Cartesian distance calculation less reliable to reflect the actual influence of LTRs. This study will not measure their actual commuting routes given the investigator's level of GIS analysis, but this will be considered in the future studies.

The final limitation is the nature of a self-reported survey. Although the validity of the current smoking item that will be used in the survey had a high Kappa value of 0.80 (Korea Centers for Disease Control and Prevention, 2009), there may be a possibility of under-reported smoking outcomes among the participants. Jung-Choi, Khang, & Cho (2012) reported that Korean female adolescents tended to underreport their smoking. To overcome this limitation, the investigator and data collectors will stress the confidentiality and anonymity of the survey data both in the Parental Consent Form and Minor Assent Form, and during the recruiting period.

Timeline

The total projected time is 12 months. The design/planning phase which includes IRB approval, preparation of materials and software, orientation for the research study will take three months. The empirical phase which includes recruiting participants and data collection will take three months. The analytical phase which includes data analysis using ArcGIS v.10.2 and SPSS

v.22 will take six months. The dissemination phase which includes completion of drafting the results, completion of dissertation, and preparation of results for journal submission will take six months (Table 4).

Table 4. Timeline

Phase	3rd quarter, 2015	4th quarter, 2015	1st quarter, 2016	2nd quarter, 2016
Design/planning				
Empirical				
Analytical				
Dissemination				

PROTECTION OF HUMAN SUBJECTS

A. Risk to Subjects

1. Human Subjects' Involvement and Characteristics, and Design

This study will examine the associations between LTR factors and smoking-related outcomes among adolescents who attend middle schools in Seoul, South Korea. The age range of the participants will be 13 to 15 years old. School health teachers in the 2nd and 3rd grades of the target middle schools will select the participants. All class students will be informed about the project verbally by the school health teacher and then be asked to deliver the Parent Notification Letter and Parental Consent Form to their parent or guardian. The students who return the Parental Consent Form with a signature will be asked to sign the Minor Assent Form. The participants will answer the questionnaires in a classroom or health service room after class. The survey will take 30 minutes. The investigator will collect the questionnaires completed. Inclusion criteria will be Korean speaking male and female adolescents aged 13 to 15 who have attended target middle schools more than 6 months, those who assented and who provided parental consent for study participation. Exclusion criteria will be those who are challenged in reading or thinking. Most middle schools in South Korea have one special class, at least, for the challenged. We will not select the special class. The survey will be conducted only one time.

2. Sources of Materials

Sources of materials will include questionnaires asking their demographic information such as year of birth, sex, grade in school, parents' education, cohabitation with family, conversation time with parents, household economic status, family smoking, and peer smoking. The questionnaire will also ask the frequency of visits to LTRs, purposes to visit LTRs, and

recognition of tobacco marketing in LTRs. The receptivity to tobacco marketing will measure the level of acceptance toward tobacco marketing messages inside LTRs. The questionnaire will ask about their smoking-related outcomes such as lifetime smoking, first time smoked, the amount of cigarettes smoked, acquisition way of smoking products, and constructs of the TPB including attitude toward smoking, subjective norms about smoking, perceived behavioral control about smoking, and smoking intention.

3. Potential Risk

There are minimal risks to participants in this study. The participants will be adolescents aged 13 to 15 years old. They may feel uncomfortable about smoking-related questions. In order to minimize this risk, the participants will be able to choose not to participate in the survey and can decide to stop participation at any point.

There will be minimal risks related to confidentiality of the data collected by surveys. During the data collection process, all efforts will be made to assure the participants' confidentiality. Identifying information of the participants will not be gathered. All physical data collected will be kept in the investigator's locked drawer of a file cabinet. All electronic data collected will be stored in a locked file in the investigator's hard drive, which will be kept in the locked drawer. Only the investigator will have access to the drawer and hard drive.

The Parent Notification Form, Parental Consent Form, and Minor Assent Form will outline study procedures and potential harm that may happen during the study. These forms will indicate that study participation is absolutely voluntary.

B. Adequacy of Protection Against Risk

1. Informed Consent

The parent or guardian of the participants will have the Parent Notification Form delivered by their child. This form will provide general information about the study and logistics of obtaining parental consent and minor assent in the investigator's voice. The Parental Consent Form will then be obtained from a participant's parent or guardian before the survey. These forms will include the purpose, procedure, potential risks, benefits, and voluntary participation of the surveys. The Minor Assent Form will be obtained from the adolescent participants after securing the Parent Consent Form. This form will also explain about the purpose, procedure, potential risks, benefits, and how to withdraw or stop the participation of the study. School health teachers will lead all steps of the informed consent and assent, and use a script to ensure the consistency of the message.

Script. This study will examine if tobacco retailers in South Korea influence adolescent smoking. You will be asked to answer the questionnaire. The questionnaire will ask you about your age and sex, the number of visits that you have made to stores that sell tobacco, and your opinions or behaviors of the smoking. This survey will take 30 minutes and be done in a classroom or health service room under the supervision of me, Seok Hyun Gwon, after class. You and your parent or guardian will decide whether you participate. It is okay to decide not to join. If you participate in the survey, you need to deliver the Parent Notification Form and Parental Consent Form to your parent or guardian and bring back the Parental Consent Form with signature to me. Then, you will be asked to sign the Minor Assent Form. Next, you will finally be asked to answer questions on a written form. Your participation in the survey has nothing to do with your grades in school. You will receive a ₩3,000 gift card if your parents and you agree to participate in study. If you want to withdraw from survey or stop the answering

questions, just tell me (school health teacher) or the researcher at any time. You will not have any penalty if you choose to stop answering questions.

2. Protection against Risk

Although this study will not collect participants' personal information such as name or address, we will assign each participant a case number and use the number to manage the survey materials. All data collected will be stored in a locked hard drive or locked drawer in a file cabinet. The investigator will be the sole person with access to the data. Also, participants will be allowed to withdraw or stop the study at any time.

C. Potential Benefit to Subjects and Others

There are no direct benefits to the participants in this research study. However, by participating in the study, participants will have an opportunity to learn about tobacco companies marketing efforts in LTRs to promote tobacco product sales and to improve the image of smoking. Participants may recognize that there are a number of LTRs near their schools. This will give them another opportunity to think about environmental factors related to smoking in their community.

D. Importance of Knowledge to be Gained

This study is the first research trial about the density of and proximity to LTRs, and adolescent smoking not only in South Korea and in Asia. The findings of this study will provide a better understanding of how Korean adolescents aged 13 to 15 visit LTRs, recognize tobacco marketing in LTRs, and their smoking outcomes are influenced by LTR factors. In addition, the results of this study will contribute to an evidence base, which supports the need for public health policy changes including licensing and zoning regulations of LTRs in areas frequented by

adolescents for youth smoking prevention.

E. Inclusion of Women

Both male and female students will be included in this study. The target population will follow the gender representation of the population of the city where this study will be conducted. The ratio between male and female adolescents will be approximately 50% vs. 50%.

F. Inclusion of Minorities

This study will not include ethnic minority populations.

G. Inclusion of Children

The target population of this study is entirely composed of children under 21 year of age (specifically, 13- to 15-year-olds) who attend middle schools. This age group represents a critical period for acquiring smoking behavior. Parental informed consent will be obtained from the children's parent or guardian before the survey. Then, the children will provide written assent. During the survey, the children will be guided by the school health teacher and supervised by the investigator. The parent or guardian and children will be informed about withdrawal of the study participation at any time.

H. Targeted/Planned Enrollment Table

Table 4. Targeted / planned enrollment

Targeted / planned enrollment: number of subjects			
Ethnic Category	Females	Males	Total
Hispanic or Latino	0	0	0
Not Hispanic or Latino	360	360	720
Ethnic Category: Total of All subjects	360	360	720
Racial Categories	Females	Males	Total
American Indian/ Alaska Native	0	0	0
Asian	360	360	720
Native Hawaiian or Other Islander	0	0	0
Black or African American	0	0	0
White	0	0	0
Racial Categories: Total of All Subjects	360	360	720

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Appendix 1. Operationalization of Study Constructs

Constructs	Variables / Coding	Level of Measurement	Instrument & Source	Methods & Completion time
Demographic information	1. Year of birth	Ratio		Self-report, 30 minutes
〃	2. Sex (1) Male; (2) Female	Nominal		
〃	3. Grade in school (1) 1st; (2) 2nd; (3) 3rd	Nominal		
Attitude	4. Attitude: Question No. 18, 19 and 20 of the KFAHQ (Appendix 2)	Ratio	KFAHQ	
Subjective norm	5. Subjective norm: Question No. 31 of the KFAHQ (Appendix 2)	Ratio	KFAHQ	
Perceived behavioral control	6. Perceived behavioral control: Question No. 17, 27 and 32 of the KFAHQ (Appendix 2)	Ratio	KFAHQ	
Intention	7. Intention: Question No. 13, 21 and 38 of the KFAHQ (Appendix 2)	Ratio	KFAHQ	
Demographic information	8. Father's education years (1) Middle school or lower; (2) High school; (3) 2- to 3-year college; (4) 4-year college; (5) I don't know	Nominal		
〃	9. Mother's education years (1) Middle school or lower; (2) High school; (3) 2- to 3-year college; (4) 4-year college; (5) I don't know	Nominal		
〃	10. Cohabitation with parents (1) Yes; (2) With my father only; (3) With my mother only; (4) No;	Nominal		
〃	11. Conversation time with father (minutes a day)	Ratio		
〃	12. Conversation time with mother (minutes a day)	Ratio		
〃	13. Economic activity of parents (1) My father only; (2) My mother only; (3) Both parents; (4) Neither parents;	Nominal		
〃	14. Household economic status	Nominal		

	(1) Very affluent; (2) Somewhat affluent; (3) Average; (4) A little poor; (5) Poor;			
〃	15. Weekly allowance (₩)	Ratio		
Demographic information	16. Family current smoking (1) none; (2) father; (3) mother; (4) siblings; (5) grandparents; (6) other; (7) no idea	Nominal	Korea Youth Risk Behavior Web-based Survey[1]	
〃	17. Number of peers smoking currently	Ratio		
LTR factors	18. A frequency of passing by LTRs when commuting school a day	Ratio		
〃	19. A frequency of visits to convenient stores or supermarkets a week	Ratio		
〃	20. Purposes of visits to those stores (1) Snacks costing ₩1,000 or less; (2) Snacks costing greater than ₩1,000; (3) Beverage; (4) Stationery; (5) Daily supplies or household items; (6) Other	Nominal		
〃	21. Recognition of tobacco selling in those stores (1) Yes; (2) No	Nominal		
〃	22. Recognition of tobacco marketing in those stores (1) Yes; (2) No;	Nominal		
Receptivity to tobacco marketing	23. Receptivity to tobacco marketing ① Smoking is enjoyable: 0 = No; 1 = Yes ② It helps people to relax: 0 = No; 1 = Yes ③ It helps people feel comfortable in social situations: 0 = No; 1 = Yes ④ It is a pleasurable pastime: 0 = No; 1 = Yes ⑤ It helps people stay thin: 0 = No; 1 = Yes ⑥ It helps reduce stress: 0 = No; 1 = Yes	Ratio	Korean Receptivity to Tobacco Marketing[2]	5 minutes

[1] Ministry of Education et al. (2014)
[2] Shin et al. (2012)

	⑦ It helps people when they are bored: 0 = No; 1 = Yes ⑧ The "in" crowd are smokers: 0 = No; 1 = Yes ⑨ Successful people smoke: 0 = No; 1 = Yes		
Smoking-related outcomes	24. Lifetime smoking (1) Yes; (2) No	Nominal	Korea Youth Risk Behavior Web-based Survey[3] (KYRBWS)
〃	25. First time of smoking (1) Before elementary school (ES); (2) 1st grade in ES; (3) 2nd grade in ES; (4) 3rd grade in ES; (5) 4th grade in ES; (6) 5th grade in ES; (7) 6th grade in ES; (8) 1st grade in middle school (MS); (9) 2nd grade in MS; (10) 3rd grade in MS	Nominal	KYRBWS
〃	26. Days of smoking in the last month	Ratio	KYRBWS
〃	27. Number of cigarettes in the last month (1) 1 cigarette (cig); (2) 1 cig; (3) 2-5 cigs; (4) 6-9 cigs; (5) 10-19 cigs; (6) 20 cigs or greater; (7) I never smoked	Nominal	KYRBWS
〃	28. Primary way of getting cigarettes (1) Tobacco in my home or friend's home; (2) Purchase at a convenience store or retailer store; (3) Got tobacco from my friends or seniors; (4) Got tobacco from adults; (5) Picked up cigarettes in the street; (6) Other;	Nominal	

[3] Ministry of Education et al. (2014)

Appendix 2. Questionnaire

ID: _____ Date: _____

Influence of Licensed Tobacco Retailers on Adolescent Smoking

Principal Investigator: Seok Hyun Gwon, University of Virginia School of Nursing
Contact information: sundaygwon@gmail.com, 010-3789-0513

This survey is anonymous. All information collected by survey will not be used except researc h purposes.

You are to fill in the blanks or mark (X) in the multiple choices that best describe your activity or your opinion.

1. Year of birth: _____
2. Sex: (1) male _____ (2) female _____
3. Grade in school: (1) 1st _____ (2) 2nd _____ (3) 3rd _____
4. In this questionnaire[4], we ask questions that make use of rating scales with seven places. You are to make a mark (X) in the space that best describes your activity or your opinion.

FOR EXAMPLE: If you were asked to rate "The weather in Seoul" on such a scale and you think the weather in Seoul is quite good, then you would place your mark as follows;

"The weather in Seoul is:"

good		X						bad
	extremely	quite	slightly	neither	slightly	quite	extremely	

If you think the weather in Seoul is neither good nor bad, then you would place your mark as follows:

good				X				bad
	extremely	quite	slightly	neither	slightly	quite	extremely	

If you think the weather in Seoul is extremely bad, then you would place your mark as follows:

good							X	bad
	extremely	quite	slightly	neither	slightly	quite	extremely	

In making the questionnaire, please remember the following:

① There are no right or wrong answers; we are interested in your opinion.

② Place your mark in the middle of the space, not on the dots.

③ Please answer all items – make one check mark on each scale.

④ Please answer each question honestly.

REMEMBER – WE ARE INTERESTED IN YOUR OPINON

[Korean Fishbein-Ajzen-Hanson Questionnaire]

1) If I do things that help me relax that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

2) If I don things that make me feel good that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

[4] Hanson (1997)

3) If I get cancer that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

4) If I get along with my friends that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

5) If I get heart disease that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

6) If I smell bad that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

7) If I do things that increase my chances for health problems that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

8) If I control my weight that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

9) If I have yellow teeth that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

10) If it is harder for me to breathe that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

11) If I spend a lot of money that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

12) If I do things that I enjoy that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

13) I intend to smoke cigarettes a month from now.

false								true
	extremely	quite	slightly	neither	slightly	quite	extremely	

14) How often are you bored?

frequently								never
	extremely	quite	slightly	neither	slightly	quite	extremely	

15) How often are you under a lot of stress?

frequently								never
	extremely	quite	slightly	neither	slightly	quite	extremely	

16) How often are you around others who smoke cigarettes?

frequently								never
	extremely	quite	slightly	neither	slightly	quite	extremely	

17) If I wanted to I could easily not smoke cigarettes during the next month.

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

18) For me, to smoke cigarettes during the next month would be:

nice								awful
	extremely	quite	slightly	neither	slightly	quite	extremely	

19) For me, to smoke cigarettes during the next month would be:

pleasant								not pleasant
	extremely	quite	slightly	neither	slightly	quite	extremely	

20) For me to smoke cigarettes during the next month would be:

not fun at all								a lot of fun
	extremely	quite	slightly	neither	slightly	quite	extremely	

21) I intend to smoke cigarettes a month from now.

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

22) Most of the time, when my friends think I should do something, I go along with it.

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

23) Most of the time, when my mother thinks I should do something, I go along with it.

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

24) Most of the time, when my father thinks I should do something, I go along with it.

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

25) Most of the time, when my best friend thinks I should do something, I go along with it.

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

26) Most of the time, when my boyfriend or sexual partner thinks I should do something I go along with it.

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

27) How much control do you think you have over whether you smoke cigarettes?

no control								complete control
	extremely	quite	slightly	neither	slightly	quite	extremely	

28) When I am bored, I smoke cigarettes:

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

29) When I am around others who smoke, I smoke cigarettes too:

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

30) When I am under a lot of stress, I smoke cigarettes:

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

31) If I smoke cigarettes, most people who are important to me would:

approve								disapprove
	extremely	quite	slightly	neither	slightly	quite	extremely	

32) Do you think it would be difficult or easy for you not to smoke cigarettes during the next month?

easy								difficult

	extremely	quite	slightly	neither	slightly	quite	extremely	

33) If I smoke cigarettes, my friends would:

approve								disapprove
	extremely	quite	slightly	neither	slightly	quite	extremely	

34) If I smoke cigarettes, my mother would:

approve								disapprove
	extremely	quite	slightly	neither	slightly	quite	extremely	

35) If I smoke cigarettes, my father would:

approve								disapprove
	extremely	quite	slightly	neither	slightly	quite	extremely	

36) If I smoke cigarettes, my best friend would:

approve								disapprove
	extremely	quite	slightly	neither	slightly	quite	extremely	

37) If I smoke cigarettes, my boyfriend or sexual partner would:

approve								disapprove
	extremely	quite	slightly	neither	slightly	quite	extremely	

38) I intend to smoke cigarettes a month from now.

probably								probably not
	extremely	quite	slightly	neither	slightly	quite	extremely	

39) If I smoke cigarettes, it will help me relax:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

40) If I smoke cigarettes, it will make me feel good:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

41) If I smoke cigarettes, I will get cancer:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

42) If I smoke cigarettes, it will make me smell bad:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

43) If I smoke cigarettes, it will be bad for my health:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

44) If I smoke cigarettes, it will help me control my weight:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

45) If I smoke cigarettes, it will help me get along with my friends:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

46) If I smoke cigarettes, I will get heart disease:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

47) If I smoke cigarettes, it will make my teeth yellow:

likely								unlikely

	extremely	quite	slightly	neither	slightly	quite	extremely	

48) If I smoke cigarettes, it will be harder for me to breathe:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

49) If I smoke cigarettes, it will cost me a lot of money:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

50) If I smoke cigarettes, it will be enjoyable:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

5. What is your father's final educational background? (1) middle school or lower _____ (2) high school _____ (3) 2 or 3 year-college _____ (4) 4 year college or university _____ (5) I don't know _____
6. What is your mother's final educational background? (1) middle school or under _____ (2) high school _____ (3) 2 or 3 year-college _____ (4) 4 year college or university _____ (5) I don't know _____
7. Do you live with your parents? (1) Yes. I live with both parents _____ (2) I live with my father only _____ (3) I live with my mother only _____ (4) I don't live with any parent _____
8. How long did you talk with your father in the last month? _____minutes a day
9. How long did you talk with your mother in the last month? _____minutes a day
10. Do your parents make money for a living? (1) My father only _____ (2) my mother only _____ (3) both parents _____ (4) neither parents _____
11. What the economic status of your household? (1) very affluent _____ (2) somewhat affluent _____ (3) average _____ (4) a little poor _____ (5) poor _____
12. How much is your weekly allowance? ₩_____

(Weekly allowance includes all money you get from parents and you make for yourself)

13. Please mark any family members who smoke currently.[5] (1) None _____ (2) father _____ (3) mother _____ (4) siblings _____ (5) grandparents _____(6) other _____ (7) no idea _____
14. How many peers are currently smoking? _____ peers
15. How many convenient stores or supermarkets do you pass by when commuting school? _____ times a day
16. How often did you stop by convenient stores or supermarkets in the last month? _____times a week
17. What were the reasons you got there? (you can mark multiple choices) (1) snacks costing ₩1,000 or less _____ (2) snacks costing greater than ₩1,000 _____ (3) beverage _____ (4) stationery _____ (5) daily supplies or household items _____ (6) other _____(please write)_____
18. Have you seen selling of tobacco products in the convenience store or supermarket in the last month? (1) yes _____ (2) no _____ (3) I have never been to there _____
19. Have you seen any tobacco promotion (such as advertising of tobacco products) in the convenience store or supermarket in the last month? (1) yes _____ (2) no _____ (3) I have never been there _____
20. Did any of the following 9 messages contain in the advertising?[6]
    1) Smoking is enjoyable _____
    2) It helps people to relax _____
    3) It helps people feel comfortable in social situations _____

[5] Ministry of Education et al. (2014)
[6] Shin et al. (2012)

4) It is a pleasurable pastime _____
5) It helps people stay thin _____
6) It helps reduce stress _____
7) It helps people when they are bored _____
8) The "in" crowd are smokers _____
9) Successful people smoke _____

21. Have you ever smoked in your lifetime?[7] (1) yes _____ (2) no _____
22. When is the first time you smoked? (1) before elementary school (ES) (2) 1st grade in ES (3) 2nd grade in ES (4) 3rd grade in ES (5) 4th grade in ES (6) 5th grade in ES (7) 6th grade in ES (8) 1st grade in middle school (MS) (9) 2nd grade in MS (10) 3rd grade in MS (11) I have never smoked.
23. How many days did you smoke in the last month?[c] (1)_____days (2) I never smoked.
24. How many cigarettes a day did you smoke in the last month?[c] (1) less than 1 cigarette (cig) (2) 1 cig (3) 2-5 cigs (4) 6-9 cigs (5) 10-19 cigs (6) 20 cigs or greater (7) I never smoked
25. How did you get the cigarettes primarily?[c] (1) tobacco in my home or friend's home (2) purchase at a convenience store or retailer store (3) got tobacco from my friends or seniors (4) got tobacco from adults (5) picked up cigarettes in the street (6) other

[7] Ministry of Education et al. (2014)

CHAPTER 3: Manuscript 1 – Systematic Review: Geographic Distribution of Licensed Tobacco Retailers and Adolescent Smoking

Target Journal: International Nursing Review

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Abstract

Background and Introduction: The presence and availability of tobacco retailers may influence adolescent smoking motivation. While some studies reported there were statistically significant associations between the density and proximity of tobacco retailers, and adolescent smoking, no systematic literature review exists regarding this topic. **Aim**: The purpose was to examine literature on the association between the density and proximity of tobacco retailers, and adolescent smoking. **Methods**: This systematic literature review included nine studies based on the following criteria: 1) data-based studies exploring the association between the density and/or proximity of tobacco retailers; and 2) adolescent smoking research published in peer-reviewed journals in the past 10 years. **Results**: Two studies found a statistically significant association between tobacco retailer density and adolescent lifetime smoking. One study found a statistically significant relation between tobacco retailer density and adolescent past 12-month smoking. Three of eight analytic models found a statistically significant association between tobacco retailer density and adolescent past 30-day smoking. One study found a statistically significant association between tobacco retailer density and adolescent susceptibility to smoking. One study found a statistically significant association between the proximity from tobacco retailers to home and adolescent lifetime smoking. **Conclusions**: The density and proximity of tobacco retailers were more associated with adolescent lifetime and past-12 month smoking, than past 30-day smoking and susceptibility to smoking. **Implications for Health Policies**: Zoning and licensing restrictions for tobacco retailers may be needed for adolescent smoking prevention. There is a need for more school-based tobacco use prevention programs provided by health professionals

such as school nurses for students who attend schools located in areas of higher tobacco retailer density and shorter proximity.

Keywords: Tobacco, Health Policy, Adolescent Care, Public Health Nursing, School Children Nursing

Systematic review: Geographic distribution of licensed tobacco retailers and adolescent smoking

Smoking has a detrimental effect on humans. According to the World Health Organization (2011), six million people die because of smoking each year worldwide, and this figure will increase to more than seven million by the year of 2020. Smoking deaths will account for 10% of the total number of deaths from all causes in one year. Smoking is a primary risk factor for cancer, heart disease and stroke, and respiratory disease; these three conditions constitute the first, second, and third leading causes of death in the United States (Centers for Disease Control and Prevention, 2013; U.S. Department of Health and Human Services, 2010b; World Health Organization, 2013). In addition, in 2014 smoking cost the United States $170 billion in direct medical costs and $156 billion in lost productivity annually (U.S. Department of Health and Human Services, 2014; Xu et al., 2014)

Most smokers begin smoking during adolescence. Approximately, 90% of smokers initiate smoking at or before the age of 18 (Center for Tobacco-Free Kids, 2013). If adolescents are protected from tobacco use, they are either less likely to ever smoke in their lifetime or more likely to start smoking later in life. According to Cho (2013), smokers who initiated smoking before the age of 19 have a 2.4 times higher probability of being hardcore smokers than those who started smoking after the age of 26. Thus, adolescent smoking prevention is an important issue in health care.

Research investigating the association between licensed tobacco retailers (LTRs) and adolescent smoking is critical due to the potential influence of marketing tactics of tobacco companies on the purchasing habits of tobacco-using adolescents. Youths get cigarettes mostly in

retail stores (McCarthy et al., 2009). The 1998 Master Settlement Agreement (MSA) restricted active marketing of tobacco products in the United States. Subsequently, companies focused marketing efforts at the point-of-sale (POS) and continued to advertise tobacco products, while still following the technical requirements of the agreement (Center for Tobacco-Free Kids, 2013).

Understanding the association between LTRs and adolescent smoking is important because even those who enter an LTR without the intention of purchasing tobacco products may be exposed to the tobacco companies' marketing materials; thus, the presence and availability of LTRs may influence visitors' smoking motivation. One method used to measure the presence and availability of LTRs is investigation of the geographic distribution of LTRs such as the density of LTRs in an area or proximity of LTRs to schools or homes. In previous studies, LTR distribution has been measured using geographic density, defined as a quantity of LTRs in a prescribed geographic area. Using this definition, a higher LTR density has been found to be associated with tobacco use among adults (Chuang et al., 2005; Li, Land, Zhang, Keithly, & Kelsey, 2009).

Although there have been numerous findings regarding the risk factors that influence smoking behavior among youths (Goldade et al., 2012; C. Lovato et al., 2013; Tjora, Hetland, Aaro, & Overland, 2011), there have been comparably small number of studies investigating the association between LTRs and adolescent smoking. Paynter and Edwards (2009) introduced a systematic review to demonstrate the association between tobacco promotions at the POS and adolescent smoking. They found that most studies showed statistically significant associations between tobacco promotions at the POS and adolescent smoking. However, to date, there has not been any synthesis of the studies associated between the density and proximity of LTRs and

adolescent smoking.

Adolescence is an impressionable time (Kinder & Sears, 1985). Adolescents tend to imitate the behaviors of others and are susceptible to their environment, which may result in a higher potential for change. Adolescents, who live in an area with a higher density of LTRs, or shorter proximity to LTRs from school or home may, are more likely to observe adults purchasing tobacco products and smoking, than those who do not. Thus, the density and proximity of LTRs may be associated with adolescent smoking. Ashe, Jernigan, Kline, & Galaz (2003) stated that zoning regulations of tobacco stores may be needed to prevent adolescents from availability of tobacco products and exposure to tobacco advertising.

The purpose of this study is to examine literature on the association between LTRs' geographic density and proximity, and adolescent smoking. This study has two research questions: (1) "Is the density of LTRs associated with adolescent smoking?" and (2) "Is the proximity to LTRs from school or home associated with adolescent smoking?"

Methods

Data Sources

To address the study purpose, literature was searched systematically within the PubMED, Ovid MEDLINE, Tobacco Control, and Nicotine & Tobacco Research databases. The search terms were "tobacco or smoking," "cigarette/s," "retail/er," "density," "proximity," and "adolescent/s."

Inclusion Criteria

Original research articles written in English and published in peer-reviewed journals in the past 10 years were selected for review. In addition, selected studies contained the following measures: density of LTRs in a prescribed area, or proximity to the LTRs from school or home, and lifetime smoking, past 12-month smoking, past 30-day smoking, current smoking and/or susceptibility to smoking among adolescents.

Measures

Lifetime smoking was defined as ever smoking in the past or currently (U.S. Department of Health and Human Services, 2010a); past 12-month smoking as smoking in the recent 12 months; past 30-day smoking as smoking in the last month; susceptibility to smoking as intention to smoke in the future in survey questions (Chan & Leatherdale, 2011; Loomis et al., 2012).

Study Selection

A total of 330 studies were selected for review (Figure 1). First, we reviewed titles and abstracts of all studies for appropriateness. This limited the articles to 50 that appeared to match the aims of the review. Next, full text articles were systematically examined on basis on the inclusion criteria. A total of 41 studies were excluded since their focus did not match the inclusion criteria. Finally, a total of nine studies were included for the review. These articles were critically evaluated, and for each study selected, the study purpose, aims, research design, outcome measures, results, and conclusions were displayed in a table (Table 1).

Results

Article descriptions

The nine studies are presented in Table 1. They were published between 2006 and 2014. All used a quantitative and cross-sectional research design, and eight used secondary data analysis while only one study evaluated primary data. The research undertaken was from a variety of disciplines including public health, medicine, and psychology. Every study had a clear purpose statement and/or research questions. None of the studies used a theoretical framework. All studies were conducted in either the United States or Canada. The main variables involved in the studies were the density of LTRs in a prescribed area and proximity to LTRs from school or home as independent variables, and lifetime smoking, past 12-month smoking, past 30-day smoking, and susceptibility to smoking as dependent variables.

Characteristics of Participants

Characteristics of participants varied. The sample number ranged from 225 to 70,427. All of the studies included both genders and in the studies that reported the distribution of gender, both genders were fairly equally represented, with five of the studies having between 48.1% and 54.4% females (Adams, Jason, Pokorny, & Hunt, 2013; Lipperman-Kreda, Grube, & Friend, 2012; McCarthy et al., 2009; Novak, Reardon, Raudenbush, & Buka, 2006; West et al., 2010). The remaining four studies did not identify the percentage breakdown of the gender (Chan & Leatherdale, 2011; Henriksen et al., 2008; Leatherdale & Strath, 2007; Loomis et al., 2012). Five studies identified the racial breakdown of the sample (Adams et al., 2013; Henriksen et al., 2008; Lipperman-Kreda et al., 2012; McCarthy et al., 2009; Novak et al., 2006). The proportion of non-Caucasian samples ranged from 29.0% to 84.4%. Three studies did not contain a detailed description of the racial or ethnic characteristics of the study sample (Chan & Leatherdale, 2011; Leatherdale & Strath, 2007; Loomis et al., 2012). One study presented acculturation, indicating

the level of adaptation of the culture from the Hispanic group, instead of reporting ethnicity (West et al., 2010). The age range of the participants in the reviewed studies was between nine and 23, and the adolescents' school grade ranged between 6th and 12th.

Measure Criteria of Density and Proximity of LTRs

There was broad variation in how LTR density was measured in the studies reviewed. While five studies described that the Geographic Information Systems (GIS) technology was used for analysis of LTRs, four studies did not. Five studies calculated LTR density within a certain radius of the school (Adams et al., 2013; Chan & Leatherdale, 2011; Henriksen et al., 2008; Leatherdale & Strath, 2007; McCarthy et al., 2009). Among these studies, the radius in four studies ranged from 0.5 mile to 1 mile and one study used a six-block radius. One study calculated the density of LTRs with home locations as the center (Novak et al., 2006). Two studies measured LTR density in the administrative district boundaries (Lipperman-Kreda et al., 2012; Loomis et al., 2012). Only two studies measured the proximity to LTRs, and these two studies measured it differently. One study assessed the distance to LTRs from the adolescents' homes (West et al., 2010), the other study measured the distance to LTRs from the adolescents' schools (Henriksen et al., 2008).

Association between LTR Density and Proximity, and Adolescent Smoking

Table 2 presents associations between LTR density and proximity, and adolescent smoking found in the studies reviewed. To address the first research question, articles that studied the association between density of LTRs and adolescent smoking were evaluated. Two studies evaluated the association between the LTR density and adolescent lifetime smoking. Both

of these studies found that LTR density was a statistically significant predictor of adolescent lifetime smoking (Adams et al., 2013; Lipperman-Kreda et al., 2012). One study assessed the relation between the density of LTRs and adolescent past 12-month smoking (Lipperman-Kreda et al., 2012). This study found that LTR density was statistically associated with participants' past 12-month smoking. Eight analytic models in seven studies examined the association between the LTR density and past 30-day smoking among adolescents. However, only three analytic models found a statistically significant association between these two variables (Leatherdale & Strath, 2007; McCarthy et al., 2009; Novak et al., 2006). Two studies explored the relation between the density of LTRs and susceptibility to smoking. Only one study discovered the statistically significant association between two variables (Chan & Leatherdale, 2011).

To answer the second research question, articles that evaluated the relation of the proximity to LTRs from school or home were reviewed. Two studies analyzed the association between the proximity of LTRs and youth smoking, but only one study found that the relationship between the distance from the LTRs to home and lifetime smoking among adolescents reached statistical significance (West et al., 2010). The second study, which examined the association between the proximity from the LTRs to school and student past 30-day smoking, failed to show a statistically significant association (Henriksen et al., 2008).

Discussion

In this study, LTR density and proximity factors were found to be more correlated with adolescent lifetime smoking and past 12-month smoking, and less correlated with past 30-day smoking and susceptibility to smoking. Only some of studies reported that LTR density and

proximity were associated with adolescent past 30-day smoking, and susceptibility to smoking. Previous studies reported that, while adolescent experimental smoking was associated with smoking friends, positive attitude toward smoking and perception that tobacco products were easily available, adolescent established smoking was associated with family influence and cost in addition to peer influence (Flay et al., 1998; Mohammadpoorasl, Fakhari, Shamsipour, Rostami, & Rashidian, 2011; Robinson, Klesges, Zbikowski, & Glaser, 1997). The higher density and shorter proximity of LTRs may be primarily related to the predictors of adolescent experimental smoking. However, because adolescent smoking behavior may lead to established smoking in adulthood (Paavola et al., 2004), we need to still pay attention to youth experimental smoking. It is possible that adolescent smoking was not measured accurately because of nature of the self-reported survey data in smoking research (Choi et al., 2012; Jung-Choi et al., 2012; M. B. Park, Kim, Nam, & Hong, 2014). Therefore, the association between the LTR density and proximity and adolescent smoking needs further evaluation by studying clinical indices such as cotinine. The way the density and proximity of LTRs with respect to school, community, and home were calculated did not appear to make a difference of the results. Previous studies reported that advertising and marketing in the LTR setting were associated with adolescent smoking (Feighery et al., 2006; C. Y. Lovato et al., 2007; Slater et al., 2007). Adolescents residing in areas with a higher density and a shorter mean proximity of LTRs may have increased motivation to smoke and purchase tobaccoe because they have more opportunities to encounter advertising of tobacco products in LTRs.

One of the reasons that the density and proximity of LTRs are associated with adolescent smoking may be that smoking rates among adults living in the areas examined were higher. LTRs

in these areas may stock more tobacco products than in areas with lower adult smoking rates. Adolescents are more likely to observe people smoking and to see cigarette butts littered in the street while they are commuting to school. For this reason, adolescents living in areas with the higher density and shorter proximity of LTRs may be familiar with smoking or have more positive attitude toward smoking and be more motivated to smoke and buy cigarettes. More research is needed to understand the relation between LTRs and both adolescent and adult smoking.

Literature in this systematic review had some common features. For one thing, all studies were conducted in the United States and Canada. Second, no studies were based on a theoretical framework. Third, all studies used a quantitative approach. Finally, the majority of the literature utilized secondary data.

Limitations in generalizing the results of this review are as follows: 1) Each study had a different standard of measurement for the density of and proximity to LTRs. 2) Each study used the cross-sectional design; and, 3) Each study was conducted in North America. Nevertheless, this review is meaningful in that this is a first attempt to systematically review and analyze studies that examined the association between the LTR density and proximity, and adolescent smoking.

Implications for Health Policies

Future studies may need to identify the number of opportunities and major purposes to visit LTRs among adolescents. A qualitative research approach might be useful for adolescents regarding their purchasing behavior of tobacco products and desire to visit LTRs. In other parts

of the world, such as Europe and Asia, additional studies are required given different adolescent smoking prevalence between the United Sates and other countries. For example, smoking rates of high schools in the United States (male: 14.1%, female: 11.2%, both 12.7%) (World Health Organization, 2015) are different from those (male: 20.8%, female: 6.5%, both: 13.5%) in South Korea (Ministry of Education, Ministry of Health and Welfare, & Korea Centers for Disease Control and Prevention, 2014). Similar studies in these countries will increase the representativeness of the influences of LTR density and proximity on adolescent tobacco use behavior.

Administrators in charge of education, finance, and health should pay attention to zoning and licensing restrictions for LTRs, at least, around areas frequented by adolescents such as schools, for adolescent smoking prevention. More school-based tobacco use prevention programs provided by health professionals such as school nurses need to be considered for the students who live or attend the schools located in areas of higher LTR density and shorter LTR proximity. Addressing those measures, for adolescents, may help reduce opportunities to visit LTRs and help adolescents recognize that advertising of tobacco products does not convey desirable messages toward smoking. These efforts will help decrease smoking among adolescents and, in the long-term, among the adults.

Conclusion

Nine studies that analyzed the association between the geographic density and proximity of LTRs, and tobacco use among adolescents were investigated in accordance with the inclusion criteria. Three studies that evaluated the relation between the density and proximity of LTRs, and

adolescent lifetime smoking found statistical significance. One study that explored the association between the LTR density and past 12-month smoking among adolescents showed statistical significance. Three of nine analytic models that examined the association between the density of and distance to LTRs, and adolescent past 30-day smoking found statistical significance. One study that explored the relation between LTR density and adolescent susceptibility to smoking showed a statistically significant result. These findings suggest the need for zoning and licensing restrictions of LTR in areas frequented by adolescents and for school-based tobacco use prevention programs for students who live or commute school in areas of the higher LTR density or shorter LTR proximity.

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Table 1.

Studies Examining the Association between the LTR Density and Proximity, and Adolescent Smoking

Study	Purpose/ Aims	Sample	Research Design	Outcome Measures	Results and Conclusions
Adams et al. (2013)	To explore the relation between the density of LTRs and illegal tobacco sales rate within school neighborhoods and smoking behaviors among students	N = 9,704 Gender: both (female 51.8%) Ethnicity/Race: 71.0% Caucasian, 12.4% Hispanic, 8.2% African American, 8.5% unknown Grade: 7-10th Region: Illinois, USA	Secondary data analysis from cross-sectional studies	Density of LTRs, illegal tobacco sales rates, past 30-day smoking, and lifetime smoking rate	The mean of the number of LTRs in a school neighborhood was 2.76. The mean of illegal sales rate was 13%. The density of LTRs was significantly associated with lifetime smoking (OR = 1.10, $p = 0.051$), but not with past 30-day smoking ($p > .05$) The rate of illegal tobacco sales was not associated with any smoking behavior ($p > .05$).
Lipperman-	To investigate the	N = 1,491	Descriptive	LTR density, local	The LTR density had a positive relation

Kreda et al. (2012)	associations between the local tobacco policy, LTR density, and youth smoking	Gender: both (female 48.1%) Ethnicity/Race: 64.5% White, 35.5% nonwhite Age: 13-16 Region: midsized California cities, USA	cross-sectional design	clean air policy, prevalence of lifetime and past 12-month smoking	with lifetime smoking (OR = 1.312, $p \leq 0.05$) and past 12-month smoking ($\beta = 0.10$, $p \leq 0.005$)
Loomis et al. (2012)	To estimate the association between LTR density and smoking-related attitudes and behaviors among middle and high school students in	N = 70,427 Gender: both (proportion of each gender not indicated) Ethnicity/Race: White, Black, Hispanic, Asian, and other (proportion of each	Secondary data analysis from cross-sectional studies	LTR density compliance with laws, attitudes toward smoking exposure to advertising, cigarette purchasing, and	The density of LTRs was associated with exposure to point-of-sale advertising among all participants (OR = 1.15, $p < 0.05$) and nonsmokers in New York City (OR = 1.14, $p < 0.05$). The density of LTRs was associated with a positive attitude towards smoking among all students (OR = 1.75, $p < 0.05$) and

	New York	not indicated) Age: 9-17 Region: New York City, USA		smoking prevalence	nonsmokers (OR = 1.68, $p < 0.05$) in the rest of the states. The density of LTRs was not associated with susceptibility to smoking. The LTR compliance was negatively related to cigarette purchase.
Chan & Leatherdale (2011)	To examine how LTR density surrounding schools and social smoking influences are associated with smoking susceptibility among the youth of never smokers, and occasional and	N = 25,893 Gender: both (proportion of each gender not indicated) Ethnicity: not indicated Grade: 9-12th Region: Ontario, Canada	Secondary data analysis from cross-sectional studies	Student- and school level characteristics, smoking status, and smoking susceptibility	The LTR density was associated with susceptibility to smoking (OR = 1.03, $p < 0.05$). Influences of family and friends were associated with future smoking, occasional smoking and daily smoking.

	daily smoking among current smokers				
West et al. (2010)	To explore the influence of the built environment (proximity to alcohol and tobacco retailers from home) on alcohol and tobacco (A&T) use	N = 225 Gender: both (female 50.7%) Acculturation: 64.0% bicultural, 27.1% Hispanic, 8.9% assimilated Age: 14-19 Region: San Diego Tijuana border region, USA	Secondary data analysis from cross-sectional studies	Proximity to A&T retailers and lifetime use of both A&T	Factors found to be associated with A&T use were the distance from home to the nearest A&T stores (OR = 0.90, $p < 0.01$), acculturation, parents' consistent use of contingency management, peer use of A&T, skipping school, attending school in immediate proximity to the US/Mexico border, and the interaction between distance to the nearest retailers and parents' consistent use of contingency management.
McCarthy et al. (2009)	To examine the relation between the density and	N = 19,306 Gender: both (female 54.3%)	Secondary data analysis from cross-	Geocoded locations of LTRs and self-reported	The LTR density was associated with experimental smoking[a] (OR = 1.11, $p <$ 0.05), but not established smoking[b].

	proximity of LTRs near their schools, and students' tobacco use	Ethnicity/Race: 43.9% White, 31.9% Hispanic, 13.2% Asian, 6.6% African American, 2.7% Native Hawaiian / Pacific islander, 1.6% American Indian / native Alaskan Grade: 6-12th Region: California, USA	sectional studies	tobacco use	The effects of experimental smoking were found among the high school students (OR = 1.17) and in urban areas (OR = 1.11); no effects were found among middle school students or in rural areas. High school students were more likely to purchase cigarettes. Middle school students tended to obtain cigarettes from social sources.
Henriksen et al. (2008)	To examine the quantity (density) and location (proximity) of LTRs and retail	N = 24,875 Gender: both (proportion of each gender not indicated) Ethnicity/Race:	Secondary data analysis from cross-sectional studies	LTR density and proximity, retail cigarette advertising, and smoking	The smoking prevalence was 3.2% higher at schools with six or more LTRs than schools without any LTRs. The smoking rate was significantly 2.2 higher in surroundings with moderate

	cigarette advertising in high school neighborhoods and their association with school smoking prevalence	41.2% Caucasian, 34.9% Hispanic, 10.3% Asian, 6.3% African American Grade: 10-12th Region: California, USA		prevalence	tobacco ads and 2.3% greater in surroundings with the highest tobacco ads than without any ads. The presence of a LTR within 1,000ft of a high school and the distance to the nearest LTR from a school were not associated with the smoking prevalence.
Leatherdale & Strath (2007)	To examine characteristics related to the cigarettes access behaviors of underage smoking youth.	N = 19,464 Gender: both (proportion of each gender not indicated) Ethnicity/Race: not indicated Grade: 9-12th Region: Ontario, Canada	Secondary data analysis from cross-sectional studies	LTR density and cigarette access behavior	34.4% underage smokers usually purchased their own cigarettes, and 42.1% were never asked for their age when buying cigarettes. The density of LTRs was associated with an increase of the cases buying their own cigarettes (OR = 1.04, $p < 0.05$) and a decrease of the cases asking someone else to buy their cigarettes (OR = 0.96, $p < 0.01$).

					The density of tobacco outlets was related to current smoking (r = 0.414, p < 0.05).
Novak et al. (2006)	To examine the relation between LTR density and adolescent cigarette smoking after control for a neighborhood characteristics	N = 2,116 Gender: both (female 50.6%) Ethnicity/Race: 43.0% Hispanic, 37.4% Black, 15.6% White, 4.0% other Age: 11-23 Region: Chicago, Illinois, USA	Secondary data analysis from cross-sectional studies	LTR density and current (past 30-day) smoking	The effect of LTR density on the current smoking was found to be marginally significant (OR = 1.13, p = 0.062). As LTR density decrease 9% from the 75 percentile to the 25th percentile, smoking rates decreased 13 %. In a model that added neighborhood demographic controls, LTR density was associated with adolescent smoking (OR = 1.21, p = 0.011). In a model that controlled for the propensity strata indicator variables, there was a significant association between the concentration of LTRs and their smoking behaviors (OR = 1.20, p = 0.049).

Note. LTR = licensed tobacco retailers.

[a]Smoking within 30 days and having ever smoked 100 or more cigarettes

[b]Smoking within 30 days and not having smoked at least 100 cigarettes

Table 2

Association between the Density and Proximity of LTRs and Adolescent Smoking

	LTR density vs. lifetime smoking	LTR density vs. past 12-month smoking[a]	LTR density vs. past 30-day smoking[b]	LTR density vs. susceptibility to smoking	LTR proximity vs. lifetime smoking	LTR proximity vs. past 30-day smoking[b]
Adams et al. (2013)	O		X			
Lipperman-Kreda et al. (2012)	O	O	X			
Loomis et al. (2012)				X		
Chan & Leatherdale (2011)			X	O		
West et al. (2010)					O	
McCarthy et al. (2009)			O[a]			
McCarthy et al. (2009)			X[b]			
Henriksen et al. (2008)			X			X
Leatherdale & Strath (2007)			O			
Novak et al. (2006)			O			

Note. LTR = licensed tobacco retailers; O = a significant association between two variables; X = no significant association between the two variables.

[a]Smoking within 30 days and having ever smoked 100 or more cigarettes

[b]Smoking within 30 days and not having smoked at least 100 cigarettes

CHAPTER 4: Manuscript 2 – Predictors of Adolescent Smoking in South Korea

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Abstract

Objectives: The purpose of this study was to determine predictors of adolescent smoking outcomes including receptivity to tobacco marketing, lifetime smoking, and current smoking in South Korea.

Methods: This study used a cross-sectional descriptive correlational design. The survey was conducted with 13- to 15-year-old adolescents (n = 740) attending middle schools in Seoul, South Korea. Addresses of licensed tobacco retailers (n = 3,488) were obtained from borough offices of Seoul. Geographic Information Systems were used to measure factors related to licensed tobacco retailers and multilevel modeling was used to determine predictors of adolescent smoking outcomes.

Results: Predictors of receptivity to tobacco marketing were peer smoking and number of licensed tobacco retailers passed on way to school. Predictors of lifetime smoking were gender, perceived economy, weekly allowance, sibling smoking, peer smoking, and number of licensed tobacco retailers passed on way to school. Predictors of current smoking were gender, weekly allowance, sibling smoking, and peer smoking.

Conclusions: Predictors found in this study need to be considered in adolescent tobacco prevention programs and policies.

Key words: Adolescent, Smoking, Multilevel Analysis, Geographic Information Systems

Predictors of Adolescent Smoking in South Korea

Smoking has a detrimental effect on nearly every organ in the body. Each year six million people die worldwide because of smoking, and this figure will increase to more than seven million by 2020 (World Health Organization, 2011). Among South Korean current adult smokers, half began smoking at age 19 or younger and 90% started smoking at age 24 or younger (Ko & Jung, 2013). The average age of smoking initiation among current adolescent smokers in South Korea was 12.6, which is the age at which students enter middle school (Ministry of Education et al., 2014). Cho (2013) reported that smokers who began smoking before age 19 were 2.4 times more likely to become heavy smokers than those who started smoking after age 26. Ko and Jung (2013) reported that 28.2% of current 18-year-olds in South Korea would die because of diseases caused by smoking before they reach the age of 85.

The current smoking rate among adolescents in South Korea was 9.2% (14% among males and 4% among females) (Ministry of Education et al., 2014) which is higher than in China (6.9%), Singapore (6.0%), and Japan (male 2.2% and female 1.1%) (World Health Organization, 2015a). Current smoking prevalence of high school students in South Korea was 13.5% (Ministry of Education et al., 2014) and that in the United States was 12.7% (World Health Organization). Established smoking behavior is difficult to change because of the addictive effects of nicotine (U.S. Department of Health & Human Services, 2016). Understanding predictors of South Korean adolescent smoking is essential for adolescent tobacco control practices and policies in South Korea.

According to previous studies, males versus females (Guindon & Boisclair, 2003), lower socioeconomic status (U.S. Department of Health and Human Services, 2012), higher allowance

(Kim & Cho, 2012), parents smoking (Gilman et al., 2009), older sibling smoking (Butterfield et al., 2011) and peer smoking (Villanti et al., 2011) predicted adolescent smoking outcomes such as lifetime smoking and current smoking. However, some studies reported that parental smoking did not have an impact on adolescent smoking (Distefan et al., 1998).

Also, some studies reported that licensed tobacco retailer (LTR) factors predicted adolescent smoking outcomes. It was reported that as the number of observation of tobacco marketing in LTRs increased the probability of higher receptivity to tobacco marketing was greater (Shin et al., 2012). A higher number of LTRs in a prescribed area (Adams et al., 2013; Lipperman-Kreda et al., 2012) and the shorter mean distance between LTRs and homes (West et al., 2010) were associated with adolescent lifetime smoking, however these factors were not associated with past 30-day smoking (Chan & Leatherdale, 2011; Henriksen et al., 2008).

Most of studies regarding the presence of LTRs and adolescent smoking were conducted in the United States (Adams et al., 2013; Chan & Leatherdale, 2011; Henriksen et al., 2008; Lipperman-Kreda et al., 2012; West et al., 2010). South Korea differs from the United States in the way that adolescents commute to school. For example, one study in South Carolina reported that only 5% of children commute to school by foot or bicycle (Sirard et al., 2005). However, 89% of elementary school students, 72% of middle school students and 36% of high school students in major cities of South Korea commute to school by foot (Statistics Korea, 2015). Data from the World Bank (2016) highlights differences in the population density per square kilometers of land between the United States (35) and South Korea (517).

In South Korea, rates of student commuting to school by foot in non-major cities including rural areas were lower than in major cities. A total of 76% of elementary school

students, 55% of middle school students and 28% of high school students were reported to commute to school by walking (Statistics Korea, 2015). Therefore, adolescents living urban areas may have greater chances to pass by LTRs.

Youths purchase tobacco products primarily from LTRs; thus, the LTR is an important location for tobacco control (McCarthy et al., 2009). South Korea has 160,142 LTRs across the country (Kim, 2013), which indicates that there is one LTR for every 300 Koreans and one for 21 Korean adolescents between 15 and 19 years of age. Therefore, these LTR factors need to be considered as potential predictors of South Korean adolescent smoking outcomes. However, fewer studies included these LTR factors in the analytic models and used multilevel modeling (MLM) to determine predictors of adolescent smoking outcomes. When the data has the nested design of sampling students within schools, general regression is not appropriate because there may be correlations between variables at the student and school levels. MLM accounts for the nested structure of the data in both student (individual) and school (group) levels (Yu, 2006).

There have been no studies in South Korea using Geographic Information Systems (GIS) to identify LTR factors such as the geographic distribution of LTRs or mean distance from LTRs to schools. GIS is a systematic approach designed to manage, analyze and present all kinds of geographically referenced data (Law & Collins, 2013). GIS makes it possible to measure LTR factors more accurately and to provide a set of tools to bring the spatial perspective.

This study used MLM and GIS to determine predictors of smoking outcomes including receptivity to tobacco marketing, lifetime smoking, and current smoking among South Korean adolescents aged 13 to 15 years old who attend middle schools. The specific aims of this study were (1) to describe LTR factors, student factors, and school factors associated with adolescent

smoking outcomes; and (2) to determine predictors of adolescent smoking outcomes.

Methods

Data Collection

This study used a cross-sectional descriptive correlational design. Secondary data of LTR addresses in the school level and primary data about adolescents in the student level gained through the survey were used. Addresses of 3,468 LTRs were obtained from the offices of the four boroughs in which the surveys were conducted, Gangseo-gu, Eunpyeong-gu, Yangcheon-gu and Seodaemun-gu of Seoul. The Seoul shapefile (a type of file read in ArcGIS, the GIS software) was obtained from the National Space Information Circulation System in South Korea. The Institutional Review board at the University of Virginia approved the study.

The survey sample consisted of 740 adolescents between 13 and 15 years of ages who had attended 14 target middle schools located in the targeted boroughs. The paper-pencil survey was implemented in both second and third grades between September 1, 2015 and September 31, 2015. One school had male adolescents only and two schools had female adolescents only. The investigator randomly chose a class in each grade using an Excel formula, and all class students who submitted both parent/guardian informed consent and minor informed assent forms were asked to answer the questionnaire. The survey was undertaken after class and it took 30 minutes on average to complete. In order to secure higher confidentiality, every participant was asked to put the questionnaire in an envelope provided by the investigator after completion of the survey and to return it, sealed, to the investigator. A gift card in the amount of 3,000 South Korean Won was given to the participants. Because 42 questionnaires had incorrect or missing answers, only 698 (94.3%) out of the total of 740 questionnaires were used in the final data analysis.

Measures

The survey asked students about demographic information including age, gender, perceived economy (higher, middle, or lower), weekly allowance (South Korean Won), father smoking (yes or no), mother smoking (yes or no), sibling smoking (yes or no), peer smoking (yes or no), number of LTRs passed in a day while commuting to school, and number of LTRs visited in a week while commuting to school. To help interpret the odds ratio in the MLM results more easily, weekly allowance was divided by 10,000. These ten variables were included in the student level.

Self-reported lifetime smoking as a dependent variable was assessed with the question, "Have you ever smoked in your lifetime?" The individuals who answered "yes" to the question were regarded as lifetime smokers. Self-reported current smoking as a dependent variable was assessed with the question, "How many days did you smoke in the last month?" The individuals who had answered "one or greater" to the question were regarded as current smokers. These questions from the Korea Youth Risk Behavior Web-based Survey and the Kappa values of lifetime smoking and current smoking evaluated by the test-retest method were 0.81 (95% confidence interval, CI: 0.78-0.85, $p < 0.001$) and 0.75 (95% CI: 0.68-0.82, $p < 0.01$) (Korea Centers for Disease Control and Prevention, 2009).

Instruments

The Korean Index of Receptivity to Tobacco Marketing was used to measure whether adolescents perceive messages conveyed by tobacco advertising. The original Index of Receptivity to Tobacco Marketing was developed by Evans, Gilpin, Berry, & Pierce (1995) in English, and one of the four dimensions of this instrument was translated by Korean researchers

(Shin et al., 2012) to apply to Korean adolescents. Participants were asked whether any of the following nine messages were included in the tobacco advertising: (a) smoking is enjoyable, (b) it helps people to relax, (c) it helps people feel comfortable in social situations, (d) it is a pleasurable pastime, (e) it helps people stay thin, (f) it helps reduce stress, (g) it helps people when they are bored, (h) the "in" crowd are smokers, and (i) successful people smoke. Any affirmative answer was considered to indicate a cognitive awareness about tobacco advertising. Cronbach's α internal consistency reliability coefficient was reported as 0.86 (Shin et al., 2012) and it was 0.71 in this study. The Cronbach's α value of 0.70 or greater is evaluated as good (Frost et al., 2007).

Geographic Information Systems Analysis

For GIS analysis, ArcGIS v.10.2 was used. The Transverse Mercator Korea was selected to project the coordinate system in the software. The investigator used Google Maps to acquire the latitude and longitude of all LTRs and schools in order to geocode them onto the shapefile of the Seoul map in ArcGIS.

The density of LTRs was calculated by buffer and density functions of ArcGIS. Round buffers from the schools were created to show a half-mile radius since this distance has been primarily used to see the influence of physical environment on health behavior such as smoking (Chuang et al., 2005; Henriksen et al., 2004). Then, the number of LTRs was counted in these prescribed areas and divided by five for easier interpretation of odds ratio in the MLM. The mean proximity to LTRs within a half-mile radius from the schools was calculated by the point distance function of ArcGIS. The density of LTRs and mean proximity to LTRs from schools were included in the school level data.

Statistical Analysis

Statistical Package for the Social Science (SPSS) v.22 and Hierarchical Linear and Nonlinear Modeling (HLM) v.7 were used for statistical analysis. Using SPSS, descriptive statistics were conducted to describe participants' demographic information and socioeconomic status, LTR factors, and smoking outcomes at the student level, the number of LTRs in a half-mile radius from school and mean proximity of LTRs in a half-mile radius from school at the school level. Also, chi square and *t*-test were used to examine differences in characteristics for each smoking outcome. Variables that had *p* values smaller than 0.05 in chi square and *t*-test were included in univariate MLM. Using the HLM, univariate MLM was conducted to determine the individual effect of smoking outcomes. Variables that had *p* values smaller than 0.1 in the univariate MLM were selected as individual variables for multivariate MLM. Although mean proximity of LTRs in a half-mile radius from school was not significant in the univariate MLM, this variable was included in the final multivariate MLM. Multivariate MLM was conducted to determine predictors of smoking outcomes. Because the number of LTRs passed while commuting to school and the number of LTRs visited while commuting to school were correlated, these two variables were each included in the multivariate MLM.

We performed several sensitivity analyses to check the robustness of findings. First, we repeated the analysis excluding three single sex schools. Second, because peer smoking was correlated with sibling smoking, we repeated the analysis excluding peer smoking from the model. Reversely, we repeated the analysis excluding sibling smoking. Substantial changes were not found in the results.

Results

Characteristics of Subjects, Smoking Outcomes, and LTRs

Descriptive statistics were used to examine characteristics of subjects (Table 1). At the student level, the mean age of the subjects was 14.48 years with more females (54.2%) than males. A total of 66.8% reported that the level of household economy was middle, 19.2% was higher, and 14.0% was lower. The mean weekly allowance was 14,768.85 South Korean Won. A total of 45.3% answered "yes" to father smoking, 5.2% to mother smoking, 7.2% to sibling smoking, and 27.8% to peer smoking. The mean number of LTRs participants passed by in a day while commuting to school was 4.90 and mean number of LTRs participants visited in a week while commuting to school was 3.96. A total of 60.5% was found to be receptive to tobacco marketing, 13.6% reported lifetime smoking, and 5.2% reported current smoking.

At the school level, the mean number of LTRs in a half-mile radius from school was 90.07 (SD = 30.77) and mean proximity of LTRs in a half-mile radius from school was 534.40 meters (SD = 36.06). The distribution of LTRs and schools and round buffers around the schools in four boroughs of Seoul were presented in the Figure 1.

Differences between Variables Depending on Smoking Outcomes

Chi square and *t*-test were conducted to examine differences between characteristics depending on each smoking outcome. There were significant statistical differences in gender (female and male), peer smoking (yes and no), number of LTRs passed in a day while commuting to school, and number of visits to LTRs a week while commuting to school depending on receptivity to tobacco marketing (yes and no). There were significant statistical differences in gender (female and male), perceived economy (higher, middle and lower), weekly allowance, mother smoking (yes and no), sibling smoking (yes and no), peer smoking (yes and

no), number of LTRs passed in a day while commuting to school, and number of visits to LTRs a week while commuting to school depending on lifetime smoking. There were significant statistical differences in gender (male and female), perceived economy (higher, middle and lower), weekly allowance, sibling smoking (yes and no), peer smoking (yes and no), number of LTRs passed in a day while commuting to school, and number of LTRs visited in a week while commuting to school depending on current smoking. Based on these univariate statistics, gender, perceived economy, weekly allowance, mother smoking, sibling smoking, peer smoking, number of LTRs passed in a day while commuting to school, and number of LTRs visited in a week while commuting to school were selected as candidate individual variables for univariate MLM. While there was no significant statistical difference in age depending on smoking outcomes, age was selected as a candidate individual variable for the univariate MLM.

Association between Each Variable and Smoking Outcomes

Univariate MLM was conducted to examine whether each variable predicted smoking outcomes (Table 2). Gender (male vs. female), peer smoking (yes vs. no), number of LTRs passed in a day while commuting to school, and number of LTRs visited in a week while commuting to school were statistically significant predictors of tobacco marketing.

Gender (male vs. female), perceived economy (per level one increase), higher weekly allowance, mother smoking (yes vs. no), sibling smoking (yes vs. no), peer smoking (yes vs. no), number of LTRs passed in a day while commuting to school, number of LTRs visited in a week while commuting to school, and number of LTRs in a half-mile radius from school were statistically significant predictors of current smoking.

Age (per one year older), gender (male vs. female), higher weekly allowance, sibling

smoking (yes vs. no), peer smoking (yes vs. no), number of LTRs passed in a day while commuting to school, number of LTRs visited in a week while commuting to school, and number of LTRs in a half-mile radius from school were statistically significant predictors of current smoking.

Predictors of Smoking Outcomes

Multivariate MLM was conducted to determine predictors of smoking outcomes. (Table 3). Peer smoking (yes vs. no) and number of LTRs passed in a day while commuting to school were found to be statistically significant predictors of receptivity to tobacco marketing controlling for other variables. Participants who had peers smoking were 1.78 times more likely to acquire receptivity to tobacco marketing than who did not. As the number of LTRs passed in a day while commuting to school increased by one, the odds of having receptivity to tobacco marketing were 1.07 times greater.

Gender (male vs. female), perceived economy (per one level increase), higher weekly allowance, sibling smoking (yes vs. no), peer smoking (yes vs. no), and number of LTRs passed in a day while commuting to school were found to be statistically significant predictors of lifetime smoking controlling for other variables. Males were 3.04 times more likely to report lifetime smoking than females. As perceived economy increased by one level, the odds of being in the lifetime smoking group were 1.61 times greater. As weekly allowance increased by one (10,000 South Korean Won), the odds of being in the lifetime smoking group were 1.23 times greater. Participants who reported sibling smoking and peer smoking were 4.78 times and 10.25 times more likely to report lifetime smoking, respectively, than those who did not.

Gender (male vs. female), higher weekly allowance, sibling smoking (yes vs. no), and

peer smoking (yes vs. no) were found to be statistically significant predictors of current smoking controlling for other variables. Males were 4.50 times more likely to report current smoking than females. As weekly allowance increased by one, the odds of current smoking were 1.23 times greater. Participants who reported sibling smoking and peer smoking were 4.63 times and 33.40 times more likely to report current smoking, respectively, than those who did not.

Discussion

In this study, 13.6% of the participants who were in second grade (mean age: 13.9) and third grade (mean age: 14.9) in middle schools reported lifetime smoking. This rate is higher than the 11.7% smoking rate among second-year students and lower than the 19.2% smoking rate among third-year students in middle schools reported by South Korea's national statistics (Ministry of Education et al., 2014). A total of 5.2% of the participants reported current smoking which is higher than the 4.2% for second-year students and lower than the 7.9% for third-year students in middle schools reported by the national statistics (Ministry of Education et al., 2014). A total of 60.5% of the participants in this study were found to be receptive to tobacco marketing. There were no benchmark statistics of receptivity to tobacco marketing in South Korea. A review of studies of adolescents in the United States showed 46.5% of middle and high school students were found to be receptive to tobacco marketing, which is lower than the 60.5% rate in this study.

In this study, peer smoking (yes vs. no) was found to be a predictor of receptivity to tobacco marketing. Adolescents who had more peers smoking reported higher receptivity to tobacco marketing, which indicated higher perception of tobacco advertising in LTR settings. Also, the number of LTRs passed in a day while commuting to school was a predictor of

receptivity to tobacco marketing. Higher receptivity to tobacco marketing among those who passed by more LTRs while commuting to school may mean that tobacco marketing effectively worked on adolescents. Receptivity to tobacco marketing was associated with increased smoking uptake in adolescents in a study by Sargent and others (2000). The influence on receptivity to tobacco marketing of peer smoking and number of LTRs passed when commuting to school need further research through path analysis.

Predictors of lifetime smoking were gender (male vs. female), perceived economy (per one level increase), higher weekly allowance, sibling smoking (yes vs. no), peer smoking (yes vs. no), and number of LTRs passed in a day while commuting to school. Predictors of current smoking were gender (male vs. female), higher weekly allowance, sibling smoking (yes vs. no), and peer smoking (yes vs. no). All of these predictors of adolescent smoking except number of LTRs passed in a day while commuting to school were consistent with the findings of previous literature (Butterfield et al., 2011; Guindon & Boisclair, 2003; J. E. Kim & Cho, 2012; Villanti et al., 2011).

Father smoking (yes vs. no) was not associated with adolescent smoking outcomes in this study. Perceived father smoking rates were considerably high in both smoking and nonsmoking groups. In South Korea, smoking rates in male adults were 41.4% overall, 48% for those in their 40s, and 40.8% for those in their 50s (Ministry of Health and Welfare, 2014). However, smoking rates in female adults were 5.7% overall, 6.2% for those in their 40s, and 3.7% for those in their 50s, which were much lower than those for male adults (Ministry of Health and Welfare). In South Korea, mother smoking seems a more important factor than father smoking in predicting adolescent smoking.

Perception of peer smoking was the strongest predictor of all adolescent smoking outcomes in this study, similar to other literature (McVicar, 2011; Villanti et al., 2011). Studies reported that adolescents with smoking friends tended to be more likely to initiate smoking than those without (Jackson, 1997; Scal et al., 2003) and to smoke more (Audrain-McGovern et al., 2006; Dierker et al., 2004). Given that adolescents tend to learn about smoking by observing people around them (Bandura & McClelland, 1977), peer smoking needs to be considered as an important factor for predicting adolescent smoking.

In this study, while the number of LTRs visited was not a predictor of adolescent smoking outcomes, the number of LTRs passed when commuting to school was found to be a predictor of adolescent lifetime smoking. This means that LTRs, which youths unintentionally pass by on the way to or from school, may have influenced adolescent experimental smoking. More than 90% of convenience stores in South Korea displayed and advertised tobacco products around the checkout counter (The Seoul Young Men's Christian Association, 2013). Thus, the built environment factor needs to be considered when developing policies for adolescent smoking prevention.

According to the literature, the density of and/or proximity to LTRs were associated with adolescent smoking. The number of LTRs and mean proximity to LTRs from school in a half-mile radius in school level analyses were not found to be statistically significant predictors of adolescent smoking outcomes in this study. This may be due to predictors other than school level factors explaining smoking outcomes, thus confounding the school effect. Gender, sibling smoking, or peer smoking may have been associated with these school level factors. Also, the half-mile radius from school may not reflect the school environment in South Korea. Further

research is needed to examine associations between predictors of adolescent smoking outcomes at the student and at the school levels, and to compare results in different mile radius from school.

Kreft (1996) recommended 30 individuals under 30 groups as adequate sample size for MLM. Hong said (2015) if the data had a nested structure, MLM is required even though the number of groups is smaller than 30. The number of schools in this study was only 14. This may have influenced the results, suggesting that the school level factors did not predict adolescent smoking outcomes. In future studies on predicting adolescent smoking outcomes, researchers may need to recruit more schools to satisfy the requirements for MLM.

Since there was a difference in the number of LTRs in a half-mile radius from school depending on lifetime smoking and current smoking in univariate MLM (Table 2), school nurses, public health nurses, public health policymakers, and nursing researchers in South Korea need to pay attention to these built environment factors for adolescent smoking prevention. This is important because the majority of South Korean children commute to school by foot and half of them take 15 to 40 minutes to commute to school (Statistics Korea, 2015). In light of the large number of LTRs across the country, South Korean students' manner of commuting to school indicates that a considerable number of adolescents may be exposed to LTRs every weekday.

This study has some limitations. Since a convenience sample of schools was selected and data were cross-sectional, the study results are limited for drawing causal relationships. Because the data at the student level were obtained from a self-reported survey, the results may have been subject to response bias. The self-reported lifetime smoking and current smoking rates may have been underestimated because smoking status is a sensitive issue among adolescents.

The perceived peer smoking rates may have been overrated because of the youths' tendency to overestimate unhealthy behaviors among their peers such as alcohol and drug use (Perkins, Meilman, Leichliter, Cashin, & Presley, 1999). The mean proximity of LTRs to participants' homes may have been more related to smoking outcomes than the distance between LTRs and schools.

Despite these limitations, this study was meaningful in that this was the first investigation of predictors of South Korean adolescent smoking outcomes using MLM with two level data. Because GIS was used to measure actual real number of LTRs and the mean proximity of LTRs in a half-mile around each school, the reliability of the school level data was high. The results of this study provided useful information for developing smoking prevention programs and policies among South Korean adolescents. In addition, this study provided information about the need for zoning and licensing regulations of LTRs around schools in South Korea by reporting that the number of LTRs passed in a day while commuting to school was associated with adolescent lifetime smoking.

In future studies, researchers should: 1) include a biomarker such as cotinine to measure adolescent smoking with greater reliability; 2) recruit more schools in other urban or rural areas using a randomized sampling method; 3) consider the distance between LTRs and participants' homes; and, 4) include more school level variables.

Conclusions

This cross-sectional descriptive study was conducted to determine predictors of adolescent smoking in South Korea. The statistically significant predictors of adolescent smoking outcomes were gender, perceived economy, weekly allowance, sibling smoking, peer

smoking, and number of LTRs passed. The study results suggest that male adolescents, who perceive higher economic status, report higher weekly allowance, and report sibling and peer smoking are a high-risk smoking initiation group. There is a need for zoning and licensing regulations of LTRs around schools. Creation of designated LTR-free zones around schools may be a good example of policy. Also, there is a need for tobacco marketing regulations of LTRs around schools or areas frequented by adolescents.

Health-care providers in charge of adolescent smoking prevention programs should establish partnerships with students, parents, and local health workers to raise awareness about tobacco marketing in LTRs and location of LTRs in school neighborhoods. In addition, community-level interventions that provide information about tobacco marketing and LTR locations, i.e., on the school homepage, in school letters or local newspapers, are warranted. This study provided useful information for adolescent smoking prevention programs and policies. Future studies need to consider the biomarker to measure smoking, greater sample size in other urban and rural areas, distance between LTRs and homes, and more variables at the school level.

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Figure 1. Licensed tobacco retailers and target middle schools in the Seoul map

Table 1. Characteristics of subjects

	Variable	Value	N (%) or mean ± SD
Student level (N = 698)	Age		14.48 ± 0.56
	Gender	Female	378 (54.2)
		Male	320 (45.8)
	Perceived economy	Higher	134 (19.2)
		Middle	466 (66.8)
		Lower	98 (14.0)
	Weekly allowance (South Korean Won)		14,768.85 ± 17,258.08
	Father smoking	No	382 (54.7)
		Yes	316 (45.3)
	Mother smoking	No	662 (94.8)
		Yes	36 (5.2)
	Sibling smoking	No	648 (92.8)
		Yes	50 (7.2)
	Peer smoking	No	504 (72.2)
		Yes	194 (27.8)
	No. of LTRs passed in a day		4.90 ± 3.90
	No. of LTRs visited in a week		3.96 ± 3.90
	Receptivity to tobacco marketing	No	276 (39.5)
		Yes	422 (60.5)
	Lifetime smoking	No	603 (86.4)
		Yes	95 (13.6)
	Current smoking	No	662 (94.8)
		Yes	36 (5.2)
School level (N = 14)	No. of LTRs in a half-mile radius from school[a]		90.07 ± 30.77
	Mean proximity of LTRs in a half-mile radius from school (meter)		534.40 ± 36.06

SD: standard deviation

[a]Density of LTRs in a half-mile radius from school

Table 2. Univariate association of student and school level factors with each smoking outcome

Level	Variable	OR	95% CI	P
Outcome: Receptivity to tobacco marketing				
Student level	Age (per one year older)	0.95	0.77-1.17	0.628
	Gender (male vs. female)	1.33	0.96-1.83	0.086
	Perceived economy (per one level increase)	1.02	0.78-1.33	0.913
	Weekly allowance[a] (per one South Korean won increase)	1.06	0.97-1.17	0.203
	Father smoking(yes vs. no)	1.17	0.86-1.59	0.328
	Mother smoking(yes vs. no)	1.10	0.55-2.22	0.788
	Sibling smoking (yes vs. no)	0.69	0.38-1.24	0.210
	Peer smoking (yes vs. no)	1.88	1.30-2.72	0.001
	No. of LTRs passed in a day (per one increase)	1.07	1.02-1.12	0.003
	No. of LTRs visited in a week (per one increase)	1.06	1.01-1.10	0.015
School level	No. of LTRs in a half-mile radius from school[b] (per five increase)	1.00	0.96-1.04	0.817
	Mean proximity of LTRs in a half-mile radius from school (per one meter increase)	1.00	1.00-1.01	0.832
Outcome: Lifetime smoking				
Student level	Age (per one year older)	1.38	0.85-2.23	0.195
	Gender (male vs. female)	3.21	1.95-5.29	<0.001
	Perceived economy (per one level increase)	1.48	1.00-2.19	0.049
	Weekly allowance[a] (per one South Korean Won increase)	1.32	1.19-1.48	<0.001
	Father smoking(yes vs. no)	1.45	0.93-2.27	0.103
	Mother smoking(yes vs. no)	2.44	1.10-5.41	0.028
	Sibling smoking (yes vs. no)	6.21	3.20-12.02	<0.001
	Peer smoking (yes vs. no)	13.12	7.62-22.61	<0.001
	No. of LTRs passed in a day (per one increase)	1.10	1.05-1.16	<0.001
	No. of LTRs visited in a week (per one increase)	1.10	1.05-1.15	<0.001
School level	No. of LTRs in a half-mile radius from school[b] (per five increase)	1.08	1.00-1.15	0.046
	Mean proximity of LTRs in a half-mile radius from school (per one meter increase)	1.00	0.99-1.02	0.552
Outcome: Current smoking				
Student level	Age (per one year older)	2.35	1.07-5.12	0.032
	Gender (male vs. female)	4.33	1.87-10.03	0.001
	Perceived economy (per one level increase)	1.18	0.65-2.16	0.587
	Weekly allowance[a] (per one South Korean Won increase)	1.35	1.17-1.56	<0.001
	Father smoking(yes vs. no)	1.53	0.76-3.06	0.230
	Mother smoking(yes vs. no)	1.02	0.23-4.54	0.983
	Sibling smoking (yes vs. no)	5.66	2.38-13.49	<0.001
	Peer smoking (yes vs. no)	49.45	11.56-211.51	<0.001
	No. of LTRs passed in a day (per one increase)	1.09	1.01-1.17	0.031
	No. of LTRs visited in a week (per one increase)	1.12	1.05-1.19	<0.001
School level	No. of LTRs in a half-mile radius from school[b] (per five increase)	1.14	1.04-1.26	0.010
	Mean proximity of LTRs in a half-mile radius from school (per one meter increase)	1.01	0.98-1.03	0.566

OR: odds ratio

[a]Divided by 10,000.

[b]Divided by 5, density of LTRs in a half-mile radius from school

Table 3. Multivariate association of student and school level factors with each smoking outcome

Model	Variable	OR	95% CI	P
Outcome: Receptivity to tobacco marketing				
Student level	Gender (male vs. female)	1.29	0.92-1.81	0.139
	Peer smoking (yes vs. no)	1.78	1.21-2.61	0.003
	No. of LTRs passed in a day[a] (per one increase)	1.07	1.02-1.12	0.004
	No. of LTRs visited in a week[a] (per one increase)	1.04	1.00-1.09	0.062
School level	No. of LTRs in a half-mile radius from school[c] (per five increase)	0.98	0.94-1.02	0.315
	Mean proximity of LTRs in a half-mile radius from school (per one meter increase)	1.00	0.99-1.01	0.935
Outcome: Lifetime smoking				
Student level	Gender (male vs. female)	3.04	1.68-5.49	<0.001
	Perceived economy (per one level increase)	1.61	1.03-2.53	0.037
	Weekly allowance[b] (per one South Korean Won increase)	1.23	1.08-1.39	0.001
	Mother smoking(yes vs. no)	1.75	0.68-4.55	0.246
	Sibling smoking (yes vs. no)	4.78	2.17-10.53	<0.001
	Peer smoking (yes vs. no)	10.25	5.61-18.73	<0.001
	No. of LTRs passed in a day[a] (per one increase)	1.07	1.00-1.13	0.045
	No. of LTRs visited in a week[a] (per one increase)	1.03	0.97-1.10	0.294
School level	No. of LTRs in a half-mile radius from school[c] (per five increase)	1.00	0.92-1.10	0.924
	Mean proximity of LTRs in a half-mile radius from school (per one meter increase)	1.00	0.99-1.02	0.883
Outcome: Current smoking				
Student level	Age (one year older)	1.66	0.65-4.20	0.288
	Gender (male vs. female)	4.50	1.66-12.24	0.003
	Weekly allowance[b] (per one South Korean Won increase)	1.23	1.03-1.46	0.020
	Sibling smoking (yes vs. no)	4.63	1.56-13.76	0.006
	Peer smoking (yes vs. no)	33.40	7.38-151.16	<0.001
	No. of LTRs passed in a day[a] (per one increase)	1.05	0.96-1.14	0.267
	No. of LTRs visited in a week[a] (per one increase)	1.06	0.99-1.14	0.116
School level	No. of LTRs in a half-mile radius from school[c] (per five increase)	1.05	0.92-1.20	0.419
	Mean proximity of LTRs in a half-mile radius from school (per one meter increase)	1.00	0.98-1.02	0.938

OR: odds ratio

[a]Two variables were not jointly included.

[b]Divided by 10,000.

[c]Divided by 5, density of LTRs in a half-mile radius from school.

Licensed Tobacco Retailers and Adolescent Smoking

Questionnaire

In this questionnaire, we ask questions about your demographic information and socioeconomic status. This survey is anonymous. All information collected by this survey will not be used except for research purposes. Completing this questionnaire is absolutely voluntary. You may leave a question blank if you feel uncomfortable. Please answer questions honestly. Thank you very much.

Direction: Please write your answer or mark the numbers that best describe yourself.

1. Date and year of birth: _____
2. Gender: (1) male _____ (2) female _____
3. What the economic status of your household? (1) very affluent _____ (2) somewhat affluent _____ (3) average _____ (4) a little poor _____ (5) poor _____
4. How much is your weekly allowance? ₩_____
5. Please mark any family members who smoke currently. (1) None _____ (2) father _____ (3) mother _____ (4) siblings _____ (5) no idea _____
6. How many peers are currently smoking? _____ peers
7. How many convenient stores or supermarkets that sell tobacco do you pass by when commuting school? _____ times a day
8. How often did you stop by convenient stores or supermarkets in the last month? _____ times a week
9. Did any of the following 9 messages contain in the advertising?
   10) Smoking is enjoyable _____
   11) It helps people to relax _____
   12) It helps people feel comfortable in social situations _____
   13) It is a pleasurable pastime _____
   14) It helps people stay thin _____
   15) It helps reduce stress _____
   16) It helps people when they are bored _____
   17) The “in” crowd are smokers _____
   18) Successful people smoke _____
10. Have you ever smoked in your lifetime? (0) no _____ (1) yes _____
11. How many days did you smoke in the last month? (1)_____days (2) I never smoked.

담배소매점과 청소년 흡연

설문조사

이 설문조사지는 여러분의 인구학적 정보와 사회경제적 상태를 묻기 위하여 실시됩니다. 이름을 안 써도 되는 익명조사이며 설문조사에서 수집된 정보는 절대로 연구 이외의 목적으로 쓰이지 않을 것입니다. 설문조사 참여는 자발적입니다. 불편한 질문은 빈 칸으로 두어도 됩니다. 최대한 솔직하게 대답해 주세요. 대단히 감사합니다.

여러분의 상황에 맞는 답을 적어주거나 보기에서 선택해주세요.

1. 생년월일: _____
2. 성별: (1) 남_____ (2) 여_____
3. 가정의 경제적 상태는 어떻습니까? (1) 상_____ (2) 중상_____ (3) 중_____ (4) 중하 _____ (5) 하 _____
4. 일주일 동안 쓰는 용돈은 얼마입니까? _____원_
5. 가족 중에서 현재 담배를 피우시는 분을 모두 표시해 주세요. (1)없다_____ (2) 아버지_____ (3) 어머니_____ (4) 형제, 자매_____ (5) 잘 모른다 _____
6. 친구들 중에서 현재 담배를 피우는 친구는 몇 명인가요? _____명_
7. 등교 및 하교할 때 담배를 파는 편의점이나 슈퍼마켓을 몇 개 정도 지나칩니까? _____개_
8. 일주일에 몇 번 정도 담배를 파는 편의점이나 슈퍼마켓에 갔습니까? _____개_
9. 최근 보았던 담배광고가 아래 메시지 중 어느 것을 포함하고 있었습니까? (모두 고르세요)
   1) 흡연은 즐거운 일이다_____
   2) 흡연을 하면 긴장이 완화된다_____
   3) 흡연은 편안하게 사회생활을 하도록 해준다_____
   4) 흡연은 즐거웠던 시간으로 기억된다_____
   5) 흡연은 날씬하게 도와준다_____
   6) 흡연은 스트레스를 감소시켜 준다_____
   7) 흡연은 지루함을 해결하는 데 도움이 된다_____
   8) 많은 사람들이 흡연자이다_____
   9) 성공한 사람들이 흡연을 한다_____
10. 지금까지 담배를 한 두 모금이라도 피워본 적 있습니까? (0) 아니오_____ (1) 네_____
11. 최근 30 일 동안, 담배를 한 대(한 개비)라도 피운 날은 며칠입니까? (1)_____일 (2) 담배를 피워본 적 없습니다.

CHAPTER 5: Manuscript 3 – The Theory of Planned Behavior Applied to Intention to Smoke and Lifetime Smoking in South Korean Adolescents

Target Journal: American Journal of Health Behavior

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Abstract

Objectives: The purpose of this study was to examine associations between intention to smoke and lifetime smoking, and four constructs of the Theory of Planed Behavior including attitude toward smoking, subjective norm about smoking, and perceived behavioral control about smoking, and intention to smoke among adolescents in South Korea.

Methods: This study used a cross-sectional descriptive correlational design. The survey was conducted with 13- to 15-year-old adolescents (N = 740) in Seoul. The questionnaire asked participants' demographics, lifetime smoking, and four constructs including attitude toward smoking, subjective norm about smoking, perceived behavioral control about smoking and intention to smoke. Multivariate multilevel modeling was conducted to analyze the data.

Results: Attitude toward smoking and perceived behavioral control about smoking were statistically significant predictors of intention to smoke and intention to smoke was statistically significant predictor of lifetime smoking of South Korean adolescents, controlling for gender, perceived economy, weekly allowance, sibling smoking, peer smoking, and number of licensed tobacco retailers passed in a day. Number of licensed tobacco retailers also predicted intention to smoke.

Conclusions: Based on the results of this study, attitude, perceived behavioral control, intention to smoke, and tobacco retailers around schools need to be considered for adolescent tobacco prevention and control programs and policies.

Key words: adolescent, smoking, intention, multilevel analysis

The Theory of Planned Behavior Applied to Intention to Smoke and Lifetime Smoking in South Korean Adolescents

Tobacco use is one of the risk factors for various illnesses including cancer, lung diseases, and cardiovascular diseases (World Health Organization, 2013). It is the leading cause of preventable death around the world. Smoking-related diseases cost billions of dollars each year in direct medical care and lost productivity (World health Organization, 2015). Most adult smokers initiate tobacco use during adolescence. Established smoking behavior is difficult to change due to the nicotine's addiction effect.

In South Korean adolescents, the lifetime smoking rate was 19.9% (male 28.5% and female 19.7%) and current smoking rate was 9.2% (male 14% and female 4%) (Ministry of Education et al., 2014). While the current smoking rate was smaller in South Korea than in the United States (14.1%), it was higher than in many Asian countries such as China (6.9%), Singapore (6.0%), and Japan (male 2.2%, female 1.1%) (World Health Organization, 2015a).

According to the Theory of Planned Behavior (TPB) (Ajzen, 1991; Fishbein & Ajzen, 1975), behavioral beliefs, normative beliefs, and control beliefs form attitude toward the behavior, subjective norm, and perceived behavioral control respectively. The TPB assumes that attitude, subjective norm, and perceived behavioral control influence the forming of a behavioral intention; behavior is determined by this intention which is considered the strongest determinant of behavior. The TPB was verified in a range of studies of health behavior (Albarracin et al., 1997; Albarracin et al., 2001; Bogart et al., 2000; Bosompra, 2001) including adolescent smoking initiation (Hanson, 1997, 1999, 2005; Hemchayat, 2003; Godin, Valois, Lepage, & Desharnais, 1992). However, few studies attempted to evaluate the TPB in adolescent smoking

initiation in South Korea.

The TPB covered individual psychosocial constructs only and did not include various social environmental effects, which were emphasized in the ecological perspective of health behavior (McLeroy et al., 1988; Sallis et al., 2006). Previous literature reported that the higher density of licensed tobacco retailers (LTRs) in a prescribed area (Adams et al., 2013; Lipperman-Kreda et al., 2012) were associated with adolescent smoking. These LTR factors in the neighborhood are imiportant in research examining predictors of adolescent smoking, in addition to socio-economic factors such as male versus female (Guindon & Boisclair, 2003), lower economic status (U.S. Department of Health and Human Services, 2012), higher allowance (Kim & Cho, 2012), sibling smoking (Butterfield et al., 2011), and peer smoking (Villanti et al., 2011). These socio-economic factors have been known to be associated with adolescent smoking. One study of the same sample reported that gender, perceived economy, allowance, sibling smoking, peer smoking and number of LTR passed in a day while commuting to school were statistically significant predictors of adolescent lifetime smoking (Gwon, 2016).

The research question for this study was “Do attitude, subjective norm, and perceived behavioral control predict intention to smoke?” and “Does intention to smoke predict lifetime smoking?” The purposes of the study were (1) to describe characteristics of the sample, (2) to determine whether attitude, subjective norm, and perceived behavioral control predict intention to smoke, and (3) to determine whether intention to smoke predicts lifetime smoking.

Methods

Data collection

This study used a cross-sectional design. A convenience sample of middle schools in

four boroughs of Seoul, Republic of Korea, was selected. Among these schools, one class in the 2nd grade (primary age range: 13-14) and another class in the 3rd grade (primary age range: 14-15) were randomly selected. All students in selected classes who were aged 13 to 15 were asked to participate in the paper-pencil survey after both parent/guardian informed consent and minor assent forms were obtained. The survey was conducted in their classrooms or school health rooms after school from September 1st to 30th, 2015. The survey took 30 minutes on average to complete. To assure confidentiality, every participant was asked to use an envelope provided after completion of the survey and return the sealed envelope to the investigator. A gift card in the amount of 3,000 South Korean Won was given to all participants. Because some questionnaires had missing or inappropriate answers, only 698 questionnaires (94.3%) were used in the analysis out of the total sample of 740. The Institutional Review Board (IRB) of the university approved this study.

Instruments

Hanson (1997) developed the Fishbein/Ajzen-Hanson Questionnaire to measure all constructs—behavioral beliefs, normative beliefs, control beliefs, attitude, subjective norm, perceived behavioral control, and intention— of the TPB (Ajzen, 1991) in a study examining predictors of smoking intention in female adolescents. The instrument included 50 items with 7-point semantic scales. The Cronbach's α of each measure (construct) in this instrument ranged from 0.96 to 0.66 (Hanson).

Because written in English, this instrument was translated to Korean by the investigator. The investigator followed the Brislin's translation model (Brislin, 1986). First, the investigator translated the instrument to Korean and this draft was validated by back-translation by a person

who was good at both English and Korean. Then, a language expert in an English major validated back-translated English version with the original instrument. If the expert disagreed, the investigator revised the Korean version and asked a person who had conducted back-translation one more time. An English expert again compared the original version with the re-translated version. This process repeated until the English expert confirmed that both English and Korean versions convey the same meaning.

Before conducting the survey, the Korean Fishbein/Ajzen-Hanson Questionnaire (KFAHQ) was verified for content validity by two experts in health behavior and adolescent health who are native Koreans. They were asked if each question was appropriate to be included in the instrument, each question covers the construct in Korean, and whether additional questions were required. Scale content validity index (S-CVI) was 0.88. Polit & Beck proposed that a value of 0.90 for S-CVI was excellent (2006). The pilot survey among 32 adolescents in a middle school located in Seoul was conducted to examine internal consistency of the instrument. Cronbach's α values calculated for each of the scales ranged from a high of 0.89 for the intention scale to a low of 0.68 for the perceived behavioral control scale. The value of 0.70 or greater for the Cronbach's α is regarded as desirable (Frost et al., 2007).

Of the 50 original items, three items were used to measure intention to smoke, three items for attitude toward smoking, one item for subjective norm about smoking, and three items for perceived behavioral control about smoking. To measure intention to smoke, participants were asked to report intention to smoke in a month on three 7-point semantic differential evaluative scales-true/false, likely/unlikely, probably/probably not-with a range of scores from +3 to -3 respectively. The average score of the three items was considered as level of intention to smoke. Participants with -2 or greater were classified as persons with higher intention to smoke;

those with -3 were classified as persons with lower intention to smoke. The Cronbach's α value for the scale of intention to smoke in this study was 0.85.

Three items were used to measure attitude toward smoking. Participants rated smoking attitude on three 7-point semantic differential evaluative scales-pleasant/not pleasant, nice/awful, a lot of fun/not fun at all-with a range of scores from +3 to -3 respectively. The sum of these three scores was considered as level of attitude toward smoking. Participants with -8 or greater were classified as persons with positive or less negative attitude toward smoking; those with -9 were classified as persons with most negative attitude toward smoking. The Cronbach's α value for the scale of attitude toward smoking in this study was 0.85.

One item was used to measure subjective norm about smoking. Participants answered how they perceive what significant others would think about their smoking with the item "If I smoke cigarettes, most people who are important to me would…" on a 7-point semantic differential evaluative scale of approve/disapprove, with a range of +3 to -3. This score was considered as level of subjective norm. Participants with -2 or greater were classified as persons with higher subjective norm about smoking; those with -3 were classified as persons with lower subjective norm about smoking.

To measure perceived behavioral control, three items were used: "If I wanted to I could easily not smoke cigarettes during the next month," "How much control do you think you have over whether you smoke cigarettes?" and "Do you think it would be difficult or easy for you not to smoke cigarettes during the next month?" on 7-point semantic differential evaluative scales of agree/disagree, complete control/no control, and easy/difficult with a range of +3 to -3 respectively. The sum of these three scores was considered as level of perceived behavioral

control. Participants with nine were classified as persons with higher perceived behavioral control about smoking; those with six to eight as persons with moderate perceived behavioral control about smoking; those with five or less than five as persons with lower perceived behavioral control about smoking. The Cronbach's α value for the scale of perceived behavioral control in this study was 0.55.

Measures

The survey gathered information on socio-economic status, and four constructs of the TPB. Socio-economic status information included gender, perceived economy, weekly allowance, sibling smoking, peer smoking, and number of LTRs passed in a day while commuting to school. Information about participants' lifetime smoking ("Have you ever smoked in your lifetime?") was also collected.

Analytic Methods

Data in this study had the nested structure which indicated that individuals belonged to upper level groups (schools). To analyze the data with the nested structure, multilevel modeling (MLM) was needed because this method enabled reflecting characteristics both in the individual and group levels (Yu, 2006). MLM was conducted using HLM v.7 and descriptive statistics was conducted using SPSS v.22.

Characteristics of subjects were described using number, mean, and standard deviation in SPSS. Relationships between intention to smoke and each of the three TPB constructs were examined by multivariate MLM (entered into the model individually), controlling for covariates including gender, perceived economy, weekly allowance, sibling smoking, peer smoking, and number of LTRs passed in a day while commuting to school. Multivariate MLM examined the

joint relationships between intention to smoke and the three TPB constructs (entered into the model simultaneously), controlling for the covariates. Also, association of lifetime smoking with intention to smoke was examined using the multivariate MLM, and attitude, subjective norm, and perceived behavioral control, respectively, entered in this multivariate MLM to compare the odds ratio. Joint association of lifetime smoking with attitude toward smoking, subjective norm about smoking, perceived behavioral control about smoking, and intention to smoke was examined by multivariate MLM. Associations between two items measuring attitude toward smoking, subjective norm about smoking, and perceived behavioral control about smoking were examined by chi square to check if any two constructs were overlapped. The level of significance was set at $p < 0.05$.

Results

Characteristics of Subjects

Characteristics of subjects are presented in Table 1. The mean age of the sample was 14.48 years with more females (54.2%) than males. The total of 66.8% of the sample answered their household economy was middle, 19.2% was higher, and 14.0% was lower. The mean weekly allowance was 14,700 South Korean Won. The total of 92.8% reported sibling smoking and 72.2% reported peer smoking. The mean number of LTRs passed in a day while commuting to school was 4.90.

The total of 21.3% answered higher attitude toward smoking and 14.9% answered higher subjective norm about smoking. In terms of perceived behavioral control about smoking, 52.3% answered higher, 22.2% answered moderate, and 25.5% answered lower. The total of 16.2% answered they had intention to smoke in the next month. The lifetime smoking rate was 13.6%.

Predictors of Intention to Smoke

Multivariate MLM was conducted to examine if each construct of the TPB predicted intention to smoke in the next month, controlling for covariates including gender, perceived economy, weekly allowance, sibling smoking, peer smoking, and number of LTRs passed in a day while commuting to school (Table 2). Participants with positive or less negative attitude toward smoking were 29.57 times more likely to have higher intention to smoke than those with most negative attitude. Individuals with higher subjective norm about smoking was 7.38 times more likely to have higher intention to smoke than those with lower subjective norm. As perceived behavioral control about smoking increased by one level, the odds of being in the higher smoking intention group was 3.70 times smaller. Each construct of the TPB was found to be a statistically significant predictor of intention to smoke.

Another multivariate MLM was conducted to examine if all TPB constructs predicted intention to smoke, controlling for covariates including gender, perceived economy, weekly allowance, sibling smoking, peer smoking, and number of LTRs passed in a day while commuting to school (Table 3). Attitude and perceived behavioral control were statistically significant predictors of intention to smoke. Also, self-reported number of LTRs passed in a day was a statistically significant predictor of intention to smoke. Participants with positive or less negative attitude toward smoking were 15.37 times more likely to have higher intention to smoke than those with a more negative attitude. As perceived behavioral control about smoking increased by one level, the odds of being in the higher smoking intention group was 2.08 times smaller.

Table 4 shows that intention to smoke was a statistically significant predictor of lifetime smoking, controlling for covariates. Participants with higher intention to smoke were 11.11 times more likely to report current smoking. Table 5 to 7 showed attitude toward smoking, subjective norm about smoking, and perceived behavioral control about smoking, were statistically significant predictors of lifetime smoking in addition to intention to smoke, controlling for the covariates. The odds ratio of attitude toward smoking was the highest compared to subjective norm and perceived behavioral control. The joint association of lifetime smoking with attitude toward smoking, subjective norm about smoking, perceived behavioral control about smoking, and intention to smoke was examined (Table 8). Participants with higher intention to smoke were 4.34 times more likely to report lifetime smoking than those with lower intention to smoke. Attitude toward smoking and perceived behavioral control about smoking, which were statistically significant factors of intention to smoke, were not statistically significant as predictors of lifetime smoking.

Discussion

In this study, attitude, subjective norm and perceived behavioral control of the TPB respectively predicted intention to smoke controlling socio-economic factors and number of LTRs passed. Although attitude and perceived behavioral control were found to be predictors of intention to smoke when they were entered simultaneously controlling for covariates, subjective norm was not. The results indicated that attitude toward smoking and perception about self-control over tobacco use influenced the forming of intention to smoke in South Korean adolescents.

Most studies of the TPB showed that attitude, subjective norm, perceived behavioral control were all predictors of adolescent smoking (Godin, Valois, Lepage, & Desharnais, 1992; Hemchayat, 2003; Spijkerman, van den Eijnden, Regina JJM, Vitale, & Engels, 2004). Hanson (1997) reported that attitude, subjective norm, and perceived behavioral control were predictors of African-American female adolescent smoking intention, but only attitude and perceived behavioral control were found to be predictors in Puerto Ricans and non-Hispanic Whites. Some studies reported that, of the three TPB constructs, attitude was the strongest and social norm was the weakest predictors of intention to smoke (Armitage & Conner, 2001; Godin & Kok, 1996; Hemchayat, 2003).

The results of this study were partly consistent with previous literature. Attitude toward smoking was the strongest predictor of intention to smoke. Tobacco marketing has focused on formation of positive attitudes toward smoking among children in middle-school years (U.S. Department of Health and Human Services, 2001). Tobacco companies tend to convey favorable images and messages about smoking and tobacco products in their advertising. Adolescent attitude change should be the main target of youth smoking prevention programs and policies.

Subjective norm was not found to be a statistically significant predictor of intention to smoke in this study. Because subjective norm about smoking was associated with attitude toward smoking and perceived behavioral control about smoking (Table 9 and Table 11), the influence of subjective norm on behavioral intention may have been hidden by attitude and perceived behavioral control. In this study, subjective norm was measured by one question. Given that subjective norm in adolescent smoking initiation is about the perception of disapproval or approval of smoking by important others, this may be associated with adolescent smoking initiation. Further studies need to examine the effects of subjective norm and smoking intention

in South Korean adolescents. In addition, the results of this study demonstrated that intention was explained by attitude and perceived behavioral control, and lifetime smoking was explained by intention. This indicates that intention mediates between attitude and perceived behavioral control, and health behavior. This was in accordance with the TPB model. Behavioral intention was the powerful predictor of health behavior.

In this study, variables including gender, perceived economy, weekly allowance, sibling smoking, and peer smoking were not significantly associated with intention to smoke. This suggests that, regardless of these factors, attitude toward smoking and perceived behavioral control about smoking were important factors in predicting adolescent intention to smoke.

Number of LTRs passed in a day while commuting to school was statistically significantly associated with intention to smoke in addition to attitude toward smoking and perceived behavioral control about smoking. This means that number of LTRs encountered daily was independently associated with intention to smoke. According to the ecological perspective of health behavior (McLeroy et al., 1988; Sallis et al., 2006), physical environmental factors surrounded by intra- and interpersonal levels influence individual health behavior. The presence of LTRs around school may have affected participants' attitude, subjective norm, perceived behavioral control, and intention to smoke. This suggests that licensing and zoning regulations of LTRs may be needed in areas frequented by adolescents for tobacco prevention and control among youths. In future research on effects of built environment on adolescent smoking intention, the addition of the density and proximity of LTRs to the TPB may be warranted.

The results of this study provide meaningful information about psychosocial factors and LTR factors in predicting intention to smoke and lifetime smoking among South Korean

adolescents. Also, the study results demonstrate that the TPB was useful in predicting adolescent intention to smoke and lifetime smoking by showing that the TPB constructs did not overlap, that attitude and perceived behavioral control predicted smoking intention, and that intention to smoke predicted lifetime smoking behavior.

There are limitations of this study. Since convenient sampling was used in selection of target schools for the survey, there was potential for bias in sample composition. Because the survey was cross-sectional, one cannot infer a causal relationship. It is possible that participants' smoking was not accurately measured because of the self-reported survey. For example, an anonymous survey of South Korean adolescents reported a Kappa coefficient for current smoking validity of self-report and urine cotinine of 0.80 (95% CI: 0.71-0.89) (Korea Centers for Disease Control and Prevention, 2009).

The calculation of attitude toward smoking, subjective norm about smoking, and perceived behavioral control about smoking differed from the manner proposed by the original instrument-developer to secure the number variables needed for statistical analysis.

Conclusions

This cross-sectional descriptive study examined associations between smoking intention and lifetime smoking, and TPB constructs including intention to smoke, subjective norm about smoking, and intention to smoke. Attitude toward smoking and perceived behavioral control were significant predictors of intention to smoke and intention to smoke was significant predictor of lifetime smoking. The results of this study support the application of the TPB in predicting adolescent intention to smoke and lifetime smoking. This study provides useful information about factors influencing intention to smoke and lifetime smoking among South Korean

adolescents. Based on the study results, attitude and perceived behavioral control should be primary targets in adolescent smoking prevention programs and policies. Researchers, school health personnel and adolescent health policy makers need to pay attention to tobacco companies' marketing effort for adolescent attitude change toward smoking and tobacco product sales. Adolescent health care providers should consider adolescent perception of control over behavioral performance. Restricting the number of LTR licenses around schools is a reasonable policy suggestion to prevent the formation of positive attitude toward smoking. It is important to begin adolescent smoking prevention programs early before those have intention to smoke. Future directions for research include the use of random sampling in data collection and biomarkers such as cotinine for measurement of smoking.

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Table 1. Characteristics of subjects (N = 698)

Variable	Value	N (%) or mean ± SD
Age		14.48 ± 0.56
Gender	Female	378 (54.2)
	Male	320 (45.8)
Perceived economy	Higher	134 (19.2)
	Middle	466 (66.8)
	Lower	98 (14.0)
Weekly allowance (₩)[a]		1.47 ± 1.73
Sibling smoking	No	648 (92.8)
	Yes	50 (7.2)
Peer smoking	No	504 (72.2)
	Yes	194 (27.8)
Number of LTRs passed[b] (per 1 LTR pass increase)		4.90 ± 3.90
Attitude toward smoking	Positive or less negative	149 (21.3)
	Most negative	549 (78.7)
Subjective norm about smoking	Higher	104 (14.9)
	Lower	594 (85.1)
Perceived behavioral control about smoking	Higher	365 (52.3)
	Moderate	155 (22.2)
	Lower	178 (25.5)
Intention to smoke	Higher	113 (16.2)
	Lower	585 (83.8)
Lifetime smoking	No	603 (86.4)
	Yes	95 (13.6)

SD: standard deviation

[a]Divided by 10,000.

[b]Number of LTRs passed in a day while commuting to school.

Table 2. Association of intention to smoke with attitude, subjective norm, and perceived behavioral control about smoking (N = 698)

Variable[a]	OR	95% CI	P
Attitude toward smoking (positive or less negative vs. most negative)	29.57	17.09-51.18	<0.001
Subjective norm about smoking (higher vs. lower)	7.38	4.51-12.09	<0.001
Perceived behavioral control about smoking (per one level increase)	0.27	0.21-0.37	<0.001

Note: Multilevel modeling controlling for gender, perceived economy, weekly allowance, sibling smoking, peer smoking, and number of LTRs passed in a day while commuting to school.

[a]Entered individually.

OR: odds ratio.

Table 3. Joint association of intention to smoke with predictors (N = 698)

Variable	OR	95% CI	P
Attitude toward smoking (positive or less negative vs. most negative)	15.37	8.43-28.05	<0.001
Subjective norm about smoking (higher vs. lower)	1.86	0.97-3.60	0.063
Perceived behavioral control about smoking (per one level increase)	0.48	0.33-0.68	<0.001
Gender (male vs. female)	1.64	0.92-2.96	0.096
Perceived economy (per one level increase)	0.80	0.51-1.27	0.350
Weekly allowance[a] (per one Korean dollar increase)	1.05	0.90-1.23	0.497
Sibling smoking (yes vs. no)	1.28	0.50-3.32	0.614
Peer smoking (yes vs. no)	1.53	0.84-2.80	0.168
No. of LTRs passed[b] (per one LTR pass increase)	1.09	1.02-1.17	0.017

OR: odds ratio.

[a]Divided by 10,000.

[b]Number of LTRs passed in a day while commuting to school.

Table 4. Association of lifetime smoking with intention to smoke (N = 698)

Variable	OR	95% CI	P
Intention to smoke (higher vs. lower)	11.11	5.92-20.84	<0.001

Note: Multilevel modeling controlling for gender, perceived economy, weekly allowance, sibling smoking, peer smoking, and number of LTRs passed in a day while commuting to school.

OR: odds ratio.

Table 5. Association of lifetime smoking with intention to smoke and attitude toward smoking (N = 698)

Variable	OR	95% CI	P
Intention to smoke (higher vs. lower)	5.53	2.51-12.21	<0.001
Attitude toward smoking (positive or less negative vs. most negative)	3.05	1.42-12.21	0.004

Note: Multilevel modeling controlling for gender, perceived economy, weekly allowance, sibling smoking, peer smoking, and number of LTRs passed in a day while commuting to school.

OR: odds ratio.

Table 6. Association of lifetime smoking with intention to smoke and subjective norm about smoking (N = 698)

Variable	OR	95% CI	P
Intention to smoke (higher vs. lower)	8.09	4.12-15.91	<0.001
Subjective norm about smoking (higher vs. lower)	2.58	1.30-5.15	0.007

Note: Multilevel modeling controlling for gender, perceived economy, weekly allowance, sibling smoking, peer smoking, and number of LTRs passed in a day while commuting to school.

OR: odds ratio.

Table 7. Association of lifetime smoking with intention to smoke and perceived behavioral control about smoking (N = 698)

Variable	OR	95% CI	P
Intention to smoke (higher vs. lower)	7.51	3.75-15.01	<0.001
Perceived behavioral control about smoking (per one level increase)	0.62	0.43-0.92	0.016

Note: Multilevel modeling controlling for gender, perceived economy, weekly allowance, sibling smoking, peer smoking, and number of LTRs passed in a day while commuting to school.

OR: odds ratio.

Table 8. Joint association of lifetime smoking with attitude toward smoking, subjective norm about smoking, perceived behavioral control about smoking and intention to smoke (N = 698)

Variable	OR	95% CI	P
Attitude toward smoking (positive or less negative vs. most negative)	2.10	0.92-4.81	0.079
Subjective norm about smoking (higher vs. lower)	1.90	0.91-3.99	0.087
Perceived behavioral control about smoking (per one level increase)	0.73	0.49-1.09	0.123
Intention to smoke (higher vs. lower)	4.34	1.91-9.86	<0.001
Gender (male vs. female)	2.78	1.44-5.38	0.002
Perceived economy (per one level increase)	1.76	1.07-2.91	0.027
Weekly allowance[a] (per one Korean dollar increase)	1.17	1.01-1.36	0.037
Sibling smoking (yes vs. no)	4.62	1.90-11.22	0.001
Peer smoking (yes vs. no)	9.15	4.65-17.98	<0.001
No. of LTRs passed[b] (per one LTR pass increase)	1.07	0.99-1.15	0.077

OR: odds ratio.

Table 9. Association of attitude toward smoking and subjective norm about smoking (N = 698)

		Attitude toward smoking		Total	P
		Less or negative	Most negative		
Subjective norm about smoking	Lower	80 (57.0)	514 (93.6)	594 (85.1)	<0.001
	Higher	69 (46.3)	35 (6.4)	104 (14.9)	
Total		149 (100.0)	549 (100.0)	698 (100.0)	

Note: Multilevel modeling controlling for gender, perceived economy, weekly allowance, sibling smoking, peer smoking, and number of LTRs passed in a day while commuting to school.

Table 10. Association of attitude toward smoking and perceived behavioral control about smoking (N = 698)

		Attitude toward smoking		Total	P
		Less or negative	Most negative		
Perceived behavioral control about smoking	Lower	85 (57.0)	93 (16.9)	178 (25.5)	<0.001
	Moderate	41 (27.5)	114 (20.8)	155 (22.2)	
	Higher	23 (15.4)	342 (62.3)	365 (52.3)	
Total		149 (100.0)	549 (100.0)	698 (100.0)	

Note: Multilevel modeling controlling for gender, perceived economy, weekly allowance, sibling smoking, peer smoking, and number of LTRs passed in a day while commuting to school.

Table 11. Association of subjective norm about smoking and perceived behavioral control about smoking (N = 698)

		Subjective norm about smoking		Total	P
		Lower	Higher		
Perceived behavioral control about smoking	Lower	119 (20.0)	59 (56.7)	178 (25.5)	<0.001
	Moderate	132 (22.2)	23 (22.1)	155 (22.2)	
	Higher	343 (57.7)	22 (21.2)	365 (52.3)	
Total		594 (100.0)	104 (100.0)	698 (100.0)	

Note: Multilevel modeling controlling for gender, perceived economy, weekly allowance, sibling smoking, peer smoking, and number of LTRs passed in a day while commuting to school.

Licensed Tobacco Retailers and Adolescent Smoking Questionnaire

In this questionnaire, we ask questions about your demographic information and socioeconomic status. This survey is anonymous. All information collected by this survey will not be used except for research purposes. Completing this questionnaire is absolutely voluntary. You may leave a question blank if you feel uncomfortable. Please answer questions honestly. Thank you very much.

Direction: Please write your answer or mark the numbers that best describe yourself.

1. Date and year of birth: _____
2. Gender: (1) male _____ (2) female _____
3. What the economic status of your household? (1) very affluent _____ (2) somewhat affluent _____ (3) average _____ (4) a little poor _____ (5) poor _____
4. How much is your weekly allowance? ₩_____
5. Please mark any family members who smoke currently. (1) None _____ (2) father _____ (3) mother _____ (4) siblings _____ (5) no idea _____
6. How many peers are currently smoking? _____ peers
7. How many convenient stores or supermarkets that sell tobacco do you pass by when commuting school? _____ times a day
8. Have you ever smoked in your lifetime? (0) no _____ (1) yes _____
9. In this questionnaire, we ask questions that make use of rating scales with seven places. You are to make a mark (X) in the space that best describes your activity or your opinion.

FOR EXAMPLE: If you were asked to rate "The weather in Seoul" on such a scale and you think the weather in Seoul is quite good, then you would place your mark as follows;

"The weather in Seoul is:"

good		X						bad
	extremely	quite	slightly	neither	slightly	quite	extremely	

If you think the weather in Seoul is neither good nor bad, then you would place your mark as follows:

good				X				bad
	extremely	quite	slightly	neither	slightly	quite	extremely	

If you think the weather in Seoul is extremely bad, then you would place your mark as follows:

good							X	bad
	extremely	quite	slightly	neither	slightly	quite	extremely	

In making the questionnaire, please remember the following:

① There are no right or wrong answers; we are interested in your opinion.

② Place your mark in the middle of the space, not on the dots.

③ Please answer all items – make one check mark on each scale.

④ Please answer each question honestly.

REMEMBER – WE ARE INTERESTED IN YOUR OPINON

[Korean Fishbein-Ajzen-Hanson Questionnaire]

1) If I do things that help me relax that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

2) If I don things that make me feel good that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

3) If I get cancer that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

4) If I get along with my friends that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

5) If I get heart disease that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

6) If I smell bad that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

7) If I do things that increase my chances for health problems that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

8) If I control my weight that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

9) If I have yellow teeth that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

10) If it is harder for me to breathe that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

11) If I spend a lot of money that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

12) If I do things that I enjoy that is:

bad								good
	extremely	quite	slightly	neither	slightly	quite	extremely	

13) I intend to smoke cigarettes a month from now. → INTENTION

false								true
	extremely	quite	slightly	neither	slightly	quite	extremely	

14) How often are you bored?

frequently								never
	extremely	quite	slightly	neither	slightly	quite	extremely	

15) How often are you under a lot of stress?

frequently								never
	extremely	quite	slightly	neither	slightly	quite	extremely	

16) How often are you around others who smoke cigarettes?

frequently								never
	extremely	quite	slightly	neither	slightly	quite	extremely	

17) If I wanted to I could easily not smoke cigarettes during the next month. → PERCEIVED BEHAVIORAL CONTROL

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

18) For me, to smoke cigarettes during the next month would be: → ATTITUDE

nice								awful
	extremely	quite	slightly	neither	slightly	quite	extremely	

19) For me, to smoke cigarettes during the next month would be: → ATTITUDE

pleasant								not pleasant
	extremely	quite	slightly	neither	slightly	quite	extremely	

20) For me to smoke cigarettes during the next month would be: → ATTITUDE

not fun at all								a lot of fun
	extremely	quite	slightly	neither	slightly	quite	extremely	

21) I intend to smoke cigarettes a month from now. → INTENTION

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

22) Most of the time, when my friends think I should do something, I go along with it.

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

23) Most of the time, when my mother thinks I should do something, I go along with it.

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

24) Most of the time, when my father thinks I should do something, I go along with it.

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

25) Most of the time, when my best friend thinks I should do something, I go along with it.

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

26) Most of the time, when my boyfriend or sexual partner thinks I should do something I go along with it.

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

27) How much control do you think you have over whether you smoke cigarettes? → PERCEIVED BEHAVIORAL CONTROL

no control								complete control
	extremely	quite	slightly	neither	slightly	quite	extremely	

28) When I am bored, I smoke cigarettes:

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

29) When I am around others who smoke, I smoke cigarettes too:

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

30) When I am under a lot of stress, I smoke cigarettes:

agree								disagree
	extremely	quite	slightly	neither	slightly	quite	extremely	

31) If I smoke cigarettes, most people who are important to me would: → SUBJECTIVE NORM

approve								disapprove
	extremely	quite	slightly	neither	slightly	quite	extremely	

32) Do you think it would be difficult or easy for you not to smoke cigarettes during the next month? → PERCEIVED BEHAVIORAL CONTROL

easy								difficult
	extremely	quite	slightly	neither	slightly	quite	extremely	

33) If I smoke cigarettes, my friends would:

approve								disapprove
	extremely	quite	slightly	neither	slightly	quite	extremely	

34) If I smoke cigarettes, my mother would:

approve								disapprove
	extremely	quite	slightly	neither	slightly	quite	extremely	

35) If I smoke cigarettes, my father would:

approve								disapprove
	extremely	quite	slightly	neither	slightly	quite	extremely	

36) If I smoke cigarettes, my best friend would:

approve								disapprove
	extremely	quite	slightly	neither	slightly	quite	extremely	

37) If I smoke cigarettes, my boyfriend or sexual partner would:

approve								disapprove

	extremely	quite	slightly	neither	slightly	quite	extremely	

38) I intend to smoke cigarettes a month from now. → INTENTION

probably								probably not
	extremely	quite	slightly	neither	slightly	quite	extremely	

39) If I smoke cigarettes, it will help me relax:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

40) If I smoke cigarettes, it will make me feel good:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

41) If I smoke cigarettes, I will get cancer:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

42) If I smoke cigarettes, it will make me smell bad:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

43) If I smoke cigarettes, it will be bad for my health:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

44) If I smoke cigarettes, it will help me control my weight:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

45) If I smoke cigarettes, it will help me get along with my friends:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

46) If I smoke cigarettes, I will get heart disease:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

47) If I smoke cigarettes, it will make my teeth yellow:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

48) If I smoke cigarettes, it will be harder for me to breathe:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

49) If I smoke cigarettes, it will cost me a lot of money:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

50) If I smoke cigarettes, it will be enjoyable:

likely								unlikely
	extremely	quite	slightly	neither	slightly	quite	extremely	

담배소매점과 청소년 흡연

설문조사

이 설문조사지는 여러분의 인구학적 정보와 사회경제적 상태를 묻기 위하여 실시됩니다. 이름을 안 써도 되는 익명조사이며 설문조사에서 수집된 정보는 절대로 연구 이외의 목적으로 쓰이지 않을 것입니다. 설문조사 참여는 자발적입니다. 불편한 질문은 빈 칸으로 두어도 됩니다. 최대한 솔직하게 대답해 주세요. 대단히 감사합니다.

여러분의 상황에 맞는 답을 적어주거나 보기에서 선택해주세요.

1. 생년월일: _____
2. 성별: (1) 남_____ (2) 여_____
3. 가정의 경제적 상태는 어떻습니까? (1) 상_____ (2) 중상_____ (3) 중_____ (4) 중하 _____ (5) 하 _____
4. 일주일 동안 쓰는 용돈은 얼마입니까? _____원_
5. 가족 중에서 현재 담배를 피우시는 분을 모두 표시해 주세요. (1)없다_____ (2) 아버지_____ (3) 어머니_____ (4) 형제, 자매_____ (5) 잘 모른다 _____
6. 친구들 중에서 현재 담배를 피우는 친구는 몇 명인가요? _____명_
7. 등교 및 하교할 때 담배를 파는 편의점이나 슈퍼마켓을 몇 개 정도 지나칩니까? _____개_
8. 지금까지 담배를 한 두 모금이라도 피워본 적 있습니까? (0) 아니오_____ (1) 네_____

9. 이제부터 각 문항에 대한 학생들의 의견을 여쭤볼 것입니다. 본인의 **행동**을 가장 잘 표현하거나 본인의 **의견**과 일치하는 곳에 동그라미 표시(O) 해 주시면 됩니다. 먼저 예를 들어 설명해 드리겠습니다.

예 1: **'오늘 서울의 날씨는...'** 이라는 질문에 본인이 서울의 날씨가 **매우 좋다**고 생각하면 '**좋다**'과 가까운 쪽에 있는 '**매우**'에 표시(O)하면 됩니다.

좋다		**O**						**나쁘다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	

예 2: **'오늘 서울의 날씨는...'** 이라는 질문에 본인이 서울의 날씨가 **보통**이라고 생각한다면 가운데 있는 '**보통**'에 표시(O)하면 됩니다.

좋다				**O**				**나쁘다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	

예 3: **'오늘 서울의 날씨는...'** 이라는 질문에 본인이 서울의 날씨가 **매우 많이 나쁘다**고 생각한다면 '**안 좋다**'과 가까운 쪽에 있는 '**매우 많이**'에 표시(O)하면 됩니다.

좋다							**O**	**나쁘다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	

쉽죠? 이해가 안 되면 손 들고 선생님께 여쭤보세요.

<참고사항>
- 정답은 없습니다. 단지 여러분의 생각이 궁금할 뿐입니다.
- 7가지 보기 중 1개만 선택해주세요.
- 모든 문항에 표시(O) 해주세요.
- 최대한 솔직하게 대답해 주세요.

지금부터 시작됩니다.

	1) 나를 (편안하게) 이완하도록 도와주는 것을 한다면 그것은...							
나쁘다								**좋다**
	매우 많이	매우	조금	모름	조금	매우	매우 많이	
	2) 나를 기분 좋게 해주는 것을 한다면 그것은...							
나쁘다								**좋다**
	매우 많이	매우	조금	모름	조금	매우	매우 많이	
	3) 내가 암에 걸린다면 그것은...							
나쁘다								**좋다**
	매우 많이	매우	조금	모름	조금	매우	매우 많이	
	4) 내가 친구들과 잘 지낸다면 그것은...							
나쁘다								**좋다**
	매우 많이	매우	조금	모름	조금	매우	매우 많이	

	5) 내가 심장병에 걸린다면 그것은...							
나쁘다								**좋다**
	매우 많이	매우	조금	모름	조금	매우	매우 많이	
	6) 나에게 나쁜 냄새가 난다면 그것은...							
나쁘다								**좋다**
	매우 많이	매우	조금	모름	조금	매우	매우 많이	
	7) 내가 건강문제를 일으킬 가능성이 높아지는 행동을 한다면 그것은...							
나쁘다								**좋다**
	매우 많이	매우	조금	모름	조금	매우	매우 많이	
	8) 내가 체중을 조절한다면 그것은...							
나쁘다								**좋다**
	매우 많이	매우	조금	모름	조금	매우	매우 많이	
	9) 내가 누런 치아를 갖는다면 그것은...							
나쁘다								**좋다**
	매우 많이	매우	조금	모름	조금	매우	매우 많이	
	10) 내가 숨쉬기가 어려워진다면 그것은...							
나쁘다								**좋다**
	매우 많이	매우	조금	모름	조금	매우	매우 많이	
	11) 내가 돈을 많이 쓴다면 그것은...							
나쁘다								**좋다**
	매우 많이	매우	조금	모름	조금	매우	매우 많이	
	12) 내가 즐기는 것을 한다면 그것은...							
나쁘다								**좋다**
	매우 많이	매우	조금	모름	조금	매우	매우 많이	
	13) 나는 한달 후에 담배를 피울 의도(계획)가 있다.							
거짓								**진실**
	매우 많이	매우	조금	모름	조금	매우	매우 많이	
	14) 얼마나 자주 지루함을 느끼세요?							
자주								**전혀 아니다**
	매우 많이	매우	조금	모름	조금	매우	매우 많이	
	15) 얼마나 자주 많은 스트레스를 받으세요?							
자주								**전혀 아니다**
	매우 많이	매우	조금	모름	조금	매우	매우 많이	
	16) 얼마나 자주 담배를 피우는 사람 주변에 있으세요?							
자주								**전혀 아니다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	17) 내가 원한다면 다음 달에 쉽게 담배를 피우지 않을 수 있을 것이다.							
동의								**반대**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	18) 내가 다음 달에 담배를 피운다는 것은...							
좋다								**끔찍하다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	19) 내가 다음 달에 담배를 피운다는 것은...							
기분좋다								**불쾌하다**

	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	20)	**내가 다음 달에 담배를 피운다는 것은...**						
전혀 재밌지 않다								**재미있다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	21)	**나는 한달 후에 담배를 피울 의도(계획)가 있다.**						
그럴 것 같다								**안 그럴 것 같다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	22)	**대부분의 경우, 내 친구들이 내가 무엇인가 해야 한다고 생각하면 나는 그것을 따른다.**						
동의								**반대**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	23)	**대부분의 경우, 어머니가 내가 무엇인가 해야 한다고 생각하면 나는 그것을 따른다.**						
동의								**반대**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	24)	**대부분의 경우, 아버지가 내가 무엇인가 해야 한다고 생각하면 나는 그것을 따른다.**						
동의								**반대**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	25)	**대부분의 경우, 나와 가장 친한 친구가 내가 무엇인가 해야 한다고 생각하면 나는 그것을 따른다.**						
동의								**반대**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	26)	**대부분의 경우, 이성친구(교제중인 나의 남자친구 또는 여자친구)가 내가 무엇인가 해야 한다고 생각하면 나는 그것을 따른다.**						
동의								**반대**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	27)	**담배를 피우는 것 또는 담배를 피우지 않는 것을 얼만큼 통제(조절) 할 수 있다고 생각하십니까?**						
통제 없음								**완전 통제**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	28)	**내가 지루할 때, 나는 담배를 피운다.**						
동의								**반대**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	29)	**내가 담배 피우는 사람들 주변에 있을 때, 나도 담배를 피운다.**						
동의								**반대**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	30)	**내가 스트레스를 많이 받을 때, 나는 담배를 피운다.**						
동의								**반대**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	31)	**내가 담배를 피우면, 나에게 중요한 대부분의 사람들은 아마도...**						
허락한다								**반대한다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	32)	**다음 달에 담배를 피우지 않는 것이 어렵거나 쉬울 것이라고 생각하십니까?**						
쉽다								**어렵다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	

	33) 내가 담배를 피우면, 내 친구들은 아마도...							
허락한다								**반대한다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	34) 내가 담배를 피우면, 어머니는 아마도...							
허락한다								**반대한다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	35) 내가 담배를 피우면, 아버지는 아마도...							
허락한다								**반대한다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	36) 내가 담배를 피우면, 나의 가장 친한 친구는 아마도...							
허락한다								**반대한다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	37) 내가 담배를 피우면, 이성친구(나의 남자친구 또는 여자친구)는 아마도...							
허락한다								**반대한다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	38) 나는 한달 후에 담배를 피울 의도(계획)가 있다.							
그럴 것 같다								**안 그럴 것 같다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	39) 내가 담배를 피우면, 그것은 나를 이완하도록 도와줄 것이다.							
그럴 것 같다								**안 그럴 것 같다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	40) 내가 담배를 피우면, 그것은 나의 기분을 좋게 해줄 것이다.							
그럴 것 같다								**안 그럴 것 같다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	41) 내가 담배를 피우면, 나는 암에 걸릴 것이다.							
그럴 것 같다								**안 그럴 것 같다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	42) 내가 담배를 피우면, 그것은 내가 나쁜 냄새가 나도록 할 것이다.							
그럴 것 같다								**안 그럴 것 같다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	43) 내가 담배를 피우면, 그것은 건강에 나쁠 것이다.							
그럴 것 같다								**안 그럴 것 같다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	44) 내가 담배를 피우면, 그것은 나의 체중 조절에 도움이 될 것이다.							
그럴 것 같다								**안 그럴 것 같다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	45) 내가 담배를 피우면, 그것은 내가 친구들과 잘 지내는 데에 도움이 될 것이다.							
그럴 것 같다								**안 그럴 것 같다**
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	46) 내가 담배를 피우면 나는 심장병에 걸릴 것이다.							
그럴 것 같								**안 그럴 것 같**

다								다
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	47) 내가 담배를 피우면, 그것은 내 치아를 누렇게 변하게 할 것이다.							
그럴 것 같다								안 그럴 것 같다
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	48) 내가 담배를 피우면, 나는 숨쉬기 어려울 것이다.							
그럴 것 같다								안 그럴 것 같다
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	49) 내가 담배를 피우면, 그것은 많은 돈(비용)이 들 것이다.							
그럴 것 같다								안 그럴 것 같다
	매우 많이	매우	조금	보통	조금	매우	매우 많이	
	50) 내가 담배를 피우면, 그것은 즐거울 것이다.							
그럴 것 같다								안 그럴 것 같다
	매우 많이	매우	조금	보통	조금	매우	매우 많이	

CHAPTER 6. Conclusion

Smoking has a detrimental effect on every human organ. Because most smokers begin smoking during teen years, it is important to prevent adolescent smoking initiation. Adolescent smokers get tobacco products primarily in licensed tobacco retailers (LTRs) and adolescents are exposed to tobacco marketing in LTRs. Adolescent smoking prevalence in South Korea is higher than many Asian countries. South Korea has 160,142 LTRs across the country (Kim, 2013), which indicates that there is one LTR for every 300 Koreans and one for 21 Korean adolescents between 15 and 19 years of age. There is a need to understand the influence of LTR factors on South Korean adolescent smoking.

The results of this study provide important information of adolescent smoking prevention and built environment factors. The findings of the literature review provide the understanding of how geographic distribution of LTRs in the neighborhood was associated with adolescent smoking. The density and proximity of LTRs in a prescribed area were related to adolescent lifetime and/or current smoking. The findings of the study on predictors of adolescent smoking indicate that LTR factors were associated with adolescent smoking outcomes as well as individual and family factors. LTR factors, from a built environment perspective, were not the major interest in health care professionals of many Asian countries. The study results provide more information about geographic LTR factors having an impact on adolescent smoking.

The results of this study indicate that attitude and perceived behavioral control of the Theory of Planned Behavior (TPB) (Ajzen, 1991; Fishbein & Ajzen, 1975), and from the ecological perspective of health behavior (McLeroy et al., 1988; Sallis et al., 2006), are prime targets for individual behavior change and provide adequate explanation of intention to smoke

and lifetime smoking in South Korean adolescents. Also, the study results indicate that the Korean Fishbein-Ajzen Hanson Questionniare (KFAHQ), which was translated by the author following the Brislin's translation model, captured major concepts of the TPB in regards to smoking initiation for Korean adolescents.

The results of this study show that the innovative technology, Geographic Information Systems (GIS), and advanced statistics, Multilevel Modeling (MLM), enhanced analysis of the data with geographic information and the nested structure. Through the use of GIS, geographic data were accurately managed and geocoded data (LTRs, schools and school buffers) were clearly presented on a map. Through the MLM, nested data with two levels of sample, the individual and group dimensions, were analyzed by minimizing the possibility of correlations between individual and group factors.

The results of this study have important implications for practice, research, theory, and policy. First, the study results have implications for practice that is helpful for adolescent smoking prevention programs in various settings such as school, community, and public health centers. Given that adolescents are easily influenced by others and by their environment, both individual and environmental predictors of adolescent smoking initiation found in this study need to be simultaneously considered in youth tobacco prevention programs. Adolescent healthcare providers should focus on adolescents who are at higher risk of smoking behavior such as male adolescents and those with smoking family or peers. Also, adolescent healthcare providers could establish partnerships with students, parents, school health personnel and local health workers to increase awareness about tobacco marketing in LTRs and location of LTRs in school neighborhoods. Community-level interventions could be used to disseminate materials about tobacco marketing in LTRs and LTR locations on the school homepage, in school letters, or in

local newspapers. It is important to start smoking prevention programs early before adolescents form positive attitude toward tobacco use and establish smoking behavior.

The results of this study have implications for research and theory. The TPB (Ajzen, 1991; Fishbein & Ajzen, 1975) and the ecological perspective of health behavior (McLeroy et al., 1988; Sallis et al., 2006) were used in this study. Attitude and perceived behavioral control are important target elements for predicting adolescent smoking intention and adolescent smoking behavior. LTRs, as a built environment factor, are also important in adolescent tobacco control in that the built environment may influence adolescents in the community. The study results provide valuable information for adolescent health behavior research and theory.

The results of this study have strong implications for health policy. LTR built environment factors were found to be associated with adolescent smoking outcomes. The LTR is a harmful environmental factor influencing the formation of smoking intention or positive attitude toward smoking among youths. In fact, many tobacco companies focus their marketing strategies in LTRs. The findings of this study underline the importance of school nurses, school professionals, public health nurses, and health policy makers promoting the healthy environment for adolescents beyond the school boundaries. Professionals in education, adolescent health, and public health need to advocate for zoning and licensing restrictions that limit the number of LTRs around schools or areas frequented by adolescents, and support for tobacco marketing restrictions in the LTR setting.

Further research is still needed. There is a need for research to validate these study results using adolescents aged older than 15 and those who live in other urban or rural areas of the country and other Asian countries. Since subjective norm, one of the major constructs of the

TPB, was not found to be a predictor of intention to smoke, future research is needed to investigate why subjective norm did not work in South Korean adolescents in Seoul. Also, research using a biomarker to capture accurate adolescent smoking is needed. Randomization in sampling is another direction for future research to increase the representativeness of the population. Future research suggestions derived from the results of this study will provide more convincing information about the dangers of adolescent smoking initiation and potential interventions to prevent or delay smoking initiation.

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