

Dynamic Analysis of Social Networks of Learners' Online Peers' Interaction Behavior in Smoking Cession Education

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Objectives: We investigated the dynamic changes in the impact of online peer support on individual behavior, using the online smoking cessation community as an example. **Methods:** This study included a longitudinal sample of 52 adolescents (aged 17-21) who volunteered to quit smoking in an online smoking cessation community. We described an actor-based model for online friendship network-smoking cessation behavior co-evolution, using social network dynamic analysis to study the interaction between learners to explore the impact of online peer support on adolescent smoking cessation behavior. **Results:** Three RSiena models exhibited high goodness of fit in the structural effect part (The estimated values of the three reciprocity effect parameters were 1.7067, 1.07384, and 1.07401, respectively). The estimated value of the in-degree effect parameter of smoking cessation behavior influenced by network structure was 0.0934. **Conclusions:** Online peer support has a significant impact on the propensity for adolescents to select offline friends. The more online peers' support, the better results of teenagers online smoking cessation. Online peer support significantly affects the changes in individual behaviors.

Key words: Social network analysis; online peer support; online smoking cessation education

Tob Regul Sci.™ 2021;7(5-1): 3396-3409

DOI: doi.org/10.18001/TRS.7.5.1.116

INTRODUCTION

The popularity of the Internet and the widespread use of social media have brought about great changes in the way of social interaction. Network communication provides a new communication medium for individual contact and makes the form and process of communication more diversified.¹ Online interpersonal communication has become an essential channel for young people to communicate with their peers. The influence mechanism of the structure characteristics of online friendship networks on individual social behavior has become a hot topic in recent years.

The influence of online peer relationships on individual behavior

The experience of personal interaction with peers can substantially impact the performance and development of their social behaviors.² Many studies have shown that direct and indirect relationships (such as friends) affect the psychology and behavior of an individual, such as emotional problems³⁻⁵ and behavioral issues such as smoking, drinking, and aggression.⁶⁻⁹ This effect also spreads and transmits in the network of relationships.¹ In addition, friendship formation and interaction between adolescents and their attributes (emotions, personalities, social attitudes, and behavioral problems) also influence a particular group network. The influence of peer status and peer group characteristics on individual psychological and behavioral development is also significant. Numerous studies of peer relationships have shown that good peer relationships contribute to the ability of adolescents to develop individual socialization and social interactions.¹¹ The importance of peer groups in adolescent life makes adolescents particularly vulnerable to social relationships.¹²

Adolescents' companionship and smoking cessation behavior

Smoking and drinking have received more attention among the social network studies of adolescents' health risk behaviors. Tobacco dependence is a chronic and addictive disease, and smoking-related conditions place a heavy burden

on families and society. In the Internet age, teenagers have more access to social media. One study has found that users who spend more time on social media are more likely to be influenced by tobacco advertising.¹³ The proportion of teens who purchased tobacco online from 2.5% to 3.3%.¹⁴

According to medical research, smoking will increase the incidence of multiple diseases such as cardiovascular and so on.¹⁵ Furthermore, adolescents are in the growth and development period, and smoking is more harmful to adolescents. Providing young people with scientific and practical smoking cessation services and smoking cessation strategies is an effective way to help them successfully quit smoking, reduce the smoking rate, and promote adolescents' physical and mental health development.

Many scholars have carried out a lot of research on the relationship between adolescent companionship and smoking behavior. A follow-up study from early to middle adolescence found that parents and family members have a more significant influence in early adolescence. The effect of friends gradually increases in middle adolescence.¹⁶ The smoking addiction among teenagers results from a mutual transformation of the friendship selection process and influence process in the long run. Prevention of adolescent smoking behavior should focus on these two effects in different stages of friendship.

Numerous studies have revealed that peer relationships likely influence adolescent smoking behavior. Long-term effects can lead to these children becoming regular smokers in adulthood.¹⁷ Peer relationships are essential for adolescent mental health, behavior norms, and social adaptation. Combined with the family environment, they form the two core systems of adolescent personality formation and socialization.^{18,19} In addition, friendship relationships and factors such as the quality, attributes, and status of individuals among friends reinforce smoking behavior among adolescents.¹⁸ Mercken has found that the selection process and the influencing process are related to smoking behavior.²⁰ Another of his studies also found that peer selection processes significantly influence adolescent smoking behavior than peer influence

Dynamic analysis of social networks of learners' online peers' interaction behavior in smoking cessation education processes. Nevertheless, over time, the peer influence process increased, and the power of the selection process gradually decreased.²¹

Online smoking cessation education

The structure of adolescents' online social support is a multi-dimensional system. Online social support and practical support are similar. Although some researchers say there is no real help in virtual Spaces, people feel less supported. But a growing body of research confirms the role of online social support. It is easier to find the people you need (such as those who have similar experiences). People can communicate better, share worries, reduce stress, and feel the support of others. And the support from the virtual space has its unique advantages: can not return, can obtain a broader range of support, can seek help at any time.²²

Online smoking cessation intervention has received more and more attention internationally due to its low cost, not limited by time and region, and protect the privacy of smokers, which is very suitable for widespread promotion. At present, facing the heavy burden of tobacco control work, learning and drawing on the experiences from this simple and cost-effective intervention is critical in promoting tobacco control for young people. The assessments to QuitCoach did by Balmford have shown that the online smoking cessation community can help improve the success rate of quitting.²³ Walters et al. have reviewed all online smoking cessation interventions and found that 47% of studies indicate that online smoking cessation interventions can significantly increase long-term smoking cessation rates.²⁴ Cameron Norman has conducted an online follow-up study of smoking cessation interventions, which means that the three-month withdrawal rate could reach 18%.²⁵ Online support groups can be an effective tool for helping teens cooperate in cancer treatment and recovery. Online support networks have important clinical significance for the psychological support they provide.

The influence of peer relationship on adolescents' behavior in social network analysis

In recent years, much new progress has been made in

the hot issue of online peer influencing adolescent behavior. Social network analysis, based on two-way friendship and the more significant relationship context, examines the interaction between peer relationships and smoking behavior problems. Social networking analysis is informative and dynamic because it can dynamically analyze changes in adolescent behavior and peer relationships over time, thus overcoming previous research deficiencies.²⁶⁻²⁸ Social networking studies also can offer distinctive data concerning the character of peer influence. For example, one study has found that reciprocal friendships are more influential than non-reciprocal friendships.²⁹

In social network research, We regard smoking behavior and peer relationship as interactive, variable, and co-evolving factors, such as the relative effect and mutual influence of the selection process and influence process. Therefore, we use social network analysis methods to distinguish between friendship selection and power (socialization) influences. Social network analysis provides a new perspective and approach for researchers to investigate the relationship between peer relationships and adolescent behavior change.³⁰ At present, more and more research combines social network structure with actor attributes (such as personality, attitude, behavior, etc.) to investigate the interaction mechanism. One study uses RSiena (Simulation Investigation for Empirical Network Analysis) and a meta-analysis of random behavior models to assess changes in friendship relationships and risky behaviors. The results show that the selection effect of adolescents is more potent than the influence effect in online smoking cessation intervention. Consequently, we need to pay more attention to the friendship choice mechanism.³¹

There are differences in peer relationships or social network effects and mechanisms of action for different groups of people. Subsequently, it is crucial to consider the distinctive characteristics of friendships in adolescents' social networks to assess peer factors' influence on adolescents' smoking cessation behavior. Although previous studies have shown that online smoking cessation communities can help smokers change their smoking behavior, we need to explore further the relationship and mechanism between online peer

support and smoking cessation behavior of adolescents. (1) Does peer support in the online smoking cessation community significantly impact changes in smoking cessation behavior? (2) Does an online friendship network affect the propensity for individuals to select offline friends? (3) How to use the online health education community to enable teenagers to quit smoking to achieve better results? On this basis, researchers can use the social network analysis method to explore the mechanism of peer factors in adolescent smoking cessation behavior and provide effective means for adolescent smoking behavior intervention, behavior habit cultivation, and online health education.

THEORETICAL FOUNDATIONS

Social cognitive theory

Social cognitive theory is one of the theories proposed by Albert Bandura to explain and predict health behavior.³² Personal, behavior and environment mutually determine individual behavior patterns. Environmental factors, such as friendship with classmates and family relationships, also affect the motivation and behavior of young students to quit smoking except for personal characteristics such as expectation, belief, cognition, and emotion. At the same time, individuals affect the environment, and the environment affects the individual in turn.

Bandura defines an individual's belief in their

ability to act as self-efficacy.³³ As shown in Figure 1, self-efficacy expectations directly impact behavior and indirectly affect all the other factors in social cognitive theory.³³ In the process of quitting smoking, the higher the self-efficacy of the learner and adolescents, the greater the possibility of success in quitting, and it may even affect the surrounding smoking partners to quit smoking together. Social cognitive theory assumes that individuals can make behavioral decisions that seek benefits and avoid harm. Social structure factors and goals are other core structures of social cognitive theory. Goals, as shown in Figure 1, directly impact behavior and regulate the effects of all other social cognitive theoretical structures.³³ Goals contribute forward guidance and self-motivation for executing behaviors. Long-term goals can be concerned as a general guide, and short-term goals can guide current actions.³⁴ Social structural factors include obstacles and promotional factors in implementing behavior that indirectly influences behavior through objectives.³³ These factors influence behavior by regulating a sense of self-efficacy. Therefore, it is essential to focus on the social structural factors of smoking cessation. Learners should strengthen their communication with peers, improve self-efficacy, even form smoking cessation groups for mutual supervision and mutual help, and finally promote smoking cessation success.

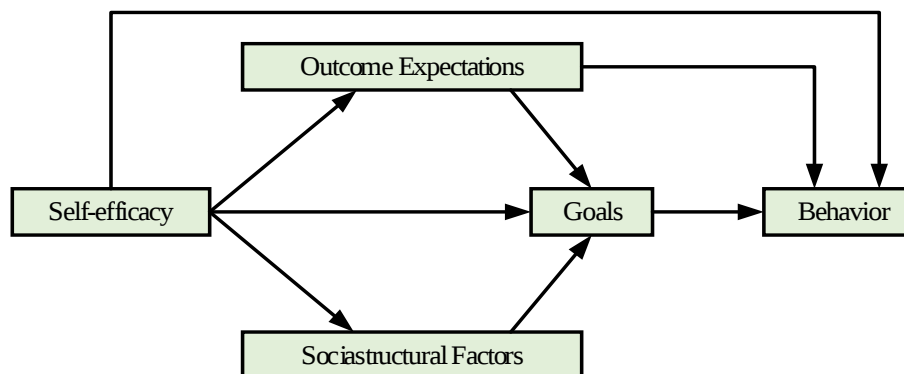


Figure 1
Social Cognitive Theory³⁰

Social network theory

Studies have shown that the influence factors affecting

the smoking of learners have peer influence and parental influence. The role of peer influence will play a more significant role over time. The theory

of social networks holds that the complex network formed among individuals will impact their behavior. The online social network created by social media has become a meaningful way to explore the tobacco control behavior of teenagers. A social network refers to a group of individuals and networks built through their interlinked relationships. Social network analysis describes the structure of a particular group's relationships and analyzes the effects of inter-group relationships on behavior.³⁵ At present, researchers, widely use social network theory to study health behaviors such as internet addiction, smoking, and so on.

Dynamic analysis of social network SIENA

When exploring the tobacco control behavior of the adolescent group of learners, we pay attention to the static relationship among the influencing factors that change their behavior and hope to understand the dynamic change process of the duration data collected based on these influencing factors. We hope to improve our understanding of smoking behavior among adolescents to propose effective interventions. To make up for the limitation that traditional social network analysis can't explain the time-lapse data, the dynamic study of social networks analyzes the factors affecting the change process according to statistical inference, which can indicate the dynamic change process of the network. Based on a random actor model, Snijders et al. have developed a tool dedicated to dynamic analysis of social networks, Siena (Simulation for empirical network analysis). Stochastic actor-oriented models can analyze the changing process of the network and explore the co-evolution of node behavior attributes and network structure. Siena can perform model calculations. We use the RSiena package of R language to implement Siena, which can easily read data, set effects, complete the estimation of model parameters, and output analysis results.

The utility principle of peer support

Subculture theory holds that a particular group must have produced a unique cultural and interpersonal network belonging to that group and formed a

unique way of information dissemination. Members prefer to resonate and accept each other's messages and ideas. As for the online community of smoking cessation, they all have the exact needs. Even if the smoking behavior changes, it is easier to get peer support and understanding. The theory of innovative communication states that the leader's point of view is a critical force in team innovation in a team or group. Although the leader and others are contemporaries, they have a relatively high social status, a better educational background, a certain prestige in the group, can be recognized by the rest of the peers, and impact them. Albert Bandura's social learning theory holds that complex human behavior is not acquired inborn but obtained in imitation in daily practice by observing the demonstrator. The above three theories affirm the influence and function of the demonstrator in the group from different aspects and provide theoretical support for the utility of peer support.

To sum up, the principle of peer support's effectiveness on learner's adolescent smoking cessation behavior is to promote other peers to have positive behavior change through the influence of example. The purpose of this paper is to use the dynamic analysis of social networks and related theories to explore the effect of online peer support on behavior change in the online health education community of adolescents, taking the behavior of smoking cessation as an example. By exploring the characteristics and dynamic evolution trend of peer friendship selection in the smoking cessation process of adolescents, we can develop scientific and practical intervention measures according to the dynamic evolution law of their smoking cessation behavior.

METHODS

Participants

Community members (2020-2021) participated in this study, including 35 junior and 15 senior learners, 42 boys and 8 girls. Teaching assistants play a leading role in this study process, organizing many educational activities on the dangers of tobacco in the evolution of community networks and participating in most discussions, which significantly impact community smoking cessation education. Accordingly, we included two

Dynamic analysis of social networks of learners' online peers' interaction behavior in smoking cessation education teaching assistants in this study.

Measures

Studies have confirmed that peer influence is an essential factor in the success of smoking cessation in adolescents. Suppose online peers discuss their goals and ideas and make friends with similar attitudes towards quitting smoking (hypothesis 1). Over time, friends with similar real-life smoking levels interact more and more with people of the same attribute (hypothesis 2). At the same time, learners who smoked less in the real world were also more likely to be asked for advice by their peers online (hypothesis 3). Peer support in online smoking cessation communities significantly impacts smoking cessation behavior (hypothesis 4). Hypotheses 1, 2, and 3 originate the effects model of network objective function; Hypotheses 4 originate the objective behavior function.

To test these hypotheses, we create an online health community in a college health education center. The community is organized by three teachers from the school, with two teaching assistants (learners, one male, and one female) who smoke. The subjects are the learners who actively participated in smoking health education. The goal is to help learners who are willing to quit better. When learners join the community, they need to care and share their feelings in community chat groups as long as they don't smoke that day. In building a friendship network, we collect the interaction of learners in the process of online discussion. We survey participants about their tobacco use and that of their friends. The characteristic of this study is that teachers and teaching assistants in the community only act as organizers and collectors of interactive data and do not arrange specific courses for online teaching. Learners develop a plan to estimate how long it will take them to quit smoking successfully.

Model Description

The actor-based network-behavioral co-evolution model presumes that at multiple observational points, one has a directional network and one or more behavioral variables are observed and summarized into a limited series of social factors.

The network, a relational circulation variable, shows the interaction between individuals in this study. This study assumed smoking cessation behavior as a discrete sequence variable. Teenagers can alter smoking cessation behavior or change their interactions to adapt to the present network structure and other youth smoking cessation behavior in the network. Suppose all participants fully understand the other participants' network status, covariates, and smoking cessation behavior. Participants are solely allowed to alter their outgoing ties and their smoking cessation behavior. This study assumes that each adolescent uses probability rules to change interactions or quit smoking behavior.

Determining the function of the change probability is called the target function. Network change and behavioral change have independent target functions. As the value of the target function increases, so does the probability of a change in the specific network or behavioral state. See Snijders et al.³⁴ One explanation is that these changes result from a combination of short-term preferences and constraints that optimize the choice of actors' positions in the network. The objective function can account for these dynamic changes in short-term preferences and constraints. Ultimately, all actors independently consider and implement changes in network and smoking behavior, taking into account the condition of the network and individual behavior currently. Participants, at any time, may alter one interaction or one quit behavior. Participants may respond to each other's changes in interactions and smoking cessation behavior, instead of negotiating or making changes together based on prior agreements.

The actor-based models for co-evolving networks are based on a continuous-time Markov process. In this progress, we estimate the developmental trajectories between observation moments (continuous-time property) and assume changes adolescents make only depend upon the present state of affairs (Markov property).³⁷ To simulate the co-evolution of friendship and smoking, we construct two models, one is a model of interaction network change and another is a model of change in smoking cessation behavior. We fuse the network evolution and behavior evolution model into an internally dependent

Dynamic analysis of social networks of learners' online peers' interaction behavior in smoking cessation education whole. In this manner, the current state of the continuously changing interactive network can dynamically constrain smoking cessation behavior. In contrast, quitting smoking can correspondingly provide an active constraint for changes in the interactive web.

Data preparation

The first steps with RSiena include data collection, data entry, creation of R objects, and checking the suitability of the data for modeling using the SAO model. We refer to the principles of social network analysis to collect and analyze data. We collect two types of data at the beginning and every other month. The first is the relationship between online learners (collected through the interaction between learners in WeChat groups). The second is their attributes (collected through content analysis in chat groups). We collected data three times. We use 0 and 1 to encode the interaction state between participants to construct the network structure. "1" indicates that there have been one or more successful interactions between learners A and B, and "0" means that there has been no interaction between learners A and B. The friendship network is a file in the form of an adjacency matrix, namely, S52-Network1.dat, S52-Network2.dat, and S53-Network3.dat. We arrange for teaching assistants to ask each learner about smoking at different times regarding learner attributes. Learners choose the five most frequently contacted offline friends and use the numbers "1-3" to represent the number of smoking friends among the five friends. "1" More than 70% of friends smoke; "2" More than 40% of friends smoke; "3" means that friends do not smoke, and 40% of friends smoke. The statistical data is coded as s52-interactive.dat. At the same time, we count the daily clocking of learners. Numbers "1-5"

indicate the smoking of participants. "1" means smoking multiple times a day, more than 14 times a week. "2" means smoking more than once a day, more than seven times a week. "3" means occasionally smoking more than three times a week. "4" indicates light smoking, more than once a week. "5" means you have quit smoking. Code these statistics as S52-smoke.dat.

Process Analysis

We used RSiena, the R-pack for simulate surveys of social network dynamic analysis (Siena), being concerning as a statistical tool designed to analyze networks with multiple observations. This approach assumes that changes within the network return from a series of separate steps taken by actors to form, maintain, or terminate contact with others. Time is a continuous concept in this scene³⁶. Using evaluation functions, RSiena analyzes the impact of network structures, node characteristics, and actions taken by other actors on individual decisions.³⁸

Multiple models that run tests with different assumptions or effects are standard operating procedures for scholars using RSiena. We run three RSiena models. The first model tests hypotheses related to social cognitive theory: reciprocity, transitive triples, periodic triples, and popularity. Considering that learners will also have corresponding friendship network changes online while quitting smoking, more and more ambient friends will not smoke. In the second model, we add a control parameter to control smoking by friends outside the learner community. In the final model, we add a test to explore the impact of friendship networks in the community on the smoking cessation of adolescents. In Table 1, we describe the effects contained in the model.³⁶

Table 1
Illustrates the effects included in RSiena's model

Effect	SIENA formula	Description
Reciprocity	$\sum_j x_{ij}x_{ji}$	The general trend towards mutually beneficial relationships

Transitive triplets	$x_{ij} \sum_h x_{ih} x_{hi}$	The general trend towards transitive triples in networks
Three-cycles	$\sum_{j,h} x_{ij} x_{jh} x_{hj}$	Also known as generalized reciprocity or as opposed to hierarchy. It reflects the general trend of the end of three cycles
Smokebeh alter	$z_i \left(\sum_j x_{ij} z_j \right) / \left(\sum_j x_{ij} \right)$	Learners with higher levels of smoking cessation tended to attract additional input
Smokebeh ego	$x_{i+}^{-1} \sum_j x_{ij} x_{+j} \left(\text{sim}_{ij}^z - \text{sim}^z \right)$	The external influence of learners with a high level of smoking cessation
Smokebeh similarity	$x_{i+(r)}^{-1} \sum_j x_{ij} x_{ji} \left(\text{sim}_{ij}^z - \text{sim}^z \right)$	The more likely the interaction was to occur with similar smoking cessation levels
Intbeh alter	$z_i \left(\sum_j x_{ij} z_j \right) / \left(\sum_j x_{ij} \right)$	Learners with high levels of smoking among their friends tended to attract extra intake
Intbeh similarity	$x_{i+(r)}^{-1} \sum_j x_{ij} x_{ji} \left(\text{sim}_{ij}^z - \text{sim}^z \right)$	Learners with high levels of smoking among their friends are more likely to interact with each other if they are similar
Smokebeh indegree	$z_i \sum_j x_{ji}$	The more engaged learners are, the more successful they are in quitting
Smokebeh outdegree	$z_i \sum_j x_{ij}$	The more active learners were, the more successful they were in quitting
Intbeh indegree	$z_i \sum_j x_{ji}$	The higher the degree of smoking, the higher the degree of smoking
Intbeh outdegree	$z_i \sum_j x_{ij}$	The higher the degree of smoking, the higher the degree of smoking

RESULTS

In Table 2, we get the specific data of the evolution of the three models, and the detailed analysis is as follows:

Structure effect

The t ratio differing from the t-statistic used for the hypothesis test checks how different the estimated parameter values differ from the

simulated parameter estimates in the network evolution simulation run (usually 1,000 times). Typically, we want the t-ratio to be 0, which means the simulated parameter values are the same as the estimated parameter values. For all effects, convergence is concerned as excellent when the t-ratio for convergence is below 0.1 (absolute value). The maximum convergence rate is the maximum average deviation standard deviation of any linear

Dynamic analysis of social networks of learners' online peers' interaction behavior in smoking cessation education

combination of the target value. In the structural effect of the three models in Table 2, we can see that the absolute value of the t-ratio of the structural impact is 0.0932. The minimum value is 0.0015, both of which are less than 0.1, which indicates the convergence is perfect. These data show that the three models' goodness of fit in the structural effect part is superior. In the attribute of reciprocal effect, the valuation of reciprocal effect parameters of the three models is 1.7067, 1.07384, 1.07401, respectively, and there are minor variations in models 1, 2, and 3, all of which are positive, indicating that the effect is positive and significant in all three models. Our test supports the assumption that online virtual peers will choose to make friends because they have a similar attitude toward quitting smoking.

Control variable

In Model 2, we join the real-life impact of smoking by friends around us on healthy community networks. The results indicate that the t-ratio of both models is also less than 0.1, and the model has high goodness of fit, indicating that the degree of smoking among the friends around them

has a significant effect on the participants' smoking cessation situation is a necessary observation. Regarding specific values, the reality of the surrounding friends' smoking situation of the alter and similarity in the two are positive 0.0003 and 0.3014, respectively. Alter values show that people with fewer friends who smoke are more prevalent in healthy communities and more likely to interact with their peers. The similarity value suggests that if people with a similar degree of smoking, in reality, the frequency of interaction will increase in healthy communities, assuming that both 2 and 3 are true.

Network-effect

As can be seen from the data of model 4, the estimated value of the in-degree effect parameter of smoking cessation behavior influenced by network structure is 0.0934, which is positive. Learners who are more successful in the network structure quit smoking, suggesting that the support and encouragement of virtual peers in the online health community significantly impact the smoking cessation of learners, assuming that 4 is true.

Table 2
Results of SIENA model

SIENA effect	Model1			Model2			Model3		
	Estimate	Standard Error	Convergence t-ratio	Estimate +	Standard Error	Convergence t-ratio	Estimate	Standard Error	Convergence t-ratio
Structure effect									
Reciprocity	1.7067	0.1454	0.0799	1.7384	0.1499	-0.0234	1.7401	0.1553	0.0253
Transitive triplets	0.4666	0.0717	0.0932	0.4530	0.0845	-0.0046	0.4539	0.0808	0.0278
Three-cycles	-0.0314	0.1370	0.0905	0.0112	0.1641	-0.0015	0.0148	0.1581	0.0154
Control variables									
Smokebeh alter	0.1199	0.0652	-0.0359	0.1197	0.0642	0.0270	0.1205	0.0647	-0.0087
Smokebeh ego	-0.0966	0.0616	-0.0266	-0.0958	0.0641	0.0286	-0.0969	0.0642	-0.0350

Smokebeh similarity	0.2271	0.3283	0.0022	0.3115	0.3947	-0.0623	0.3186	0.3661	0.0399
Intbeh alter				0.0003	0.0881	-0.0015	0.0002	0.0893	-0.0612
Intbeh similarity				0.3014	0.2151	0.0054	0.3010	0.2197	0.0647
Network changes									
Smokebush indegree							0.0934	0.3091	-0.0653

DISCUSSION

At present, there is still a lack of dynamic research on the relationship between online friendship networks of teenagers and smoking cessation behavior at home and abroad. Specifically, after reviewing the existing research, we still have two main questions. The first is whether peer support obtained by adolescents in online communities significantly impacts their smoking cessation behavior. The second is whether the friendship network built-in the online health community of teenagers will affect their choice of the offline friendship network. This study collected interactive and smoking cessation behavior data among learners who voluntarily participated in online smoking cessation to solve these problems. We use a model analysis based on the co-evolution of online friendship networks and smoking cessation behaviors based on actors and discuss the results.

A significant effect of online peer support on smoking cessation behaviors

This study has found that peer support in the online smoking cessation community significantly impacted adolescent smoking cessation behavior. We investigate the participants for three months. The results show that the online smoking cessation group could promote the smoking cessation effect of adolescents. The more learners interact with peers in the online communication group, the more positively the smoking cessation behavior changes, and the better the smoking cessation effect d. The current research also shows the

importance of online peers.

With the help of the network to establish online peer support groups for young people can better achieve the effect of health education. On the one hand, the development of online peer support groups, flexible and convenient, to a certain extent, save the time cost of team members and the school to carry out adolescent health education intervention costs, and not limited by geographical space, more conducive to expanding the coverage of participants. The limited number of offline peer support project participants and the positive benefits generated are limited to few participants. In contrast, the online community can reach more peers across geographic spaces, creating a more significant community effect that expands the positive utility of peers and benefits more peers. In addition, it can save more time and energy to improve themselves. On the other hand, the communication between online companions creates a barrier for the strange socialization between teenagers. It is more conducive to protecting the privacy and security of adolescents. Web-based online intervention is also more conducive to obtaining participant interaction data, analyzing it, and giving timely feedback.

The influence of teenagers' online friendship network on offline friend choice

Peer support from the smoking cessation community online can significantly influence their choice of offline friends. The more interaction teenagers have with their smoking cessation peers in the online community, the

more peer support they receive, and the easier it is to develop friendships with non-smoking friends in actual dating. The number of non-smokers in learners' offline friendship networks gradually increases, and the number of smoking companions decreases. Positive comments from friends on social networking sites are also related to teenagers' behavioral adaptation.³⁹ Another study has found that healthy online relationships can helpfully complement offline ones.⁴⁰ Teenagers' online friendship network can promote them to choose offline friends whose behaviors are more similar to their own.

Some studies have found that peer selection and peer influence processes are not antagonistic but symbiotic. Online peer support can influence online friendship networks, and adolescents can strengthen communication with peers who share the desire to quit smoking in online communities. In the stage of offline friendship formation, adolescents will choose peers similar to themselves to establish friendship according to deviant behaviors. Therefore, online friendship networks can influence the selection of offline friends. In adolescents, the number of friends with less smoking behavior gradually increased, which contributes to quitting smoking for adolescents.

Strengthening teacher intervention and using analytical tools

School is a critical natural place in the process of physical and mental development of young people. Consequently, in addition to actively playing the role of support between online peers, the school health education center should also be through the education of teachers to appropriately intervene and feedback on learner behavior. Studies have found that objective performance indicators, such as test scores, teacher encouragement, and positive feedback, also play a crucial role in studying behavioral changes of learners. Therefore, teachers and administrators should be fully aware that their subjective positive feedback to learners may be as important as intervention programs for adolescent smoking. Managers should make more efforts. For example, schools and teachers are encouraged to actively carry out online

health education and raise their awareness of the potential impact of reducing tobacco use among adolescents. In addition, managers can establish an online health education community to encourage teenagers to interact and communicate actively to get more peer support. This study builds good relationships and enables participants to gain more online peer support required by appropriate external intervention. Good peer relationships help create a positive learning environment and enhance the stickiness of participants in the online health education community for adolescents. Participants do not know each other at the beginning of the project. Their personalities are not the same. It is difficult to form an atmosphere of active mutual assistance spontaneously, and hence teachers or teaching assistants need intervention and guidance. For example, in a project, teachers organize participants to introduce themselves online before the event begins and do not have to give their real names to protect young people's privacy. In addition, teachers can design games that need to be worked together by online peers to get participants to know each other, build friendships, and gain more online peer support for better health education.

To better promote the interaction between adolescents, the online health education community can use tool analysis. For example, the dialogue discussion generated by the interaction between participants and peers is used as the data source to visually present the development and change of critical topics in the interaction between participants. We can use the association rules of data mining to visually show the behavior pattern characteristics of learners in the collaborative process. To sum up, this method can better help teachers effectively analyze the interaction quality between learners in the collaborative process. Moreover, teachers can provide timely help for adolescents to achieve better results of online health education.

Study Limitations

There are some limitations to this study. This study time is short, the survey for participants for three months of research is shorter, the long-term effects of youth online smoking cessation need

to be further verified. Since the participants in this study voluntarily participated in the online smoking cessation program and all had the intention to quit smoking, this study did not compare the effect of the participants quitting smoking with online peer support on their behavior change. Besides, the research sample is small. We selected only 140 college students (average age 19 years old) who voluntarily participate in online smoking cessation as the research objects. In the follow-up research, it is necessary to expand the sample size and continue the follow-up observation study to provide a more scientific basis for exploring adolescents' online health education model.

Implications for Practice and Suggestions for Future Research

The results of this study are of practical significance to adolescent health education. Specifically reflected in the following aspects: on the one hand, taking into account the physical and mental characteristics of adolescents, school intervention in youth smoking cessation behavior can take the online organization of online smoking cessation community, and encourage young people to participate in the online smoking cessation community. On the other hand, the results show that the more interactions learners have with their peers in the neighborhood of quitting smoking online, the more peer support they get, and the more effective it is for learners to quit smoking. As a result, teachers can organize diverse activities in the online smoking cessation community, provide opportunities for interaction between smoking cessation adolescents, and enhance peer support among smoking cessation youth. In addition, this study results provide the theoretical basis for the effective smoking cessation community of teenagers online and provide ideas for tobacco control strategies to adapt to the changing times.

Because of the short duration of interventions in this study, researchers can use more interventions in subsequent studies. In addition, researchers can combine text analysis to analyze the specific content of interactions in the quitter community and understand the topics of

interaction between learners. The research proves that the social network of teenagers is one of the factors influencing the production and development of smoking behavior and an essential factor affecting the process of quitting smoking. This study is to investigate the influence of peer support in online smoking cessation communities on the smoking cessation behaviors of adolescents. Researchers can compare and analyze peers' virtual and offline impact in online smoking cessation communities on the smoking cessation process in the follow-up study. With the widespread use of social media among teenagers, online friendship networks among teenagers are expanding. The researchers could conduct a dynamic analysis of online friendship network structure and smoking cessation behavior in the follow-up study. At present, there are still many gaps between the characteristics of online social networks and their influence and mechanism on smoking behavior among adolescents. Researchers should consider the differences caused by gender, age, culture, and race and conduct more longitudinal and empirical research on online social networks. In addition, the effectiveness of mental health education interventions may be affected by several factors. Suppose further exploration of these potential influences will help to improve the effectiveness of interventions. In that case, future studies should provide a comprehensive assessment of adolescent social media behavior and adolescent personality traits. At the same time, the intervention method of health education for adolescents should further consider the needs of learners, make full use of the advantages of modern information technology, and provide personalized intervention. Further longitudinal experimental research is also one of the future research directions to deepen this study of the effectiveness of online social media intervention methods.

Human Subjects Approval Statement

Participation in the study was voluntary. Respondents were informed about the aim of the study and anonymity during the entire process of data collection and analysis. They could withdraw from the study at any time and there was no pressure to complete the questionnaire.

Conflicts of Interest Disclosure Statement

The authors declare no conflict of interest in the authorship or publication of this work. The authors declare no sponsored financial sources for the undertaken study.

Acknowledgement

This work was supported by Science and Technology Research Projects of Educational Commission of Henan Province(No. 19A880015, 19A880016).

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