Promoting Health Behaviors with Help of Online Social Ties: An Exploratory Study

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Abstract

Human behavior is the largest source of variance in health-related outcome, and the increasingly popular online health network can be used to promote health behavior and health outcome. Based on social norm, social support and number of social ties, this study explores how different online social ties correlate with the health behavior of users. With the ordered logistic regression model, we find that social norms and social supports from online social ties positive related with both dietary and exercise behavior. We also find that the competing relationship gets a stronger relationship with behavior than the mutual support relationship. This study extends the research on health behavior to online social environment. The result could be used for guiding users to make use of online social ties for changing and keeping health behavior; and for helping the healthcare website improve their services.

1. Introduction

Many technical breakthroughs have happened in healthcare recently, however, human behavior remains the largest source of variance in health-related outcome [1]. The modifiable behaviors, such as diet, lack of exercise, tobacco use, and drinking too much alcohol cause much of the illness, suffering, and early death related to chronic diseases and conditions [2]. As the key role of behavior in well-being, morbidity and mortality, as well as health care costs [1], health behavior change is the greatest hope for reducing the burden of preventable disease and death around the world [3]. The changing and adhering of health behavior mainly depends on self-management of patients, and patients often find it difficult, particularly for the diet and exercise [4]. Thanks to efforts in public health education and peoples’ personal interest in learning about health related issues, most people are aware of the risks of unhealthy behaviors. However, they continue to engage in these behaviors. It is even more difficult for the individuals attacked by chronic disease, who have to keep the health behavior for a long time, even a life long time.

Social environment plays a critical role in adoption and maintenance of health behavior [5]. McNeill etc. identified social networks as one of the most important dimensions of people’s social environment [6]. Social networks provide a great number of social ties to exert social influence (the process by which thoughts and actions are changed by actions of others) and offer social support [3]. Many studies have explored the relationship between health behaviors and social ties, but most of the works are based on the offline environment. The development of the Web 2.0 technology results in dramatic growth of electronic (online) social environment and blurring boundaries between the real and the virtual world [7]. Most of the social contacts and entertainment happen in online environment, and the online social ties become one of the most important parts of our life. The virtual online social environment has an increasingly high influence on human beings’ behavior and attracts more and more attention.

Following the patient-driven health care model, many Health 2.0 applications combining health information with experience through the use of information and communication technologies, allowing the user to be active and responsible in improving his/her own health [8], emerge to help patients improve their health behavior, both commercial and free. Health Applications are becoming recognized as an effective self-care information sharing and disease self-management tool today [9]. Online Health Community (OHC) is one of the popular applications and provides functions of social support, Q&A with physicians,
quantified self-tracking and clinical trials access [10], which provides users with tools for self-entertainment, self-association, self-design, self-discipline, self-healing [11]. It is convenient to find the peers who have experienced similar situations to share information and experience, or get personal stories and practical advice [12].

Many users join the OHC to make use of the online environment to get healthier. The communication in online social environment is characterized by physical separation, the anonymity of the user, temporal flexibility, and the absence of non-verbal communication [13]. With extending one’s social network to individuals that could not be accessed in the offline environment, the online social environment allows the users to communicate with each other at any time within a short time, ignoring the social class, the affluence level, the education level and many other features in the offline social context. To improve the health of the participants, the OHC allow the users to form various social ties with others, such as developing friendships with each other, joining groups to support each other and compete with each other. Just as “real world contacts”, online friends may shape people’s opinions [14], which will further affect the behavior of the users. Compared to offline health program, users participating OHCs with lower cost (for both money and time) could access more peers and get more choices. The OHC is so amazing that researchers started to pay attention to OHC. The previous researches mainly focused on the health outcome of the patients in the OHC. However, improving the health behavior could be used in the prevention of many diseases, which could benefit the users much more. Many works have tried to study the health behavior, but little work studies it from an online environment. Very few works explore how the different social ties in online environment relate to the health behavior. How could the OHC work to get users to be involved in health behavior and becoming healthier?

In this paper, we will explore what is the relationship between special online social ties and the health behavior. We consider online social ties in OHC from perspectives of the number of ties, providing social support and social norms, and study how to get oneself involved in health behaviors with the help of others in the online environment. We found that the social support, descriptive norms in OHC get positive relationship with the health behavior. Emotional support gets a stronger relationship with health behavior than the informational support. The competing environment has a stronger relationship with health behavior than the mutual support environment.

The reminder of this paper is organized as follows. We develop the hypotheses in Section 2. We introduce our study setting and describe our data in Section 3. Section 4 presents the research framework and reports the results of our analysis. Finally, in Section 5, we conclude with a discussion of study implications, limitations of current work and future research directions.

2. Theories and Hypotheses

The OHC provides a platform for users to self-monitor and form social ties for personal interaction. We will analyze how the health behavior is affected by the social ties from the perspective of ties number, social support and social norms.

2.1. Health behavior

Human behavior is the largest source of variance in health-related outcome [1]. Conner suggested the prevalence of key health behaviors including smoking, diet, exercise, screening, sexual behaviors and alcohol use [15]. Pingree etc. list the extension of health behavior, which include self-monitoring, treatment adherence, improved personal relationship behaviors, proactive use of the healthcare system, and caregiving [16]. Self-monitoring is the centerpiece of behavioral weight loss intervention programs [17] and other behavior change programs, which involves recording the details of health behaviors so that individuals are aware of their current behaviors. Self-monitoring could increase participants’ self-awareness of their targeted behaviors through reminding participants when the behavior is diminishing and implementing strategies to counteract compliance problems [18]. According to self-regulation theory, self-monitoring precedes self-evaluation of progress made towards one’s goal and self-reinforcement for the progress made [19]. Consistent self-monitoring of exercise was significant associated with fewer difficulties with exercise, greater exercise and weight loss [18]. Studies focused on dietary self-monitoring also found significant associations between self-monitoring and weight loss [17]. Participants with increased frequency of self-weighing got significantly better weight loss outcomes than those who maintained or decreased their frequency of self-weighing [20].

2.2. Social ties

Emmons thinks that distal social structural forces obviously shape people's day to day experiences [5],
which can affect the daily behaviors of a person. The social ties around the individuals could provide social support and social norm, which could promote the health behavior of individuals [21, 22]. With more social ties, the member gets more social support and descriptive norms from the social networks. Participation or membership in groups (viewed as a type of social ties) has also been identified as a potentially important factor that may influence physical activity [23]. People with smaller social networks are significantly less physically active than people with larger social networks [24]. Social network size or connectedness is inversely related to health risk-related behaviors, such as tobacco and alcohol consumption, physical inactivity, consequent obesity and drug use [25]. Data from Alameda County show a steady correlation between decreasing social connection and the cumulative prevalence of health-damaging behaviors [25]. However, there are severe limits in how much can be kept in mind at once [26]. Professor Robin Dunbar proposed that the theoretical cognitive limit the number of people with whom one can maintain social relationships[27]. As friends and other social ties increase, it will attract more attention of users, which will lead less attention for health behavior.

H1a: The number of social ties is positive related with the health behavior.
H1b: The number of social ties is negative related with the health behavior.

2.3. Social Norms

Social norms are the standards or models for evaluating the appropriateness of a specific behavior and one of the least visible yet most powerful forms of social control over human behavior [28], which provides a context in which an individual makes decisions about his or her behaviors [29]. As described in theory of planned behavior, social norms influence behavior through the perceived social pressure to perform or not to perform the behavior and predict behavioral intentions [30]. Shared norms around behaviors (e.g. alcohol, and cigarette consumption, treatment adherence or dietary patterns) will lead to direct consequences for behaviors of network members [25]. Descriptive norm is one type of social norms that describes what others actually do [31] and has a significant effect on intentions, which summarize a person's motivation to act in a particular way, and represent how hard he would try and how much time and effort he or she would devote to perform a behavior [22]. Social learning theory puts forward that people learn from others through observing others’ behavior in the social context [32]. With the information learned from others, they can get their behaviors adjusted. According to the social cognitive theory and self-efficacy, one believes in one's ability to succeed in specific situations [33]. As one sees others’ behaviors, the user could get higher self-efficacy and get encouragement that he could do that. People will also feel guilty to not perform the positive health behavior as their surroundings. In OHC, users participate in the health behavior together and share the behavior progress with others. They can get descriptive norms from different social ties.

H2a: Descriptive norms in OHC are positive related with the health behavior.

To help the users to improve the health condition, the OHC are usually designed to contain various environment, such as mutual support environment and competing environment. The mutual support environment allows the individuals to support each other. The competing environment provides the participants with a context not only for cooperating to support each other, but also for positively competing for the ranking of change in health condition. According social comparison theory, social comparisons can drive competition among peers. Teixeira etc. promote that a challenging contexts may facilitate the intrinsic motivation [34].

H2b: Descriptive norms from competitive ties get a stronger relationship with the health behavior than norms from cooperative ties.

2.4. Social support

Social support is defined as an exchange of resources between at least two individuals, and it is perceived by the provider or the recipient to be intended to enhance the wellbeing of the recipient [35]. Referring to the web of social ties that surround individuals, one important function of social network is provision of social support [3]. The connectedness in the network indicates a patient’s social embeddedness and how she derives the support from the environment [36]. According to the self-determination theory (SDT), people feel that support and intrinsic motivation [37] are what drives them to perform a behavior for the sake of enjoyment. Berkman etc. found social support could enhance the self-efficacy [25]. Cobb finds that sustainability of social support and social influence are required to promote smoking cessation and smoking abstinence in online social network [21]. Low support from family and friends are barriers to follow-up care behavior for patient with breast cancer [38]. Bambina (2007) illustrates the difference between OHC social support and traditional social support, and think the social support in OHC
includes informational support, emotional support, and companionship [39].

The informational support includes advice, referral, and teaching, information broadcasting寻求和 personal experience [39]. With providing much health relevant advice and recommendation, the OHC gives the users much more choices as they make their own informed decision about how to behave. According to SDT, with the much more choices and a free environment to decide on the treatment, the OHC could satisfy autonomy need, which is one of the three basic psychological needs (Autonomy, competence and relatedness) that must be satisfied to perform behaviors [37]. The experiential information from other patients provides users with a window on other’s second opinions, information that is “difficult” to ask directly, could help understand the health condition and determine their own behaviors [36]. The overcoming experience within similar conditions could help satisfy the basic psychological need of competence to perform behaviors [37]. According to the social cognitive theory, knowledge about health risks and benefits is one of the core determinants for the changing of individual behaviors and habits [40].

H3a: Informational support from online social ties get positive relationship with the health behavior.

The emotional support provided by OHC includes understanding/empathy, encouragement, affirmation/validation, sympathy, caring/concern [39]. With the emotional support, the users could feel to be concerned and understood, which would support the relatedness need of the users [37]. The supported relatedness need will promote users’ behavior. Getting encouragement from others could make the users feel competent to perform behaviors [37]. The lack of emotional support or isolation for cancer survivors can become a barrier to health behavior adherence [41]. With the OHC, the users could get support from a large number of persons without time and space limit.

H3b: Emotional support from online social ties gets positive relationship with the health behavior.

The companionship in OHC includes chatting, humor/teasing and groupies [39]. It can satisfy the relatedness by making individuals feel there are others who enjoy their presence and that they are a valuable part of something bigger than themselves [42]. Such support could be always provided in the discussion forum of OHC and make individual feel they are not isolated from the world.

3. Research context

In this part, we will test the hypothesis based on a free online weight loss community. Many treatments have been used to address obesity, including surgery [43](which is expensive, carries some risk, and is suitable for only the most obese individuals), behavior therapy, and various dietary approaches [44]. The last two approaches mainly get the weight losing through changing personal behavior. The energy imbalance between consumed and expended calories is the fundamental cause of obesity [45].

The free online weight losing community provides apps, online tools and community support for the members: 1) find available diet, 2) record their food, exercise and weight diary 3) exchange support with others. We downloaded members’ information, including all the personal profile, food diary, exercise diary, weight diary, forum communication, and group participation. For future analysis, we delete some members’ information: 1) members who do not share information , 2) members who record weight less than one time, 3) members who want to lose weight less than 3kg or get initial weight less than 50 kg( to exclude the users who are not really obese or do not want lose weight). We include members’ information during the 52 weeks from 2011.1.2 to 2011.12.31 and finally random selected 6,225 members.

3.1. Dependent variables

The health behavior for people wanting to lose weight are mainly diet and exercise, and self-monitoring behavior for weight loss mainly consists of recording dietary intake and physical activity [46]. We adopt the diet and exercise self-monitoring behavior as the dependent variables. As the different health condition, everyone has his own definition of health behavior, even for the individuals with similar conditions; there are several sets of health behaviors. It is difficult for us to identify whose behavior is healthier. What’s more, the behavior information in OHCs is self-recorded by users, which may lead the frequently incomplete and false input and wrong statistical result for calorie consumption. The recorded behavior is improper to measure the health behavior. As the self-care of members who are overweight or obese, they will pursue to behave properly for their own health. The self-monitoring functionality provided by OHC consists of easy-to-use data entry screens for condition, symptom, treatment and other biological information, which will be seen in a graphical display [10]. The more one monitors his health behavior, the more healthier he will behave (more exercise involved and healthier dietary intake). Therefore, the record frequency of diet and exercise in a week is a proper proxy of the health behavior. We adopt the record days of a week to measure the health behavior that members participated.
The table 1 presents the record frequency for all the users in the 25 weeks. Members record their diet behavior more frequently than exercise. Users record nothing most of the time. The next most frequently recorded behavior is 7 times in a week. 93.77% of users in the sample have not recorded Diet in a week. Whereas 23.88% of the users have recorded diet 7 times in a week.

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Percentage</th>
<th>Member</th>
<th>Percentage</th>
<th>Behavior</th>
<th>Percentage</th>
<th>Member</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>84.14%</td>
<td>165534</td>
<td>93.77%</td>
<td>179097</td>
<td>91.04%</td>
<td>5726</td>
<td>96.35%</td>
</tr>
<tr>
<td>1</td>
<td>3.74%</td>
<td>7348</td>
<td>45.45%</td>
<td>4562</td>
<td>2.32%</td>
<td>2109</td>
<td>35.49%</td>
</tr>
<tr>
<td>2</td>
<td>1.95%</td>
<td>3833</td>
<td>31.65%</td>
<td>2322</td>
<td>1.18%</td>
<td>1310</td>
<td>22.04%</td>
</tr>
<tr>
<td>3</td>
<td>1.51%</td>
<td>2969</td>
<td>26.45%</td>
<td>1762</td>
<td>0.90%</td>
<td>982</td>
<td>16.52%</td>
</tr>
<tr>
<td>4</td>
<td>1.42%</td>
<td>2799</td>
<td>23.84%</td>
<td>1640</td>
<td>0.83%</td>
<td>869</td>
<td>14.62%</td>
</tr>
<tr>
<td>5</td>
<td>1.48%</td>
<td>2904</td>
<td>21.87%</td>
<td>1418</td>
<td>0.72%</td>
<td>695</td>
<td>11.69%</td>
</tr>
<tr>
<td>6</td>
<td>1.24%</td>
<td>2443</td>
<td>18.96%</td>
<td>1138</td>
<td>0.58%</td>
<td>576</td>
<td>9.69%</td>
</tr>
<tr>
<td>7</td>
<td>4.52%</td>
<td>8898</td>
<td>23.88%</td>
<td>4789</td>
<td>2.43%</td>
<td>762</td>
<td>12.82%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>196728</td>
<td>285.87%</td>
<td>196728</td>
<td>100%</td>
<td>5943</td>
<td>219.22%</td>
</tr>
</tbody>
</table>

Note. The behavior frequency is how many times the record of N(0-7) appears in the sample. The Member frequency is how many members have got the N in the sample.

### 3.2 Independent variables

As we discuss in the previous section, we focus on the distal structure of online social networks in online environment, including social ties, social support and social norms, which influence individuals directly.

**Social ties.** Social network maintains series of social ties, which aim to assemble similar members to behave healthier and get a healthier outcome together. In OHC, members connect with each other through friend relationship and participating groups. The friendship is formed as two individuals follow each other directly, whereas the group is formed as a
This document discusses the impact of social support and social ties on health behavior. The OHC (On-line Health Community) facilitates peer interaction, where users make friends and participate in shared goals. This paper introduces the next variable to explain the observed norm, including friend number (FNum), support group number (SpNum) and challenge group number (ChalNum).

**Descriptive norm.** The observed norm is the behavior of surrounding others and has been recognized as an important variable that affects the behavior. As in the OHC, the surroundings include the friends and other group members. Therefore, the challenge groups provide a warm and accepting interpersonal climate, in which the client is accepted whether or not the goals are achieved [39]. Compared to the mutual support group, the challenge groups show additional rankings for weight loss result, which provide the participants with an environment for competing with each other.

We employ the number of social ties to measure the distal structure of members' social network, including the friend number (FNum), the support group number (SpNum) and the challenge group number (ChalNum).

**Social support.** On OHC, users make friends with each other and participate in groups to communicate with others and pursue the goal of becoming healthier. They talk in the forum to share information and care others, which express the process of exchanging social support. In this paper, we identify the social support as informational support (InfoSp), emotional support (EmotSp) and companionship (CompSp), and code the messages according to Bambina's research [43]. Members in OHC communicate with each other in the forum and exchange social support with others through posting messages. We compute the detail support by making use of the Sentiment Analysis in lingpipe [47] and recognize the support in a member's post as her support exchange [36].

**Member variables.** The member's special information significantly affects the behavior herself. We introduce the next variables: 1) the member's initial weight (InitWeight), which is the initial condition of individuals. We can infer that the member who gets a larger initial weight may get a higher level of motivation to participate health behavior; 2) the member's expect weight loss ratio (ExpLossRatio), which is the initial goal of individuals for health behavior; 3) the time of the member participating the OHC (Membership); 4) the times of changing diets (DietChangeTs), which reflect the activity level of the member in weight losing.

As the user's health behavior could be affected by his/her past behavior level, we include the users' past behavior as an independent variable to control the omitted variables. The previous three month health behavior (PastDietNum, PastExerNum), which presents the health behavior level of the individuals. We also include the interaction term of the past health behavior and the social variables to explain how the impact of the social ties on a user’s health behavior level.

### 4. Data analysis

As dependent variable, the self-monitoring behavior is the records frequency of a member in a week, which is an integer ranging from zero to seven. More records represent healthier behavior and the dependent variable is ordinal. We introduce the Ordered Logistic Model to relate latent health behavior level to user’s monitor frequency,  

\[
\text{Record}_{ij} = \beta T_{ij} + \delta N_{ij} + \gamma S_{ij} + \alpha M_{ij} + \eta P_{ij} + \epsilon_{ij},
\]

where  

\[
T \text{ is the social ties variables, } N \text{ is the social norm variables, } S \text{ is the social support variables, } P \text{ is the past health behavior and } M \text{ is the member specific variables.}
\]

Let  

\[
\text{Record}_{i} = \text{Record}_{i,1} + \text{Record}_{i,2} + \ldots + \text{Record}_{i,7}
\]

The observed record times are generated by applying thresholds  

\[
s = 0, 1, \ldots, 7
\]

\[
P(R_{i} = s) = p(R_{i} = k) = \frac{1}{1 + \exp(\beta_{0} + \gamma_{0} T_{ij} + \delta_{0} N_{ij} + \alpha_{0} M_{ij} + \eta_{0} P_{ij} + \epsilon_{ij})}
\]

\[
\text{Record}_{i} = \beta_{0} S_{ij} + \gamma_{0} T_{ij} + \delta_{0} N_{ij} + \alpha_{0} M_{ij} + \eta_{0} P_{ij} + \epsilon_{ij}
\]

The users' observed characteristics control part of the individual heterogeneity. In order to verify the unobserved heterogeneity between users, we include
random intercepts of users. Therefore user \( i \)'s health behavior on week \( t \) is modeled as:

\[
\text{Record}_{i,t} = \beta_{i1} S_{i,t-1} + \gamma_{i2} T_{i,t-1} + \delta_{i3} N_{i,t-1} + \alpha_{i1} M_{i,t} + \eta_{i2} P_{i,t} + \xi_{i2} + \epsilon_{i,t}
\]

Where \( \xi_{i2} \) is an individual-level random intercept, and \( \epsilon_{i,t} \) has a logistic distribution. We further assume \( \xi_{i2} \sim N\left(0, \psi^{(2)}\right) \). We apply the generalized linear latent variable and mixed models(GLLAMM) to estimate the parameters.

### 4.1. Estimation Result and Hypothesis Testing

The table 3 shows the results of GLLAMM estimation using equation (4) for latent rating response. The variance information factor (VIF) is less than five in our models; the multicollinearity does not appear to be an issue. The unobserved heterogeneity between users with a variance is significant at 0.1% level for both Model 1 and Model 2 on diet and exercise behavior. Furthermore, the likelihood of the Model 2 increases from the Model 1 on diet and exercise behavior, the interaction items are included in the Model 2. The past health behavior of users could explain the future behavior. The start weight of the users tends to have no relationship with the health behavior. Users who pursue to lose higher proportion of weight concern their diet and exercise less; this can be explained by that a big goal may lower the self-efficacy itself, which will lead the member to be inactive. The OHC participating time of a user gets a negative relationship with his or her health behavior, which is consistent with previous work, individuals who try more times to lose weight are more likely to fail in weight loss. With changing diet more times, the user is more involved in health behavior. This suggests that changing diet is a signal of the eagerness degree of individuals.

**Social ties.** The FNum, ChalNum and SpNum get a significantly negative relationship with the health behaviors (\( \gamma_1 < 0, \gamma_2 < 0, \gamma_3 < 0 \) for both Model 1 and Model 2 on diet and exercise), which means that the more social ties in the OHC, the lower level of health behaviors he or she tends to have. H1b is supported and the H1a is rejected. To contrast the relative importance between social ties, we multiply the coefficient of social ties by its mean and compare the results (\( \gamma_2 \cdot \text{SpNum} < \gamma_1 \cdot \text{FNum} < \gamma_1 \cdot \text{ChalNum} < 0 \)). The mutual support groups get the strongest negative effect on the health behavior and the challenge groups get the weakest relationship with the health behavior (for both Model 1 and Model 2 on diet and exercise). The interaction item of social ties and past health behavior is included in Model 2. The negative coefficients (\( \mu_1 < 0, \mu_2 < 0, \mu_3 < 0 \)) shows that the negative relationship between the social ties and health behavior will increase as the increasing level of one’s past health behavior.

**Descriptive norms.** The coefficient of behaviors of social ties is positive (\( \delta_1 > 0, \delta_2 > 0, \delta_3 > 0 \) for both Model 1 and Model 2 on diet and exercise). The behaviors from one’s social ties are significantly positive related with ones’ health behavior, the hypothesis H2a is supported. Comparing the relative importance of the descriptive norms, behaviors of members in the challenge group (\( \delta_1 \cdot \text{ChalDietNum} \) and \( \delta_3 \cdot \text{ChalExerNum} \) are the largest in the models respectively) get the strongest relationship with the health behavior, which is more related with the health behavior than the mutual support group. The H2b is supported. In Model 2, the coefficients (\( \mu_1 > 0, \mu_2 > 0, \mu_3 > 0 \)) of interaction items between descriptive norms and past health behavior are positive, which shows that the increasing of one’s past health behavior will lead that descriptive norms get stronger relationship with the health behavior.

**Social support.** The InfoSp and EmotSp have a significantly positive relationship with the health behaviors (\( \beta_1 > 0, \beta_2 > 0, \beta_3 > 0 \) for both Model 1 and Model 2 on diet and exercise), with higher level of social support, the users have a higher level of dietary and exercise behaviors. The hypothesis 3a and 3b are supported, individuals who get more informational and emotional support will involve in health behavior more. Multiplying coefficient by its mean, we find the emotional support is more related with the health behavior than informational support (\( \beta_1 \cdot \text{InfoSp} > \beta_3 \cdot \text{EmotSp} \)). The coefficient (\( \mu_1 > 0 \)) of the interaction item between informational support and past health behavior is positive, which means the informational support get stronger relationship with users who have higher past health behavior level. However, the coefficient (\( \mu_3 < 0 \)) of interaction item between emotional support and past health behavior is negative, the positive relationship of the emotional support with health behavior will decrease as the increasing of the users’ past health behavior.
Table 3. Generalized linear latent variable and mixed model

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\eta_1$ PastDietNum(PastExerNum)</td>
<td>0.3623*** (0.0033)</td>
<td>0.3662*** (0.0035)</td>
<td>0.3595*** (0.0031)</td>
<td>0.3576*** (0.0040)</td>
</tr>
<tr>
<td>$\gamma_1$ FNum</td>
<td>-0.0151*** (0.0009)</td>
<td>-0.0068*** (0.0008)</td>
<td>-0.0085*** (0.0006)</td>
<td>-0.0021*** (0.0005)</td>
</tr>
<tr>
<td>$\gamma_2$ SpNum</td>
<td>-0.0405*** (0.0067)</td>
<td>-0.0170*** (0.0041)</td>
<td>-0.0302*** (0.0028)</td>
<td>-0.0169*** (0.0027)</td>
</tr>
<tr>
<td>$\gamma_3$ ChalNum</td>
<td>-0.0566*** (0.0090)</td>
<td>-0.0540*** (0.0124)</td>
<td>-0.0728*** (0.0068)</td>
<td>-0.0424*** (0.0081)</td>
</tr>
<tr>
<td>$\delta_1$ FDietNum(FExerNum)</td>
<td>0.0255*** (0.0009)</td>
<td>0.149*** (0.0011)</td>
<td>0.1816*** (0.0011)</td>
<td>0.0606*** (0.0010)</td>
</tr>
<tr>
<td>$\delta_2$ SpDietNum(SpExerNum)</td>
<td>0.0001*** (0.0000)</td>
<td>0.0000*** (0.0000)</td>
<td>0.0001*** (0.0000)</td>
<td>0.0000*** (0.0000)</td>
</tr>
<tr>
<td>$\delta_3$ ChalDietNum(ChalExerNum)</td>
<td>0.0016*** (0.0001)</td>
<td>0.0013*** (0.0001)</td>
<td>0.0017*** (0.0001)</td>
<td>0.0011*** (0.0001)</td>
</tr>
<tr>
<td>$\beta_1$ InfoSp</td>
<td>0.1295*** (0.0133)</td>
<td>0.1543*** (0.0231)</td>
<td>0.2156*** (0.0098)</td>
<td>0.2272*** (0.0112)</td>
</tr>
<tr>
<td>$\beta_2$ EmotSp</td>
<td>0.4176*** (0.0223)</td>
<td>1.0154*** (0.0366)</td>
<td>0.3089*** (0.0168)</td>
<td>0.3711*** (0.0223)</td>
</tr>
<tr>
<td>$\beta_3$ CompSp</td>
<td>0.0804 (0.0654)</td>
<td>-0.1856 (0.1069)</td>
<td>-0.0348 (0.0487)</td>
<td>-0.0860 (0.0648)</td>
</tr>
<tr>
<td>$\mu_1$ FNum*PastDietNum</td>
<td>-0.0047 (0.0004)</td>
<td>-0.0047 (0.0004)</td>
<td>-0.0047 (0.0004)</td>
<td>-0.0047 (0.0004)</td>
</tr>
<tr>
<td>$\mu_2$ SpNum*PastDietNum</td>
<td>-0.0388*** (0.0022)</td>
<td>-0.0388*** (0.0022)</td>
<td>-0.0388*** (0.0022)</td>
<td>-0.0388*** (0.0022)</td>
</tr>
<tr>
<td>$\mu_3$ ChalNum*PastDietNum</td>
<td>0.00086 (0.0041)</td>
<td>-0.0086 (0.0041)</td>
<td>0.0086 (0.0041)</td>
<td>0.0086 (0.0041)</td>
</tr>
<tr>
<td>$\mu_4$ FDietNum*PastDietNum</td>
<td>0.0044*** (0.0004)</td>
<td>0.0044*** (0.0004)</td>
<td>0.0044*** (0.0004)</td>
<td>0.0044*** (0.0004)</td>
</tr>
<tr>
<td>$\mu_5$ SpDietNum*PastDietNum</td>
<td>0.0001*** (0.0000)</td>
<td>0.0001*** (0.0000)</td>
<td>0.0001*** (0.0000)</td>
<td>0.0001*** (0.0000)</td>
</tr>
<tr>
<td>$\mu_6$ ChalDietNum*PastDietNum</td>
<td>0.0002*** (0.0000)</td>
<td>0.0002*** (0.0000)</td>
<td>0.0002*** (0.0000)</td>
<td>0.0002*** (0.0000)</td>
</tr>
<tr>
<td>$\mu_7$ InfoSp*PastDietNum</td>
<td>0.0179*** (0.0065)</td>
<td>0.0179*** (0.0065)</td>
<td>0.0402*** (0.0052)</td>
<td>0.0402*** (0.0052)</td>
</tr>
<tr>
<td>$\mu_8$ EmotSp*PastDietNum</td>
<td>-0.1546*** (0.0080)</td>
<td>-0.1546*** (0.0080)</td>
<td>-0.436*** (0.0095)</td>
<td>-0.436*** (0.0095)</td>
</tr>
<tr>
<td>$\mu_9$ CompSp*PastDietNum</td>
<td>0.0748*** (0.0276)</td>
<td>0.0748*** (0.0276)</td>
<td>0.0138 (0.0212)</td>
<td>0.0138 (0.0212)</td>
</tr>
<tr>
<td>$\alpha_1$ InitWeight</td>
<td>0.0000 (0.0002)</td>
<td>0.0000 (0.0002)</td>
<td>0.0000 (0.0001)</td>
<td>0.0000 (0.0001)</td>
</tr>
<tr>
<td>$\alpha_2$ ExpLossRatio</td>
<td>-0.0014*** (0.0004)</td>
<td>-0.0014*** (0.0004)</td>
<td>-0.0005* (0.0003)</td>
<td>-0.0005* (0.0003)</td>
</tr>
<tr>
<td>$\alpha_3$ Membership</td>
<td>-0.0002*** (0.0000)</td>
<td>-0.0002*** (0.0000)</td>
<td>-0.0001*** (0.0000)</td>
<td>-0.0001*** (0.0000)</td>
</tr>
<tr>
<td>$\alpha_4$ DietChangeTs</td>
<td>0.0695*** (0.0074)</td>
<td>0.0642*** (0.0073)</td>
<td>0.0330*** (0.0050)</td>
<td>0.0330*** (0.0050)</td>
</tr>
<tr>
<td>$\alpha_{cons}$</td>
<td>0.5926*** (0.0168)</td>
<td>0.6251*** (0.0169)</td>
<td>0.5346*** (0.0116)</td>
<td>0.5346*** (0.0116)</td>
</tr>
<tr>
<td>$\psi$</td>
<td>0.8871*** (0.0125)</td>
<td>0.9702*** (0.0161)</td>
<td>0.8311*** (0.0104)</td>
<td>0.9126*** (0.0119)</td>
</tr>
<tr>
<td>Number of obs</td>
<td>196,728</td>
<td>196,728</td>
<td>196,728</td>
<td>196,728</td>
</tr>
<tr>
<td>VIF</td>
<td>2.02</td>
<td>4.44</td>
<td>1.94</td>
<td>3.05</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-323190.65</td>
<td>-326323.79</td>
<td>-266695.85</td>
<td>-266070.12</td>
</tr>
</tbody>
</table>

Note. - p < 0.1, * p < 0.05; ** p < 0.01; *** p < 0.001.

Comparing the three constructs, the $\gamma_1$ TieNum is negative, the $\delta_1$ DescNorm and $\beta_1$ Support are positive. The $\delta_1$ DescNorm is greater than $\beta_1$ Support for all the descriptive norms variables and all the social support variables, which means that the descriptive norms get stronger relationship with health behavior than social support.

5. Conclusions

This study reveals that social network plays an important role in promoting the health behavior. Empirical data was collected from an online weight loss community and Ordered Logistic Model was employed to test the proposed hypothesis. The results indicate that social support and social norms get a positive relationship with user’s health behavior, whereas number of social ties plays a negative role in health behavior. The more social ties one has, the less frequently he will self-monitor his behavior. Regarding social norms, it has a stronger positive relationship with the health behavior than social support. People in a group with competing environment will involve in health behavior more frequently than a group where people support each other. For social support, empirical results indicate that users’ health behavior responds positively to social support. The emotional support has stronger relationship with the behavior than information support. We also consider the past health behavior level of the users. With higher past health behavior level, social ties tend to get more negative, social norms and information support tend to get more positive related with health behavior, whereas the
emotional support gets less positive related with health behavior.

Most previous research on health behavior are based on the survey data, the variables could only be static as the data collected at one time, which could not get the relationship between social ties variables and the health behavior. We extend the research of health behavior from offline environment to the online environment, and explore how the health behavior is affected by online environment with experimental verification by a set of longitudinal data. With understanding the motivation mechanism to stimulate health behavior, our research has the following implications. For individuals, we found that they should get more social norms and social supports to improve their health behaviors. With the number of social ties get negative effect on the health behavior, individual should choose the active social ties, which will provide more social norms and social supports. For health application designers, they should recommend more active friends for the user to choose and provide more opportunity to see others’ behavior information when design the health application.

Reference


