

Factors Related to Smoking Initiation by Adolescents and a Causal Model for Early Smoking Initiation

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Abstract

The fact that adolescents are starting to smoke at a younger age is an issue in Japan, but no studies have identified the causal relationship between factors affecting this early smoking initiation. The aim of this study was to produce a causal model of factors related to smoking initiation by adolescents and early smoking initiation. A specially prepared questionnaire containing 72 items extracted from previous studies as constituting factors in smoking by minors was administered to 215 students aged ≥ 20 years. All items were rated on a 5-point Likert scale according to how closely they were connected to smoking initiation. Exploratory factor analysis of factors related to smoking initiation by adolescents was performed, after which the data were analyzed by structural equation modeling. The following five factors were found to affect early smoking initiation: *self-disgust, growing up in an inappropriate home environment, reduction of norms consciousness for adolescents' smoking, perception of smoking as stress relief, and inadequate knowledge of the dangers of smoking*. The findings suggest that antismoking education for adolescents should provide more information on smoking, and that assessing the home environment and mediating in the parent-child relationship, increasing self-control of stress, emotions, and the capacity for self-regulation, and incorporating parents into antismoking education may also be important.

Keywords

Adolescence, Smoking Initiation Factor, Early Smoking Initiation, Structural Equation Modeling

1. Introduction

The rates of habitual smoking and having tried smoking by junior and senior high school students in Japan had been increasing until around 2000, but a 2004 survey found that they were starting to fall [1]. According to a 2010 survey of smoking rates among minors under 20 years of age by Ohida *et al.* [2], 10.2% of male and 7.2% of female junior high school students, and 19.5% of male and 12.5% of female senior high school students had tried smoking. However, in Japan, the fact that adolescents are starting to smoke at a younger age is now an issue, with some studies finding that 3% of elementary school pupils are smokers [3].

The younger the age at which people take up smoking, the more likely they are to experience health damage and become addicted to nicotine [4], and starting to smoke at a young age leads to serious health problems. Any decrease in the age of smoking initiation by adolescents is thus an extremely serious health issue.

Over 90% of Japanese who smoke started before they were 25 years old, and more than half took up smoking while they were still minors [5] [6] [7] [8]. Therefore, we can say that the vast majority of smokers first smoked during adolescence.

Kitayama [9] stated that smoking initiation is strongly linked to the particular feelings, thinking, and behavior patterns of adolescents, suggesting that smoking in adolescence may start from specific psychological characteristics. It is therefore necessary to identify the characteristic factors related to starting to smoke at this stage, and to engage in educational activities to prevent adolescents from taking up smoking.

A variety of studies conducted since the 1980s have examined the factors associated with smoking initiation. However, almost all previous research has been limited to describing whether associations between variables are present, with very few studies going so far as to ascertain the structure of the causal relationship explaining which factors have what effect in encouraging adolescents to smoke [10] [11] [12] [13]. No studies have identified the cause of early smoking initiation. Therefore, in the present study, we developed a causal model to identify factors related to smoking initiation by adolescents and their direct and indirect associations with early smoking initiation.

2. Study Methods

2.1. Definitions

Adolescence is defined as the transitional phase between childhood and adulthood, which takes place between about 8 and 25 years of age. This phase is characterized by dramatic physical changes and associated mental turmoil, and is the stage during which individuals overcome a range of psychological conflicts and form their own self-image.

2.2. Conceptual Framework of the Study and Hypothesized Relationships between Factors

In this study, we considered the hypothesized relationships between factors in terms of Bandura's social cognitive theory, which integrates a range of factors that affect health behavior and behavioral changes [14], and may explain smoking behavior among adolescents.

We utilized the main concepts of social cognitive theory and devised a hypothesis of the relationships between the environment, individual factors, and early smoking initiation based on the interactions between these factors (Figure 1).

2.3. Preparation and Selection of the Survey Items in This Study

Based on the hypothetical framework of the study, we extracted factors related to smoking by minors from previous studies on this subject that have identified such factors. We searched for original research papers published during the previous 10 years, between January 2005 and June 2016, that included the Japanese key words *kitsuen* ("smoking") and *yōin* ("factors") in the Ichushi Web Version 5 (hereafter "Ichushi") Japanese language medical database, and the English key words "initiation", "smoking", "factor," and "children" in the PubMed and CINAHL databases. These searches returned 578 results in Ichushi, 63 in PubMed, and 23 in CINAHL. We extracted factors related to smoking by minors from the titles and abstracts of original research papers. In most cases, the participants of these studies were minors, but in others, they were adults who had started smoking while minors. Three of the overseas studies were excluded because they were written in languages other than English, and four because they were duplicates. A total of 64 papers were finally identified, 27 Japanese studies and 37 from overseas, from which, 228 items were extracted as factors in smoking by minors (Table 1). The items extracted were analyzed by qualitative recursive analysis on the basis of the similarity of their semantic content, and then combined into 110 items. These were then classified deductively into the following 10 categories corresponding to the main concepts of Bandura's social cognitive theory: *physical environment*, *social environment*, *situation*, *behavioral capability*, *observational learning*, *reinforcements*, *expectations*, *expectancies*, *self-efficacy*, and *emotional coping responses*. Next, proposed items for the questionnaire were selected. Their content and means of expression were then investigated under the supervision of an investigator experienced in the preparation

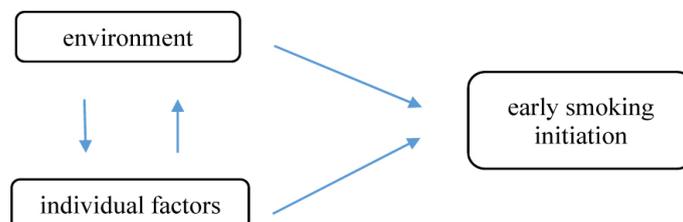


Figure 1. Hypothesized relationships between the environment, individual factors, and decreased age at smoking initiation, based on Bandura's social cognitive theory.

Table 1. Extraction literature list.

| Author | Year of issue | Title | Journal title |
|---------------------------|---------------|--|---|
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of questionnaires using qualitative procedures. The items were then amended to deal with duplicate meanings and issues with their content or means of expression, leading to the final selection of 105 items.

Preliminary Survey

A preliminary survey was carried out on 74 university students aged ≥ 20 years recruited by the snowball sampling method during November and December 2016 to investigate face and content validity. The responses were measured on a 5-point Likert scale by asking the respondents to rate how closely each item was connected to their having started smoking (from “1. No connection” to “5. Very closely connected”). To confirm the appropriateness and consistency of the content of questions, the correlation coefficients between questionnaire items were evaluated by using Item-Total (I-T) correlation analysis, and items with a correlation coefficient of <0.3 were eliminated. Pairs of questions among the proposed 105 items with a correlation coefficient of ≥ 0.7 were shown to have similar content, and either one of the pair was eliminated or the two were changed to use common expressions. Respondents were asked whether any questions were difficult to answer or whether any of the expressions were difficult to understand, and the expressions used were amended at the same time. This resulted in a revised version with 72 items.

2.4. Main Survey

2.4.1. Study Participants and Survey Period

The study participants were 1597 students aged ≥ 20 years belonging to nine tertiary educational institutions (four universities, one college offering a single course of study, one school of nursing, one school of social welfare, and two fire academies) in the Tokai and Kinki regions of Japan. All surveys were conducted during January and February 2017. Investigators or representatives of the institutions concerned gave the students a request for cooperation in the study, an explanation of the survey, the anonymous self-administered questionnaire form, and a return envelope. All responses were collected by post.

For the selection of research subjects, tertiary educational institutions for research cooperation were conveniently selected.

Minors were excluded from being study participants on ethical grounds, as smoking by minors is prohibited in Japan. To reduce the effect of memory bias, the age group selected for the study was students aged ≥ 20 years, the age group closest to adolescence.

2.4.2. Survey Items

i) Participants' characteristics and individual factors

Sex, age, institution, experience of smoking, age at first experience of smoking, current smoking habits, number of cigarettes currently smoked per day, family smoking habits, experience of antismoking education.

ii) Items concerning factors related to smoking by minors

We used a specially produced questionnaire (72 items) composed of the factors

extracted from previous studies as related to smoking by minors. The responses were measured on a 5-point Likert scale by asking the respondents to grade how closely each item was connected to their having started smoking (from “1. No connection” to “5. Very closely connected”).

2.4.3. Method of Analysis

The statistical software packages IBM SPSS Statistics for Windows, version 22.0, and AMOS 22.0 (Armonk, NY: IBM Corp.) were used for statistical analysis.

i) Item analysis: Analysis of the ceiling/floor effects of responses, I-T correlation analysis, and item correlation analysis were performed.

ii) Assessment of construct validity: A comparative investigation of environment and individual factors, which are constituent elements of the social cognitive theory used in the extraction of questionnaire items, was carried out using exploratory factor analysis.

iii) Assessment of internal consistency: Cronbach's α was calculated for the scale as a whole and for each individual factor to confirm internal consistency.

iv) Assessment of model fit: Structural equation modeling was performed to produce a structural model using the factors finally adopted after exploratory factor analysis (maximum-likelihood estimation and promax rotation) as latent variables. The model fit was confirmed using goodness-of-fit index (GFI), adjusted GFI (AGFI), confirmatory fit index (CFI), and root mean square error of approximation (RMSEA) values.

2.4.4. Ethical Considerations

Representatives of each of the institutions at which the surveys were performed and the study participants were provided with a written document explaining the study purpose, method, and time required, the voluntary nature of participation, that no disadvantage would be incurred by withdrawing from the study, that responses were anonymous and that individuals could not be identified, that the content of responses would not be used for any purpose other than the study, and that returning the questionnaire to the investigators was considered as indicating consent to participate in the study. The names of the participants and institutions were not indicated on either the questionnaire form or the return envelope, and the participants were requested to close the envelope securely before posting it addressed to the investigators.

3. Results

3.1. Overview of the Study Participants

Responses were received from 1010 of the 1597 study participants (63.2% response rate). The participants were 235 individuals who had tried smoking and 775 never-smokers. Responses with no missing data were received from 215 of those who had tried smoking (91.5% valid response rate), and this group was included in the final analysis. The mean age of the participants, who included 170 men (79.1%) and 45 women (20.9%), was 22.3 ± 2.7 years.

Table 2. Characteristics of the study participants (n = 215).

| Variable | N | % |
|--|------------------------|-----------|
| | median (mean \pm SD) | (range) |
| Sex men | 170 | 79.1 |
| women | 45 | 20.9 |
| Age(years) | 21 (22.3 \pm 2.7) | (20 - 33) |
| Age at smoking initiation (years) | 18 (16.9 \pm 3.0) | (8 - 24) |
| Current smoker | 119 | 55.3 |
| Number of cigarettes smoked per day | 10 (9.7 \pm 7.2) | (1 - 40) |
| With family smokers | 123 | 57.2 |
| Had undergone smoking prevention education | 129 | 60 |

Mean age at smoking initiation was 16.9 ± 3.0 years, minimum age was 8 years, and maximum age was 23 years. There were 119 current smokers (55.3%), and the mean number of cigarettes smoked per day was 9.7 ± 7.2 . In addition, 123 participants (57.2%) had family members who smoked, and 129 (60%) had undergone smoking prevention education (**Table 2**).

3.2. Item Analysis

Ten items were eliminated because their I-T correlation was ≤ 0.3 . Descriptive statistics were calculated, and five items for which either the ceiling or the floor effect applied were eliminated. Six pairs of questions with correlation coefficients of >0.7 were judged to have similar content, and one of each pair was eliminated.

3.3. Extraction of Factors by Exploratory Factor Analysis

Factor analysis (maximum-likelihood estimation and promax rotation) was performed for the 54 items remaining after 18 items had been eliminated by item analysis. Items for which the factor loading was <0.4 were eliminated, and ultimately, five factors comprising 18 items were extracted, with a cumulative contribution ratio of 59.3%. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.86, and Bartlett's test of sphericity was significant at $p < 0.01$ (**Table 3**).

3.4. Factor Naming

The Factor 1, which included items such as a personality susceptible to anxiety or stress and having negative feelings toward oneself, was named *self-disgust*. Factor 2, which included items such as having been disciplined by violence and living in poverty, was named *growing up in an inappropriate home environment*. Factor 3, which included items such as a lack of interest in smoking on the part of parents or local communities, was named *reduction of norms consciousness for adolescents' smoking*. Factor 4, which included items such as smoking as stress relief and distraction, was named *perception of smoking as stress relief*.

Table 3. Factor analysis of factors related to smoking initiation by adolescents.

| Item | Factor loading | | | | |
|--|----------------|-------------|-------------|-------------|-------------|
| | 1 | 2 | 3 | 4 | 5 |
| Factor Cronbach's α for all factor = 0.89 | | | | | |
| Factor 1: <i>Self-disgust</i> Cronbach's α = 0.87 | | | | | |
| 65) My self-esteem was low | 0.91 | 0.02 | -0.02 | -0.13 | 0.04 |
| 60) I had an anxious personality | 0.88 | -0.13 | 0.13 | -0.02 | -0.06 |
| 64) I was easily stressed | 0.71 | -0.01 | -0.05 | 0.25 | -0.03 |
| 51) I was a personality who could not ask someone for help when I was having difficulty | 0.65 | 0.10 | -0.09 | 0.04 | 0.08 |
| 56) I felt that no-one was listening to me when I resisted pressure from my surroundings | 0.57 | 0.12 | 0.11 | -0.15 | 0.11 |
| Factor 2: <i>Growing up in an inappropriate home environment</i> Cronbach's α = 0.84 | | | | | |
| 22) I was disciplined inappropriately by a parent, such as by violence | -0.03 | 0.84 | -0.04 | -0.06 | 0.09 |
| 24) I had a bad relationship with my parents | 0.11 | 0.83 | -0.09 | 0.09 | -0.12 |
| 28) I was living in poverty | -0.15 | 0.71 | 0.13 | 0.08 | -0.03 |
| 25) I felt unable to live up to my parents' excessive expectations | 0.22 | 0.61 | -0.02 | 0.03 | -0.03 |
| Factor 3: <i>Reduction of norms consciousness for adolescents' smoking</i> Cronbach's α = 0.8 | | | | | |
| 19) My parents did not monitor whether or not I smoked | 0.02 | -0.09 | 0.89 | 0.10 | -0.19 |
| 18) My parents never told me not to smoke | 0.05 | -0.07 | 0.74 | -0.01 | 0.03 |
| 21) My parents never scolded me for smoking | 0.03 | 0.20 | 0.50 | -0.08 | 0.16 |
| 20) Adult members of my community had no interest in smoking by minors | -0.08 | 0.26 | 0.46 | -0.01 | 0.19 |
| Factor 4: <i>Perception of smoking as stress relief</i> Cronbach's α = 0.73 | | | | | |
| 39) I had the image or idea that smoking was good for relieving stress | -0.16 | 0.10 | 0.03 | 0.78 | 0.07 |
| 35) I was stressed | 0.23 | 0.06 | -0.02 | 0.68 | -0.14 |
| 45) I smoked as a means of recreation | 0.04 | -0.14 | 0.08 | 0.52 | 0.36 |
| Factor 5: <i>Inadequate knowledge of the dangers of smoking</i> Cronbach's α = 0.75 | | | | | |
| 48) I didn't know how difficult it is to stop smoking | 0.06 | -0.07 | -0.04 | 0.05 | 0.83 |
| 46) I didn't have any knowledge about smoking | 0.00 | 0.03 | -0.04 | 0.02 | 0.73 |
| Cumulative contribution rate | | | | | 59.3 |

Factor extraction method: Maximum likelihood method. Rotation method: Promax rotation with Kaiser normalization. KMO = 0.86, Bartlett's test of sphericity was significant $p < 0.01$.

Factor 5, which included items such as lack of knowledge about smoking and being unaware of the difficulty of giving up smoking, was named *inadequate knowledge of the dangers of smoking* (Table 3).

3.5. Assessment of Reliability

Cronbach's α coefficient was calculated to confirm the reliability of the internal consistency of each of these factors and the questionnaire items as a whole. Cronbach's α for all 18 items was 0.89, and the values for the five factors were within the range 0.73 - 0.87 (Table 3).

3.6. Assessment of Validity

Construct validity was investigated by comparing the five factors adopted as a

result of the exploratory factor analysis with the elements of social cognitive theory used in the hypothetical framework, that is, environment and individual factors. Factors 1, 3, and 4 included items related to individual factors, and factors 2 and 3 included items related to environment.

3.7. Factors Related to Smoking Initiation by Adolescence and Causal Model of Early Smoking Initiation

Based on the proposed hypothesis, we developed a causal model with five latent variables and early smoking initiation as the dependent variable. Subsequently, we searched for causal models with a high degree of explanation. At that time, we attempted to correct from the paths with smaller degrees of explanation using the Wald test. We successfully identified a causal model consisting of the five latent variables (Figure 2).

The fitness indices of this model were GFI = 0.86, AGFI = 0.82, CFI = 0.90, and RMSEA = 0.07. Although these could not be described as sufficiently high, they did demonstrate a high level of fit, and the model was judged to be valid.

The only factor in the selected model that showed a significant direct correlation with early smoking initiation was *inadequate knowledge of the dangers of smoking*.

Growing up in an inappropriate home environment increased *self-disgust* and

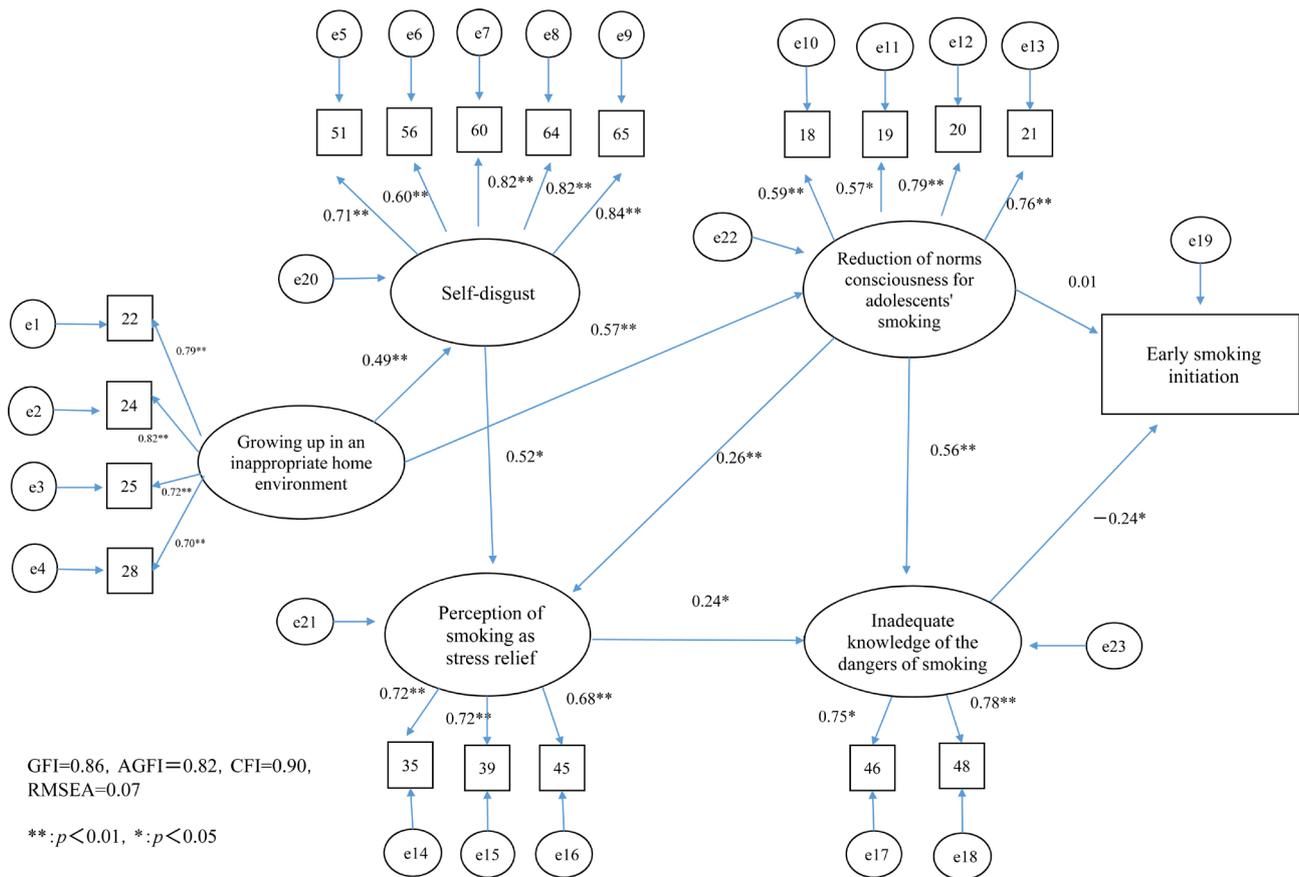


Figure 2. Factors related to smoking initiation in puberty/adolescence and causal model of decreased age at smoking initiation.

reduction of norms consciousness for adolescents' smoking, while *self-disgust* increased *perception of smoking as stress relief*, and *reduction of norms consciousness for adolescents' smoking* increased *perception of smoking as stress relief* and *inadequate knowledge of the dangers of smoking*.

All of these factors acted indirectly to lower the age of smoking initiation via *inadequate knowledge of the dangers of smoking*. In particular, *reduction of norms consciousness for adolescents' smoking* had a greater effect than other factors on indirectly lowering the age of smoking initiation via *inadequate knowledge of the dangers of smoking*.

4. Discussion

4.1. Factors Related to Smoking Initiation in Adolescence

In this study, we used a specially produced questionnaire to investigate factors related to smoking initiation during adolescence. In terms of the reliability of the questionnaire items, the I-T correlation coefficient was maintained, while the factor structure extracted by exploratory factor analysis met the standards of the cumulative contribution ratio, the KMO measure of sampling adequacy, and Bartlett's test of sphericity. Cronbach's α for each factor was also high, within the range 0.73 - 0.87, indicating that the internal consistency of the factor structure was maintained. These results suggested that the items in the specially produced questionnaire were valid for investigating "factors related to smoking initiation in adolescence".

4.2. Factors Related to Smoking Initiation by Adolescents and a Causal Model for Early Smoking Initiation

Our results contribute to an understanding regarding whether, and if so, how, factors related to smoking initiation in adolescence are related to early smoking initiation.

The factors extracted on the basis of factor analysis—*self-disgust* [11] [15] [16] [17], *growing up in an inappropriate home environment* [18]-[24], *reduction of norms consciousness for adolescents' smoking* [21] [22] [24] [25] [26] [27], *perception of smoking as stress relief* [17] [20] [24] [28] [29], and *inadequate knowledge of the dangers of smoking* [17] [30]—have all been identified as factors affecting smoking in various previous studies.

4.2.1. Factors Directly Affecting Early Smoking Initiation

The only factor directly affecting early smoking initiation was *inadequate knowledge of the dangers of smoking*. This indicates the importance of conveying information on smoking in antismoking education. The other factors—*self-disgust*, *growing up in an inappropriate home environment*, *reduction of norms consciousness for adolescents' smoking* and *perception of smoking as stress relief*—were not directly associated with early smoking initiation. Therefore, no apparent correlations were found between these factors and early smoking initiation. However, as shown in the conceptual framework of the hypothesis, environmental

and individual factors do not act directly on age at smoking initiation independent of each other, but rather, various factors are believed to interact to decrease the age of smoking initiation in adolescence. This is because antismoking education has been found to have no effect on preventing smoking, even if more information on the health effects of smoking is provided [31].

This suggests that *inadequate knowledge of the dangers of smoking* does not in itself reduce age at smoking initiation; rather, other underlying factors may act indirectly to lower the age at which young people start smoking.

This means that antismoking education to stop people from starting smoking at a younger age should provide more information on smoking, and that working via these indirect factors may also be an important means of prevention.

4.2.2. Factors Indirectly Affecting Early Smoking Initiation

Turning to factors that exert an indirect effect, *growing up in an inappropriate home environment* increased both *self-disgust* and *reduction of norms consciousness for adolescents' smoking*. *Growing up in an inappropriate home environment* may reduce self-esteem and causes anxiety and stress, increasing *self-disgust*. In an *inappropriate home environment*, parents are also unconcerned about their children smoking, causing *reduction of norms consciousness for adolescents' smoking*. This may result in a situation in which there is no intervention to prevent childhood smoking. Maladaptive behavior to smoking and other such actions by adolescents has also been reported to be associated with the quality of care received by children from parents and the stability of attachment [32]. Assessing the home environment and mediating the parent-child relationship may therefore be important means of preventing smoking initiation by adolescents at a younger age.

Greater *self-disgust* also increases the *perception of smoking as stress relief*, leading young people to hold the mistaken view of smoking as a means of reducing stress. This idea may indirectly affect early smoking initiation via *inadequate knowledge of the dangers of smoking*. Negative self-perception is a psychological characteristic that is particularly strong in adolescents. People with a strong sense of self-disgust tend to blame themselves when a problem occurs, and are therefore likely to exhibit stress responses [33]. It is therefore important that antismoking education provided during puberty and adolescence includes material on assessing one's own personality type, self-control of stress and emotions, and fostering the capacity for self-regulation. Factors that inhibit self-regulation include the home environment and stress. This also suggests that understanding the home environment and self-control of stress may be important [34].

Reduction of norms consciousness for adolescents' smoking also affects *inadequate knowledge of the dangers of smoking*, and may indirectly lead to early smoking initiation. Lipperman *et al.* [12] found that social norms and school antismoking policies affected personal views on smoking, and stated that they are associated with smoking by adolescents. In this study, we also found that *reduction of norms consciousness for adolescents' smoking* in the form of nonintervention

by the local community or parents might indirectly affect age at smoking initiation. Exposure to cigarettes, alcohol, and other hazardous substances increases dramatically during adolescence, so intervention by parents and other members of the community is essential.

4.2.3. Policies for Educational Antismoking Programs Aimed at Adolescents

Our results suggest that providing more information on smoking is an important item for inclusion in antismoking education to prevent adolescents from starting smoking at a younger age. However, this by itself is inadequate, and in order for such educational programs to be more effective, it is necessary for parents and other members of the community to pay attention to children's smoking and intervene. For this to happen, it is important that parents have the correct information about health and smoking [30] [35] [36]. This suggests that the incorporation of parents in antismoking education may be vital.

While local communities must put effective measures to prevent smoking by adolescents into practice, society as a whole must also have stricter social norms regarding adolescent smoking. It is necessary for members of the community to speak out to adolescents about the dangers of starting smoking and the risks of smoking itself.

Further studies are required in future, both in terms of the implementation of interventional studies based on the factors identified in this study as related to early smoking initiation, and in terms of the development of educational anti-smoking programs.

5. Study Limitations

The participants in this study did not constitute a randomly selected sample, and selection bias may therefore have occurred. In addition, the questionnaire items were about past events, so there is also the potential for memory-induced measurement bias. The nature of this study as a cross-sectional study means that the effects of *self-disgust*, *growing up in an inappropriate home environment*, *reduction of norms consciousness for adolescents' smoking*, *perception of smoking as stress relief*, and *inadequate knowledge of the dangers of smoking* should be studied over time to understand their relationship better. The implementation of interventional studies to demonstrate a clear causal relationship is thus an important future task.

6. Conclusions

The objective of this study was to develop a causal model for factors related to smoking initiation in adolescence and early smoking initiation. The study participants were 215 students aged ≥ 20 years, and the data were subjected to analysis using structural equation modeling. Four points were suggested by the results.

1) We identified the following five factors in smoking initiation in adolescence: *self-disgust*, *growing up in an inappropriate home environment*, *reduction*

of norms consciousness for adolescents' smoking, perception of smoking as stress relief, and inadequate knowledge of the dangers of smoking.

2) The only factor directly affecting early smoking initiation was *inadequate knowledge of the dangers of smoking.*

3) The other factors affected age at smoking initiation indirectly via *inadequate knowledge of the dangers of smoking. Reduction of norms consciousness for adolescents' smoking* exerted a particularly strong effect on decreasing age at smoking initiation compared with the other factors via *inadequate knowledge of the dangers of smoking.*

4) Our results suggest that antismoking education for adolescents should provide more information on smoking, and that assessing the home environment and mediating in the parent-child relationship, increasing self-control of stress and emotions and the capacity for self-regulation, and incorporating parents into antismoking education may also be important.

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