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The impacts of new technologies on physical activities: Based on fitness app use and fitness social media postings

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by

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ABSTRACT

Focusing on fitness app use and social context of fitness postings on social media, this study examined the implications of mHealth technologies use for fitness. This study explored descriptive information about respondents' use of fitness apps such as *self-monitoring*, *self-regulation*, *social facilitators*, and *rewards*. Furthermore, respondents' fitness posting experience was also explored. For respondents who saw others' fitness posts, this study examined how viewers' social comparison on fitness postings (upward and downward) related to their *physical activity (PA) self-efficacy*, *motivation*, and *participation*. For those who posted about their fitness information on social media, this study investigated fitness posters' ways of *self-presentation* related to receiving *supportive feedback*, and how supportive feedback related to fitness posters' *PA motivation* and *participation*. This study recruited fitness app users from a crowdsourcing

internet marketplace. Quantitative data analysis examined the role of *social comparison*, *self-presentation*, and *supportive feedback* in respondents' *PA self-efficacy*, *motivation*, and *participation*. The results revealed that people mostly used fitness apps for physical activity-related *self-monitoring* and *self-regulation*. For those who engaged in *upward social comparison* tended to have more *self-efficacy for PA*, *PA motivation*, and therefore participated more in PA. Both positive and negative self-presenters received more *supportive feedback* from others. The more *supportive feedback* fitness posters received, the more *self-efficacy for PA* they had. The more *self-efficacy for PA* fitness posters had, the more *PA motivation* they had. The results also showed that people received more *esteem support* and *emotional support* from others when they positively presented their fitness on social media. Fitness posters with negative self-presentation received more *emotional support* and *informational support*.

INDEX WORDS: mHealth, Fitness apps, Gamification, Social comparison, Self-presentation, Social support, Physical activity

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DEDICATION

I want to dedicate this dissertation to my family in Seoul. I have never imagined that my graduate studies take a decade long. This would not have achieved without my family's unconditional support and sacrifice. I know they are proud of me. But, I doubted myself every day. I often felt down and sometimes frustrated. Whenever I wanted to give up and run away, God sent precious people to me. My dear friends in Seoul, Bloomington, Philadelphia, and Atlanta, please forgive me for not being able to mention you all by name in this small piece of paper. I want to express my gratitude to you all. And I love you all. I don't believe this is the destination of my academic journey. This is just a new beginning.

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1 INTRODUCTION

As mobile devices are deeply involved in the daily lives of people, their health-related functions have been highlighted more than ever before. According to Edison Research in 2017, 60% of the U.S. smartphone users have accessed mobile applications (apps) or websites in the fitness and health category (Chadha, 2017). With fitness apps, users can check their health- and fitness- reports and data. Not only do users check their health and fitness status, but they also share outcomes of fitness app use on social media. Fitness reports from apps provide an opportunity to present self to others and make social connections. As general social media users do, fitness app users may engage in social comparison via others' postings. Further, those who post their fitness performance on social media may expect supportive communication with others.

From maintaining a healthy body to recovering from a disease, mobile technology plays a practical role in modern life. For example, patients can search for the therapeutic effects of medicine anytime without pharmacists' help. Health-related apps remind patients to take medicine on time. Moreover, health monitors such as body cardio scales, blood pressure monitors, and wearable devices are mutually connected via Bluetooth technology. To be specific, measured body fat and blood pressure are transmitted to a mobile phone, and then a health app displays the user's physical condition based on daily fitness records from wearable devices. Wearable device users may be purchasing body cardio scales as well as blood pressure measuring devices. As Apple grows its ecosystem (purchasing one Apple item often causes people to buy additional Apple items), health monitors also could build a technological ecosystem for their users.

Wearable technology has been applied to businesses, military forces, and medical professionals for decades, but recent trends in the private consumer market are also upwards from smartwatches to health and fitness trackers (Gordon, 2017). Hoy (2016) defined personal activity trackers as wearable devices that track the wearer's movements and biometric data with sensors such as accelerometers and altimeters. Above all, smartwatches and fitness/activity trackers are the most successful wearable devices on the market. Those devices are expected to be sold more than any other wearable category by 2020. Although there has recently been a downturn in sales of fitness/activity trackers, smartwatches have taken over the role of tracking fitness and health information (Williams, 2017). According to International Data Corporation (IDC), shipments of smartwatches indeed grew 60.9 % in the second quarter of 2017 (Shirer, Llamas, & Ubrani, 2017). The popularity of fitness/activity trackers has become a gateway to smartwatches (Shirer et al., 2017). The two types of devices are similar because they tell the time and record fitness tracking information. Fitness/activity trackers measure biometric data which in turn assist their users in maintaining health and engaging in physical activities. Smartwatches perform essential functions of smartphones such as texting, calling, and e-paying in addition to providing health and fitness data (Courage, 2017). Smartwatches are the most advanced wearable fitness device ever. However, the boundary between fitness/activity trackers and smartwatches are getting blurred with advancing technologies. In this study, wearable devices measure fitness and health data will be called wearable fitness devices.

Wearable fitness devices such as *Fitbit*, *Apple Watch*, and *Samsung Gear* can quantify users' health and fitness information such as the distance and pace of a walk or run, the number of steps, heart rate, and sleep quality. However, the tracking data can be embodied more specifically through designated apps. Fitness apps illustrate users' physical movements and

provide entertainment in use. For example, users can see their running path on a digital map and daily performance data in-depth. As such, fitness apps augment the features of wearable fitness devices. Tracking and visualizing fitness information adds fun for users, and therefore they may feel as if using fitness apps is a game.

Beyond checking health and tracking fitness information, fitness apps provide topics to discuss and contents to post on social media. Users can share statistics, and can encourage or compete with other users via social media functions on the apps. From number of steps walked to burned calories, fitness app users can display their health and fitness tracking information on social media. They not only share their fitness outcomes with connected friends on social media, but they also compete for daily or weekly fitness performance with others who have a common interest. Although mass media have been influential for social standards and norms, the sheer volume of social media use and its distinct features triggered a transition in social influence of media (Lee, Lee, Choi, Kim, & Han, 2014).

Through social media, people in contemporary digital culture have many opportunities to compare themselves with others besides face-to-face interaction. Intended or not, social media users are often exposed to others' fitness posts and therefore may engage in social comparison by comparing themselves to others. As Festinger (1954) argued, evaluating self-abilities, attitudes, and status through social comparison is human nature. In terms of fitness capability, comparing self with others may influence one's sense of efficacy either positively or negatively.

Some social media users voluntarily disclose their personal lives to others even though public postings can be shown to any social media users including global users. A study found that young adults were less concerned than older individuals about exposing self on social media (Peluchette & Karl, 2008). According to Herring and Kapidzic (2015), teenagers may have less

understanding of possible repercussions from social media use. Rather, they tend to perceive social media as an effective vehicle to form social relationship and display their attractiveness. For many users, the number of likes on one's visual postings is regarded as a barometer of one's popularity, an interpretation of peer validation, and social legitimation (Mascheroni, Vincent, & Jimenez, 2015). For people who have gotten used to communicating through digital platforms, social media is one of the best outlets to present self. Since how others view them on social media is meaningful, social media users are used to managing profile information, including pictures, and to paying attention to what others post.

Arguably, fitness app users also tend to manage themselves on social media and even manipulate information about themselves to be shown as favorable and attractive. Making a good impression of self is intended to get social approval and maintain social acceptance (Baumeister, 2010). As social animals, human beings tend to look for social support from their ties in social networks. Social support is nothing extraordinary but is embedded in ordinary human relationships in social life (Albrecht & Goldsmith, 2003). Through interaction, direct or indirect social support can be secured. Fitness app users also may experience social support through other users' feedback on their fitness postings. As with face-to-face interaction, computer-mediated support groups decrease depression and increase social support, quality of life, and self-efficacy regarding one's health (Rains & Young, 2009).

In eHealth studies, social media has been mostly regarded as an interventional resource for health promotion. Meanwhile, few studies have focused on the use of fitness apps, and how fitness postings are related to users' fitness per se. This research will investigate the use of fitness apps and fitness postings from both viewers' and posters' perspectives. This study consists of three parts: 1) use of fitness apps, 2) viewers' social comparison on fitness postings,

and 3) fitness posters' way of self-presentation and social support from the viewers. In the first section, this study will explore descriptive information about current fitness app use. In the second section, the relationship between social comparison on fitness postings and physical activity (PA) self-efficacy, PA motivation, and PA participation will be examined. In the third section, the study will examine how ways of self-presentation lead to different feedback from viewers, and how feedback is related to fitness posters' PA motivation and participation.

2 LITERATURE REVIEW

2.1 Communication Technologies for Health

With the explosion of technological innovations in computers and the internet, electronic/digital processes in health communication have become a growing field, which is called eHealth. According to Eysenbach (2001), eHealth refers to "health services and information delivered or enhanced through the internet and related technologies (p.1)." In a broad sense, eHealth indicates the use of information and communication technology to improve health. As a more comprehensive concept, eHealth includes mHealth, which is defined as "medical and public health practice supported by mobile devices" ("eHealth at WHO," n.d.). As internet-based computer devices have become more compact and affordable, mobile devices such as smartphones, tablet PCs, and smartwatches have permeated into ordinary lives. Indeed, in 2017, over 66% of people globally had at least one mobile device (Weiss, 2017). With their advantages of speed and ease of communication, mobile devices have been increasingly utilized for health (Hampton, 2016).

2.1.1 Overview of mHealth

Through mobile devices, health providers can communicate with the target audience in real-time, interact anywhere, and propose adaptive health behavior interventions (Riley et al.,

2011). As a top-down strategy, healthcare providers reach out to target audiences to educate about health-related issues. Compared to face-to-face communication, for example, text messaging via mobile phones is one of the most practical intervention methods for smoking cessation because of its cost-efficiency and time-efficiency (Kong, Ells, Camenga, & Krishnan-Sarin, 2014). Mobile technologies enable health providers to overcome the limited access to target audiences and increase treatment accessibility (Bull & Ezeanochie, 2016; Kong et al., 2014; Thirumurthy & Lester, 2012). Because mobile technologies have several advantages such as 'just-in-time,' 'interactivity,' and 'adaptiveness,' healthcare providers have utilized mHeath predominately as an intervention strategy (Riley et al., 2011).

Although use of mobile devices for health has been mainly focused on one-way intervention from healthcare providers' side, mHealth can be utilized not only for health education but also for health decision support (Barton, 2012; Terry, 2010). Advanced mHealth technologies support people to be more active in health. For example, internet-based mobile phones maximize mobility that reduces the constraints of time and space to access health information (Hampton, 2016). With mobile phones, people can "search, find, understand, appraise, and apply health information [actively] to address or solve [their] health problem[s] (Lin & Bautista, 2017, p. 347)." Moreover, social interaction has become enabled in the web 2.0 era. Beyond interpersonal communication, individuals interact for health information and to provide social support to each other through internet-based bulletin boards and social media (Bull & Ezeanochie, 2016). People may develop social attachments through social media interaction. Such attachments can be beneficial for health not only because people can share health-related information but also because the need to belong is a basic human need.

2.1.2 Need to Belong and Social Aspects of New Media Technology

According to Baumeister and Leary (1995), "human beings are fundamentally and pervasively motivated by a need to belong (p. 522)." The need for belonging indicates human beings' intrinsic desire to form and maintain affectively positive interaction with particular people or groups of individuals. As one of the major social needs that motivate human behaviors, the need for love and belonging is the basic human need (Maslow, 1968). This intrinsic desire for social attachment is nearly universal among human beings, and therefore people seek periodic, constant, and durable interaction with at least a minimum quantity of others. Social attachments are readily created by frequent contact, living nearby, and spending time together. Frequent interpersonal contacts with minimal conflict and negatives allow people to feel connected to each other, and therefore they feel pleasant from the interactions. When a person perceives that another person cares about their welfare with affection, they will be satisfied with the interaction. Yet, that affection should not be uni-directional. Mutual affection builds interpersonal bonds which in turn leads to the social attachment between two parties. Moreover, not all social attachments endure. People need to invest a great deal of time and effort in order to maintain a supportive interpersonal relationship. Even in busy lives, mediated-communication technologies allow individuals to keep connected. Frequent interaction and mutual support via social media are the driving force of maintaining social network (Ellison, Steinfield, & Lampe, 2010; Vitak & Ellison, 2013).

Social media technology is highly involved in Americans' everyday lives. As of 2018, 69% of American adults have at least one social media account (Pew Research Center, 2018). From pictures to live videos, users can share images of their daily lives on social media. Making new friends or expanding social networks online is not surprising, particularly for the generations

that are comfortable with internet technology and social media. Social media users readily form social relationships with people with whom they have something in common such as experiences or interests. 'Hashtagging,' a feature of social media, enables users to engage in the social media community and to connect with new people who have similar interests or topic to share (Marcus, 2015). The visual images are displayed to those who have the same interests via hashtags, which may increase feelings of interconnectedness. As such, users not only can create bonding social capital with strong social ties but also create bridging social capital with weak social ties (Hampton, 2016). *Bonding social capital* indicates benefits from the inner circle of connections (strong social ties) such as emotional support, physical support, or even financial support (Putnam, 2000). *Bridging social capital* describes benefits from weak social ties such as novel information or broader world-views from casual acquaintances or distant connections. Strong social ties are closer, multiplex, and dense relationships such as family and friends (Albrecht & Adelman, 1987; Albrecht & Goldsmith, 2003). Weak social ties are less developed relationships such as acquaintances, distant neighbors, and even strangers (Granovetter, 1983). As such, social media use helps to maintain and create social relationships (Ellison, Steinfield, & Lampe, 2007; Ellison et al., 2010; Steinfield, Ellison, & Lampe, 2008).

Because human beings want to be validated, recognized, and valued by other people (Baumeister & Leary, 1995), social media users might want to share their experience or achievements with someone supportive. Indeed, people tend to have higher self-esteem when more social support and approval are provided from their social belongingness (Harter, 1993). As a former Freudian, Carl Jung explained, human beings believe their life will be richer and more abundant through social attachments (Seligman & Csikszentmihalyi, 2000). Indeed, "people who have strong connection with others are happier, healthier, and better able to cope

with the stresses of everyday life (Baumeister & Leary, 1995, p. 510).” Happiness is incompatible with social isolation, since belongingness and social attachments are requirements for happiness. The failure to meet belongingness needs may cause physical health problem and relationship problems. Moreover, a lack of social attachment makes people feel lonely, which in turn can lead to psychological health problems such as anxiety and depression. The availability of social support from social bonds can be a buffer against the ill effects of stress and can reduce depression (Cohen, Sherrod, & Clark, 1986; Cutrona, 1989).

In this digital communication era, new media technologies supplement human beings’ desire for the need to belong. In particular, social media gather people based on common interests or experience. Maher, Ryan, Kernot, Podsiadly, and Keenihan (2016) argued that some people use online forums for seeking and sharing social support and advice with each other. For those who need health information and want to share their symptoms with others, web-based groups become great supporters (Rains & Young, 2009). Beyond internet-based bulletin boards and social media, apps related to health and fitness provide information and support for users.

2.1.3 Positive and Negative Roles of Social Media Use for Health

As previous studies demonstrated, social media use can positively and negatively impact users’ health and wellbeing. From the face-to-face social interaction standpoint, online communication affects users negatively, and the opportunities of comparison with superior others cause a relative deprivation. However, recent studies in the digital era focus more on a positiveness of online communication for social attachments with social networks and social belongingness.

Online communication research concluded that internet use can reduce individuals’ social circle and communication with family members, which in turn can cause depression and

loneliness (Kraut et al., 1998). Social media use also can cause a reduction in the number and quality of face-to-face social relationships, and it can negatively impact users' mental health (Huang, 2010). In particular, heavy social media users tend to feel more socially isolated and depressed than light users (Lin et al., 2016; Primack et al., 2017). Diminished offline social connectedness due to the excessive use of social media negatively impacts users' anxiety and depression, since it can weaken users' social belongingness (Glaser, Liu, Hakim, Vilar, & Zhang, 2018). Moreover, the more users spend time on social media and view others' postings without interaction, the more they tend to have social anxiety symptoms (Shaw, Timpano, Tran, & Joormann, 2015). Social media users who are seeking feedback and engage in negative social comparison tend to have depressive symptoms and lower life satisfaction (Nesi & Prinstein, 2015).

At the same time, however, some studies argue that social media use positively impacts users' mental health. Arguably, in modern society, people have less chance to communicate in person (face-to-face) while having more opportunity to interact via online media. Social technologies in communication, social media, have been reshaping social networks and the cost of communication (Ellison et al., 2010). Online interactions supplement face-to-face interactions and have become a means of social attachment in the digital age. According to Huang (2010), social media use facilitates people's ability to maintain and develop offline social connectedness. Social media provides an opportunity to stay connected with old friends (Ellison et al., 2007; Steinfield et al., 2008). Social media use allows people to maintain social relationships with networks (persistent contact) and to know each other well, from trivial information to life course transitions (pervasive awareness) (Hampton, 2016). Online communication for social involvement positively impacts on users' mental health, and the impacts are stronger for

extraverts who receive a high degree of social support (Kraut et al., 2002). For those with physical disabilities, social support through social media lowers their depression levels (Lee & Cho, 2019).

2.1.4 Uses and Effects of mHealth Apps

Healthcare providers have utilized mobile phones mainly as a time- and cost-efficient communication tool to support and encourage healthy behavior. With convergence between mobile devices and internet technologies, however, individuals became able to access and search for health information on mobile phones. mHealth apps allow users to decide what to do for their health. For example, iPhone exclusive 'health' app allows users to record their health history such as lab results, immunizations, and medications. Users can create an emergency medical ID card to allow first responders can access the critical medical information such as blood type, allergies and reactions, and medications. With compatible third-party apps and devices, users also can track and record health data like insulin delivery and reproductive health like menstruation.

According to McGrath and Scanaill (2014), mHealth apps help people to maintain health and wellness with *monitoring*, *improving*, and *supporting*. Regarding *monitoring*, users can check sleep quantity and quality for health and wellness, such as measuring the ratio between REM and non-REM sleep. Real-time physiological parameters can be monitored, such as heart rate and respiration rate. In addition, biomechanical fitness can be monitored, including range of motion and shoulder alignment. For those who would like to *improve* their performance, mHealth apps can provide information and guidance. Health measurements or fitness results are displayed on screen, for example, and users can easily check health status or analyze performance based on the measured data. Those who want to get social support can share and

publicize their health or fitness outcomes through social media or social media features of designated-mHealth apps. Exchanging support via social media may help users to feel secure (Rains & Young, 2009), because seeking support from social network is human nature (Albrecht & Goldsmith, 2003). Social support indeed helps receivers' psychological health (Cohen et al., 1986; Cutrona, 1989).

Three factors may influence mHealth app users to engage in specific behaviors for health: *predisposing* factors, *enabling* factors, and *reinforcing* factors (West et al., 2012). Health apps have the potential to develop or enhance one or more of these factors. *Predisposing* factors refer to antecedents to behaviors such as knowledge, attitude, beliefs, values, and confidence or motivation. For example, predisposing apps provide information about health-related statistics, knowledge of preventing adverse health outcomes, or motivating messages. *Enabling* factors refer to antecedents to promote changes in behavior such as teaching skills, providing a service, or tracking progress/recording behaviors. For example, enabling apps provide instructions on healthy behaviors (e.g., how to stretch), geographical locations for PA, or fitness report (e.g., walking distance, calorie burning). *Reinforcing* factors refers to providing a reward or feedback for health- and fitness-related behaviors, such as interaction with social networks or health professionals. For example, reinforcing apps interfaced with social networking sites provide social networks' or coaches/doctors' encouragement and evaluation. As such, users can actively apply mHealth apps not only for health but also for PA.

2.2 Physical Activity

Several studies demonstrated that regular PA is beneficial for health. According to Kilpatrick, Hebert, and Bartholomew (2005), regular PA improves physiological and psychological health. CDC (Centers for Disease Control and Prevention) reported that physically

active people tend to have low risk for several illness such as heart disease, stroke, type 2 diabetes, depression, and cancers (Centers for Disease Control and Prevention, 2018). Regular PA also can help people who are dealing with psychiatric disorders or depressive disorders (Weyerer & Kupfer, 1994). However, recent data show that PA participation rate is turning downward while diseases related to physical inactivity are increasing.

2.2.1 Participation in Physical Activities

Over the past decade, more than 27% of the U.S. population aged 6 and over consistently avoided even the lowest caloric burning activity, and inactivity levels got higher for older people (from 17% to 40.4%) (Physical Activity Council, 2019). In a study from 2005, only about a half of the college students participated in either vigorous or moderate PA regularly compared to when they were in high school, and the percentage decreased further with college graduation (Kilpatrick et al., 2005). PA participation rate has decreased with age, whereas disease related to lack of exercise has increased. From 1997 to 2016, adults (aged 18 and over) diagnosed with diabetes steadily increased from 5.1% to 9.4%, and the percentage of obese adults (aged 20 and over) drastically increased from 19.4% to 30.6% (Clarke, Norris, & Schiller, 2017).

Because of the importance of PA for preventing disease, several studies explored ways to encourage people to participate in PA. Among several approaches, Dacey, Baltzell, and Zaichkowsky (2008) demonstrated that perception of PA is closely related to actual participation. According to them, older adults who maintained or increased their involvement in PA were more aware of the importance of exercise than those who with less involvement. Even though individuals may have different motivations depending on demographical characteristics and types of PA, their self-efficacy for PA will promote actual participation.

2.2.2 Motivations for Physical Activities and Sports

Three motivational factors for engaging in PA – interest/enjoyment, competence, and body-related motives – have been mainly discussed in previous studies, but the salience of each factor is different depending on the types of activities and the participants' gender (Frederick & Ryan, 1993, 1995; Ryan, Frederick, Lepes, Rubio, & Sheldon, 1997). Regarding gender differences, the motive of weight management is strongly linked to female college students (Kilpatrick et al., 2005). Further, females were more likely than older males to have appearance and stress management motives: younger females had more appearance motive while older females had more stress management motive (Dacey et al., 2008). Women tend to have more body-related concerns whereas men tend to have more competence motivation. For both PA and sports, male college students were more highly motivated than female college students by performance and ego-related factors, including challenge, strength and endurance, competition, and social recognition (Kilpatrick et al., 2005). The difference might be related to cultural pressures related to women's beauty and attractiveness as well as societal expectations toward men's physical ability (Grogan, 2016).

Regarding types of physical activities (a skeletal muscle movement through energy expenditure), people participate in sports (a PA that involves competition under rules) with intrinsic reasons such as for affiliation, challenge, competition, enjoyment, and social recognition (Kilpatrick et al., 2005). For example, Individual sports (e.g., golf, racquetball, bowling) participants tend to have high level of interest/enjoyment and competence motives (Frederick & Ryan, 1993). Informational feedback (e.g., coaching, advice) or psychological rewards (e.g., praise, encouragement) enhances intrinsic motivation and challenge seeking, whereas criticism or pressure to attain certain outcomes (e.g., winning) generates an adverse effect. As such, sports

participation is a function of intrinsic motives, such as interest, enjoyment, and challenge, and is closely related to ego-involvement for preserving self-esteem through goal achievements (Frederick & Ryan, 1995). In contrast, exercise (a PA with sufficient exertion to achieve or maintain fitness or athletic objectives) participation is a function of extrinsic motives such as appearance, strength and endurance, stress management, weight management, and health (Kilpatrick et al., 2005). Those who participate in exercise activities (e.g., weight lifting, yoga, running) tend to have high levels of body-related motive (Frederick & Ryan, 1993). However, exercise participants' perceived satisfaction is relatively lower than sports participants, because extrinsic motivation is associated with lower task enjoyment and lower levels of autonomy in participation (Frederick & Ryan, 1995). As such, interest/enjoyment, and competence motivations draw positive psychological outcomes, but body-related motivations may cause depression and anxiety (Frederick & Ryan, 1993).

2.2.3 PA Self-Efficacy

Self-efficacy is one of the cognitive factors that predicts individuals' behavior (Bandura & Adams, 1977). Bandura (1986) defined self-efficacy as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances (p. 391)." Perceived self-efficacy determines an individual's choice of activities, effort, and persistence of behavior (Bandura & Adams, 1977). Those who have a low sense of self-efficacy might avoid a suggested behavior, whereas those who trust their capability might participate in it readily (Schunk, 1991). People acquire capability information from their performance accomplishments (Bandura, 1986). They also observe and get vicarious experience from others (Schunk, 1989). Comparison with similar others provides the best basis to acquire capability information of self (Schunk, 1991).

As mHealth has been utilized for health intervention, fitness apps could be utilized to encourage users' PA self-efficacy. With outcome expectations, indeed, enhancement of self-efficacy in healthcare apps increase users' healthy behaviors (Yoganathan & Kajanan, 2013). Based on meta-analysis, Williams and French (2011) found that feedback on performance accomplishments, comparison to others' performance, and vicarious experience can enhance the PA self-efficacy. Along the same lines, feedback from others and social comparison with similar others may influence on individuals' PA self-efficacy.

2.3 Uses and Effects of Fitness Apps and Postings on Social Media

Many people use fitness apps to track and measure their fitness performance, and to compete with other users. They also are willing to post their fitness performance and competition results on social media. This section will explore the features of the most downloaded fitness apps designed to assist users' PA and fitness postings on social media.

2.3.1 Fitness App Use

There is no single health and fitness app that is most popular in the current mobile applications market as of March 2019. Hundreds of thousands of apps are available regardless of platforms. As of 2017, 325,000 mHealth apps were available in major app stores such as Google Play Store and Apple App Store (Pohl, 2017). Health and fitness apps are mixed together in the same category in most of the app charts. Each chart is ranked differently depending on operating systems, device types, free/paid, and country/region. Nevertheless, some popular heath- and fitness- apps have some overlapping features. These overlapping features are even more apparent for fitness apps than health apps. This might be because health is a broader concept, whereas fitness is mainly related to weight loss and physical ability. Users take advantage of fitness apps when they engage in several physical activities (PA) from walking to sports participation.

Some apps need a designated device or sensor, whereas others operate based on smartphone technologies such as GPS and internet connectivity. For example, ***Fitbit*** app is designed exclusively for *Fitbit* fitness watch and/or smart scales users. This wearable fitness device tracks users' steps, running/walking distances, burning calories, and heart ratings. The smart scales tracks weight, body fat percentage, and BMI (body mass index). The tracking fitness trends and progresses are described in charts and graphs on the *Fitbit* dashboard. Users can set daily goals and compete/compare with daily/weekly challenges with friends through the *Fitbit* App. ***Nike+ Run Club***, one of the first generation and regularly downloaded fitness apps, also requires a designated sensor or a designated wearable fitness device to operate. This runners' app provides information about pace, location, elevation, heart rate, and mile splits. Moreover, the app motivates and inspires through in-ear audio from Nike coaches, elite athletes, and entertainers to improve users' performance (e.g., strength, speed, and endurance) and to have fun while running. Personalized coaching plans from Nike coaches are offered to each user, and trophies/badges are awarded every time achieving the goals. Through the app leaderboards, users can compare and compete with friends and fellow runners. ***Sweatcoin Pays You to Get Fit***, one of the most downloaded apps in both Appstore and Google Play store, is a step counter and activity tracker app that pays users digital currency. Users receive digital currency based on their performance and can exchange it for goods or services such as gadgets, sports kits, or even gift cards. In addition, ***MyFitnessPal***, which was purchased and acquired by Under Armour, a sports apparel brand, is designed for those who want to manage weight and build up healthy habits. Through barcode scanner or manually, users can log calories and nutrients of foods. Working in conjunction with other fitness devices and apps, users can track and synchronize their fitness

data. Like other apps, ***MyFitnessPal*** supports and motivates users to achieve their personalized fitness and health goals.

Some other apps require payment for downloads, extra contents, or subscriptions. Those paid apps or in-app purchases are mainly designed for specific market segments and provide customized services and programs. For example, *30 Day Fitness Challenge Log* and *Weight Loss Fitness* provide personalized training plans, workout programs, or audio services. ***Coach to 5K*** is programed to help new runners to finish their first time 5km (3.1 mile) race with smartphone technologies. ***Runtastic Road Bike PRO*** is for cycling, and offers tracking bike tours via GPS, searching bike routes, and coaching with voice. ***Full Fitness: Exercise Workout Trainer*** is a weight training app that provides workout instructions with text, pictures, and videos. When it comes to providing services and features, some free and paid apps are similar. ***My Macros+*** is a diet tracking app for those who want to lose weight, bulk up, or maintain healthy lifestyle. The features of this app are comparable to that of ***MyFitnessPal***.

Fitness app use can be beneficial for anyone who needs motivation, from beginners to those with extensive experience. Some fitness apps teach ways to exercise that will help prevent injury. For example, O'Reilly, Slevin, Ward and Caulfield (2018) researched an app that connects to an inertial measurement unit device, *Formulift*, for beginner gym-goers, experienced gym-goers, and qualified strength and conditioning coaches. The results showed that it aided users to improve technique, provided motivation and reassurance, and protected them from injury.

In general, most downloaded fitness apps for weight loss have gamification aspects and feedback elements (Chen, Cade, & Allman-Farinelli, 2015). Using amusing elements in gaming mechanisms to increase motivation in non-gaming contexts is called gamification (Maher et al.,

2016). The use of gaming mechanisms to motivate and engage people in non-entertainment contexts has drawn interest in many fields, including health, education, and business (Seaborn & Fels, 2015). For example, in the domain of health, fitness performances are statistically measured with graphs, running routes are visualized with maps, and calorie earnings/burnings are calculated. By achieving personal goals, rewards are awarded such as trophies, badges, or even digital currency (can purchase products or exchange to coupons). Fitness app users may feel as if it is a game and a form of play. As shown by the commercial success of motion-sensor gaming consoles (Yim & Graham, 2007), body movement in the context of a game creates fun for users. From Wii and Kinect for Xbox360 to virtual reality games, gamers enjoy body movements for realistic gameplay. Those fitness video games are called 'exergames,' a portmanteau word of exercise and game. Dove and Astell (2017), demonstrated that exergames were beneficial for people with dementia or mild cognitive impairment.

Several studies also demonstrated the beneficial health outcomes of fitness app use for elders. Wearable fitness devices and apps let seniors check increases in their PA and enhance their enjoyment of it (Ehn, Eriksson, Åkerberg, & Johansson, 2018). Mercer, Giangregorio, Burns, and Grindrod (2016) conducted a critical analysis to demonstrate behavior change techniques (BCT) in seven wearable fitness devices and apps: *Fitbit Flex*, *Misfit Shine*, *Withings Pulse*, *Jawbone UP24*, *Spark Activity Tracker by SparkPeople*, *Nike+ FuelBand SE*, and *Polar Loop*. The study results showed that *self-monitoring* and *self-regulation* techniques increased PA in older adults. Enjoyable features in fitness apps promote older people to be more vigorous in PA.

In addition to the gamification aspect, feedback from others encourages users to participate in PA and motivates them to continue. In Coughlin, Whitehead, Sheats,

Mastromonico and Smith's (2016) review of several qualitative research studies about apps for promoting PA, all ages and genders favored fitness apps: Users "prefer apps that coach and motivate them and provide tailored feedback toward personally set goals (p. 8)." Not only coaches, but users can also set group fitness goals and leave feedback on others' performance in the leaderboard. According to Hutchesson et al. (2015), the combination of self-monitoring through the app and PA intervention such as feedback and counseling were effective for PA participation and health. Hartman, Nelson, and Weiner (2018) also researched patterns of wearable fitness device and app (*Fitbit*) use and activity levels throughout a PA intervention with female breast cancer survivors. Adherence to wearing the device was high and stable across the 12-week intervention period, and it led to greater increases in PA participation in terms of frequency, duration, and intensity. Further, being accountable to someone else was more strongly associated with increasing PA, than was the frequency of checking one's data. The authors interpreted that being accountable may be a greater motivating factor for PA participation than being self-aware of one's own progress.

Some fitness apps interface with social networking features, and users also can post fitness results and screenshots of their fitness performance on their social media. According to Hartman et al. (2018), fitness posters should be more engaged in PA than those who do PA without others' observation, because they are aware that others can observe their fitness progress. The next section will explore users' sharing of fitness performance with others through social media.

2.3.2 Fitness Postings on Social Media

Fitness is a popular posting keyword with high search volume. All#ASHTAG.com reported that #fitness is the 19th most popular hashtag of all time as of March 2019 ("Top

hashtags", n.d.). Fitness app users store their fitness outcomes and can post their fitness achievements on social media. The fitness postings are displayed on social feeds of their followers or friends. Moreover, many fitness posters are willing to present their records, videos, and/or photos of working-out scenes to the general public. With hashtags, the postings even can reach global users who have similar interests. Social support may be one of the motivations of posting fitness information with hashtags, and support on the fitness postings may encourage people to keep participating in PA. Fitness posters may feel emotional support and social attachments when connected to other users.

Regarding the platform, Facebook was the most popular for health behavior change research because it has the most active users (Maher et al., 2016). As a mix of text and images platform, Facebook has been a central resource for sociocultural research (Highfield & Leaver, 2016). Twitter is also popular, with its signature hashtag function and app compatibility. Indeed, fitness apps like *Runkeeper* and *Nike+* highlight how the users share their fitness records and engage in auto-tweets after running (Maher et al., 2016). Beyond text-driven content, however, visual has become a key component of everyday social media communication (Highfield & Leaver, 2016). The visual presentation is popular, particularly for younger users (Mascheroni et al., 2015). Since fitness postings primarily contain images, graphs, or maps with numbers, fitness posters may tend to prefer using visual posting-optimized social media. Arguably, Instagram is currently the most usable social medium for those who like visual presentation, and it might be the most open social media platform in terms of bridging social capital. Furthermore, Instagram is the fastest growing social media globally, in terms of number of users (Lunden, 2014). Recent data showed that 35% of online adults use Instagram, and its heavy users are typically young females (Pew Research Center, 2018). Facebook users tended to maintain existing offline

contacts rather than make new relationships (Ellison et al., 2007). Facebook focuses more on relational identity and social relationships, whereas Instagram is based more on personal identity (Marcus, 2015). Instagram users are more likely to post selfies and photos of personal memories. Therefore, Instagram is regarded as a more personal social media based on a visual posting-optimized platform (Highfield, 2015). Image-sharing social media users have many chances to see visual information of others.

2.4 Social Comparison on Others' Fitness Postings

People in contemporary digital culture have many opportunities to compare themselves with others through social media. As social comparison theory posits, people tend to compare themselves to others for self-evaluation (Festinger, 1954). Individuals engage in social comparison on social media, and this can influence their mental health and well-being. On the bright side, engaging in social comparison on social media has the potential to increase individuals' well-being. When individuals are in a bad mood, they tend to seek social comparison with inferior others on social media for self-enhancement (Johnson & Knobloch-Westerwick, 2014). They were more likely to feel joyful, experience more schadenfreude, superiority, relief as well as less envy, sadness, inferiority, jealousy (Rosenthal-von der Pütten et al., 2019). In contrast, those who engage in comparison with highly skilled and unrealistic portrayals on social media may have distorted positive perceptions of others' lives, which in turn may make them feel more socially isolated (Primack et al., 2017). Interestingly, image-sharing social media users who follow more strangers are more likely to compare themselves negatively with others and experience greater depressive symptoms than are those who follow fewer strangers (Lup, Trub & Rosenthal, 2015). Those who follow people they know are more likely to compare themselves favorably to others than are users who mostly follow strangers, and this is

associated with greater well-being and less depressive symptoms (Feinstein, Bhatia, Hershenberg & Davila, 2012; Lup et al., 2015). Fitness app users also have an opportunity to compare their fitness with other users through social media postings. This section will explore what is social comparison and how fitness app users compare themselves with others via fitness postings.

2.4.1 Social Comparison Theory

According to psychologist Leon Festinger (1954), all humans have a drive for self-evaluation. When objective means for self-evaluation are not readily available, comparison with others can provide information about the self. The human tendency to compare oneself with others is called social comparison (Festinger, 1954). Through social comparison, individuals can analyze the self in relation to others, in terms of their abilities, attitudes, and status (Gilbert, Price, & Allan, 1995; Reis, 2010). Festinger (1954) suggested an example that "if a person evaluates his running ability, he will do so by comparing his time to run some distance with the times that other persons have taken" (p. 118).

People engage in three types of social comparison depending on their type of motivations: lateral, upward, and downward. Lateral social comparison involves seeking similar others (e.g., same gender, age) to compare, when people want to evaluate themselves accurately (Cialdini & Griskevicius, 2010). In upward social comparison, people compare themselves with those whose attributes and abilities are better than their own. Upward social comparisons can lead to lower self-esteem if people evaluate themselves negatively in comparison to others. But when people make upward comparisons in an effort toward self-improvement, such comparisons could potentially enhance their self-assessment (Collins, 1996). A highly motivated person may voluntarily engage in upward comparison to be a better person like the targeted comparison person. People even may alter their personal beliefs to achieve uniformity with admired others

(Festinger, 1954). However, people usually engage in downward social comparison when they are motivated to enhance or protect their self-esteem (Bodenhausen & Richeson, 2010). According to Wills (1981), comparing oneself with others who are less fortunate enhances one's subjective well-being. In downward social comparison, people compare themselves to others whom they perceive as worse off than themselves in terms of life circumstances, traits or abilities. When people experience ego threat, depression, or low self-esteem, they tend to engage in downward social comparison, and may devalue and derogate others for self-enhancement (Wills, 1981).

People who use social media regularly encounter other people. Therefore, they have many chances to compare themselves with others. Depending on their motivation, social media users might engage in upward or downward social comparison.

2.4.2 Appearance-related Social Comparison on Social Media

Lee et al. (2014) argued that messages from other members of society and media messages create societal expectations for ideal body and norms of beauty. Media portrayals of the thin-ideal body often cause body dissatisfaction, thin body ideals, and eating disorder symptomatology for preadolescents and young adults (Perloff, 2014). In addition to messages from mainstream media, peers' normative concerns on social media also can be expanded to social beliefs. Users tend to spend time on social media "to validate their self-concepts, satisfy personal reassurance needs, and convince themselves they measure up to thinness ideals" (Perloff, 2014, p. 369). Social media users might seek to feel better or enhance self-assessment by engaging in downward comparison. However, social media may trigger appearance-focused upward comparisons, which often leads to problematic effects on body dissatisfaction and body image disturbance.

Social media is a personal social outlet (Smith, 2011). Arguably, users more likely to display positive body appearance of themselves, such as slim and healthy, even if it is not a realistic portrayal of self-image. Therefore, users might have less chance of being exposed to postings of someone worse than themselves. Therefore, much rely on social media can influence users' perception of body image and body image disturbance (Perloff, 2014). Several studies demonstrated that engaging in upward social comparisons regarding body image may cause self-body dissatisfaction and pathogenic weight control methods (Arroyo, 2014).

In general, upward physical appearance comparison tends to cause lower self-appearance evaluation and higher symptoms and characteristics of disordered eating, whereas downward physical appearance comparison tends to cause higher self-appearance evaluation and greater anti-fat attitudes (O'Brien et al., 2009). The more satisfied people are with their self-body, the higher their psychological well-being. As such, many research studies have examined body appearance-related social comparison. However, a paucity research has examined fitness-related social comparison, particularly based on fitness app users' social media postings.

2.4.3. Social Comparison on Fitness Postings

Burke and Rains (2019) demonstrated that those who are exposed to others' exercise-related social media posts were more likely to be concerned about self-weight, especially when perceived similarity to the posters was high. They focused on several exercise- and fitness-related social media postings such as "reports of recent exercise, pictures of others exercising or dressed in fitness attire, fitness-related accomplishments or milestones, checking into the gym, fitness inspired quotations,…" (p. 2). According to Arroyo and Brunner (2016), individuals tend to see their friends as similar others, and therefore friends' fitness post can change their health- and fitness-related norms and beliefs. Those who are frequently exposed to fitness postings of

friends are more likely to engage in healthy eating and exercising, but at the same time, they tend to be involved in making self-disparaging comments and dissatisfied with own bodies.

People tend to compare themselves with those who possess superior or inferior qualities of an attribute depending on motivations (Festinger, 1954). The tendency of upward or downward comparison on fitness postings should lead to different outcomes (Burke & Rains, 2019). Social comparison evaluates individuals' past behaviors and present abilities but also predicts future prospects (Suls, Martin, & Wheeler, 2002). Thus, social comparison on fitness postings may influence individuals' future behavior or attitude for PA.

Arroyo and Brunner (2016) demonstrated that upward social comparison to friends' fitness posting may produce higher body dissatisfaction, dieting and pathogenic weight control methods. According to Suls et al. (2002), however, people are not always engaged in social comparison with similar others to validate self. People sometimes intentionally engage in social comparison with superior others to make self-view more positive (Collins, 2000). Burke and Rains (2019) found that those who have a greater tendency toward upward social comparison for appearance were more likely to have positive exercise attitudes, although there was no significance in downward social comparison regarding exercise-related social media posts. They interpreted that fitness-related upward social comparison on their social connections' posting may make PA seem desirable, normative, or even rewarding for users. Meanwhile, the scope of the study measures was limited to subjects' social networks. Since social media users can be connected to other users via hashtags, they can compare themselves with a much wider range of people. Still, those who want self-enhancement may engage in downward comparison with inferior others regardless of similarity because users can selectively lookup any public posts with hashtags.

2.5 Self-Presentation through Fitness Posting and Others' Feedback

Social media users tend to present highly positive self-images to enhance self-esteem as a way of self-development (Yang & Brown, 2016). The digital communicative technologies enable users to customize online interaction and enhance autonomy in selective use of media on their demands such as sharing favorites with other users and displaying only what they want to show (Sundar & Limperos, 2013). Some fitness app users also post their fitness outcomes on social media and selectively disclose on purpose. Fitness posters can present their fitness outcomes either positively or negatively for supportive communication, and viewers may give supportive feedback. Those who observe fitness postings may have different responses depending on ways of presentation. In general, social media observers tend to express positive feedback for those who are humble rather than braggarts, because "they judge 'hard work stories' as warm and relatable" (Steinmetz, Sezer, & Sedikides, 2017, p. 4). Others' responses and feedback affect self-presenters' self-concepts and evaluation of self-worth (Leary & Kowalski, 1990). Social support via social media encourages leisure-time physical activity, whereas lack of social support may be a barrier to the practice of physical activity (Zhang et al., 2015). Lack of feedback on social media postings may be perceived as lack of social support or even perceived as negative feedback, which in turn may negatively affect self-presenters. This section will explore self-presentation through fitness postings and viewers' feedback. It will also be discussed how posters perceive lack of feedback on their fitness postings and how it may affect their physical activities.

2.5.1 Self-Presentation Theory

According to psychologist Carl Rogers (Rogers, 1959), human personality is composed of 'ideal self,' in addition to 'real self'. Instead of disclosing real self, people are more likely to

display desirable self-image to others. Behavior “that attempts to convey some information about oneself or some image of oneself to other people" is called self-presentation (Baumeister & Hutton, 1987, p.71). Presenting an ideal self to other people is closely related to impression management. Fundamentally, people engage in self-presentation to make a good impression of self to maintain social acceptance (Baumeister, 2010). Even when they present themselves negatively, it might be self-handicapping to protect self-esteem from potential failure (Berglas & Jones, 1978).

Self-presenting is a goal-directed behavior with the motive for success and to avoid failure in social networking (Arkin, 1981). Two types of self-presentation motivation such as pleasing the audience (situational factors) and self-construction (disposition of individuals) are also for success and for avoiding failure in social networking. Baumeister and Hutton (1987) explained that *pleasing the audience motivation* is matching one’s self-presentation to the expectations and preferences of others. Therefore, this motivation may produce different self-presentation depending on situation and audiences (e.g., job interview and public speaking). *Self-construction motivation,* matching one’s self-presentation to one’s ideal self, is relatively stable and consistent regardless of situations and audiences. Yet, group context may affect self-presentation because human social interactions are structured by mutual interpersonal evaluations and the groups may control rewards and punishments to their members (Baumeister & Hutton, 1987).

2.5.2 Self-Presentation in Physical Activities

Human beings have a strong desire to confirm and stabilize their self-views (Bareket-Bojmel, Moran & Shahar, 2016). Individuals not only want social approval but also want to maintain social acceptance. Self-presentation involves protecting self-esteem (Berglas & Jones,

1978). Therefore, people tend to present themselves with self-enhancement strategies rather than self-derogation strategies that disparage the self (Bareket-Bojmel et al., 2016). Individuals' self-presentation types might be related to their on- and off-line self-presentation of PA.

According to Arkin's (1981) self-presentation types, *acquisitive self-presentation* explains that people want to be attractive because they believe the attraction would be a potential benefit (such as material and social rewards) for them. *Protective self-presentation* often occurs when a presenter is negatively evaluated by audience (disapproval) and is aware of it; his/her protective orientation will arise to avoid undesirable treatment. To be specific, he/she will minimize interaction with others or behave protectively. Regarding the acquisitive self-presentation, PA participants may want to present their physical achievements to others to be shown as attractive or to appear diligent enough to exercise regularly as well as enjoying a healthy lifestyle. For protective self-presentation, those who are not satisfied with their fitness or think they are underestimated by others may not want to present their PA, even though they exercise regularly. Meanwhile, those who less care about disapproval from others are less likely to engage in protective self-presentation. For them, ingroup solidarity and a desired outcome would be fostered by outgroup disapproval (Arkin, 1981). For instance, a runner would have strong ingroup solidarity with other runners, even though non-runners disapprove them. Those who have high self-presentation motivation tend to evaluate other exercisers positively, whereas they tend to evaluate non-exercisers negatively (Lindwall & Martin Ginis, 2010). From the understanding of human's need to belong, people categorize groups and produce positive emotions for their group once social attachments are formed and solidified (Baumeister & Leary, 1995).

In addition to acquisitive and protective motives, individuals also use agentic and communal descriptors when representing themselves (Uchronski, 2008). Agentic motives focus on individuals' influence, control, and mastery, whereas communal motives focus on individuals' interpersonal relationships and connectedness with others (Horowitz, Wilson, Turan, Zolotsev, Constantino, & Henderson, 2006; O'Brien & DeLongis, 1996; Roche, Pincus, Hyde, Conroy, & Ram, 2013). Those who endorse an agentic motive tend to differentiate the self from others and desire to be respected by others. Therefore, they try to demonstrate their competence and task-related merit (Locke, 2000; Wojciszke, Abele & Baryla, 2011). In regard to PA, individuals with an *agentic motive* might want to impress others by demonstrating their ability in fitness such as muscular strength or endurance (Howle, Jackson, Conroy, & Dimmock, 2015). Meanwhile, those who endorse a communion focus on a value affiliation and a sense of interpersonal connectedness. Therefore, they care about being liked by others and strive for intimacy and solidarity (Locke & Nekich, 2000; Wiggins, 1991; Wojciszke, Abele, & Baryla, 2009). In PA contexts, individuals with a *communal motive* might want to develop close interpersonal relationships and connections (Howle, Jackson, et al., 2015).

Alongside on Arkin's (1981) acquisitive and protective motives and Bakan's (1966) agentic and communal motives, Howle, Dimmock, Whipp, and Jackson, (2015) proposed 2 x 2 framework for self-presentation motives in PA. According to them, those who adopted *acquisitive-agentic* motives tried to obtain social approval regarding their physical qualities and task ability. Therefore, the motives might lead individuals to have a desire to be presented as athletic, fit, and physically competent. *Acquisitive-communal* motives reflected individuals' desire to gain social approval in their interpersonal qualities. For positive social interactions, the motives might lead individuals to assist and encourage teammates for others to view them as

friendly, helpful, and likable. Individuals who endorsed *protective-agentic* motives wanted to avoid social disapproval regarding their physical qualities and task ability. Therefore, the motives might lead individuals not to present certain images that related to their physical incompetent or athletically inferior. *Protective-communal* motives reflected individuals' desire to avoid social disapproval in their interpersonal qualities. Rather socially proactive, such motives might lead individuals to behave as socially reactive because they do not want to be perceived as an offensive, unfriendly, or unlikeable teammate.

Based on the literature, PA participants may have several motives for presenting their fitness to others. As individuals' self-presentation type varies depending on contextual factors, fitness app users' way of online self-presentation might also vary.

2.5.3 Online Self-Presentation and Physical Activities

Social media is regarded as an outlet for people to fulfill the need to belong and the need for self-presentation (Nadkarni & Hofmann, 2012). Self-presentation forms an online identity, and visual content of self is a central resource to create one's online impression (Herring & Kapidzic, 2015). Compared to other social media, users of visual-based social media (such as Instagram) have more motivation for self-promotion (Marcus, 2015). Those who are accustomed to visual communication do care about how to take a better selfie or what is a trendy digital filter for a better look. They carefully select images to promote their self-concept (Jackson & Luchner, 2018). Indeed, most social media users set their facial picture for profile and commonly edit it to display an ideal impression (Mascheroni & Cuman, 2014; Mascheroni et al., 2015). As such, visual self-presentation is "aimed at managing the impressions made on others and gaining acceptance by the peer group" (Mascheroni et al., 2015, p. 10).

Herring and Kapidzic (2015) found young adults tended to manipulate their social media profiles to create a favorable impression to social networks. The young adults in the study group were aware that others were forming an impression of them and using the impression in social interaction process. Social media serve as a tool for self-presentation, particularly the most positive aspects of self (Bareket-Bojmel et al., 2016; Rosenberg & Egbert, 2011). Self-critical individuals who prioritize their needs for an independent sense of self use social media with more self-presentation motivation (Jackson & Luchner, 2018), whereas narcissistic persons even present a false self on social media to gain recognition from others (Balick, 2014).

Fitness app users who post their fitness information on social media (Fitness posters) are certainly aware that others observe them. Hence, they may try to give a healthy impression or may want to show off that 'my life is healthy and admirable' to other social media users. Individuals tend to overreport normative or positively viewed behaviors like PA (Brenner & DeLamater, 2014; Sallis & Saelens, 2000). Some self-critical or narcissistic users might even exaggerate their fitness information. Further, there might be gender differences in sharing fitness posts. In social media use, girls are less likely to open their profiles to people who they don't know (Herring & Kapidzic, 2015). Male fitness posters may have less resistance to open their fitness performance to the public than females. As such, fitness posters might have differences in ways of self-presentation and degree of openness for fitness information. For example, female users might not want to share their weight changes to the public even if it has been decreased. In accordance with personalities or gender, posters might present their fitness information selectively.

Based on research on self-presentation motives for PA (Howle, Dimmock et al., 2015; Howle, Jackson et al., 2015), it would be assumed that people present their fitness on social

media with purpose. They may present their fitness either in a positive or negative way, while seeking to boost self-esteem or manage threats to self-esteem. Fitness posters could publish their fitness achievements or evidence of PA participation, which are examples of positive self-presentation. As a negative way of self-presentation, however, difficulties that they have had exercising or how they have been neglecting PA also could be posted. Even so, their postings might not to get social disapproval. Rather, this may be a form of self-handicapping to avoid social disapproval (Howle, Jackson et al., 2015), for example by making excuses for neglecting to exercise or attributing difficulties to external factors such as a busy work schedule or bad weather. In online communication, it becomes simple for people to selectively present their self-image.

Some fitness posters present a positive aspect of their fitness such as goal achievements and physical outcomes, and may expect positive feedback supporting or sharing in their success. Some users present their fitness in a negative way such as failure or struggles in PA. Fitness posters who present their fitness negatively might expect supportive feedback from social networks. From positively exaggerated to negatively understated, users' fitness postings might be seeking social support.

2.5.4 Others' Feedback on Fitness Postings and Social Support

Social support is one of the most important reasons for social media use (Park, Kee, & Valenzuela, 2009). Along these lines, fitness app users share tracked health information on social media to seeking supportive communication and indeed receive social support, which in turn can improve their health behavior (Oeldorf-Hirsch, High, & Christensen, 2018).

Social support communicates the message that a person is loved, esteemed, and belongs to a mutually obligated network (Cobb, 1976). Social support can be secured through social

networks such as strong ties (e.g., family or friends) and weak ties (e.g., acquaintances or friends of friends) (Albrecht & Goldsmith, 2003; Stefanone, Kwon, & Lackaff, 2012). Through verbal and nonverbal communication, social support recipients and providers manage uncertainty about the situation, the self, or the relationship; therefore, individuals enhance controllability in their life experience through social support (Albrecht & Adelman, 1984).

According to Burleson and MacGeorge (2002), there are five types of social support: *Emotional* support indicates telling people that they are loved and cared for. *Esteem* support refers to reminding individuals that they are worthwhile. *Network* support is defined as efforts to bolster individuals' social ties or offers to spend time together. *Informational* support refers to provision of facts, advice, or perspective to remedy a problem. *Tangible* support indicates practical aid to ease people's daily burdens. There are individual differences in feelings of social support, depending on personalities and variations in social interactions. Regardless of the differences, supportive communication is beneficial for one's quality of life and healthy living from a health communication standpoint. Social support psychologically functions as social therapy (Albrecht & Goldsmith, 2003). As a buffer, social support protects health from life stress (Cobb, 1976; Cohen & Wills, 1985). Moreover, supportive communication can assist recovery from physical trauma or illness (Albrecht & Adelman (1984). A lack of supportive relationships may affect mortality from serious physical conditions (Uchino, 2004). In terms of health-related contexts, social support may help people feel connected with others. Support from others who have similar health concerns can help people feel less alone, and can also provide health information or feedback on one's own health behavior.

Social connections afford frequent interpersonal interactions, and therefore individuals may have social support for health behavior through their social network ties (Martire & Franks,

2014). However, the provision of social support has been reshaped by online communication (Ellison et al., 2010; Vitak & Ellison, 2013). Pew Internet & American Life Project reported that people seek health-related social support from social media (Davis, Anthony, & Pauls, 2015). Oh, Lauckner, Boehmer, Fewins-Bliss, and Li (2013) researched health-related social support seeking and the relationship between social support and health outcomes in the context of Facebook. They concluded that social media users who had a health concern tended to seek social support such as emotional, esteem, tangible, and appraisal support (which is a combination of informational and network support). All the dimensions of social support were sought, while only the emotional support enhanced one's health self-efficacy.

In Davis et al.'s (2015) content analysis study about the relation of seeking and receiving social support on social media for surgery, users received more responses from others when they mentioned 'family' members and asked 'prayer' for surgery. They assumed the numbers of response posts indicated the amount of emotional support. The amount of social networks' feedback on social media posting was positively associated with the amounts of emotional, esteem, network, and informational support (Oeldorf-Hirsch et al., 2018).

According to Ballantine and Stephenson (2011), individuals who are not actively seeking support are unlikely to receive it from their online networks. In contrast, those who are seeking support might have a high chance to get social support. A social outcome of disclosing personal information is others' supportive feedback (Barbee & Cunningham,1995; Tichon & Shapiro, 2003), and indeed individuals who post fitness outcomes on social media received supportive reactions from others (Oeldorf-Hirsch et al., 2018).

Previous research demonstrated that seeking social support is a significant motivation for using social media (Davis et al., 2015; Park et al., 2009). Moreover, users who were seeking

support received supportive feedback from their social networks (Oeldorf-Hirsch et al., 2018; Oh et al., 2013). Based on these demonstrations, it could be speculated that many fitness postings are seeking social support, regardless of ways of presentation. Furthermore, fitness posters may present their fitness outcome either positively or negatively to get particular types of social support.

2.6 Overview of the Study

The advantages of mobile technologies have been received attention for health and fitness, because of their key features such as mobility and interactivity (Hampton, 2016; Riley et al., 2011). Mobile devices particularly have been evaluated as cost-efficient tools that allow people to enhance or maintain their health (Bull & Ezeanochie, 2016; Hampton, 2016). mHealth technologies have much potential to obtain, understand, and communicate information for health decisions (Barton, 2012; Terry, 2010). Nevertheless, previous studies mainly focused on the role of delivering health information and services in mobile technologies (Lin & Bautista, 2017). Moreover, a paucity of research has studied the implications of mobile technologies for fitness. As motivators, fitness apps are loved especially by those who run and workout, due to the opportunity for self-checking and sharing through social media. Focusing on fitness app use and fitness postings, this study examines the implications of mHealth technologies for users' fitness. Specifically, the research examines what people do with fitness apps and how fitness postings (both viewing and sharing) relate to their PA self-efficacy, motivation, and participation.

First, this study will explore descriptive information about respondents' fitness app use. According to the literature, fitness apps provide users with the ability to monitor their fitness (e.g. keeping track of exercise, calories, nutrition); regulate their fitness (e.g. set targets or goals); receive social facilitation (e.g. participate in competitions, group challenges, missions,

leaderboard); and obtain rewards (e.g., badges, trophies, digital currency). This study will examine how people use fitness apps for these purposes.

Second, this study will examine how fitness app users' social comparison on fitness postings (upward vs. downward comparison) relates to their PA self-efficacy, motivation, and participation. A recent trend in fitness posting is sharing one's fitness scenes or performances on social media in which photo- and video-friendly platform. Not every fitness app user posts their fitness information on social media, whereas nearly every social media user might have been exposed to fitness postings. Fitness app users might be engaged in social comparison to those who are perceived as inferior or superior in PA. This study will examine how social comparison on fitness postings is related to viewers' PA self-efficacy, motivation, and participation.

Finally, for those who post their fitness performance on social media, this study will investigate fitness posters' ways of self-presentation and the supportive feedback they receive. Fitness posters tend to have motivations for obtaining social approval and for avoiding social disapproval regarding their fitness qualities and abilities (Howle, Dimmock, et al., 2015; Howle, Jackson, et al., 2015). Fitness posters often present their fitness in a positive way or a negative way, to seeking social support. Even if they present their fitness in a negative way such as failure or struggle, it is typically not a self-derogation strategy. It is rather a form of excuse or self-handicapping because they might still want others' support for self-enhancement. This study will examine how different ways of self-presentation are related to receiving supportive feedback. In addition, it will be examined how supportive feedback is related to fitness posters' PA motivation, and participation.

2.7 Research Questions and Hypotheses

2.7.1 Fitness App Use

The first focus of this study is to obtain descriptive data regarding participants' use of fitness apps. Hundreds of thousands of fitness apps are available in the mobile application market. Some apps need wearable tracking devices, but several top downloaded fitness apps, such as *BetterMe: Weight Loss Workouts*, *Sweatcoin Pays You to Get Fit,* and *MyFitnessPal*, operate with basic smartphone technologies. People can use fitness apps to monitor and regulate their fitness, receive social facilitation, and obtain rewards.

From daily walking to sports participation, people apply fitness apps to various physical activities. Users' physical activities are tracked and recorded via GPS technologies and internet connectivity. Fitness apps not only display numerical information such as calorie spending and running distance but also map the running routes on a digital map. Entertaining features in fitness apps may captivate users' interests and motivate them to use the apps for fitness. For example, gamification fitness apps like 'Cyclemeter' displays stats of individual rides with maps, graphs, laps, and more. Rather than just riding to exercise, some of its features such as breaking personal records, sharing road safety conditions with other riders, and competing with connected riders would provide amusement for its users.

For fitness app users, walking down the street or climbing stairs in daily life may be perceived as 'missions' not only to burn calories but also for competition. No need to go to the gym or schedule a time for a fat-burning cardio workout; people can exercise every day. Connected users can share their fitness progress on a daily or weekly basis, and can compete with others regarding their fitness outcomes, such as who walked the most steps or who burned out the most calories. Based on the mission and goal accomplishments or the competition results,

rewards are awarded such as trophies, badges, or even digital currency. Users can collect those rewards and even purchase products or exchange them to coupons. Through the leaderboards, users can set group fitness goals and leave feedback on others' performance. Therefore, users may feel as if they are playing a game. The game elements in fitness apps might help users to perceive that physical activities are fun and exciting.

Beyond using fitness apps per se, users post their fitness records and performances on social media. Fitness posters communicate with others regarding their fitness postings. Those who do not post about their fitness also may be exposed to others' fitness postings such as screenshots of fitness goal achievements and selfie of fitness scene. To explore people's use of fitness apps, the following research questions will be addressed:

RQ1) What types of fitness apps do users use?

RQ2) What gamification aspects of fitness apps do users use?

RQ3) What kinds of fitness postings are users exposed to?

2.7.2. Social Comparison and Self-Efficacy in Physical Activities

This study will also examine how people respond when they are exposed to fitness posts on social media. Social comparison theory posits that people tend to compare themselves with others to evaluate self-abilities, self-attitudes, and self-status (Festinger, 1954; Gilbert et al., 1995). Fitness app users, particularly those who use social media, may have opportunities to see others' fitness postings. They may be exposed to others' fitness postings intentionally with hashtags or unintentionally while browsing. From body image to fitness performance, they may be comparing themselves with others. Depending on their moods or motivations, people may engage in upward or downward social comparison regarding fitness. Figure 2.1 presents a model

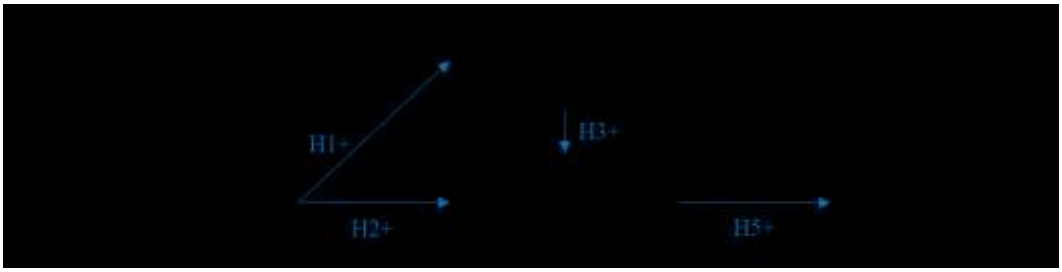

Figure 2.1 Model for Social Comparison on Fitness Postings

of the expected relationships among social comparison on fitness postings, PA self-efficacy, PA motivation, and PA participation.

Comparing self to others' exercise-related postings on social media may trigger concerns about personal weight or exercise activities (Burke & Rains, 2019). In particular, social comparison with others who are perceived as superior may cause lower evaluation for self-appearance, body dissatisfaction, and body discrepancies (Arroyo, 2014; O'Brien et al., 2009). Similarly, upward comparison to fitness postings may negatively influence fitness app users' perception of their own fitness. However, people may have wishful identification with others whom they admire or regard as role models (Hoffner & Buchanan, 2005). Through upward social comparison, people may also have the desire to be like or act like similar fitness posters. Burke and Rains (2019) found that fitness-related upward social comparison tend to cause positive attitudes for exercise. People deliberately engage in upward social comparison to see themselves more positively (Collins, 2000). Thus, upward comparison to fitness postings, users may be either frustrated or motivated by the better performance of others. They might think that either 'I could never be like him/her' or 'If he/she can do it, I also can do it to.' Based on social comparison theory and previous studies, it could be assumed that upward social comparison could either enhance or decrease one's self-efficacy for PA and PA motivation. Therefore, research questions were proposed:

RQ4) How will upward fitness comparison be related to self-efficacy in PA?

RQ5) How will upward fitness comparison be related to PA motivation?

In contrast, users may be relieved or satisfied with their fitness status when they compare their fitness with others they perceive as inferior. O'Brien et al. (2009) demonstrated that downward comparison for physical appearance tends to cause higher evaluation for self-appearance and greater anti-fat attitudes. Downward social comparison to fitness posting may function similarly. Comparing oneself to others whose performance is perceived as worse than their own may provide mental gratifications (Huang & Zhou, 2019) and allow more positive feelings of self (Arroyo, 2014). Moreover, people tend to compare themselves to people who are less valued or worse off than themselves to enhance self-regard or to protect self-esteem (Bodenhausen & Richeson, 2010; Wills, 1981). In downward comparison to fitness postings, users might think that 'I am doing well in fitness' or 'I am better in fitness than him/her.' As such, downward comparison to fitness posting could enhance users' self-efficacy for PA as well as their motivation for PA. Moreover, because self-efficacy plays a key motivational role in physical activity (van Stralen, De Vries, Mudde, Bolman, & Lechner, 2009), the greater self-confidence and sense of competence people have regarding their PA ability, the more motivated they should be to participate in PA. In fact, self-efficacy may partially or fully mediate the expected relationship between downward social comparison and PA motivation. Thus, it was predicted that:

H1) The more people engage in downward fitness comparison, the more self-efficacy in PA they will have.

H2) The more people engage in downward fitness comparison, the more PA motivation they will have.

H3) The more self-efficacy in PA people have, the more PA motivation they will have.

H4) Self-efficacy in PA will mediate the relationship between downward fitness comparison and PA motivation predicted in H2.

RQ6) Will self-efficacy in PA mediate the relationship between upward fitness comparison and PA motivation?

Frederick and Ryan (1993) argued that those who have more motives for enjoyment, to improve skill, and to increase fitness tended to participate more in PA. Based on this, those who are more inspired or motivated to participate in PA indeed should participate more in PA. Thus, it was predicted that:

H5) The more PA motivation people have, the more they will participate in PA.

2.7.3. Self-Presentation and Feedback on Fitness Postings

Finally, for fitness app users who post about their fitness on social media, this study examines self-presentation and receipt of supportive feedback. Human beings have an 'ideal self,' which denotes individuals' self-concept of what they would like to be like (Rogers, 1959) and tries to convey personal information or image ('ideal self') to others (Baumeister & Hutton, 1987). For a good impression, users tend to present ideal-self. Such human tendency for making a good impression of self to maintain social acceptance is self-presentation (Baumeister, 2010). When it comes to the desire to make a favorable impression, self-presentation is highly involved in impression management. People are aware that others form impressions of them and use the impressions in social interaction (Arkin, 1981). Figure 2.2 presents a model of the expected relationships between self-presentation and receipt of supportive feedback, as well as consequences for PA self-efficacy, PA motivation, and PA participation.

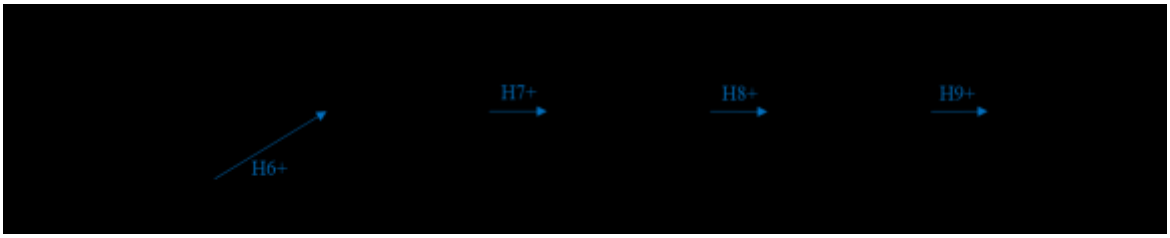

Figure 2.2 Model for Social Support on Fitness Self-Presentation

For modern people, social media is one of the most accessible ways to display themselves to others. People aware that social media postings create their online identity, and therefore they used to manage their social media profiles for an ideal impression (Mascheroni & Cuman, 2014; Mascheroni et al., 2015). People also tend to manage their impression with a particular intention for potential benefits or to protect self-esteem (Arkin, 1981). According to Leary (1992), "self-presentation usually entails a selective presentation of those parts of oneself that will make desired impressions on specific people within a particular encounter, combined with the selective omission of self-relevant information that will create undesired impressions (p. 339-340)." As such, people selectively present self and believe it will bring about benefits for them.

People sometimes present themselves negatively. Like positive self-presenters, negative self-presenters also seek benefits from social networks. However, it is a management of expectation, and they still want social support such as help and assistance. In terms of health-related self-presentation, some presenters intentionally misrepresent (either positively or negatively) their health conditions. For example, when they present themselves as sick, it may be a convenient excuse for possible failures (self-handicapping) or it may be a good opportunity to receive attention and consideration from others (Baumeister & Hutton, 1987).

As part of self-presentation, fitness app users also share their fitness outcomes such as performance stats or pictures of self-body shape through designated community forums or trendy social networking sites. Fitness posters have motivations to obtain social approval (*acquisitive-*

agentic) or to avoid social disapproval (*protective-agentic*) (Howle, Dimmock, et al., 2015; Howle, Jackson, et al., 2015). In research in the health domain, online interaction with others who have or had a similar health condition allows opportunities to exchange information, emotional, and esteem support (Rains & Young, 2009). These social supports can buffer stress (Cohen & Wills, 1995), manage uncertainty in health (Albrecht & Goldsmith, 2003), and provide positive health outcomes (Uchino, Cacioppo, & Kiecolt-Glaser, 1996). Either positively presented or negatively presented, all fitness postings might expect members of their social networks to give social support.

Based on previous studies, Albrecht and Goldsmith (2003) argued that support seekers' way of presentation and degree of requested social support might affect how support providers react and their willingness to offering support. Self-promoters, who usually present self in a positive way, tend to overestimate positive emotional reactions while underestimating negative emotional reactions from others (Scopelliti, Loewenstein, & Vosgerau, 2015). Also, self-promoters who fail to adopt the audience's perspective (failed perspective taking) and narcissists tend to be related to suboptimal impression management strategies such as hubris, humblebragging, hypocrisy, and backhanded compliments (Steinmetz et al., 2017). Self-promoters are less likely to display their mistakes on performance, because they believe observers would judge them more harshly and underrate their competence or intelligence. However, observers care less about others' mistakes and are more benevolent in their judgments (Steinmetz et al., 2017). Observers tend to like those who ascribe their success to hard work rather than who boast their natural talent (Steinmetz et al., 2017).

Although fitness posters who positively present their fitness may anticipate positive emotional reactions from others, there may be negative social repercussions. Engaging in

positive self-presentation may cause others to view them as less likable and as braggarts (Scopelliti et al., 2015). Positive fitness posters might be feeling proud of and happy for them, but those who are exposed to the postings would be feeling annoyed. In short, viewers' ways of feedback would be different depending on the ways of self-presentation for fitness. Thus, a research question and hypothesis were proposed:

RQ7) What kinds of fitness information do users post on social media?

RQ8) What kinds of feedback do fitness posters receive?

RQ9) How will positive fitness presentation be related to supportive feedback?

H6) The more people present their fitness negatively, the more they will get supportive feedback.

Several disciplines such as gerontology, psychology, and sociology have examined the concept of social support for health and well-being since the 1970s (Cohen & Syme, 1985). However, less research has been done to demonstrate the relationship between supportive feedback on fitness postings and self-efficacy for PA. As social therapy, social support psychologically functions for one's quality of life and healthy living (Albrecht & Goldsmith, 2003). Furthermore, computer mediated-support leads to an increase in self-efficacy and a decrease in depression (Carpenter & Buday, 2007; Rains & Young, 2009; Shaw & Grant, 2002). Based on the positive effects of social support on one's self-efficacy and mental health, social networks' supportive feedback on fitness postings should lead to greater PA self-efficacy, and possibly to greater motivation to engage in PA. As predicted in H3 and H5 above, positive relationships are also expected between PA self-efficacy and PA motivation, and between PA motivation and PA participation. These are repeated here because this model will be tested on the subgroup of participants who post about their fitness on social media. Therefore, the following hypotheses and research question are proposed:

H7) The more people get supportive feedback, the more self-efficacy for PA they will have.

RQ10) Will there be a relationship between social support and PA motivation?

H8) The more self-efficacy for PA people have, the more PA motivation they will have.

H9) The more PA motivation people have, the more they will participate in PA.

Finally, this study will more deeply explore the relationship between self-presentation and supportive feedback, by examining how positive and negative fitness self-presentation relate to receipt of three different types of supportive feedback. Figure 2.3 presents the expected relationships. Online communication, particularly social media use, helps people to maintain social relationships (Ellison et al., 2007; Ellison et al., 2010; Steinfield et al., 2008) and exchange social support (Bull & Ezeanochie, 2016; Maher et al., 2016). In general, social media users are mutually supportive. Even under the assumption that fitness posters primarily get supportive feedback from their social networks, types of social support may still be different depending on ways of presentation in fitness postings.

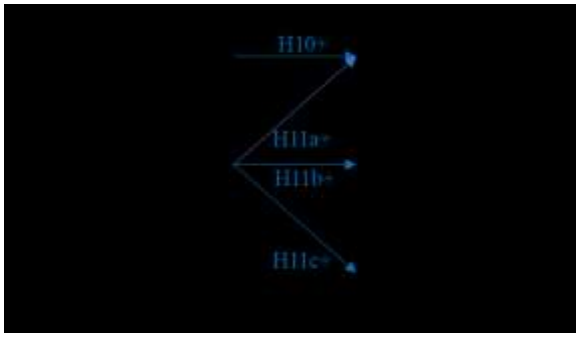

Figure 2.3 Model for Ways of Fitness Self-Presentation and Types of Social Support

Previous studies demonstrated that observers in computer-mediated bulletin boards tend to provide social support based on the context of postings (Coulson, 2005; Coulson, Buchanan, & Aubeeluck, 2007; Mo & Coulson, 2008; Oh et al., 2013). Of the five types of support most commonly examined – esteem, emotional, informational, network, and tangible – this study will focus on the three that seemed most likely to be shared on fitness posts: esteem support,

emotional support, and informational support. Positive self-presentation often reflects a desire for self-enhancement and the seeking of positive regard from others. In one study of social support, group members gave esteem support such as compliments on individuals' abilities or on the attributes of those who shared positive perspectives on difficult life experiences (Mo & Coulson, 2008). Those who positively present their fitness – such as sharing successes and achievements – might want to verify their efforts and would get appreciative feedback from others. Of the three types of support examined in this study, only esteem support, such as providing validation and praise, seems likely to be associated with positive fitness presentations. In contrast, negative self-presentation, such as sharing difficulties or struggles with fitness, may lead to greater receipt of all three types of supportive feedback. In the health domain, people who report having greater health concerns tend to seek more supportive feedback, and support-seeking is associated with receiving more supportive feedback of all types. Esteem support can help restore self-concept when people struggle or can reduce negative self-feelings such as guilt or shame. Those who have difficulties or are experiencing distressing events also receive more emotional support like expressions of empathy, care or concern. Informational support may also be provided when people share troubles or challenges. When group members have inquiries, members of the group offered informational support such as suggestions and advice including guidance for coping with difficulties or challenges. Moreover, they performed an educational role by explaining difficult language or concepts that group members did not understand (e.g., Mo & Coulson, 2008). Those who negatively present their fitness might share frustration in PA, and therefore others may attempt to bolster their confidence, provide empathy and understanding, and offer information to help them get through their difficulties. Based on the above analysis, the following hypotheses were proposed.

H10) The more people positively present their fitness, the more they will get esteem support.
H11) The more people negatively present their fitness, the more they will get a) esteem, b) emotional and c) informational support.

3 METHODS

3.1 Research Design Overview

The study objective was to explore the impact of mobile technology on physical activity. The survey was conducted with fitness app users. Some aspects of the study focused on those who had been exposed to other users' fitness postings, and on those who had posted about their own fitness outcomes on social media. First, descriptive information of fitness app use was explored, such as what types of fitness apps they use and what features of these apps they use. Second, the study examined responses to others' fitness postings. Specifically, the relationship between ways of social comparison on fitness postings and PA self-efficacy was explored. The relationship between PA self-efficacy and PA motivation also was examined. Third, the study examined respondents' reports about their own fitness postings. It was investigated how two ways of fitness self-presentation, positive and negative, were related to receiving supportive feedback, including esteem, emotional, and informational support. The relationship among supportive feedback and PA self-efficacy and PA motivation also were analyzed. Finally, the study examined the relationship between PA motivation and PA participation.

3.2 Procedure

Prior to recruiting potential participants, Georgia State University's Institutional Review Board (IRB) approved the proposed data collection methods, recruitment messages, an informed consent form, and questionnaires. Upon receiving IRB approval, the investigator recruited those who are using fitness apps with a recruitment message (Appendix A) through a crowdsourcing

internet marketplace, Amazon Mechanical Turk. Those who wanted to participate in the study visited Survey Monkey (www.surveymonkey.com) online survey tool, by clicking the survey link. The survey took place online through SurveyMonkey. Participants were asked to read the informed consent form (Appendix B) and selected “I agree” or “I decline” to take part in or refuse to participate in the survey. In the consent form, participants were told that the study investigates uses of fitness apps and responses to fitness postings. They were also informed that they would receive $0.50 through Mechanical Turk after completion of the survey. Participation in the survey was completely voluntary. Those who refused to participate in the survey were directed to a page that thanked them for their time. Participants who selected “I agree” could elect to skip and/or stop answering at any point if they desired. In SurveyMonkey, the order of the items on each scale was randomized for each respondent that accessed the survey.

3.3 Participants

There were 748 submitted surveys, but 84 respondents were dropped from the study: 79 people either did not provide their MTurk ID or stop responding, and 5 respondents had duplicate MTurk ID. For the 5 duplicate respondents, only their first submission was retained for data analysis. After deletion of incomplete questionnaires and duplicated responses, a total of 664 completed surveys remained (364 females, 290 males, 5 other, and 5 not reported). Five-hundred sixty-seven respondents had seen others’ fitness postings and 283 respondents had posted about their fitness performance on social media. Those two groups are not mutually exclusive. A total of 79 participants reported that they had engaged in neither of these two activities (i.e., had neither seen others' posts nor posted about their own fitness).

In the full sample ($N = 664$), the age of participants ranged from 18 to 74 years ($M = 36.27$, $SD = 10.48$), while one respondent did not report her age. More than half of respondents

(68.8%) identified themselves as White/Caucasian (n = 457), 9.2% as Black/African American (n = 61), 8.7% as Asian/Asian American (n = 58), 6.8% as Hispanic/Latino(a) (n = 45), 5.1% as Multiracial (n = 34), 0.8% as Native American/American Indian (n = 5), 0.2% as Native Hawaiian/Pacific Islander (n = 1), and 3 participants did not report their race/ethnicity. All the survey participants were currently living in the United States. Among the respondents, 0.5% had some high school but no diploma (n = 3); 6.9% had high school graduate, diploma or the equivalent (n = 46); 19.4% had some college credit with no degree (n = 129); 3% had trade/technical/vocational training (n = 20); and 8% had associated degree (n = 53). More than half of respondents had bachelor's degree or above; 45.3% had bachelor's degree (n = 301), 14.5% had master's degree (n = 96), 0.9% had professional degree (n = 6), and 1.5% had doctorate degree (n = 10). Detailed description of these two subsamples is provided in the results section.

3.4 Measures

The survey consisted of three sections, in addition to demographics and descriptive questions for social media use. The first section of the survey was designed to explore overall fitness app use. All participants reported their use of fitness apps such as what fitness apps they used, the most used fitness apps, the classification of the most used app, and the device on which that app is used. They also reported what gamification aspects of fitness apps they used and purchase experience for fitness apps.

The second section of the survey focused on those who had seen others' fitness postings on social media. The respondents reported the frequency of exposure to others' postings regarding fitness information, numerical fitness records, and fitness scenes. They also reported

types of social media which they had seen others' fitness postings. For fitness social comparison, the survey asked if they tend to compare their fitness with superior others or inferior others.

The third section of the survey focused on those who had posted their fitness on social media. The survey asked about the respondents' posting frequency of fitness information, numerical fitness records, and fitness scenes. They also reported what kinds of physical activities they posted and what social media they used for fitness postings. For the ways of self-presentation, the survey asked the extent to which they tended to post their fitness negatively and positively on social media. They reported who usually responded to their fitness postings and the extent to which they typically received positive feedback and negative feedback. The participants also responded to questions about the types of social support they received from others.

All participants were asked to report self-efficacy for PA, motivation for PA, and PA participation. In addition to the demographic information, all respondents' social media use also explored such as types of social media they use at least once in a week and their social media uses and behaviors. The list of measures is in Appendix C.

3.4.1 Types of Fitness Apps Used and Devices

The study asked about the fitness apps respondents used and the fitness app they used most. The options provided in the questions were based on the most downloaded fitness app charts as of June 2019. *Appannie.com* provides lists of the most downloaded apps in each application store. The respondents were also asked to classify their most used fitness app and report the device they used it on. Therefore, respondents classified the most used fitness app as based on a list that included: fitness tracking apps (e.g., tracking your fitness activity or caloric intake); workout fitness apps (e.g., assist your workout with instruction); social fitness apps (e.g., connects you with friends, family, and co-workers); competitive fitness apps (e.g.,

compare/challenge your performance with others); altruistic fitness apps (e.g., earn money/credit for charity when you walk, run, or bike); and other. The respondents also reported the device that they used for the app: iPhone, Android Phone, BlackBerry Phone, Window Phone, Smartwatch, Fitness tracker, Tablet PC, and Laptop.

3.4.2 Use of fitness apps

Four types of fitness app use were examined: self-monitoring, self-regulation, social facilitators (adapted from Yoganathan & Kajanan, 2013), and rewards (Seaborn & Fels 2015). Self-monitoring included: a) tracking steps or distance, b) burning calories, c) storing nutrition/eating, d) tracking weight loss, e) tracking sleep quality. Self-regulation included: a) setting steps or distance goals, b) setting calorie-burning goals, c) setting calorie intake/energy balance goals, d) setting weight loss goal, e) setting sleep goal. Social facilitators (interactions or connections with members of social network) included: a) participate in competition through leader boards, b) participates on challenges with group, c) connects/interact with other users in app, d) connects/interact with other social media users via app. Rewards included: a) obtaining extra credit, b) obtaining extra level, c) obtaining tangible or desirable items, d) obtaining badges/rewards. Example items include: “How often do you use fitness apps to track steps or distance? (self-monitoring)” “How often do you use fitness apps to set calorie-burning goals? (self-regulation)” “How often do you use fitness apps to participate in competition through leader boards? (social facilitators)” “How often do you use fitness apps to attempt to obtain extra credit? (rewards)” The items were rated on a 7-point scale (1 = never to 7 = very often). Scores on the four types of fitness app use were calculated by averaging the items for each type of use: self-monitoring (M = 4.54, SD = 1.42, α = .65); self-regulation (M = 4.34, SD = 1.52, α = .72); social facilitators (M = 2.60, SD = 1.78, α = .90); rewards (M = 2.70, SD = 1.62, α = .82). The

reliability of the self-monitoring scale (α = .65) was low but minimally acceptable. Deleting one of the self-mionitoring items (tracking steps or distance) would have raised Cronbach's alpha slightly to .67. But since this was a negligible increase, it seemed preferable to retain all Moreover, alpha with all five items was higher than alpha with low mean score items deleted.

3.4.3 Others' fitness postings

The survey asked if respondents had ever seen others' fitness postings on social media. Those who had, reported how frequently they had seen others' fitness postings on social media, on three parallel items, including: "How often have you seen others' fitness information on social media (e.g., running/walking routes, graphs, charts)?" "How often have you seen others' numerical fitness records on social media (e.g., steps, calories, distances)?", "How often have you seen others' fitness scenes on social media (e.g., any pictures describing their fitness experience including selfie in the gym, marathon, athletic outfits: a commemorative photo for exercise)?" The items were rated on a 7-point frequency scale (1 = never to 7 = very often). The three items did not form a reliable scale (α = .53), so the items were examined separately: fitness information (M = 3.98, SD = 1.74); numerical fitness records (M = 3.94, SD = 1.82); and fitness scenes (M = 5.32, SD = 1.64).

Respondents also reported about the types of social media on which they had seen others' fitness posts. They saw a list of 21 different types of social media (e.g., Instagram, Facebook, Twitter, Snapchat) as well as an "other" option, and could check as many as applied.

3.4.4 Social comparison to others' fitness postings

Upward and downward social comparison were measured using sixteen items adapted from the upward and downward physical appearance comparison of O'Brien et al. (2009). There were eight items for upward social comparison to fitness postings (e.g., "I compare myself to

others who have better fitness performance/habits/behaviors than me rather than those who do not") and eight items for downward social comparison to fitness postings: (e.g., "When I see a person who has below average fitness performance/habits/behaviors, I think about how my fitness compares to theirs"). All items were rated on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree).

The factorability of the 16 social comparison items was examined. First, all items were significantly correlated and suggested reasonable factorability. Second, the Kaiser-Meyer-Olkin measure of sampling adequacy was .96, above the recommended value of .6, and Bartlett's test of sphericity was significant (χ^2 (120) = 9708.57, $p < .05$). Third, the communalities were all above .7, further confirming that each item shared some common variance with other items. Given the indicators, factor analysis was deemed to be suitable with all 16 items.

To identify the factors underlying the 16 items measuring social comparison for fitness, principal components analysis with varimax rotation was used. Initial eigenvalues indicated that two dimensions accounted for 80.4% of the variance after Varimax rotation: *upward social comparison* accounted for 40.0% of the variance and *downward social comparison* accounted for 40.4% of the variance. Overall, the factor analysis indicated that two distinct factors were underlying individuals' responses to the social comparison to others' fitness postings and that the intended items loaded on each factor. The results of the factor analysis are reported in Table 3.1.

Table 3.1 Factor loadings based on a principal component analysis with varimax rotation for 16 items from Social Comparison Scale (N = 531)

	Factor Loading	
	1	2
Factor 1: Downward Social Comparison (α = .97)		
12) I compare myself to people with LOWER fitness performance/habits/behaviors than me.	**.925**	.117
15) I often compare myself to those who are LESS physically fit.	**.915**	.106
14) I often compare my fitness performance/habits/behaviors to people are LESS physically active than me.	**.908**	.126
11) I compare my fitness performance/habits/behaviors to those with LESS athletic fitness than me.	**.900**	.139
16) I tend to compare my fitness performance/habits/behaviors with people who are NOT as physically fit.	**.896**	.137
10) I tend to compare myself to those whose fitness performance/habits/behaviors are BELOW AVERAGE.	**.888**	.113
9) When I see a person who has BELOW AVERAGE fitness performance/habits/behaviors, I think about how my fitness compares to theirs.	**.839**	.224
13) I think about how competitive my fitness performance/habits/behaviors are compared to people who are NOT physically active.	**.832**	.211
Factor 2: Upward Social Comparison (α = .96)		
7) I find myself comparing my fitness with people who have BETTER fitness performance/habits/behaviors than me.	.157	**.925**
8) I compare my fitness performance/habits/behaviors to people who have BETTER fitness than me.	.127	**.912**
2) I tend to compare my fitness performance/habits/behaviors to that of people with EXCELLENT fitness.	.104	**.911**
6) When I see a person who has EXCELLENT fitness performance/habits/behaviors, I wonder how I compare to them.	.158	**.889**
1) I compare myself to others who have BETTER fitness performance/habits/behaviors than me rather than those who do not.	.113	**.889**
4) I tend to compare myself to people I think have BETTER fitness performance/habits/ behaviors than me.	.164	**.883**
5) When I see a person with GREAT fitness performance/habits/behaviors, I tend to wonder how I 'match up' with them.	.195	**.858**
3) I find myself thinking about whether my own fitness performance/habits/behaviors compare well with the fitness of HIGHLY SKILLED or PROFESSIONAL athletes.	.135	**.765**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Composite scores were created for upward social comparison and downward social comparison, based on the items that had their primary loadings on each factor. Specifically, the item scores were separately averaged to create one upward comparison scale (M = 4.25, SD = 1.72) and one downward comparison scale (M = 3.16, SD = 1.67). The upward comparison scale reliability was high (α = .96). The downward comparison scale reliability was high (α = .97). Higher scores indicate greater social comparison.

3.4.5 Own fitness postings

The survey asked if respondents had ever posted about their fitness on social media. Those who had posted were asked to report the frequency of their own fitness postings, on three separate items, including: "How often do you post your fitness information on social media (e.g., running/walking routes, graphs, charts)?" "How often do you post numerical fitness records on social media (e.g., steps, calories, distances)?" "How often do you post your fitness scenes on social media (e.g., any pictures describing your fitness experience including selfie in the gym, marathon, athletic outfits: a commemorative photo for exercise)?" The item scores were averaged to create one scale of respondents' own fitness postings (M = 3.49, SD = 1.48). This scale was found to be reliable (α = .78).

Respondents also reported about the types of social media on which they post about their fitness. They were shown a list of 21 different types of social media (e.g., Instagram, Facebook, Twitter, Snapchat) as well as an "other" option, and could check as many as applied.

3.4.6 Self-presentation in fitness postings

The ways of self-presentation in fitness postings (three positive items, three negative items) were measured using five items adapted from Yang, Holden, and Carter (2017) and one positive item from Yang and Brown (2016). Examples of positive fitness postings are: "On

social media, I normally reveal good feelings about my fitness on social media," "On social media, I usually disclose positive things about my fitness on social media." Examples of negative fitness postings are: "On social media, I usually reveal more undesirable things about my fitness then desirable things," "On social media, I share negative things (e.g. frustrations, struggles) about my fitness." All items were rated on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree).

The factorability of the six self-presentation items was examined. First, four of six items were significantly correlated and suggested reasonable factorability. Second, the Kaiser-Meyer-Olkin measure of sampling adequacy was .72, above the recommended value of .6, and Bartlett's test of sphericity was significant (χ^2 (15) = 651.46, $p < .05$). Third, the communalities were all above .5, further confirming that each item shared some common variance with other items. Given the indicators, factor analysis was deemed to be suitable with all 6 items.

To identify the factors underlying the self-presentation for fitness, principal components analysis with varimax rotation was used. Initial eigen values indicated that two social comparison dimensions accounted for 72.9% of the variance: positive self-presentation accounted for 32.8% of the variance and negative self-presentation accounted for 40.1% of the variance. Overall, the factor analysis indicated that two distinct factors were underlying individuals' self-presentation on their fitness postings. The results of the factor analysis are presented in Table 3.2.

Composite scores were created for positive self-presentation and negative self-presentation, based on the items that had their primary loadings on each factor. Items on the positive scale (M = 5.58, SD = 1.14) and the negative scale (M = 2.65, SD = 1.60) were averaged

Table 3.2 Factor loadings based on a principal component analysis with varimax rotation for 6 items from Self-Presentation Scale (N = 277)

	Factor Loading	
	1	2
2) I share things about my fitness that could lead to NEGATIVE judgments of me.	**.904**	-.084
1) I usually reveal more UNDESIRABLE things about my fitness then desirable things.	**.868**	-.175
3) I share NEGATIVE things (e.g. frustrations, struggles) about my fitness.	**.864**	-.070
4) I normally reveal GOOD feelings about my fitness.	-.174	**.840**
6) I usually disclose POSITIVE things about my fitness.	-.239	**.797**
5) I normally reveal more DESIRABLE things about my fitness then undesirable things.	.065	**.765**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

separately. The positive scale (α = .74) and the negative scale (α = .86) were reliable. Higher scores indicated greater self-presentation.

Those who had posted about their fitness on social media reported who usually responded to their fitness postings, from a list of options (e.g., close friends, casual friends, family, people who have common interests in physical activity). Three additional items assessed the feedback from others, including how much feedback they typically received, how much positive/supportive feedback they received, and how much negative/unsupportive feedback they received. These three items were rated on a 7-point Likert-type scale (1 = none to 7 = a great deal).

3.4.7 Supportive feedback on fitness postings

Supportive feedback on fitness postings was measured using a total of twelve items, four on each of three subscales. Ten of the items were adapted from Freeman, Coffee, and Rees (2011). Two items in Freeman et al.'s emotional dimension were deleted because they were not very relevant to online fitness support ("…always be there for you"; "…care for you"), and were

replaced by two items from Oh et al. (2013) that assessed emotional support ("…provide encouragement to you"; "…show you empathy"). The scale includes four items measuring each of three distinct types of supportive feedback: esteem, emotional, and informational support. Network support and tangible support were excluded because they were not central to the goals of this study. Examples of the three types of supportive feedback include: "When I post about my fitness, other users reinforce the positives of my physical activities" (esteem), "…provide me with comfort and support" (emotional), "…give me constructive feedback" (informational). All items were rated on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree).

The factorability of the 12 social support items were examined. First, all 12 items were significantly correlated and suggested reasonable factorability. Second, the Kaiser-Meyer-Olkin measure of sampling adequacy was .92, above the recommended value of .6, and Bartlett's test of sphericity was significant (χ^2 (66) = 2113.52, $p < .01$). Third, the communalities were all above .5, further confirming that each item shared some common variance with other items. Given the indicators, factor analysis was deemed to be suitable with all 12 items.

To identify the factors underlying the supportive feedback on fitness postings, principal components analysis with varimax rotation was used. However, total variance was explained by four dimensions instead of three, as had been designed. Although the esteem support items and informational support items loaded on distinct factors, the items for emotional support did not load on a single factor and either had low factor loadings or high cross-loadings. Thus, the principal components analysis was re-run without the four emotional support items. In this analysis, initial eigenvalues indicated that two supportive feedback dimensions accounted for 74.9% of the variance after Varimax rotation: esteem support accounted for 36.0% of the

variance and informational support accounted for 38.9% of the variance. The results of this factor analysis are presented in Table 3.3.

Although the four items measuring emotional support did not load on a separate factor in the initial factor analysis of the 12 items, this subscale was retained because the items had face validity, formed a reliable scale (see below), and may offer useful insight for the study. Therefore, the emotional support subscale was included in the study, along with the subscales for esteem support and informational support.

Table 3.3 Factor loadings based on a principal component analysis with varimax rotation for 8 items from Social Support Scale (N = 274)

	Factor Loading	
	1	2
11) Give me fitness-related advice	**.881**	.205
12) Give me advice on my performance	**.849**	.245
10) Give me fitness-related information	**.830**	.317
9) Give me constructive feedback	**.828**	.233
3) Instill me with confidence	.201	**.834**
2) Enhance my self-esteem	.207	**.818**
4) Boost my sense of competence at physical activities	.320	**.812**
1) Reinforce the positives of my physical activities	.235	**.779**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Composite scores were created for esteem support, informational support, and emotional support. Scores for each of the three types of supportive feedback were calculated by averaging the four items on each subscale: esteem support (M = 5.14, SD = 1.30, α = .87), informational support (M = 4.10, SD = 1.72, α = .91), and emotional support (M = 4.60, SD = 1.40, α = .80) . For analyses involving overall level of supportive feedback, the scores on all 12 items were averaged to form a single measure of social support (M = 4.60, SD = 1.30). The scale was found to be reliable (α = .92). Higher scores indicate a greater degree of social support.

3.4.8 Self-efficacy for PA

Self-efficacy for PA was measured using four items adapted from Oh et al. (2013) (e.g., "I am confident I can have a positive effect on my fitness or health," "I can actively work to improve my fitness or health"). All items were rated on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree). The item scores were averaged to create a PA self-efficacy score. The scale was found to be reliable for both the subsample of those who had seen others' fitness posts (M = 5.93, SD = 0.99; α = .90), and the subsample of those who posted about their fitness (M = 5.95, SD = 0.96; α = .88).

3.4.9 PA motivation

PA motivation was measured using five semantic differential scales adapted from Lowe, Eves, and Carroll (2002). They used affective and instrumental attitude for exercise intention scales based on Godin (1987): "For me, taking part in physical activities regularly over the next month is"; Affective (1 = extremely unenjoyable to 7 = extremely enjoyable); (1= extremely dull to 7 = extremely stimulating); (1 = extremely harmful to 7 = extremely beneficial); Instrumental (1= extremely unimportant to 7 = extremely important); (1= extremely bad to 7 = extremely good). The wording in the question, "exercising regularly" was revised to refer to physical activity. The five semantic differential scale scores were averaged to create a PA motivation score. The scale was found to be reliable for both the subsample of those who had seen others' fitness posts (M = 5.68, SD = 1.32; α = .85), and those who posted about their fitness (M = 5.78, SD = 1.09; α = .88).

3.4.10 PA participation

Their PA participation was measured using three items from Godin's Leisure Time Physical Activity Questionnaire (Godin, 2011; Godin & Shepard, 1985): "During a typical 7-day

period (a week), how many times on the average do you do the following kinds of physical activity for more than 15 minutes?" Three types of physical activity were described: strenuous, moderate, and mild. The scores on the three rated items were calculated using Godin's formula. To calculate the PA participation scale, each frequency score was multiplied by a corresponding metabolic equivalent of task (MET) value and the scores were summed: (frequency of strenuous PA×9) + (frequency of moderate PA×5) + (frequency of mild PA ×3) (Godin, 2011). The PA participation scores for the two subsamples were: seen others' fitness posts (M = 78.26, SD = 54.34); posted about their fitness (M = 84.63, SD = 56.26).

3.4.11 Social Media Use

Participants reported how actively they use and engage in social media. The items to measure social media activity and engagement were adapted from Hou (2017). One item measured overall social media use: "How often each day, on average, do you use social media?" Seven other items measure social media engagement, with the question: "How often each day, on average, do you do the following?" Example items are: "… read others' posts" "… post or share own photos, messages, or videos." The items were rated on a 7-point frequency scale (1 = never to 7 = multiple times a day). These eight items were averaged (M = 4.24, SD = 1.37). The scale was found to be reliable (α = .90).

3.4.12 Body Mass Index of The Study Participants

All participants were asked to report height and weight. Adult Body Mass Index (BMI) was calculated by dividing weight in pounds (lbs.) by height in inches (in.) squared and multiplying by a conversion factor of 703. A total of 6 respondents who did not report their height and 10 respondents who reported apparently false information about their height or weight (e.g., weight = 25 pounds) were excluded from the calculation. Based on self-reported height and

weight, respondents' BMI (body mass index) was calculated (*M* = 25.31, *Mdn* = 24.13, *SD* = 5.89).

BMI classification was also calculated, based on CDC recommendation. Those who reported < 18.5 were classified as underweight; those who reported between 18.5 and 24.9 were classified as normal or healthy weight; those who reported between 25.0 and 29.9 were classified as overweight range; and those who reported ≥ 30.0 were classified as obesity. More than half of respondents (52.3%) were normal or healthy weight (n = 347), 23.3% were overweight (n = 155), 16.4% were obese (n = 109), and 5.6% were underweight (n = 37).

4 RESULTS

4.1 Overview of Analysis

Survey data were downloaded and converted into SPSS 22 for analyses. This study consisted of three parts. The first part of the research explored the use of fitness apps and gamification aspects in the apps. To address RQ1 and RQ2, descriptive statistics reported participants' uses of fitness app for four main categories: self-monitoring, self-regulation, social facilitators, and rewards.

The second part of the research investigated fitness app users' viewing experience of others' fitness postings. For RQ3, descriptive analyses were conducted to examine types of fitness information respondents saw in others' fitness postings. For those who have seen others' fitness postings on social media, the study scrutinized how social comparison is related to their physical activity self-efficacy, physical activity motivation, as well as participation.

A series of linear regression analyses estimated the path coefficients for the paths between variables in the model shown in Figure 2.1. According to Pedhazur (1997), "a path coefficient indicat[es] the amount of expected change in the dependent variable as a result of a

unit change in the independent variable (p. 772).” All the regression analyses included covariates of age, gender, and BMI. Specifically, a regression analysis was conducted to predict PA self-efficacy from upward social comparison (RQ4) and downward social comparison (H1). A regression analysis was conducted to predict PA motivation from upward social comparison (RQ5), downward social comparison (H2), and PA self-efficacy (H3). Finally, a regression analysis was conducted to predict PA participation from PA motivation (H5). With Hayes’s (2018) regression-based PROCESS 3.0, Model 4, mediation analysis was also conducted to assess if PA self-efficacy mediated the relationship between upward social comparison and PA motivation (H4). Mediation analysis was further conducted if PA self-efficacy mediated the relationship between downward social comparison and PA motivation (RQ6).

The last part of the research explored fitness app users’ social media posting experience. For RQ7 and RQ8, descriptive analyses were conducted to examine what fitness app respondents posted on social media and what kinds of feedback fitness posters received from others. Based on their ways of self-presentation, the study examined the relationship between supportive feedback on fitness postings and the posters’ PA self-efficacy and PA motivation. The relation of PA motivation and PA participation was also examined. A series of linear regression analyses was conducted to estimate the path coefficients in the model in Figure 2.2. All the regression analyses included covariates of age, gender, and BMI. A regression analysis was conducted to predict supportive feedback (social support) from positive fitness posting (RQ9) and negative fitness posting (H6). A regression analysis was conducted to predict PA self-efficacy from supportive feedback (H7). A regression analysis was conducted to predict PA motivation from supportive feedback (RQ10) and PA self-efficacy (H8). Finally, a regression analysis was conducted to predict PA participation from PA motivation (H9).

With covariates of age, gender, BMI, and overall amount of feedback from others, linear regression analyses were conducted to predict each type of supportive feedback from positive and negative self-presentation (see Figure 2.3). Even though this study hypothesized that positive self-presentation predicts only esteem support, regression analyses included positive self-presentation as an independent variable to predict emotional support and informational support. It was expected that esteem support would be positively predicted by both positive fitness postings (H10) and negative fitness posting (H11a). It was anticipated that emotional support would be positively predicted by negative fitness posting (H11b). It was also expected that informational support would be positively predicted by negative fitness posting (H11c).

4.2 Overview of the Main Sample and Two Subsamples

All the study participants responded about their uses of fitness apps. To address the first two research questions, the full sample of 664 respondents was included in the analyses. For the analyses of social comparison to others' fitness postings and self-presentation in own fitness postings, the two subsets of the sample consisted of individuals who had seen others' fitness postings (n = 567) and who had posted their fitness information on social media (n = 283). To provide context, the demographics of the two subsamples are presented in Table 4.1, compared to the demographics for the whole sample. Overall, the two subsamples and the whole sample were quite similar on age, ethnicity and education. However, a greater portion of women posted about their fitness on social media compared to the whole sample and those who saw others' fitness posts.

Of those who had seen others' fitness postings (n = 567), 55.6 percent of them were females (n = 315), 42.9% were males (n = 243), and 0.7% were reported other (n = 4). The age of the participants ranged from 18 to 72 years (M = 36.1, SD = 10.14). More than half of them

Table 4.1 Demographic Characteristics of Whole Sample and Two Subsets

Demographics	Whole sample	Those who had seen other's posts	Those who had posted
Number of Participants	664	567	283
Gender			
Female	364 (54.8%)	315 (55.6%)	175 (61.8%)
Male	290 (43.7%)	243 (42.9%)	103 (36.4%)
Other	5 (0.8%)	4 (0.7%)	3 (1.1%)
Did not respond	5 (0.8%)	5 (0.8%)	2 (0.7%)
Age			
Mean	36.27	36.10	35.45
Range	18-74	18-72	19-73
Ethnicity			
White/Caucasian	457 (68.8%)	387 (68.5%)	179 (63.7%)
Black/African American	61 (9.2%)	52 (9.2%)	30 (10.7%)
Asian/Asian American	58 (8.7%)	54 (9.6%)	32 (11.4%)
Hispanic/Latino(a)	45 (6.8%)	36 (6.4%)	20 (7.1%)
Multiracial	34 (5.1%)	32 (5.7%)	17 (6.0%)
Native American/American Indian	5 (0.8%)	4 (0.7%)	3 (1.1%)
Native Hawaiian/Pacific Islander	1 (0.2%)	-	-
Education			
Some high school but no diploma	3 (0.5%)	2 (0.4%)	-
High school diploma or equivalent	46 (6.9%)	37 (6.5%)	15 (5.3%)
Some college credit with no degree	129 (19.4%)	102 (18.0%)	41 (14.5%)
Trade/technical/vocational training	20 (3.0%)	17 (3%)	10 (3.5%)
Associate's degree	53 (8.0%)	46 (8.1%)	24 (8.5%)
Bachelor's degree	301(45.3 %)	265 (46.7%)	141 (49.8%)
Master's degree	96 (14.5%)	86 (15.2%)	47 (16.6%)
Professional degree	6 (0.9%)	4 (0.7%)	1 (0.4%)
Doctoral degree	10 (1.5%)	8 (1.4%)	4 (1.4%)

(68.5%) identified themselves as White/Caucasian (n = 387), 9.6% as Asian/Asian American (n = 54), 9.2% as Black/African American (n = 52), 6.4% as Hispanic/Latino(a) (n = 36), 5.7% as Multiracial (n = 32), and 0.7% as Native American/American Indian (n = 4). When it comes to their levels of education, 0.4% had some high school but no diploma (n = 2); 6.5% had a high school diploma or the equivalent (n = 37); 18.0% had some college credit with no degree (n = 102); 3% had trade/technical/vocational training (n = 17); and 8.1% had an associate's degree (n

= 46). More than half of respondents had a bachelor's degree or higher; 46.7% had a bachelor's degree (n = 265), 15.2% had a master's degree (n = 86), 0.7% had a professional degree (n = 4), and 1.4% had a doctorate degree (n = 8).

Of those who had posted their fitness information on social media (n = 283) 61.8 percent of them were females (n = 175), 36.4% were males (n = 103), and 1.1% were reported other (n = 3). Their age ranged from 19 to 73 years (M = 35.45, SD = 9.80). More than half of them (63.7%) identified themselves as White/Caucasian (n = 179), 11.4% as Asian/Asian American (n = 32), 10.7% as Black/African American (n = 30), 7.1% as Hispanic/Latino(a) (n = 20), 6.0% as Multiracial (n = 17), and 1.1% as Native American/American Indian (n = 3). When it comes to their levels of education, 5.3% had a high school diploma or the equivalent (n = 15); 14.5% had some college credit with no degree (n = 41); 3.5% had trade/technical/vocational training (n = 10); and 8.5% had an associate's degree (n = 24). More than half of respondents had a bachelor's degree or higher; 49.8% had a bachelor's degree (n = 141), 16.6% had a master's degree (n = 47), 0.4% had a professional degree (n = 1), and 1.4% had a doctorate degree (n = 4).

4.3 Results for the Use of Fitness Apps and Gamification Aspects in the Apps

4.3.1. Popular Fitness Apps and the Most Used Fitness App

RQ1 asked: What types of fitness apps do users use? First, respondents received a list of 21 fitness apps (with an "other" option to write in other apps) and indicated which apps they used. They could check as many as applied. These results are reported in the first two columns of Table 4.2. The frequency analyses showed that 47.1% of the respondents used *MyFitnessPal* (n = 313) and 41.1% of them used *Fitbit* (n = 273). *Fitbit* apps are exclusively compatible with *Fitbit* fitness trackers. Only those who have *Fitbit* trackers can use *Fitbit* apps. About 19 percent of the respondents (n = 125) used *Pre-installed apps* such as *Apple health* and *Samsung health*. About

Table 4.2 Fitness Apps Participants Used and Their Most Used Fitness App

	Frequency of Used	Percent of Used	*Frequency* of Most Used	Percent of Most Used
MyFitnessPal	313	47.1%	164	24.9%
Fitbit	273	41.1	178	27.1
Pre-installed apps	125	18.8	67	10.1
Lose It! – Calorie Counter	71	10.7	24	3.6
Calm	67	10.1	16	2.4
30 Day Fitness Challenge ◦	64	9.6	20	3.1
Nike Training Club	59	8.9	16	2.4
7 Minute Workout Challenge	58	8.7	14	2.1
HeartWatch. Heart & Activity	55	8.3	10	1.5
Nike+ Run Club	52	7.8	17	2.6
Sweatcoin - Sweat for Coins	48	7.2	23	3.5
AllTrails	47	7.1	9	1.4
Headspace: Guided Meditation	41	6.2	10	1.5
Flo Period & Ovulation Tracker	36	5.4	5	0.8
Workout Trainer	30	4.5	6	0.9
Lifesum: Diet & Macro Tracker	25	3.8	8	1.2
Instant Heart Rate: HR Monitor	21	3.2	2	0.3
Workout for Women: Fitness App	20	3.0	7	1.1
Full Fitness : Exercise Workout Trainer	20	3.0	5	0.8
BetterMe: Weight Loss Workouts	15	2.3	2	0.3
My Macros+ | Diet & Calories	9	1.4	3	0.5
Fabulous - Motivate Me	9	1.4	2	0.3
Gamin Connect	7	1.1	5	0.8
Strava	6	0.9	3	0.5
FitOn: Social Fitness Workouts	6	0.9	2	0.3
C25K	6	0.9	1	0.2
Achievement – Rewards for Health	6	0.9	1	0.2
MapMyFitness	5	0.8	3	0.5
Other	52	7.8	35	5.3

Note. Frequency of Used indicates the number of respondents who used each app (they could choose as many as applied). *Frequency* of Most Used displays the number of respondents who selected each app as their "most used" app (they could choose only one). The percentage for both was based on the total number of respondents (N = 664). Although 10 respondents did not report their most used app, 4 of them chose only one app on the first question. Therefore, those 4 respondents' answers were included in the analysis for the most used app.

11 percent of the respondents (n = 71) used *Lose It! – Calorie Counter* while 10.1% of the respondents (n = 67) used *Calm*.

In addition to reporting all fitness apps that they used, the respondents reported on their most used fitness app. These results are reported in the third and fourth columns of Table 4.2. The most frequently used apps were as follows: *Fitbit* (27.1%), *MyFitnessPal* (24.9%), and *Pre-installed apps on their phones* (10.1%).

Respondents also reported on several aspects of their most-used fitness app. First, they were asked to classify the app into one or more different types. Table 4.3 shows that more than 80% of the most used fitness apps were classified as Fitness Tracking App (n = 532). In addition, 23.6% of the apps were classified as Workout Fitness App (n = 157), 15.5% of the apps were classified as Social Fitness App (n = 103), 5.6% of the apps were classified as Competitive Fitness App (n = 37), and 2.4 % of the apps were regarded as Altruistic Fitness App (n = 16).

Table 4.3 Classifications of the Most Used Fitness App

	Frequency	Percent
Fitness Tracking Apps	532	80.1%
Workout Fitness Apps	157	23.6
Social Fitness Apps	103	15.5
Competitive Fitness Apps	37	5.6
Altruistic Fitness Apps	16	2.4

Note. Respondents had five options to choose for classification of their most used fitness app (with an "other" option to write in other types). The apps could be classified in multiple ways by allowing respondents to check as many options as applied. The percentage was based on the total number of respondents (N = 664).

Respondents also identified the device on which they most often used the fitness app they had identified as most used. They reported that they mostly used the fitness app on their smartphone: Android Phone (46.1%, n = 306) and iPhone (42.2%, n = 280). In addition, some respondents used the fitness app on a smartwatch (4.8%, n = 32), a fitness tracker (2.9%, n = 19),

a laptop (2.7%, n = 18), and a tablet PC (1.1%, n = 7) (see Table 4.4). In addition to the reports in the table, only 26.4% of the respondents (n = 175) reported that they had paid for fitness apps, including download or in-app purchase.

Table 4.4 Operating Devices for the Most Used Fitness App

	Frequency	Percent
Android Phone	306	46.1%
iPhone	280	42.2
Smartwatch	32	4.8
Fitness tracker	19	2.9
Laptop	18	2.7
Tablet PC	7	1.1
No response	2	.3
Total	664	100

4.3.2 RQ2 - Uses of Gamification aspects of Fitness Apps

RQ2 asked: What gamification aspects of fitness apps do users use? First, respondents received a list of 18 items for gamification aspects of fitness apps use such as self-monitoring, self-regulation, social facilitators, and rewards. They rated the items on a 7-point scale. These results are reported in the Table 4.5.

Although the gamification aspects of fitness app use were intended to tap into four dimensions discussed in the literature review (monitoring for fitness, regulation for fitness, social facilitation for fitness, and rewards from fitness participation), the items did not load on the intended factors in a factor analysis. Thus, the individual items are reported in Table 4.5, but for completeness, the four intended subscales were also calculated. The ‘n’ in the table indicates the numbers of people who had used the fitness app for each item at least once.The greatest number of respondents used fitness apps for self-monitoring, whereas the least number of respondents used fitness apps for social facilitation. The results of the repeated-measure ANOVA demonstrated a significant means difference between the four gamification aspects, $F(3, 1845) =$

604.59, p < .001: self-monitoring (*M* = 4.56, *SD* = .06), self-regulation (*M* = 4.36, *SD* = .06), social facilitators (*M* = 2.59, *SD* = .07), and rewards (*M* = 2.66, *SD* = .07). Post hoc tests using the Bonferroni correction revealed that self-monitoring was significantly greater than self-regulation ($p < .001$), social facilitators ($p < .001$), reward ($p < .001$). Self-regulation was significantly *greater than social facilitators* ($p < .001$) and rewards ($p < .001$). There was no significant mean difference between social facilitators and rewards ($p < .606$).

The descriptive analyses showed that respondents most often used fitness apps for physical activity-related behaviors. As a self-monitoring behavior, about 88% (n = 582) of respondents tracked steps/distance (*M* = 5.38, *SD* = 2.05), about 85% (n = 564) of respondents used fitness apps to burn calories (*M* = 4.86, *SD* = 2.08), and about 81 % (n = 537) of respondents tracked weight loss (*M* = 4.63, *SD* = 2.24). As a self-regulation behavior, about 86% (n = 570) of respondents set steps/distance goals (*M* = 5.07, *SD* = 2.10), about 82% (n = 542) of respondents set weight loss goal (*M* = 4.56, *SD* = 2.22), and over 81% (n = 539) of respondents set calorie-burning goals (*M* = 4.58, *SD* = 2.18).

Table 4.5 Means, Standard Deviations, Numbers of Respondents who Had Used Gamification Aspects and Cronbach's Alphas of Fitness App Use Scale

	M	*SD*	*n* who used app for each purpose
Self-monitoring (α = .65)	4.54	1.42	-
1) track steps/distance	5.38	2.05	582
2) burn calories	4.86	2.08	564
3) store nutrition/eating	4.36	2.31	517
4) track weight loss	4.63	2.24	537
5) track sleep quality	3.47	2.33	418
Self-regulation (α = .72)	4.34	1.52	-
6) set steps/distance goals	5.07	2.10	570
7) set calorie burning goals	4.58	2.18	539
8) set calorie intake/energy balance goals	4.43	2.26	527
9) set weight loss goal	4.56	2.22	542
10) set sleep goal	3.06	2.23	379
Social facilitators (α = .90)	2.60	1.78	-
11) participate in competition through leader boards	2.56	2.02	309
12) participate in challenges with group	2.64	2.05	327
13) connect/interact with other users in app	2.66	2.01	339
14) connect/interact with other social media users via app	2.51	1.95	313
Rewards (α = .82)	2.70	1.62	-
15) obtain extra credit	2.22	1.81	261
16) obtain extra level	2.62	1.96	328
17) obtain tangible/desirable items	2.79	2.08	340
18) obtain badges/rewards	3.16	2.19	390

Note. The last column displays the number of respondents who had used the fitness app for each purpose (i.e., chose 2 or higher on a scale that ranged from 1, never, to 7, very often). The range for number of respondents who answered each item was 656 to 660.

4.4 Results for Respondents Who Had seen Others' Fitness Posts

4.4.1. RQ3 - Descriptive Results for Those Who Had Seen Others' Fitness Posts

RQ3 asked what kinds of fitness postings are users exposed to? Over 85.0% (n = 567) of respondents in the whole sample (N = 664) reported that they had seen others' fitness postings on social media. Those 567 respondents were asked to report the kinds of fitness posts they saw.

Respondents also reported on the types of social media where they had seen others' fitness postings.

Based on a 1 to 7 scale, respondents reported how frequently they had seen different types of fitness postings by others. Table 4.6 displays the results. The frequency in the right column indicates the number of people who had seen each type of fitness post at least once.

Table 4.6 Means, Standard Deviations, and Numbers of Respondents who Had Seen Each Type of Others' Fitness Postings

	M	*SD*	*Frequency* who had seen each type of fitness posting
1) Seen others' fitness information on social media?	3.98	1.74	503
2) Seen others' numerical fitness records on social media?	3.94	1.82	508
3) Seen others' fitness scenes on social media?	5.32	1.64	548

Note. The last column displays the number of respondents who had seen others' fitness postings at least once for each item. Five hundred sixty-seven respondents answered that they saw others' fitness postings.

Nearly all respondents (96.6%; n =548) had seen posts showing "others' fitness scenes" (M = 5.32, SD = 1.64), 89.6% of respondents (n = 508) had seen "others' numerical fitness records" (M = 3.94, SD = 1.82), and 88.7% (n = 503) had seen "others' fitness information" (M = 3.98, SD = 1.74). The results of the repeated-measure ANOVA demonstrated significant mean differences between the three types of fitness post seen, $F(2, 1132) = 161.97$, $p < .001$. Post hoc tests using theBonferroni correction revealed that respondents had seen "others' fitness scenes" more than they had seen "others' fitness information" ($p < .001$) or "others' numerical fitness information" ($p < .001$). There was no significant mean difference between how often respondents had seen "others' fitness information" and "others' numerical fitness information" ($p < .073$).

Of the respondents who saw others' fitness postings, over three-quarters saw others' postings on *Facebook* (84.7%, n = 480) and *Instagram* (76.7%, n = 435) (see Table 4.7). About

Table 4.7 The Frequency and Percentage of Respondents Who Saw Others' Fitness Posts & Posted About Their Fitness on Each Social Media Platform

	Seen Others' Post		Posted About Own Fitness	
	Frequency	Percent	*Frequency*	Percent
Facebook	480	84.7%	213	75.3%
Instagram	435	76.7	179	63.3
Twitter	189	33.3	48	17.0
YouTube	189	33.3	17	6.0
Reddit	115	20.3	9	3.2
Snapchat	111	19.6	41	14.5
Pinterest	68	12.0	11	3.9
WhatsApp	35	6.2	13	4.6
Google+	24	4.2	14	4.9
Tumblr	15	2.6	4	1.4
LinkedIn	14	2.5	3	1.1
TikTok	13	2.3	2	.7
Flickr	8	1.4	1	.4
Vine	7	1.2	1	.4
StumbleUpon	4	.7	-	-
Quora	3	.5	-	-
Bizsugar	2	.4	2	.7
Digg	2	.4	-	-
Periscope	1	.2	1	.4
Delicious	1	.2	-	-
Viber	1	.2	2	.7
other	2	.4	1	.4

Note. For social media where respondents had seen others' fitness postings, the percentages were calculated based on the total of 567 respondents who had done so (they could check as many as applied). For social media where respondents had posted about their own fitness, the percentages were calculated based on the total of 283 respondents who had done so (they could check as many as applied).

one-third of these respondents saw others' fitness postings on *Twitter* (33.3%, n = 189) and *YouTube* (33.3%, n = 189). Nearly 20% reported that they saw fitness posts on *Reddit* (20.3%, n = 115) and *Snapchat* (19.6%, n = 111), whereas 12% saw fitness posts on *Pinterest* (n = 68). These seven social media platforms are considered microblogging sites where users can share short sentences, images, and videos. Respondents rarely saw fitness posts from other social

media platforms. The types of social media where respondents reported posting about their own fitness is also included in the table, to facilitate comparison, but will be discussed later in section 4.5.1.

4.4.2. Overview of Variables in Analyses of Social Comparison with Others' Fitness Posts

Zero-order correlation analysis was computed for upward social comparison, downward social comparison, PA self-efficacy, PA motivation, and PA participation. Age, gender, and BMI were also included in the table of zero-order correlations because they are covariates in the analyses.

Results indicated that upward social comparison had a moderate positive correlation with downward social comparison ($r[531] = .32$, $p < .001$) and a very weak positive correlations with PA self-efficacy ($r[539] = .13$, $p < .01$), PA motivation ($r[529] = .10$, $p < .05$), and PA participation ($r[536] = .10$, $p < .05$) (see Table 4.8). Upward social comparison also had a weak negative correlation with age ($r[547] = -.26$, $p < .001$), and gender ($r[538] = -.09$, $p < .05$). The younger respondents were, the more they engaged in upward social comparison. Further, males engaged in upward social comparison more than females. Downward social comparison had a very weak negative correlation with PA self-efficacy ($r[543] = -.09$, $p < .05$) and age ($r[550] = -.10$, $p < .05$), whereas it had a very weak positive correlation wit*h PA participation* ($r[549] = .11$, $p < .01$). There was a moderate positive correlation *between PA self-efficacy and PA motivation* ($r[540] = .52$, $p < .001$). PA motivation had a very weak positive correlation with PA participation ($r[538] = .11$, $p < .05$). PA participation had a very weak negative correlation with *BMI* ($r[542] = -.16$, $p < .001$). Although it was a very weak correlation, age and gender were positively correlated ($r[558] = .10$, $p < .05$). It could be interpreted that the older the respondents in the study, the more likely they were male. Age also had a very weak positive correlation with *BMI* ($r[551] = .16$, $p < .001$).

Table 4.8 Means, Standard Deviations, and Zero-Order Correlations between Variables for Those Who Have Seen Others' Fitness Posts

	USC	DSC	PASE	PAM	PAP	Age	Gender	BMI
USC	1							
DSC	**.32*****	1						
PASE	**.13****	**-.09***	1					
PAM	**.10***	-.06	**.52*****	1				
PAP	**.10***	**.11****	.06	**.11***	1			
Age	**-.26*****	**-.10***	.08	.05	-.01	1		
Gender	**-.09***	.03	-.02	-.02	.04	**.10***	1	
BMI	-.05	.05	-.04	-.08	**-.16****	**.16*****	.02	1
Mean	4.25	3.13	5.93	5.68	78.26	36.10	.56	25.39
SD	1.73	1.65	.99	1.13	54.34	10.14	.50	6.02

Note. USC = Upward Social Comparison, DSC = Downward Social Comparison, PASE = Physical Activity Self-Efficacy, PAM = Physical Activity Motivation, PAP = Physical Activity Participation, Gender (coded; 0 = male, 1 = female), BMI = Body Mass Index.
The range for the numbers of respondents was from 531 to 558.
*. Correlation is significant at the .05 level (2-tailed).
**. Correlation is significant at the .01 level (2-tailed).
***. Correlation is significant at the .001 level (2-tailed).

4.4.3. Main Analyses for Those Who Had Seen Others' Fitness Posts

A series of three hierarchical linear regression analyses were conducted to estimate the path coefficients of the paths specified in Figure 2.1. Specifically, the analyses predicted (1) PA self-efficacy from upward and downward social comparisons, (2) PA motivation from the two types of social comparison and PA self-efficacy, and (3) PA participation from PA motivation. A path coefficient "indicates the direct effect of a variable hypothesized as a cause of a variable taken as an effect (Pedhazur, 1997, p. 772)." Covariates of age, gender, and BMI were included in the first block of all the regression analyses.

RQ4 asked how will upward fitness comparison be related to self-efficacy in PA? H1 predicted that the more people engage in downward fitness comparison, the more self-efficacy in PA they will have. To test these hypotheses, a regression analysis was conducted that regressed PA self-efficacy on the two types of social comparison. Three covariates (age,

gender, and BMI) were entered in the first block, and upward and downward social comparison were entered in the second block.

As illustrated in Table 4.9, results indicated that the full model was statistically significant, R^2Adj = .033, $F(2, 497) = 4.405$, $p < .01$. The two type of social comparisons accounted for a significant amount of variance in PA self-efficacy, ΔR^2 = .039, $p < .001$.

Table 4.9 Regression Predicting PA self-efficacy from Social Comparison

		B	*SE B*	*β*	*Δ R²*
1	Age	.006	.004	.060	.003
	Gender	-.017	.088	-.009	
	Body Mass Index	-.002	.007	.015	
2	Upward Social Comparison	.110	.027	.198***	.039***
	Downward Social Comparison	-.079	.027	-.134**	
	R^2Adj = .033, $F(2, 497) = 4.405$, $p < .01$				

Note. Betas at entry. Gender (coded; 0=male, 1=female).
** p < .05, **p < .01, ***p < .001*

Regarding RQ4, the analysis revealed that upward social comparison positively predicted PA self-efficacy when downward social comparison was controlled (β = .198, $p < .001$). The more people engaged in upward social comparison, the more self-efficacy in PA they had. Downward social comparison significantly predicted PA self-efficacy. However, H1 was not supported, because downward social comparison negatively predicted PA self-efficacy when upward social comparison was controlled (β = -.134, $p < .01$). The more people engaged in downward social comparison, the less self-efficacy in PA they had.

RQ5 asked how will upward social comparison be related to PA motivation? H2 hypothesized that the more people engage in downward social comparison, the more PA motivation they will have. H3 predicted that the more PA self-efficacy people have, the more PA motivation they will have. To test these hypotheses, a regression analysis was conducted that regressed PA motivation on the two types of social comparison and PA self-efficacy. Three

covariates (age, gender, BMI) were entered in the first block, and upward social comparison, downward social comparison, and PA self-efficacy were entered in the second block.

The results in Table 4.10 indicate that the full model was statistically significant, R^2Adj = .243, $F(3, 479) = 26.969$, $p < .001$. The two types of social comparisons and PA self-efficacy accounted for a significant amount of variance in PA motivation, $\Delta R^2 = .249$, $p < .001$. Regarding RQ5, the analysis founded that upward social comparison did not predict PA motivation when downward social comparison and PA self-efficacy were controlled ($\beta = .055$, $p = .204$). H2 was not supported, because downward social comparison did not predict PA motivation when upward social comparison and PA self-efficacy were controlled ($\beta = -.021$, $p = .620$). However, H3 was supported, because PA self-efficacy positively predicted PA motivation when upward and downward social comparison were controlled ($\beta = .488$, $p < .001$). The more self-efficacy in PA people had, the more PA motivation they had.

Table 4.10 Regression of Predicting PA motivation from Social Comparisons and PA self-efficacy

		B	*SE B*	*β*	*Δ R^2*
1	Age	.005	.005	.041	.004
	Gender	-.041	.105	-.018	
	Body Mass Index	-.010	.009	-.053	
2	Upward Social Comparison	.036	.028	.055	.249***
	Downward Social Comparison	-.014	.029	-.021	
	PA self-efficacy	.568	.047	.488***	
	R^2Adj = .243, $F(3, 479) = 26.969$, $p < .001$				

Note. Betas at entry. Gender (coded; 0=male, 1=female).
** p < .05, **p < .01, ***p < .001*

The path coefficients derived from the series of three linear regression analyses reported above are displayed in Figure 4.1. Upward social comparison had a positive direct effect on PA self-efficacy, whereas downward social comparison had a negative direct effect on PA self-efficacy. PA self-efficacy had a positive direct effect on PA motivation, while the two types of

social comparison had no direct effect on PA motivation. PA motivation had a positive direct effect on PA participation.

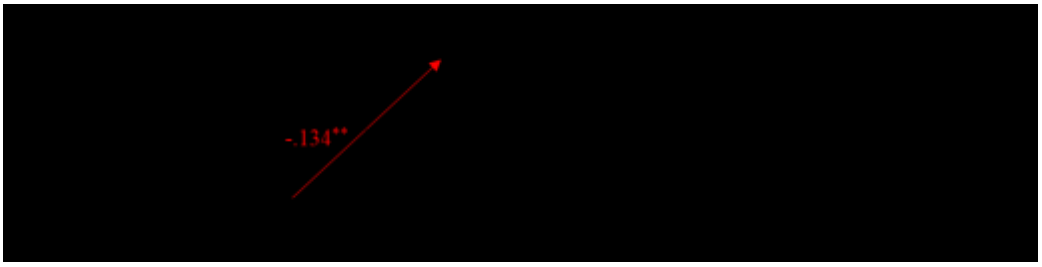

Figure 4.1 Regression path coefficients for those who had seen others' fitness posts

Note. Covariates of age, gender, and BMI were included.
$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

H4 hypothesized that PA self-efficacy will mediate the relationship between downward social comparison and PA motivation. Hayes' (2018) PROCESS v3.3 macro in SPSS, Model 4, was used to assess if PA self-efficacy mediated the relationship between downward social comparison and PA motivation. Covariates of age, gender, and BMI were included in the mediation analysis.

According to Baron and Kenny (1986), mediation only occurs when each regression equation produces a statistically significant effect, such as from independent variable (*X*) to mediator (path *a*), from mediator to dependent variable (*Y*) (path *b*), and from *X* to *Y* (direct effect, path *c'*). However, Baron and Kenny's hierarchical regression method cannot estimate indirect effects. Hayes and Rockwood (2017) argue that "[t]he significance or nonsignificance of *a* and *b* may be diagnostic of the likelihood that *ab* (referring to indirect effect) is significant, but …What matter is *ab*, not *a* and *b* (p. 43)." Therefore, this study tested mediation effects with Hayes's process analysis, which calculates direct effect (*c'*) and indirect effect of *X* on *Y*.

Using bootstrap confidence intervals in PROCESS macro, the indirect effect of downward social comparison on PA motivation through PA self-efficacy was tested along with the direct effect. The pathways were quantified and examined if downward social comparison

(*X*) transmits its effect on PA motivation (*Y*) through PA self-efficacy (*M*).

After accounting for the mediator, *c'* refers to the direct effect of downward social comparison (*X*) on PA motivation (*Y*). Total effect (*c*) – direct effect (*c'*) = indirect effect (*ab*). If *ab* is different from zero, it is the evidence of indirect mediation (Hayes, 2018).

The result revealed only path *b* of the mediation model was statistically significant, indicating that PA self-efficacy was positively related to PA motivation independent of downward social comparison and the covariates ($b = .583$, $SE = .045$, $t(497) = 12.989$, $p < .001$, [LLCI = .4946, ULCI = .6709]). Downward social comparison was not significantly related to PA self-efficacy (a, = -.047, $SE = .027$, $p = .082$, [LLCI = -.0994, ULCI = .0059]), or PA motivation after controlling for PA self-efficacy ($c' = -.005$, $SE = .027$, $p = .850$, [LLCI = -.0580, ULCI = .0478]). Results of the analysis revealed no statistically significant indirect effect of downward social comparison on PA motivation through PA self-efficacy, $ab = -.027$, $SE = .0156$, [LLCI = -.0588, ULCI = .0022]. Therefore, H4 was not supported.

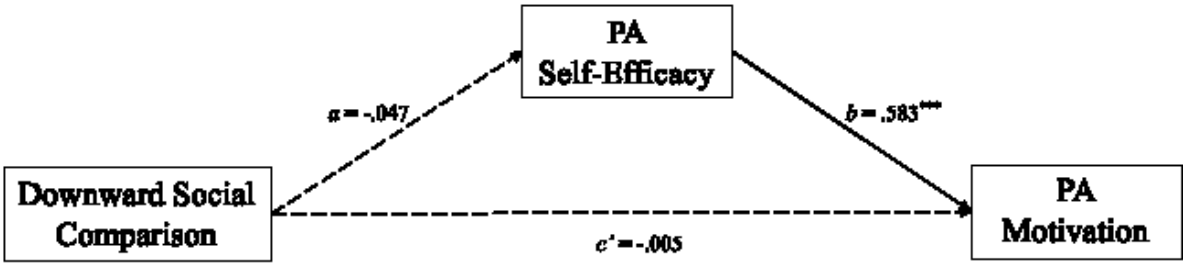

Figure 4.2 Mediating effect of PA self-efficacy on the effect of Downward Social Comparison on PA motivation.
Note. Covariates of age, gender, and BMI were included.
$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

To address RQ6, the indirect effect of upward social comparison on PA motivation through PA self-efficacy was tested with Model 4 in Hayes' PROCESS v3.3 macro. Covariates of age, gender, and BMI were also included in this analysis.

Results of the analysis revealed upward social comparison was significantly related to

PA self-efficacy (a =.083, SE = .026, $t(493) = 3.191$, $p < .01$, [LLCI = .0317, ULCI = .1334]). PA self-efficacy was positively related to PA motivation independent of upward social comparison and the covariates, b = .571, SE = .046, $t(492) = 12.471$, $p < .000$, [LLCI = .4807, ULCI = .6605]. Controlling for the mediator (PA self-efficacy), upward social comparison was not a significant predictor of PA motivation (c' = .032, SE = .027, p = .236, [LLCI = -.0207, ULCI = .0837]). However, there was a statistically significant indirect effect of upward social comparison on PA motivation through PA self-efficacy, ab = .047, SE = .016, [LLCI = .0170, ULCI = .0792]. It was found that PA self-efficacy mediated the relationship between upward social comparison and PA motivation.

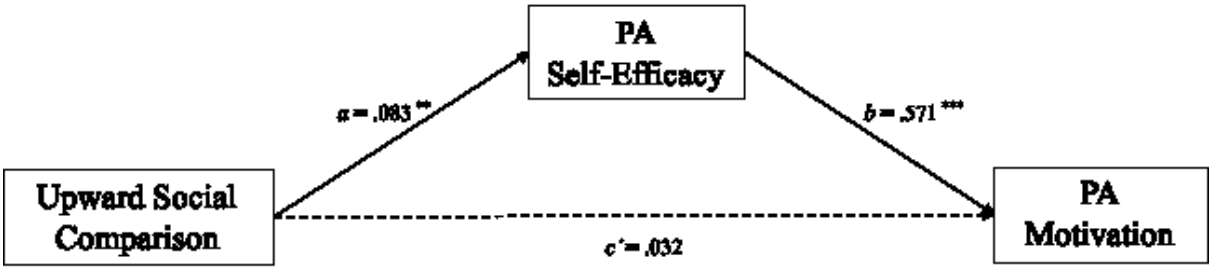

Figure 4.3. Mediating effect of PA self-efficacy on the effect of Upward Social Comparison on PA motivation.
Note. Covariates of age, gender, and BMI were included.
$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

H5 hypothesized that the more PA motivation people have, the more they will participate in PA. To test the hypothesis, a regression analysis was conducted that regressed PA participation on PA motivation. Three covariates (age, gender, and BMI) were entered in the first block, and PA motivation was entered in the second block.

The results in Table 4.11 indicate that the full model was statistically significant, R^2Adj = .028, $F(1, 510) = 4.669$, $p < .01$. PA motivation accounted for a significant amount of variance in PA participation, ΔR^2 =.008, $p < .05$. H5 was supported, because PA motivation positively predicted PA participation (β = .090, $p < .05$). The more PA motivation people had,

Table 4.11 Regression Predicting PA participation from PA motivation

		B	*SE B*	*β*	*Δ R^2*
1	Age	.099	.216	.020	.027**
	Gender	-6.477	4.398	-.065	
	Body Mass Index	-1.318	.381	-.154**	
2	PA motivation	4.058	1.958	.090*	.008*
	R^2Adj = .028, $F(1, 510) = 4.669$, $p < .01$				

Note. Betas at entry. Gender (coded; 0=male, 1=female).
** p < .05, **p < .01, ***p < .001*

the more they participated in PA.

Table 4.12 provides a list of the hypotheses and research questions about those who have seen others' fitness posts, as well as the findings for each.

Table 4.12 List of the Hypotheses and Research Questions regarding Fitness Comparison

	Hypothesis or Research Question	Results
RQ3)	What kinds of fitness postings are users exposed to?	Descriptive findings reported on p.72-73.
RQ4)	How will upward fitness comparison be related to self-efficacy in PA?	Upward social comparison positively predicted PA self-efficacy
RQ5)	How will upward fitness comparison be related to PA motivation?	Upward social comparison did not predict PA motivation
H1)	The more people engage in downward fitness comparison, the more self-efficacy in PA they will have.	Not supported. Downward social comparison negatively predicted PA self-efficacy
H2)	The more people engage in downward fitness comparison, the more PA motivation they will have.	Not supported. Downward social comparison did not predict PA motivation
H3)	The more self-efficacy in PA people have, the more PA motivation they will have.	Supported. PA self-efficacy positively predicted PA motivation
H4)	Self-efficacy in PA will mediate the relationship between downward fitness comparison and PA motivation predicted in H2.	Not supported. PA self-efficacy did not mediate the relationship between downward social comparison and PA motivation
RQ6)	Will self-efficacy in PA mediate the relationship between upward fitness comparison and PA motivation?	PA self-efficacy mediated the relationship between upward social comparison and PA motivation
H5)	The more PA motivation people have, the more they will participate in PA.	Supported. PA motivation positively predicted PA participation

4.5 Results for Respondents Who Had Posted about Fitness on Social Media

4.5.1 RQ7 - Descriptive Results for Posting About Fitness on Social Media

RQ7 asked what kinds of fitness postings do users post on social media? Respondents were asked to report kinds of fitness posts they posted on social media. They also reported on the types of social media where they posted about their fitness.

Respondents who had posted about their fitness on social media reported how frequently they had posted three types of information about their fitness, using a scale from 1 to 7. The frequency results in the right column of Table 4.13 indicate the number of people who had

posted each type of fitness information at least once. Most fitness posters (n = 256, 90.4%) reported that they had posted about their "fitness information on social media" (*M* = 3.49, *SD* = 1.67). Nearly as many fitness posters (n = 246, 86.9%) had posted about their "fitness scenes on social media" (*M* = 3.68, *SD* = 1.82), whereas 225 fitness posters (79.5%) had posted about their "numerical fitness records on social media" (*M* = 3.31, *SD* = 1.85).

Table 4.13 Means, Standard Deviations, and Cronbach's Alphas of Own Fitness Postings

	M	*SD*	*Frequency* who had posted each type of information
Own Fitness Postings (α = .78)	3.49	1.48	-
1) Post your fitness information on social media?	3.49	1.67	256
2) Post your numerical fitness records on social media?	3.31	1.85	225
3) Post your fitness scenes on social media?	3.68	1.82	246

Note. The last column displays the number of respondents who had posted each type of fitness information on social media (i.e., chose 2 or higher on a scale that ranged from 1, never, to 7, very often). Two hundred eighty-three respondents answered that they had fitness posting experience.

Respondents checked the kinds of social media where they posted about their fitness; they could choose as many as applied. Just under half of the respondents in the whole sample (42.6%, n = 283) reported that they had posted about their fitness on social media. Table 4.7 in section 4.4.1 reported the types of social media where respondents posted about their fitness. Among the respondents who had fitness posting experience, three-quarters of respondents posted about their fitness on Facebook (75.3%, n = 213). Nearly two-thirds of these respondents used Instagram (63.3%, n = 179) to post their fitness. About one in six of these respondents used Twitter (17.0%, n = 48) and Snapchat (14.5%, n = 41) for fitness posts. These four most-used social media sites are optimized to post sentences, images, and videos. Other social media platforms were rarely used for fitness postings.

4.5.2 RQ8 – Descriptive Results for Feedback from Others on Fitness Postings

RQ8 asked: What kinds of feedback do fitness posters receive? Respondents were asked to rate three items about the feedback they receive on their fitness postings. These results are reported in Table 4.14.

Table 4.14 Means and Standard Deviations for Feedback from Others on Fitness Postings

	M	*SD*
1) How much **feedback** do you typically receive overall?	4.35	1.42
2) How much **positive**/**supportive** feedback do you tend to receive?	5.14	1.42
3) How much **negative**/**critical** feedback do you tend to receive?	2.08	1.58

Based on a 1 to 7 scale, respondents who had fitness posting experience (n = 283) reported how much overall, positive, and negative feedback they typically received. As the descriptive results in Table 4.14 show, on average, respondents reported receiving a moderate amount of feedback from others, with a mean score that is just above the scale mid-point of 4 (M = 4.35, SD = 1.42). Of those who received feedback, nearly all (n = 278, 98.6%) reported that they received at least some "positive/supportive feedback" from others, whereas less than half (n = 132, 46.6%) reported that they received at least some "negative/critical feedback" from others. A paired-sample t-test demonstrated a significant difference in the scores for amount of "positive/supportive feedback" (M = 5.14, SD = 1.42) and amount of "negative/critical" (M = 2.08, SD = 1.58), $t(280) = 25.10$, $p < .001$. This result indicates that fitness posters tended to receive more "positive/supportive feedback" than "negative/critical feedback".

Respondents also indicated who usually provided feedback on their fitness postings. They could select as many of the six options as they wanted. These results are reported in Table 4.15. More than 9 out of 10 fitness posters (n = 255, 90.1%) reported that they usually received responses from close friends. Over half of fitness posters received responses from family (n = 178, 62.9%) and from casual friends (n = 163, 57.6%). About one-third of fitness posters (n = 99,

Table 4.15 Who usually responds to fitness postings

	N	%
Close friends	255	90.1
Family	178	62.9
Casual friends	163	57.6
People who have common interests in physical activity	99	35.0
Acquaintances	82	29.0
Strangers	48	17.0
No one ever responds	5	1.8

Note. The percentages were calculated based on a total 283 respondents who had posted about fitness on social media. Respondents checked as many types of people as applied.

35.0%) received responses from people who have common interests in physical activity. Responses were received least often from acquaintances (n = 82, 29.0%) and from strangers (n = 48, 17.0%). Only 5 respondents (1.8%) reported that they did not receive responses from anyone.

4.5.3. Overview of Variables in Analyses of Self-Presentation and Supportive Feedback

Zero-order correlation analysis was computed for positive self-presentation, negative self-presentation, supportive feedback (combined social support), esteem support, emotional support, informational support, PA self-efficacy, PA motivation, and PA participation. Age, gender, BMI, and feedback amount were also included in the table of zero-order correlations because they were used as covariates. Overall feedback amount was added as a covariate for the analyses involving each of the three types of supportive feedback.

Results displayed in Table 4.16 show that positive self-presentation had a moderate positive correlation with PA self-efficacy ($r[278] = .49$, $p < .001$) and a weak positive correlation with PA motivation ($r[268] = .31$, $p < .001$), whereas negative self-presentation had a weak negative correlation with PA self-efficacy ($r[278] = -.21$, $p < .001$) and PA motivation ($r[268] = -.26$, $p < .001$). PA self-efficacy had a moderate positive correlation with PA motivation ($r[269] = .47$, $p < .001$), whereas there was not a statistically significant correlation

between PA motivation and PA participation (r[265] = .03, p = .690).

Even though the correlations were weak, supportive feedback was positively correlated with both positive self-presentation (r[265] = .21, p < .01) and negative self-presentation (r[265] = .18, p < .01). Looking at specific types of positive feedback, positive self-presentation had a weak positive correlation with esteem support (r[276] = .32, p < .001) and a very weak positive correlation with emotional support (r[273] = .18, p < .01), but was not correlated with informational support (r[275] = .11, p = .080). In contrast, negative self-presentation had a weak positive correlation with informational support (r[275] = .23, p < .001) and a very weak positive correlation with emotional support (r[273] = .18, p < .01), but was not correlated with esteem support (r[276] = -.021, p = .726).

Supportive feedback (overall) had a very strong positive correlation with emotional support (r[268] = .92, p < .001), informational support (r[268] = .88, p < .001), and esteem support (r[268] = .84, p < .001). This is not surprising, since supportive feedback is the average of the three supportive feedback subscales (esteem, emotional, informational). All three types of supportive feedback measures were positively correlated with each other. Esteem support had a strong correlation with emotional support (r[273] = .74, p < .001) and a moderate correlation with informational support (r[274] = .54, p < .001). Emotional support had a strong correlation with informational support (r[271] = .70, p < .001). Furthermore, supportive feedback had a very weak positive correlation with PA self-efficacy (r[266] = .23, p < .001) and PA motivation (r[257] = .12, p < .05).

Feedback amount (overall) had a weak positive correlation with positive self-presentation (r[280] = .16, p < .01) and negative self-presentation (r[280] = .19, p < .01). Moreover, it had a moderate positive correlation with supportive feedback *(r[268] = .58, p*

< .001), esteem support (r[279] = .50, p < .001), emotional support (r[276] = .51, p < .001), and informational support (r[278] = .52, p < .001). Feedback amount also had a weak positive correlation with PA motivation (r[271] = .15, p < .05), and PA participation (r[277] = .15, p < .05).

Esteem support had a weak positive correlation with PA self-efficacy (r[277] = .33, p < .001) and PA motivation (r[267] = .22, p < .001), while emotional support had a moderate positive correlation with PA self-efficacy (r[274] = .21, p < .001). Among the three types of supportive feedback, only informational support had a positive correlation with PA participation (r[273] = .15, p < .05) although it was weak.

Gender had a weak negative correlation with supportive feedback (r[263] = -.13, p < .05) and informational support (r[273] = -.23, p < .001). These correlations indicate that *males* had more supportive feedback and informational support than females. BMI had a weak positive correlation with supportive feedback (r[258] = .14, p < .05), esteem support (r[268] = .16, p < .01), emotional support (r[265] = .12, p < .05), and age (r[272] = .13, p < .05). However, it had a weak negative correlation with PA participation (r[268] = -.17, p < .01).

Table 4.16 Means, Standard Deviations, and Zero-Order Correlations between Variables for Those Who Have Posted about Fitness

	PSP	NSP	SF	Est	Emo	Info	PASE	PAM	PAP	Age	Gen	BMI	FA
PSP	1												
NSP	**-.25*****	1											
SF	**.21****	**.18****	1										
Est	**.32*****	-.02	**.84*****	1									
Emo	**.18****	**.18****	**.92*****	**.74*****	1								
Info	.11	**.23*****	**.88*****	**.54*****	**.70*****	1							
PASE	**.49*****	**-.21*****	**.23*****	**.33*****	**.21*****	.10	1						
PAM	**.31*****	**-.26*****	**.12***	**.22*****	.12	.06	**.47*****	1					
PAP	-.01	.11	.11	.06	.08	**.15***	-.05	.03	1				
Age	-.09	.06	-.00	.01	.02	-.08	.08	-.00	-.01	1			
Gen	-.07	.03	**-.13***	-.01	-.06	**-.23*****	-.10	-.11	-.08	.05	1		
BMI	-.03	-.01	**.14***	**.16****	**.12***	.09	.07	-.04	**-.17****	**.13***	-.02	1	
FA	**.16****	**.19****	**.58*****	**.50*****	**.51*****	**.52*****	.11	**.15***	**.15***	-.02	-.06	.04	1
Mean	5.60	2.65	4.59	5.14	4.60	4.10	5.95	5.78	84.63	35.45	.63	25.15	4.35
SD	1.08	1.59	1.30	1.30	1.40	1.72	.96	1.09	56.26	9.80	.48	6.20	1.42

Note. PSP = Positive Self-Presentation, NSP = Negative Self-Presentation, SF = Supportive Feedback, Est = Esteem Support, Emo = Emotional Support, Inf = Informational Support, PASE = Physical Activity Self-Efficacy, PAM = Physical Activity Motivation, PAP = Physical Activity Participation, Gen = Gender (coded; 0=male, 1=female), BMI = Body Mass Index, FA = Feedback Amount (overall).

The range for number of respondents was from 258 to 278.

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

***. Correlation is significant at the .001 level (2-tailed).

4.5.4. Main Analyses for Fitness Posters' Self-presentation and Supportive Feedback

A series of four hierarchical linear regression analyses were conducted to estimate the path coefficients of the paths specified in Figure 2.2. Specifically, the analyses predicted (1) supportive feedback from both type of self-presentation, (2) PA self-efficacy from supportive feedback, (3) PA motivation from PA self-efficacy and supportive feedback, and (4) PA participation from PA motivation. Age, gender, and BMI were included as covariates in all four analyses.

RQ9 asked how will positive fitness presentations be related to supportive feedback? H6 predicted that the more people present their fitness negatively, the more they will get supportive feedback. To test these hypotheses, a regression analysis was conducted that regressed supportive feedback on the two types of self-presentation. Three covariates (age, gender, and BMI) were entered in the first block, and positive and negative social comparison were entered in the second block.

As illustrated in Table 4.17, results indicated that full model was statistically significant, R^2Adj = .110, $F(2, 242) = 7.079$, $p < .001$. The two types of self-presentation accounted for a significant amount of variance in supportive feedback, $\Delta R^2 = .089$, $p < .001$. Regarding RQ9, the analysis revealed that positive self-presentation positively predicted supportive feedback ($\beta = .251$, $p < .001$). The more people presented their fitness positively, the more they received supportive feedback from others. H6 was supported; negative self-presentation positively predicted supportive feedback ($\beta = .241$, $p < .001$). The more people presented their fitness negatively, the more they received supportive feedback from others. In other words, both types of self-presentation were associated with more supportive feedback. A later section explores differences in the types of supportive feedback they received from others based on their way of self-presentation.

Table 4.17 Regression Predicting Supportive Feedback from Self-presentation

		B	*SE B*	*β*	*Δ R²*
1	Age	-.001	.008	-.005	.039*
	Gender	-.325	.165	-.124	
	Body Mass Index	.031	.013	.152*	
2	Positive Self-presentation	.290	.072	.251***	.089***
	Negative Self-presentation	.200	.052	.241***	
	R^2Adj = .110, $F(2, 242) = 7.079$, $p < .001$				

Note. Betas at entry. Gender (coded; 0 = male, 1 = female).
*$p < .05$, **$p < .01$, ***$p < .001$

H7 predicted that the more people get supportive feedback, the more self-efficacy for PA they will have. To test the hypothesis, a regression analysis was conducted that regressed PA self-efficacy on supportive feedback. Three covariates (age, gender, and BMI) were entered in the first block, and supportive feedback was entered in the second block.

As illustrated in Table 4.18, results indicated that full model was statistically significant, R^2Adj = .033, $F(1, 246) = 3.133$, $p < .05$. Supportive feedback accounted for a significant amount of variance in PA self-efficacy, $\Delta R^2 = .035$, $p < .01$. H7 was statistically supported, because supportive feedback positively predicted PA self-efficacy ($\beta = .190$, $p < .01$). The more people received supportive feedback from others, the more self-efficacy for PA they had.

Table 4.18 Regression Predicting PA Self-efficacy from Supportive Feedback

		B	*SE B*	*β*	*Δ R²*
1	Age	.005	.006	.057	.014
	Gender	-.158	.122	-.082	
	Body Mass Index	.009	.009	.058	
2	Supportive Feedback	.139	.046	.190**	.035**
	R^2Adj = .033, $F(1, 246) = 3.133$, $p < .05$				

Note. Betas at entry. Gender (coded; 0 = male, 1 = female).
*$p < .05$, **$p < .01$, ***$p < .001$

RQ10 asked whether supportive feedback would be related to PA motivation, and H8 predicted that PA self-efficacy would be related to greater PA motivation. To address the

research question and hypothesis, a regression analysis was conducted that regressed supportive feedback and PA self-efficacy on PA motivation. Three covariates (age, gender, and BMI) were entered in the first block, and supportive feedback and PA self-efficacy were entered in the second block.

As illustrated in Table 4.19, results indicated that full model was statistically significant, R^2Adj = .172, $F(2, 234) = 10.928$, $p < .001$. Supportive feedback and PA self-efficacy accounted for a significant amount of variance in PA motivation, ΔR^2 = .179, $p < .001$. Regarding RQ10, supportive feedback did not predict PA motivation (β = -.035, p = .566). However, H8 was statistically supported because PA self-efficacy positively predicted PA motivation (β = .431, $p < .001$).

Table 4.19 Regression Predicting PA motivation from Supportive Feedback and Self-efficacy

		B	*SE B*	*β*	*Δ R²*
1	Age	.002	.007	.015	.010
	Gender	-.216	.144	-.097	
	Body Mass Index	-.005	.012	-.028	
2	Supportive Feedback	-.030	.052	-.035	.179***
	PA Self-efficacy	.489	.068	.431***	
	R^2Adj = .172, $F(2, 234) = 10.928$, $p < .001$				

Note. Betas at entry. Gender (coded; 0 = male, 1 = female).
** p < .05, **p < .01, ***p < .001*

H9 predicted that the more PA motivation people have, the more they will participate in PA. To test the hypothesis, a regression analysis was conducted that regressed PA participation on PA motivation. Three covariates (age, gender, and BMI) were entered in the first block, and PA motivation was entered in the second block.

As illustrated in Table 4.20, results indicated that full model was statistically significant, R^2Adj = .035, $F(1, 246) = 3.281$, $p < .05$. PA motivation did not account for a significant amount of variance in PA participation, ΔR^2 = .000, p = .931. H9 was not statistically

Table 4.20 Regression Predicting PA participation from PA motivation

		B	*SE B*	*β*	*Δ R^2*
1	Age	.123	.289	.027	.051**
	Gender	-14.854	5.976	-.154*	
	Body Mass Index	-1.322	.504	-.164**	.000
2	PA motivation	-.241	2.780	-.005	
	R^2Adj = .035, $F(1, 246) = 3.281$, $p < .05$				

Note. Betas at entry. Gender (coded; 0 = male, 1 = female).
** p < .05, **p < .01, ***p < .001*

supported that PA motivation predicts PA participation ($\beta = -.005$, $p = .931$).

The path coefficients derived from a series of four linear regression analyses are displayed in Figure 4.4. Both positive and negative fitness postings had a positive direct effect on supportive feedback. Supportive feedback had a positive direct effect on PA self-efficacy but had no direct effect on PA motivation. PA self-efficacy had a positive direct effect on PA motivation, while PA motivation had no direct effect on PA participation.

Figure 4.4 Regression path coefficients for those who had posted about their fitness

4.5.5. Analyses for Fitness Posters' Self-Presentation and Types of Supportive Feedback

This study also examined three distinct types of supportive feedback that fitness posters may receive from other social media users, depending on the two kinds of self-presentation. H10 predicted that the more people positively present their fitness, the more they will get esteem support. H11 predicted that the more people negatively present their fitness, the more they will get a) esteem, b) emotional, and c) informational support.

To test H10 and H11, three separate hierarchical regression analyses were conducted to

predict each type of supportive feedback (esteem, emotional, and informational) from positive and negative self-presentation. Four covariates (age, gender, BMI, and amount of feedback from others) were entered in the first block of each analysis, and the two types of self-presentation were entered in the second block. Although no predictions were made about receipt of emotional and informational support in response to positive self-presentation, both types of self-presentation were included in the regression analyses predicting each type of supportive feedback.

Table 4.21 reports the regression analysis predicting receipt of esteem support. As the table shows, results indicated that full model was statistically significant, R^2Adj = .302, $F(2, 251) = 19.561$, $p < .001$. Positive and negative self-presentation accounted for a significant amount of variance in esteem support, $\Delta R^2 = .065$, $p < .001$. H10 was supported, because positive self-presentation positively predicted esteem support ($\beta = .237$, $p < .001$). The more people positively presented their fitness, the more they received esteem support from others. However, H11a was not supported, because negative self-presentation did not predict esteem support ($\beta = -.053$, $p = .348$).

Table 4.21 Regression Predicting Esteem support from Self-presentation

		B	*SE B*	*β*	*Δ R²*
1	Age	.000	.007	-.001	.254***
	Gender	.077	.144	.029	
	Body Mass Index	.030	.011	.147**	
	Feedback Amount	.428	.049	.476***	
2	Positive Self-presentation	.279	.065	.237***	.065***
	Negative Self-presentation	-.044	.047	-.053	
	R^2Adj = .302, $F(2, 251) = 19.561$, $p < .001$				

Note. Betas at entry. Gender (coded; 0 = male, 1 = female).
** p < .05, **p < .01, ***p < .001*

Table 4.22 reports the regression analysis predicting receipt of emotional support. As illustrated in the table, results indicate that the two types of self-presentation accounted for a

significant amount of variance in emotional support, R^2Adj = .250, $F(2, 248) = 15.115$, $p < .001$. H11b was supported, because negative self-presentation positively predicted emotional support ($\beta = .138$, $p < .05$). The more people negatively presented their fitness, the more they received emotional support from others. It was also demonstrated that positive self-presentation predicts emotional support ($\beta = .141$, $p < .05$). The more people positively presented their fitness, the more they received emotional support.

Table 4.22 Regression Predicting Emotional support from Self-presentations

		B	*SE B*	*β*	*Δ R^2*
1	Age	.005	.008	.035	.241***
	Gender	-.079	.159	-.027	
	Body Mass Index	.024	.012	.108	
	Feedback Amount	.461	.054	.471***	
2	Positive Self-presentation	.179	.073	.141*	.026*
	Negative Self-presentation	.126	.053	.138*	
	R^2Adj = .250, $F(2, 248) = 15.115$, $p < .001$				

Note. Betas at entry. Gender (coded; 0 = male, 1 = female).
** p < .05, **p < .01, ***p < .001*

Table 4.23 reports the regression analysis predicting receipt of informational support. As illustrated in the table, results indicated that positive and negative self-presentation accounted for a significant amount of variance in informational support, R^2Adj = .310, $F(2, 251) = 20.200$, $p < .001$. H11c was supported, because negative self-presentation positively predicted informational support ($\beta = .156$, $p < .01$). The more people negatively presented their fitness, the more they received informational support from others. However, positive self-presentation did not predict informational support ($\beta = .064$, $p = .247$).

Table 4.23 Regression Predicting Informational support from Self-presentations

		B	*SE B*	*β*	*Δ R^2*
1	Age	-.012	.009	-.072	.304***
	Gender	-.709	.186	-.201***	
	Body Mass Index	.018	.015	.067	
	Feedback Amount	.589	.064	.487***	
2	Positive Self-presentation	.101	.087	.064	.020*
	Negative Self-presentation	.174	.062	.156**	
	R^2Adj = .310, $F(2, 251) = 20.200$, $p < .001$				

Note. Betas at entry. Gender (coded; 0 = male, 1 = female).
** p < .05, **p < .01, ***p < .001*

The findings obtained in the regression analyses predicting each type of supportive feedback from the two types of self-presentation are summarized in Figure 4.5. This figure does not represent a path model, but is presented to illustrate the findings. Positive self-presentation stimulated esteem support and emotional support, whereas negative self-presentation stimulated emotional support and information support from other social media users.

Figure 4.5 Regression coefficients for the two types of self-presentation predicting the three types of supportive feedback.

The results of a repeated-measure ANOVA demonstrated a significant difference between the three types of supportive feedback from others, $F(2, 266) = 92.017$, $p < .001$: esteem support ($M = 5.12$, $SD = .08$), emotional support ($M = 4.59$, $SD = .09$), and informational support ($M = 4.07$, $SD = .11$). Post hoc tests using the Bonferroni correction revealed that esteem support

was significantly greater than both emotional support ($p < .001$) and informational support ($p < .001$). Emotional support was significantly greater than informational support ($p < .001$).

Table 4.24 provides a list of the hypotheses and research questions about those who have posted about fitness on social media, as well as the findings for each.

Table 4.24 List of the Hypotheses and Research Questions Regarding Fitness Posts

	Hypothesis or Research Questions	Results
RQ7)	What kinds of fitness information do users post on social media?	Descriptive findings reported on p.83-84.
RQ8)	What kinds of feedback do fitness posters receive?	Descriptive findings reported on p.84-85.
RQ9)	How will positive fitness presentation be related to supportive feedback?	Positive self-presentation positively predicted supportive feedback
H6)	The more people present their fitness negatively, the more they will get supportive feedback.	Supported. Negative self-presentation positively predicted supportive feedback
H7)	The more people get supportive feedback, the more self-efficacy for PA they will have.	Supported. Supportive feedback positively predicted PA self-efficacy
RQ10)	Will there be a relationship between social support and PA motivation?	Supportive feedback did not predict PA motivation
H8)	The more self-efficacy for PA people have, the more PA motivation they will have.	Supported. PA self-efficacy positively predicted PA motivation
H9)	The more PA motivation people have, the more they will participate in PA.	Not supported. PA motivation did not predict PA participation
H10)	The more people positively present their fitness, the more they will get esteem support.	Supported. Positive self-presentation positively predicted esteem support
H11)	The more people negatively present their fitness, the more they will get a) esteem, b) emotional and c) informational support.	Partially supported. a) negative self-presentation did not predict esteem support; b) negative self-presentation positively predicted emotional support; c) negative self-presentation positively predicted informational support

5 DISCUSSION

With the widespread diffusion of wireless communication devices and mobile technologies, mHealth apps became an innovative resource for health behavior promotion (Barton, 2012; Terry, 2010). Beyond healthcare providers' interventional tools such as monitoring and surveilling patients' health behaviors, mHealth apps are receiving increased attention for those who are interested in health and physical wellness (McGrath & Scanaill, 2011; Riley et al., 2011). People not only make use of mHealth apps for health information but also for health decisions (Barton, 2012; Terry, 2010). Nielsen reported that nearly one-third of U.S. smartphone users accessed apps in the fitness and health category in 2014 January ("Hacking health," 2014). Over three-hundred and eighteen thousand mHealth apps are available in global app stores and the market value is projected to reach up to 102.35 billion US dollars by 2023 ("The rise of mHealth apps," 2018). With fitness apps, users track and measure their daily physical activities such as the distance and pace of a walk or run, the number of steps, heart rates, and even quality of sleep. That tracked information can be visualized to routes, graphs, or numbers through fitness apps. The visualized fitness outcomes, daily fitness goals, and competition with other users may stimulate people's interests in fitness apps use and therefore enjoy physical activities. Although numerous people use fitness apps, little research has examined the gamification aspects of fitness app. Fitness app users also obtain topics to discuss and contents to post on social media feeds. Comparing with others' fitness postings and receiving feedback from others would affect fitness app users' physical activities. However, a paucity of research has explored fitness app users' social media postings and how interactions through fitness postings affect actual physical activity participation. The current research explored the uses of gamification aspects of fitness apps as well as social comparison and self-

presentation through fitness posts. The major findings of three sections of the study are briefly summarized here and are then discussed in subsequent sections.

The first section of the study examined the descriptive information of fitness app uses. Most people (over 85%) used fitness apps on smartphones rather than smartwatch or fitness tracker. Findings revealed *MyFitnessPal*, *Fitbit*, and *Pre-installed apps* such as *Apple Health* and *Samsung Health* are the most used fitness apps. Some fitness apps such as *Fitbit* apps are exclusively compatible with particular fitness trackers. The full functions of fitness apps such as graphic data and leaders' boards only available on smartphone apps. The majority of people regarded their most-used app as Fitness Tracking Apps rather than Workout Fitness Apps or Social Fitness Apps. Using apps for fitness would be entertaining like mobile games because fitness apps contain gaming mechanisms that draw people's attention to get involved in non-entertainment contexts with fun such as physical activities and healthy behaviors. This study discovered that people mostly used the fitness apps for physical activity-related self-monitoring and self-regulation, for example, tracking or setting goals for steps/distance.

The second section of the study examined fitness app users' experience in seeing others' fitness-related posts on social media. The descriptive results revealed that people had seen the most posts showing fitness scenes, particularly on Facebook and Instagram. Further, this study examined fitness app users' self-efficacy for PA, PA motivation, and PA participation based on social comparison theory. Those who engaged in upward social comparison tended to have more self-efficacy for PA, whereas those who engaged in downward social comparison tended to have less self-efficacy for PA. As predicted, those who had more self-efficacy for PA had higher PA motivation. In addition, individuals' self-efficacy for PA mediated the positive relationship between upward social comparison and PA motivation. However, there was no mediation effect

of self-efficacy for PA for the relationship between downward social comparison and PA motivation. It was also verified that people with higher PA motivation were more likely to participate in PA.

The third section of the study explored fitness posters' ways of self-presentation and types of supportive feedback provided to them. The descriptive results revealed that fitness posters most frequently posted about their fitness scenes, primarily on Facebook and Instagram. They received a moderate amount of feedback mostly from close friends, family, and casual friends, and they received much more positive/supportive feedback than negative/critical feedback. This section also examined the impact of supportive feedback on self-efficacy for PA, PA motivation, as well as PA participation. The regression results showed that both positive and negative self-presentation received more supportive feedback from others. As predicted, supportive feedback from others appeared to increase fitness posters' self-efficacy for PA, whereas it was unrelated to PA motivation. It was also demonstrated that the more self-efficacy for PA fitness posters had, the more PA motivation they had. However, fitness posters' PA motivation did not stimulate their PA participation. Further, types of supportive feedback from others were predicted based on ways of self-presentation. The results showed that fitness posters received more esteem support and emotional support from others when they positively presented their fitness. Fitness posters with negative self-presentation received more emotional support and informational support.

5.1 Fitness App Use

The study findings showed that nearly half of the respondents used *MyFitnessPal*. This app is designed to help users to take or keep weight off by tracking physical activities and calorie intakes. The users can not only track daily physical activities but also simply search nutrition

information of foods through barcodes. Nearly half of the respondents used *Fitbit*, the same brand fitness tracker exclusive app. Despite downturns in the fitness tracker industry (Williams, 2017), Fitbit is still predominant in the fitness app market. Meanwhile, one in five respondents used pre-installed apps such as *iHeath*, *Samsung Health*, or *Google Fit*. Since these tracker-free fitness apps were factory installed, some people might not be aware of the apps or might not know how to activate or use them. However, those who were interested in fitness might have tried to use and enable the apps for their fitness. Some respondents used *Lose It! – Calorie Counter* and/or *Calm*. Except the meditation and sleep checking app, *Calm*, the majority of people liked to use fitness apps designed for physical activities and weight management.

Indeed, most of the respondents perceived their most used fitness apps as Fitness Tracking App (80.1%) as followed by Workout Fitness App (23.6%) and Social Fitness App (15.5%). Fitness Tracking Apps provide fitness data to users to maintain or improve fitness and health. Workout Fitness Apps assist workout with instruction and motivate users to exercise. Social Fitness Apps allow users to interact and communicate with friends, family, and co-workers for their fitness and health. As such, the study results revealed that most people used apps that track physical activities or caloric intakes, more than apps that assist workout with instruction or apps that connect with others to compare and share fitness information. Tracking fitness or calorie intake was not only the primary function of fitness apps but also the main purpose of the use. However, only a few respondents reported they were using Competitive Fitness App (5.6%) and Altruistic Fitness Apps (2.4%). Competitive Fitness App users compare their performance or challenge missions with others and receive badges or trophies if they accomplish the tasks or winning the competition. They might want to get a sense of achievement in physical activities by comparing their fitness outcomes with others. Altruistic Fitness App

users earn money or credit for charity by walking, running, or cycling. Some other users even get paid digital currency or cryptocurrency that convert tracked steps into coupons, services, or even merchandise. As such, Altruistic app users might want to donate practical benefits via physical activities.

Only a few respondents used either smartwatch (4.8%) or fitness tracker (2.9%) to run fitness apps. On the contrary, nearly all the respondents used smartphones, such as Android Phone or iPhone, to use fitness apps. Although smartphones are not usually regarded as wearable devices, they also can track users' steps and distances. Wearable devices such as smartwatches and fitness trackers would be more accurate; nevertheless, smartphones perform enough to track users' physical activities because it is in their hands nearly all the time, wherever they go. Moreover, users might need smartphones to elaborate on fitness information with graphs and charts on a high-resolution screen.

This study also explored the most used gamification aspects of fitness apps. The results revealed that more than 85% of fitness app users used fitness apps for self-monitoring and self-regulation, whereas less than 60% used fitness apps for social facilitation and rewards. Similar findings were observed for frequency of use ratings. On average, fitness apps were used more often for self-monitoring and self-regulation (both ratings above 4 on a scale of 1-5) than for social facilitation or rewards (both ratings below 3). As such, fitness app users were more likely to monitor and set goals for physical activity-related behaviors such as steps/distance, calorie-burning, and weight loss. About half of the respondents had participated in competition through leader boards and group challenges and had connected/interacted with other fitness app users or other social media users via the apps. But even though they had participated in such social facilitators, they did not frequently use fitness apps for that. Connection and competition with

others might motivate fitness app users to participate in physical activity (Coughlin et al., 2016), but it simultaneously might be regarded as annoying homework to do every day. People also had used fitness apps to obtain rewards, but this was not done frequently. Although receiving rewards from app use is a reinforcing factor (West et al., 2012), it might not be the primary reason for using fitness apps. Social connection or rewards may be useful mainly when it performs a supplemental role for self-monitoring or self-regulation (Hutchesson et al., 2015).

5.2. Fitness App Users' Social Comparison for Physical Activity

Among the entire study sample, more than four in five respondents had seen others' fitness posts on social media. They saw others' fitness scene posts more than fitness information posts and fitness records posts. From a selfie at the gym to a commemorative photo at a marathon competition, fitness scenes imply comprehensive fitness-related images. Even those who do not use fitness apps also might be able to post their fitness scenes on social media, and fitness app users might be exposed to anyone's fitness posts. In contrast, fitness information and records can only be obtained with fitness apps. Therefore, respondents might have seen others' fitness scene posts more than the other types of posts.

Subsequent analyses focused on participants who had seen others' fitness posts. With the popularity of fitness apps, social media users have many chances to see others' fitness posts on a variety of social media platforms. Respondents saw others' fitness posts mostly on Facebook, Instagram, Twitter, YouTube, Reddit, Snapchat, and Pinterest, in that order. Most of these platforms are visual posting-optimized, and all seven platforms can post visual content. This result is consistent with Highfield and Leaver's (2016) contention that visual content has become vital in social media communication. Among the seven social media platforms, Facebook and Instagram are the two most popular channels, where over three-quarters of the respondents saw

others' fitness posts. When it comes to the number of users, Facebook is still dominant: around four in ten U.S. adults use Instagram while seven in ten use Facebook (Gramlich, 2019). Consistent with this, most of the respondents saw others' fitness posts on Facebook followed by Instagram. Twitter is often regarded as a text-based microblogging service, but images also can be posted, similar to the other visual-based social networking services. Reddit is more focused on news aggregation, web content rating, and discussion, but its contents also include images and visuals. Even though the difference was minor, it is still surprising that more people saw others' fitness posts on Reddit than a photo-sharing multimedia messaging app, Snapchat. This might be because of user-created boards, called "subreddits." A variety of topics and posts are organized by subject, and therefore those who are interested in fitness might be able to see others' fitness posts during the discussion. Pinterest includes visuals such as illustrations, short GIFs and videos, and it is widely used as an image search engine.

5.2.1. Social Comparison for Physical Activities

It has been acknowledged that people obtain capability information of self and gain vicarious experience by observing others (Bandura, 1986; Schunk, 1989; Schunk, 1991). Based on Festinger's social comparison theory (1954), this study examined the influence of social comparison on fitness app users' belief (self-efficacy for PA), attitudes (PA motivation) and behaviors (PA participation) toward physical activities. Social comparison theory posits that people compare with others to evaluate self-abilities, self-attitudes, and self-status (Festinger, 1954; Gilbert et al., 1995). In this sub-study, a path model tested the relationship of upward and downward social comparison to self-efficacy for PA as well as PA motivation respectively. The path from self-efficacy for PA to PA motivation and the path from PA motivation to PA participation were also examined. In addition, a mediation analysis tested if social comparison affected PA motivation through self-efficacy for PA.

Previous studies found that upward social comparison can be either aspirational, leading to self-improvement (Collins, 1996) or frustrative, leading to more negative self-evaluations (Arroyo, 2014; Arroyo & Brunner, 2016; O'Brien et al., 2009). Interestingly, the current study discovered that upward social comparison – comparing self with those who have superior abilities or performances in fitness – was associated with individuals' greater self-efficacy for physical activities. The result for upward social comparison for PA can be interpreted based on Collins' studies. According to her, people compare themselves with superior others to view themselves positively (Collins, 2000). Collins (1996) also argued that people could have more chances to enhance self-assessment when they are engaged in upward social comparison for self-improvement. As a form of wishful identification (Hoffner & Buchanan, 2005), fitness app users might want to be like superior others and may even perceive them as role models. Burke and Rain's (2019) study also discovered a positive relationship between upward social comparison and exercise attitude, even though their study focused on appearance-related social comparison. The current study results imply that upward social comparison is motivational for physical activity participation. Fitness app users might want to get inspiration from superior performers and might have ideal goals to achieve since they are interested in physical activities.

In terms of downward social comparison, previous literature argued that people enhance self-assessment by comparing themselves with inferior others. People tend to engage in downward social comparison to protect and enhance self-assessment through devaluing and derogating others (Bodenhausen & Richeson, 2010; Willis, 1981). Therefore, this study hypothesized that fitness app users who are engaged in downward social comparison would have higher self-efficacy for physical activities. Contrary to the hypothesis, the study revealed that downward social comparison was associated with lower self-efficacy for PA. Comparing self

with those who have inferior fitness abilities damaged people's self-efficacy for PA. Instead of establishing relative superiority and enhancing self-confidence through devaluing and derogating others, observing others' failure or struggles in fitness made people frustrated. People might doubt their physical abilities after engaging in downward social comparison. Together, the findings for upward and downward social comparison and PA self-efficacy suggest that fitness app users engaged in social comparison to get inspiration and to be prompted for physical activities rather than finding excuses for neglecting PA.

The study also examined the role of social comparison and PA self-efficacy in PA motivation. A research question asked if upward fitness comparison encourages or discourages PA motivation, since literature shows that comparing with superior others can lead to either aspiration (Collins, 1996) or frustration (O'Brien et al., 2009) for self-assessment. Downward social comparison was expected to increase fitness app users' PA motivation, because it provides mental gratifications through positive feelings of self (Arroyo, 2014; Huang & Zhou, 2019). However, the study results revealed that neither upward social comparison nor downward social comparison predicted PA motivation in this study. The results were surprising because both types of social comparisons predicted self-efficacy for PA. It may be that people's motivation for PA is affected by social comparison only via the influence on confidence or competence in PA. As predicted, another path demonstrated that self-efficacy for PA positively predicted PA motivation. People with higher self-efficacy in PA tended to have higher PA motivation, while people with lower self-efficacy in PA tended to have lower PA motivation. This corresponded to the contention that individuals' confidence in performance is crucial for physical activity motivation (van Stralen et al., 2009). Bandura and Adams (1977) also argued that self-efficacy is

individuals' judgments of capabilities to execute an action, and it determines their motivation of performance such as choice, effort, and persistence.

Even though direct relations between social comparison and PA motivation were not demonstrated, additional analyses were conducted to see if individuals' self-efficacy for PA mediated the relationships between the two types of social comparison and PA motivation. Self-efficacy for PA did not mediate the relationship between downward social comparison and PA motivation. However, self-efficacy for PA did mediate the relationship between upward social comparison and PA motivation. It implies that those who engaged more in upward social comparison had higher PA motivation through higher self-efficacy in PA. Unsurprisingly, those who had higher PA motivation participated more in PA. This finding corresponded to Dacey et al.'s (2008) argument that those who perceive PA positively tended to participate more in PA.

On one hand, this sub-study implies that engaging in comparison with inferior others damaged people's self-efficacy for PA, but had no influence on PA motivation or PA participation. On the other hand, social comparison with those who had better performances or abilities in PA enhanced fitness app users' self-efficacy for PA, which in turn increased PA motivation, and to greater participation in PA. This latter finding is consistent with the findings of Burke and Rains (2019) that upward social comparison leads to positive exercise attitudes. Frederick and Ryan (1993) also asserted that motives for enjoyment, skill improvement, and fitness enhancement affect physical activity participation. Based on their idea, these results can be interpreted as indicating that fitness app users engage in social comparison to enhance their fitness ability. Comparison with aspirational role models catalyzes people to have self-efficacy in PA along with higher motivation in PA, and therefore they participate more in PA.

5.3. Fitness Posters' Self-Presentation and Others' Supportive Feedback

Among the entire study sample, more than two in five people had posted about fitness on social media. And the vast majority (79% or more) of those who posted about fitness shared each of the three types of fitness postings on social media at least once. Nearly the same number of people posted about fitness information and fitness scenes, whereas the least number of people posted about numerical fitness records on social media. In terms of frequency, however, people posted more frequently about fitness scenes than fitness information and numerical fitness records.

More people posted about fitness information and fitness scenes than numerical fitness records. In contrast, more people saw others' fitness scenes posts than numerical fitness records and fitness information posts. It might seem two results are contradicting. However, the results are congruent when it comes to the frequency of posting. Of the three types of postings, fitness scenes were both most frequently seen and most frequently posted. Some fitness apps facilitate posting of fitness data directly on social media. However, most others are not compatible with social media. One of the reasons people more frequently post their fitness scenes might be because taking photos is a more convenient process than capturing fitness outcomes from apps and then posting them on social media.

Fitness posters mostly used visual posting-optimized social media platforms, such as *Facebook*, *Instagram*, *Twitter*, and *Snapchat*. This is similar to the list of the popular social media platform where people have seen others' fitness posts. It implies that visual presentation through visual posting-optimized social media is a predominant trend in the digital media era (Highfield & Leaver, 2016; Mascheroni et al., 2015).

5.3.1. Supportive Feedback from Social Networks

This study discovered that fitness posters received a moderate amount of feedback from others. In addition, they received much more positive or supportive feedback than negative or critical feedback. This was not surprising because the result shows that feedback givers were primarily their strong ties such as close friends, family, and casual friends. Strong social ties are closer, multiplex, and dense relationships that provide comfort, safety, assistant (Albrecht & Adelman, 1987; Albrecht & Goldsmith, 2003). Social support from strong social ties are influential in initiating physical activities (van Stralen et al., 2009). Granovetter (1983) also argued strong ties are usually provide mental support and encourage people to do suggested behavior.

In addition to supportive feedback from strong ties, about one in three fitness posters have received feedback from those who have common interests in PA. According to Kitabere (2005), people can obtain health-related benefits from supportive social networks. People with common interests maybe not their strong ties. Nevertheless, weak social ties could also be regarded as supportive social networks in terms of providing supportive feedback on fitness postings. Granovetter (1983) said that weak social ties are less developed loose connections but known to provide useful information. Strong ties often encourage, reinforce, and regulate health behavior, whereas weak ties are known for providing novelty in information, goods, and service based on the diversity in social contact (Albrecht & Adelman, 1987; Albrecht & Goldsmith, 2003).

5.3.2. Fitness Self-Presentation and Impact of Supportive Feedback on Physical Activities

The study results demonstrated that others provided supportive feedback on both positive and negative self-presentation, and the supportive feedback boosted fitness posters' self-efficacy

for PA. The fitness posters with higher self-efficacy had higher motivation for PA. Further, the study results revealed that those who positively presented their fitness received more esteem support and emotional support. In contrast, those who negatively presented their fitness received more emotional support and informational support.

Human beings have an intrinsic desire for social approval and social attachment (Leary, Tambor, Terdal, & Downs, 1995). Being accepted or rejected by other people indicates the interpersonal aspect of self and affects one's self-esteem (Baumeister, 2011; Leary & Baumeister, 2000). Since people have a desire to make a good impression when they engage in self-presentation (Baumeister, 2010), both positive and negative fitness posters would want to maintain social acceptance. Even those who presented their fitness negatively might have engaged in self-handicapping to protect self-esteem from potential failure (Berglas & Jones, 1978) or to avoid social disapproval (Howle, Jackson et al., 2015). Indeed, both positive and negative fitness posters received supportive feedback from other social media users. Supportive feedback online not only acts as a stress buffer but also produces positive health outcomes (Cohen & Wills, 1995; Uchino et al., 1996). Supportive feedback from others might have enhanced fitness users' self-esteem, and therefore they were able to have greater self-efficacy for physical activities.

Consistent with analyses of the subsample that had seen others' posts, greater PA self-efficacy among fitness posters was associated with greater PA motivation. However, unlike the findings from that subsample, higher PA motivation was not related to actual PA participation. This might be due in part to the fact that the subgroup of fitness posters was much smaller than the subgroup of people who saw others' fitness posts. Over 85 percent of the study sample had seen others' posts, whereas only about 43 percent of them, less than half, had posted their fitness

on social media. That indicates the subsample of people who saw others' fitness posts included a wider range of participants. It may be that those who posted about their fitness engaged in physical activity for additional reasons that were not captured in the motivation measure.

Furthermore, this study explored the types of supportive feedback from others based on fitness posters' types of self-presentation. The results revealed that fitness posters received more esteem support than emotional and informational support, regardless of their ways of self-presentation. Scopelliti et al. (2015) argued that those who engaged in positive self-presentation might be perceived as braggarts, and therefore others would be reluctant to provide supportive feedback to them. However, the current study illustrated the opposite results. Not only those who negatively presented their fitness but also those who positively displayed their fitness received supportive feedback.

The more positively posters presented their fitness, the more esteem support and emotional support they received from others. Feedback givers might have given compliments on the fitness posters' abilities by instilling posters' confidence, reinforcing the positives of posters' physical activities, or boosting posters' sense of competence at physical activities. They also might have expressed their devotion or concern for fitness posters by showing empathy or providing encouragement. This study did not obtain data to show what types of social ties conveyed what kinds of social support. However, those who showed their affection for positive self-presenters were probably strong ties because the study results revealed that most of the feedback givers were family and friends. Negative self-presentation was associated with receiving more emotional support and informational support from others. For those who negatively displayed their fitness, feedback givers might have provided comfort and support. Suggestions or advice also might have given for those who posted their struggles in fitness. It

seems likely that people with common interests in fitness provided more informational support, given their familiarity with fitness activities. This would be consistent with Granovetter's (1983) contention that weak ties provide more functional and informational knowledge than strong ties. Interestingly, both positive and negative self-presentation received emotional support from others. Feedback givers have provided encouragement, empathy, and comfort to fitness posters. At the same time, some feedback givers might have responded to the posts with emoticons as an alternative to comments. Davis et al. (2015) regarded others' reactions on social media posts about family member's surgery as emotional support. In this regard, both positive and negative fitness posters might have accepted others' emoticons as emotionally supportive feedback. Emotional support allows fitness posters to feel they are being loved and being cared for by others. According to Oh, et al. (2013), emotional support strongly cultivated health posters' self-efficacy.

In sum, this sub-study model implies that both positive and negative self-presenters received supportive feedback from others through their fitness posts. Both ways of self-presentation received emotional support from others. Social media users provided more esteem support for those who like to display positive aspects of their fitness, whereas they offered more informational support for those who struggle with fitness. This corresponds to the literature that social media users like to receive social support (Park, Kee, & Valenzuela, 2009) and those who pursue health-related social support receive all types of supportive feedback from others (Oeldorf-Hirsch, High et al., 2018; Oh et al., 2013). The model also implies that online social support improves fitness posters' self-efficacy for PA, and therefore they can develop PA motivation. These results correspond to Burke and Rains's (2019) study, which found that social

support from other social media users who had similar interests in health increased self-efficacy for health.

5.4. Theoretical Implications

The first part of the study represented the current state of fitness app uses and explored the uses of gamification aspects of the apps. Several other domains have been focused on the use of gaming mechanisms that increase people's motivation in non-entertainment contexts. Despite the benefits of gamification, the health and wellness domain has been neglected to review the capability of gamification compared to the education domain (Seaborn & Fels, 2015). Indeed, there is a paucity of research on the gamification elements in fitness apps and fitness-related behaviors. It has been acknowledged that gaming mechanisms in fitness apps would encourage people to get involved in fitness and health-related activities by arousing users' sense of enjoyment. The results revealed that more than half of the entire sample had used gamification in fitness apps at least once. According to McGrath and Scanaill (2014), mHealth app technologies improve and support people to maintain health and well-being. The current study results imply that the gamification elements in fitness apps were used for their health and fitness. People used fitness apps more frequently for self-monitoring and self-regulation than for social facilitation and rewards. To be specific, people tended to track their steps/distance and to set step/distance goals more frequently than to participate in challenges with groups and to try to obtain badges/rewards.

On the one hand, the results showed that monitoring and regulating physical activity are primary gamification elements that people use the most. People used fitness apps predominantly for physical activities. Self-monitoring by checking performances and self-regulation by setting goals to achieve would elevate users to participate more in physical activities. On the other hand,

some people also used fitness apps to interact with others and to receive compensation based on their performance. Social facilitation and rewards stimulate users to keep engaging in physical activities by competing with others and earning benefits. If fitness app users used more gamification elements in the apps, they may participate more in physical activities. Further, Hutchesson et al. (2015) contended that the intervention of healthcare providers reinforces fitness app users' self-monitoring. Similarly, connection and interaction with others might encourage fitness app users to pay more attention to monitoring and regulating fitness goals. As a result, they may participate more in physical activities.

The second part of the study used social comparison theory to explore those who compare their fitness through others' fitness posts. This sub-study demonstrated that upward social comparison was positively associated with PA self-efficacy, and therefore people had higher PA motivation and participated in more PA. Regarding downward social comparison, the study found it was negatively associated with PA self-efficacy, whereas there was no association with PA motivation.

Human beings compare self-abilities, attitudes, and status to others to evaluate themselves (Festinger, 1954; Gilbert et al., 1995; Reis, 2010). However, people decide social comparison targets depending on their motivations (Festinger, 1954). The study findings of upward social comparison for PA self-efficacy were in line with the literature: Collins (1996) argued that people engaged in upward social comparison for self-improvement, and indeed they could enhance self-assessment. The result was also consistent with Burke and Rains' (2019) social comparison and exercise attitudes study: A comparison with those who have better performance or ability in PA stimulated and promoted people to cultivate self-confidence in PA. Past literature has argued that downward social comparison usually makes people feel better

about their abilities and enhances self-assessment (Huang & Zhou, 2019; O'Brien et al., 2009). However, the study results were opposite to the positive consequences of downward social comparison (e.g., O'Brien et al., 2009). The result revealed that engaging in downward social comparison appeared to devalue one's self-efficacy in PA and was not related to PA motivation. From the perspective of social comparison theory, the study findings imply that PA performance of social comparison targets affects fitness app users' confidence in PA. Upward social comparison offers inspiration for physical activity, whereas downward social comparison leads to frustration for fitness app users.

The study demonstration of the positive relationship between self-efficacy in PA and PA motivation corresponded to van Stralen et al.'s (2019) study. The more confidence in PA people had, the more they had a positive attitude towards PA. Moreover, the mediation model demonstrated that upward social comparison with higher self-efficacy in PA escalated PA motivation. People probably used fitness apps to have better performance in PA. Comparing self-fitness ability with superior others prompted peoples' competence in PA, and therefore they appeared to have pro-exercise attitudes and participated more in physical activities. It implies that engaging in upward social comparison is strategic to improve PA self-efficacy and motivation. Although the theory indicates that upward social comparison could also negatively affect individuals' self-efficacy, the study findings suggest that it motivates self-improvement for fitness app users.

The third part of the study used self-presentation theory and work on social support to examine the outcomes of posting fitness information on social media. This sub-study demonstrated that other social media users provided social support regardless of ways of self-presentation. Both positive and negative self-presentation received supportive feedback, which

appeared to enhance fitness posters' PA self-efficacy and PA motivation. According to Baumeister and Hutton (1987), human beings attempt to convey some information or image of self to others. Self-presentation is a goal-directed behavior that is intended to make a good impression of self as well as to avoid potential failure in social networking (Arkin, 1981; Baumeister, 2010; Baumeister & Hutton, 1987). Social support from networks is a significant motivation of social media use (Davis et al., 2015; Park et al., 2009) and social media users tend to display self selectively on purpose (Sundar & Limperos, 2013). Based on that, fitness app users' social media posts can be understood as social support seeking behavior. Negative self-presentation on social media may be a form of self-handicapping to receive social support. Indeed, the current study demonstrated the positive impacts of supportive feedback on fitness posters' physical activities. The results corresponded to the Oeldorf-Hirsch et al.'s (2018) study, which found that people developed pro-health perceptions through others' supportive feedback on social media. It demonstrated that social support via social media encouraged people to have confidence in PA. This study also confirmed the principal tenets of self-presentation theory that people want to produce a good impression of self for social acceptance. The results showed that both positive and negative ways of fitness posts get social support from others. It suggests that fitness posters may have sought to improve and protect self-efficacy for PA through fitness posts even when they negatively presented their fitness. In other words, fitness posting appears to be a self-presentation behavior to get social support.

Yet, this study demonstrated that social networks provided distinct types of supportive feedback depending on the ways of self-presentation. Positive fitness presentations received more esteem and emotional support, while negative fitness presentations received more emotional and informational support. This implies that social networks provide distinctive social

support depending on self-presenters' perceived needs, such as esteem support or informational support. Other social media users provided emotional support to fitness posters for both ways of self-presentation. The study results indicate that social media is a source for fitness posters to obtain social support.

The two sub-study results corresponded to Williams and French's (2011) meta-analysis that fitness comparisons and others' feedback on fitness achievements improve the self-efficacy for physical activities. The current study also supports the idea that social media is a source to present positive aspects of self (Bareket-Bojmel et al., 2016; Rosenberg & Egbert, 2011) and to obtain social support (Bull & Ezeanochie, 2016). And it functions as an outlet to fulfill people's need to belong (Nadkarni & Hofmann, 2012). Social media is an open place where people share experiences or interests with others as well as maintain or create social networks (Ellison et al., 2007; Ellison et al., 2010; Steinfield et al., 2008). For fitness app users, social media is where they can compare and present their fitness abilities as well as receive social support. The study demonstrated that social media plays a pivotal role where advocate fitness app users' physical activities and provide a place to interact in this digital communication era.

5.5. Practical Implications

As mHealth uses continue to grow, its market size is expected to reach nearly 100 billion dollars by 2021 (Mikulic, 2018). Also, the role of mHealth apps to help in fitness care and prevention receives attention more than ever, as diabetes and other chronic illnesses become significant threats worldwide (Mikulic, 2019). mHealth intervention, such as healthcare providers' supervision through mobile technologies, is efficient and effective for health improvement (Yi, Kim, Cho, & Kim, 2018). The current study suggests practical insights in

designing fitness apps that promote people to enjoy physical activities and in use of social media to encourage people to participate in physical activities.

The results showed that fitness app users participated more to track and set goals for physical activity than general health-related monitoring and regulation. In particular, self-monitoring and self-regulation are primary gamification aspects of fitness app use. This implies that fitness app developers should design apps for physical activities and focus on developing more features in monitoring and regulation. Still, physical activity participation was fueled to some extent by the other gamification elements such as social facilitators and rewards. In addition to the self-checkup through monitoring and regulation, comparing with others would reinforce vigilant participation in physical activity. For example, physical activity participation might be encouraged when people compare self-monitored fitness data on competition leader boards and receive rewards on goal accomplishments. As such, fitness app users who monitor and regulate to improve physical activity would benefit from becoming involved in leaders' boards and trying to obtain rewards. The combined use of these gamification elements may stimulate them to participate more in physical activities. Hutchesson et al. (2015) demonstrated that combining fitness self-monitoring with others' counseling helped prevent and treat overweight and obesity. Yi et al.'s (2018) meta-analysis also demonstrated the effectiveness of healthcare providers' support and care through mobile technologies for chronic diseases. Social facilitation and rewards might urge physical activity participation in the same manner as health interventions assist patients. Thus, fitness practitioners should consider operating fitness apps to check and encourage people's physical activity participation.

The study also demonstrated the benefits of fitness posts for physical activities. First, the study showed that comparing self-fitness abilities or accomplishments with better performers

promoted fitness app users to have self-efficacy about their physical activities. And therefore, they perceived physical activities more positively and participated more in physical activities. The results imply that fitness app users who are interested in physical activity should compare with superior others' fitness posts because it is aspirational. Fitness practitioners should teach people to compare their fitness abilities with better performers or their role models. Fitness app developers should design apps for users to have more comparison opportunities with superior others. The aspirations from upward social comparison would promote fitness app users to participate more in physical activities.

Second, the study showed posting fitness-related materials on social media provided people an opportunity to receive supportive feedback from social networks. The supportive feedback inspired fitness posters to have confidence, and therefore they had positive attitudes in physical activities. Networks in social media provided more esteem and emotional support for those who positively described their fitness. At the same time, they gave more informational and emotional support for those who negatively presented their fitness. These findings imply that for fitness app users, social media is an excellent channel to receive social support. Others can give feedback at any time that fitness posters want to share their accomplishments and their frustrations in physical activities. Fitness app users who need social support should consider posting about their physical activities on social media. Fitness practitioners should advise people to publish their fitness achievements or struggles on social media, as this is a practical way to interact with others and potentially receive social support. Fitness app developers should consider making an open forum for users to get social support or designing an accessible interface for them to upload fitness information directly on social media.

Overall, the current study suggests that the use of gamification aspects of fitness apps and fitness postings may be encouraging physical activity participation. Maher et al. (2016) argued that gamification with social support might increase positive health effects. They contended that gamification use advances individuals' health behavior while the impact might be increased with online networks' support. Accordingly, fitness practitioners should reinforce social facilitation features for users to be able to compare with others they admire or regard as role models. Fitness app developers should design apps to upload their fitness outcomes handily on social media to receive social support from others. Fitness app users should compare their tracked fitness information with superior others and seek supportive feedback on their fitness posts. This should help build their confidence and positive attitudes in PA and therefore increase their participation in PA.

5.6. Limitations

The current study demonstrated the uses of gamification aspects of fitness apps and the influence of engaging in social comparison via social media and posting about fitness on social media. Yet, the study has limitations that need to be acknowledged.

The current study method, survey research, is relatively strong on external validity but weaker on internal validity. First, it is impossible to draw inferences about causal relationships from cross-sectional correlational data. Even if correlations between variables are found, it is not possible to determine whether one variable causes the other variable. In a cross-sectional study, it is hard to determine the time ordering. For example, it is impossible to know whether people developed higher self-efficacy in physical activities after comparing themselves with superior others, or they engaged in upward social comparison because they already had higher competence in physical activities. Second, survey research relies on self-reports of recalled past

actions or answers to topics which people may not have thought about before. Survey participants may not be able to accurately recall past behavior or assess their position on questions, or they may make more socially acceptable answers. Third, the measures of upward and downward comparison have some drawbacks. For example, some upward comparison items asked people about comparing themselves to people in "excellent fitness" and some downward comparison items asked people about comparing themselves to others who were "below average" in fitness. However, there also was no measure of how respondents perceived themselves. Therefore, the items might not be accepted as questions about higher or lower fitness than the respondents.

When it comes to external validity, the findings of the study cannot be generalized since this study used convenience sampling. The study sample from a crowdsourcing marketplace was not a perfect representation of all fitness app users. For the first section on descriptive uses, it is impossible to categorize numerous kinds of fitness apps in the market into just the four types. In app stores, hundreds of fitness apps are available and newly released continuously. Each fitness app has different usability for health, exercise, and well-being, while people use fitness apps for various purposes. The results of the most used fitness app might also differ from period-by-period and store-by-store. Hence, the study results do not represent all aspects of gamification in fitness apps and the most used fitness app. For the findings related to fitness app users' social media use, the study sample's social comparison and self-presentation experiences were not representative of the population of fitness app users. Moreover, the questions on the survey could not capture the range of ways and circumstances in which people see others' posts and post their own fitness information via various kinds of social media.

An additional limitation is the composition of the sample. The survey participants were recruited through Amazon's Mechanical Turk (MTurk), an internet-based participant-pool platform. With a fast and cost-efficient data collection method, MTurk has become a reliable option for social science research (Holden, Dennie, & Hicks, 2013). Compared to a sample of college students, MTurk allows a much broader sample for the study. The current study subjects were aged from 18 to 74. However, most of the participants in this study identified as White/Caucasian (68.8%), and relatively few participants identified as Black/African American (9.2%) or Hispanic/Latino(a) (6.8%). Also, a majority (62.2%) had a college degree or higher. The education level of the sample was relatively high (over 92% had some education beyond high school and over 60% had at least a college degree). Although this study did not collect subjects' income information, education and income tend to be positively related. Thus, this study likely includes a smaller percentage of lower-income people than the general population. Therefore, the study results may not apply to people who may have lower income and less access to mobile apps. In terms of the digital divide, the study findings of fitness app use and social media use might not be applicable for those who have-nots. Second, the advance of wearable technologies promotes many people to use fitness apps on smartwatches. In contrast to fitness/activity trackers, smartwatch users can download and access fitness apps on the devices. The popularity of smartwatches has absorbed a downturn in sales of fitness/activity trackers (Williams, 2017). Recent data shows that a very similar percentage of people have used fitness apps on wearable devices and smartphones (McCarthy, 2019). However, less than 10 percent of the respondents in this study operated fitness apps with their wearable devices. Hence, the study results cannot be generalized to the broader U.S. population, or to those who use fitness apps on fitness watches.

5.7. Future Research

As based on the study results and limitations, several topics need to be complemented and developed for future research. The first part of the study explores gamification aspects of fitness apps, and the results indicate that people primarily use fitness apps for monitoring and regulation of physical activities. However, this study did not exclusively recruit subjects who use fitness apps for physical activities. Although this study recruited subjects who use fitness apps, some apps designed for meditation and/or period-related information, for example, are also regarded and classified as fitness apps. Therefore, the concept of fitness and health was not clearly distinguished for users. Future research should include only apps designed for physical activities so that they can demonstrate the benefits of fitness app use for physical activities. In addition to the descriptive results of this study, future research should examine if the use of gamification elements positively affects physical activity competence, attitudes, and actual participation. According to Frederick and Ryan (1993), those who enjoy physical activities tend to perceive more satisfaction and competence. If people enjoy gamification elements in fitness apps, they should have higher self-efficacy in physical activities. A diary study that longitudinally collects qualitative data about users' experience in fitness app use would be beneficial to examine the role of gamification elements in fitness apps in actual physical activity participation.

The study suggests that social comparison through fitness posts either reduces or improves ones' competence, attitudes, and participation in physical activity. However, the study did not consider whether participants intentionally sought to compare themselves to others. For example, some people may have engaged in social comparison after being unintentionally exposed to others' fitness posts, whereas others may have sought others' fitness posts (e.g., with hashtags) for the purpose of social comparison. Study participants' self-esteem also should be

considered in future studies. Self-esteem may influence people's self-exposure to upward or downward social comparison figures in others' fitness posts. In addition, fitness app users' BMI or fitness history may influence their intention of social comparison and self-presentation. Social comparison theory posits that people compare themselves with others to enhance self-assessment (Collins, 1996) or to protect self-esteem (Bodenhausen & Richeson, 2010). Those who seek others' fitness posts might be engaging in upward social comparison or downward social comparison with a clear purpose, self-improvement. They can get inspiration from upward social comparison (Collins, 1996) or relative superiority from downward social comparison (Arroyo, 2014; Huang & Zhou, 2019). Therefore, future research should investigate whether fitness app users engage in social comparisons with intention or not. If people intentionally engage in social comparison for self-improvement, they might have higher self-efficacy in physical activities regardless of social comparison engagement types.

This study was not designed to examine age and gender differences in social comparison and self-presentation online. Social media is highly involved in our lives to keep in touch with friends and family (Smith, 2011). Still, it might be a more central communication channel for younger generations than older generations. Younger people might have more chances to engage in social comparison and be more familiar with presenting themselves to others online. Older people are increasingly using social media, but the ways they engage in or respond to social comparison and self-presentation may differ from younger people. Research that explores unique factors associated with specific age groups could yield insight regarding how to best encourage physical activity among people of different ages. In terms of gender differences, women are more likely to have a fear of being overweight after upward social comparison (Arroyo, 2016). Further, women are more interested in losing weight, whereas men are more interested in having

a muscular body (Engeln, Sladek, & Waldron, 2013). They might engage in social comparison with different purposes, and therefore the consequences may be different. In addition, upward fitness comparison may draw different consequences depending on the users' gender. Comparison with those who have lower weight may be depressive for female users as their thin body ideals cause self-body dissatisfaction (Arroyo, 2014; Perloff, 2014). In contrast, comparison with muscular figures may be aspirational for male users as they desire to have muscular bodies and are interested in changing their body shape (Engeln et al., 2013). Future research should consider these and other demographic differences in social comparison and self-presentation in relation to physical activity. Study participants' backgrounds may affect their fitness social comparison and fitness posting behaviors. For example, there might be ethnic or cultural differences in social comparison, self-presentation, and social support. In some cultures, disclosing self is uncommon, and positive self-presentation could be interpreted as bragging or showing off. Therefore, positive fitness posters may receive less supportive feedback from people in certain ethnic or cultural groups. Further, some people may have less opportunity to compare themselves to similar others because of a lack of fitness posts from people in their own ethnic group or age group.

This study also demonstrated that people tend to provide supportive feedback on others' social media postings while refusing to leave negative feedback as a social networking strategy. Indeed, respondents received more positive/supportive feedback than negative/critical feedback on their fitness posts, regardless of their ways of self-presentation. Still, some respondents received negative or critical responses from networks. However, this study did not measure the types of negative/critical feedback fitness posters received. Zhang et al. (2015) insisted that a lack of supportive feedback depresses the application of physical activities. Fitness posters may

regard the lack of feedback as a lack of social support or even negative feedback, as well as they may be dissatisfied because of fewer amounts of supportive feedback than their expectations. In this study, the lack of feedback was not considered as unsupportive feedback. Future research should measure both negative/unsupportive feedback and perceived lack of feedback to analyze their impact on fitness posters' physical activities.

Regarding the types of supportive feedback, the current study parallels the research of Oeldorf-Hirsch et al. (2018) and Oh et al. (2013), who found that all dimensions of supportive feedback were provided on health- or fitness-related posts. However, this study did not examine supportive feedback from different types of social ties. It is known that strong social ties tend to provide psychological support, whereas weak social ties tend to provide knowledge support (Albrecht & Adelman, 1987; Albrecht & Goldsmith, 2003) or informational support (Granovetter, 1983). Social media networks include not only strong ties such as family and friends but also weak ties like those who have common interests. Different types of social ties may provide different types of social support on fitness posters' demands. Additional research should consider types of supportive feedback from strong and weak ties to elaborate their effects on fitness posters.

This study demonstrated that fitness posters received supportive feedback regardless of their ways of self-presentation. The more people positively presented their fitness, the more they received esteem support and emotional support. The more people negatively presented their fitness, the more they received emotional support and informational support. However, this research did not study how each type of social support distinctively affected fitness posters' physical activities. Future research should analyze the impact of the three different types of

social support. For example, emotional support may increase fitness posters' self-efficacy in PA, PA motivation, and PA participation.

5.8. Conclusion

This research studied the use of fitness apps and the users' social media use for physical activities. The first part of the study explored descriptive information about the use of fitness apps. Based on Festinger's (1954) social comparison theory, the second part of the study investigated the influence of social comparison through others' fitness postings. Based on self-presentation theory (Arkin, 1981; Baumeister & Hutton, 1987), the study examined how people presented their fitness on social media and the impact of others' supportive feedback on posters' physical activities.

The current study explicated the popular gamification aspects of fitness apps. It was revealed that people most often used fitness apps for self-monitoring and self-regulation, particularly for physical activities. But they also frequently used other gamification mechanisms such as social facilitation and rewards. It would require further research to examine how the gamification aspects of fitness app affect actual physical activities. Future research should consider how use of those gamification aspects in fitness apps relates to physical activities.

The major contributions of the study involve fitness app users' social comparison through others' fitness posts and self-presentation via their own fitness posts. Physical appearance-related social comparison literature demonstrated that those who engaged in downward social comparison tended to evaluate self positively (O'Brien et al., 2009), whereas engaging in upward social comparison via social media appeared to cause negative self-evaluation (Perloff, 2014). In contrast, the current research found that downward social comparison appeared to thwart fitness app users' self-efficacy in physical activities, and upward social comparison appeared to enhance

self-efficacy in physical activities. As a consequence, people who engaged in upward social comparison had elevated motivation and participation in physical activities. In particular, self-efficacy was a crucial variable to improve people's motivation for physical activities.

Regarding fitness posts, supportive feedback was given for both positive and negative ways of self- presentation. Supportive feedback is accepted as social support for fitness posters. As was proposed, social support from others appeared to enhance fitness posters' self-efficacy in physical activities. Hence, they had elevated motivation for physical activities. Further, it was discovered that different types of social support were given depending on the ways of self-presentation. On one hand, emotional support was provided for both positive and negative self-presenters. On the other hand, positive self-presenters received more esteem support, but negative self-presenters received more informational support. It can be speculated that social networks provide dissimilar support based on ways of self-presentation. Future research should explore how each type of social support affects fitness posters' physical activity related-self-efficacy, motivation, and actual participation. Furthermore, online social networks consist of not only strong social ties but also weak social ties. Each type of social ties would provide different types of social support, as Granovetter (1983) argued. Future research should examine how social support from different social ties affect fitness posters' physical activity self-efficacy, motivation, and participation.

In conclusion, this study demonstrated that new media technologies could encourage people to participate in more physical activities. In particular, interactions through social media can stimulate fitness app users to get motivated for physical activity with confidence. Those who want to improve their fitness activities should engage in comparing themselves with superior others and post about their fitness achievements or struggles. For fitness posters who need social

support, others provide supportive feedback on fitness posts. This implies that social interaction is central for fitness app users and fitness posters to improve their physical activities.

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APPENDICES

Appendix A

Recruitment Message: Invitation for Amazon MTurk Users

Subject Heading: Fitness App use and Responses to Fitness Postings – Invitation to Participate in Research

Hello,

This is an invitation to participate in a research study that we are doing at GSU. The study explores your perceptions and experience of fitness app use and fitness postings. People who use any types of fitness apps can participate. The study involves completing an online survey on Amazon MTurk. The survey will take you about 20 to 25 minutes to complete.

A total of 800 participants will be recruited for this study. You are invited to participate because you are aged over 18 and use fitness apps. Participating in this research is voluntary and may not benefit you personally. For your participation in the research, you will receive monetary compensation ($0.50).

To participate in the study, you will click the next button below. See details below about when the survey will be available. Clicking the next button will take you to an Informed Consent Form. If you decide to participate after reading the consent form, click “I agree” and you will be taken to the first page of the survey.

Personal information will be stored separately – no identifying information will be linked to your survey responses.

Please feel free to contact us with any questions. Thank you for considering your participation in this research.

Sincerely,

Hyung-Min Kim, Student Principal Investigator
Cynthia Hoffner, Professor and Principal Investigator
Department of Communication, Georgia State University
Contact information: hkim123@gsu.edu or 404-413-5650

Appendix B

Georgia State University
Department of Communication
Informed Consent

Title:	The Impacts of New Technologies on Physical Activities: Based on Fitness App Use and Fitness Social Media Postings
Principal Investigator:	Cynthia A. Hoffner
Student Principal Investigator:	Hyung-Min Kim

Introduction and Key information

You are invited to take part in a research study. It is up to you to decide if you would like to take part in the study. The purpose of this study is to investigate uses of fitness apps and responses to fitness posting. Your role in the study will last 20-25 minutes of your time over on a single day. You will be asked to take part in an online survey. Participating in this study will not expose you to any more risks than you would experience in a typical day. This study is not designed to benefit you. Overall, we hope to gain information about use of fitness apps and fitness postings for physical activity.

Purpose

The purpose of the study is to investigate uses of fitness apps and responses to fitness posting. You are invited to take part in this research study because you are using fitness apps. A total of 800 people will be invited to take part in this study.

Procedures

If you decide to take part, you will complete an online survey. When you click the "I Agree" below, you will be directed to the first page of the survey. The survey will ask your experience of fitness app use and fitness postings on social media (fitness scenes or records). You will be asked about your fitness posting experience and perception of others' fitness postings. All respondents will report on personal characteristics and demographics. Participation will require 20-25 minutes of your time over on a single day.

Future Research

Researchers will remove information that may identify you and may use your data for future research. If we do this, we will not ask for any additional consent for you.

Risks

In this study, you will not have any more risks than you would in a normal day of life. No injury is expected from this study, but if you believe you have been harmed, contact the

research team as soon as possible. Georgia State University and the research team have not set aside funds to compensate for any injury.

Benefits

This study is not designed to benefit you personally. Overall, we hope to gain information about use of fitness apps and fitness postings for physical activity.

Alternatives

The alternative to taking part in this study is to not take part in the study.

Compensation

You will receive $0.50 through Mechanical Turk for participating in this study. This money will be deposited in your Amazon Payments Account.

Voluntary Participation and Withdrawal

You do not have to be in this study. If you decide to be in the study and change your mind, you have the right to drop out at any time. You may skip questions or stop participating at any time. You may refuse to take part in the study or stop at any time. This will not cause you to lose any benefits to which you are otherwise entitled.

Confidentiality

We will keep your records private to the extent allowed by law. The following people and entities will have access to the information you provide:

- Dr. Cynthia Hoffner and Hyung-Min Kim
- GSU Institutional Review Board
- Office for Human Research Protection (OHRP)

We will use a study number rather than your name on study records. The information you provide will be stored on the researchers' firewall-protected computers, in a locked GSU office or home office. When we present or publish the results of this study, we will not use your name or other information that may identify you. Because this is an online study, anonymity cannot be guaranteed. Data sent over the Internet may not be secure. However, we will not ask any identifying information about you, except your MTurk ID, for the purpose of giving monetary compensation. We will not collect your IP addresses and no identifying information will be connected to your answers.

Contact Information

Contact Dr. Cynthia Hoffner at 404-413-5650 and choffner@gsu.edu or Hyung-Min Kim at 404-413-5600 and hkim123@gsu.edu

- If you have questions about the study or your part in it

- If you have questions, concerns, or complaints about the study

The IRB at Georgia State University reviews all research that involves human participants. You can contact the IRB if you would like to speak to someone who is not involved directly with the study. You can contact the IRB for questions, concerns, problems, information, input, or questions about your rights as a research participant. Contact the IRB at 404-413-3500 or irb@gsu.edu.

Consent

If you wish to keep a copy of this consent form, please print a copy.

If you are willing to volunteer for this research, please check "I Agree" below.

__ I Decline __ I Agree

Appendix C

Scales and Measures for Study

Fitness Apps and Social Media Use

1. Which Fitness apps do you use regularly (at least once a week)? (Check all that apply).

a) 30 Day Fitness Challenge ◦
b) 7 Minute Workout Challenge
c) AllTrails
d) BetterMe: Weight Loss Workouts
e) BetterMen: Workout Trainer
f) Calm
g) Fabulous - Motivate Me
h) Fitbit
i) FitOn: Social Fitness Workouts
j) Flo Period & Ovulation Tracker
k) Full Fitness : Exercise Workout Trainer
l) Headspace: Guided Meditation
m) HeartWatch. Heart & Activity
n) Instant Heart Rate: HR Monitor
o) Lifesum: Diet & Macro Tracker
p) Lose It! – Calorie Counter
q) My Macros+ | Diet & Calories (paid)
r) MyFitnessPal
s) Nike Training Club
t) Nike+ Run Club
u) Pre-installed apps (e.g. Apple Health, Samsung Health, Activity etc.)
v) Sweatcoin - Sweat for Coins
w) Workout for Women: Fitness App
x) Other (please specify) _____

2. Which Fitness app do you use the most?

a) 30 Day Fitness Challenge ◦
b) 7 Minute Workout Challenge
c) AllTrails
d) BetterMe: Weight Loss Workouts
e) BetterMen: Workout Trainer
f) Calm
g) Fabulous - Motivate Me
h) Fitbit
i) FitOn: Social Fitness Workouts
j) Flo Period & Ovulation Tracker
k) Full Fitness : Exercise Workout Trainer
l) Headspace: Guided Meditation
m) HeartWatch. Heart & Activity

n) Instant Heart Rate: HR Monitor
o) Lifesum: Diet & Macro Tracker
p) Lose It! – Calorie Counter
q) My Macros+ | Diet & Calories (paid)
r) MyFitnessPal
s) Nike Training Club
t) Nike+ Run Club
u) Pre-installed apps (e.g. Apple Health, Samsung Health, Activity etc.)
v) Sweatcoin - Sweat for Coins
w) Workout for Women: Fitness App
x) Other (please specify) _____

3. How would you classify the fitness app you selected in the previous Question? (Check all that apply)

a) Fitness Tracking Apps (e.g. tracking your fitness activity or caloric intake) (i.e., MyFitnessPal, Fitbit, Jawbone Up, Moves)
b) Workout Fitness Apps (e.g. assist your workout with instruction) (i.e., Nike Training Club, The Johnson & Johnson 7 Minute Workout)Social Fitness Apps (i.e., inKin)
c) Social Fitness Apps (e.g. connects you with friends, family and co-workers) (i.e., inKin, Fitbit)
d) Competitive Fitness Apps (e.g. compare/challenge your performance with others) (i.e., Strava)
e) Altruistic Fitness Apps (e.g. earn money/credits for charity when you walk, run or bike) (i.e., Charity Miles)

4. On what device, do you use the fitness app you selected in the previous Question?

a) iPhone b) Android Phone c) BlackBerry Phone d) Window Phone e) Smartwatch f) Fitness tracker g) Tablet PC h) Laptop

Use of Fitness Apps (adapted from Seaborn & Fels, 2015; Yoganathan & Kajanan, 2013)

1. How often do you use fitness apps to…? (1=never to 7=almost always)

i) Self-monitoring
a) track steps or distance b) burn calories c) store nutrition/eating d) track weight loss e) track sleep quality

ii) Self-regulation
a) set steps or distance goals b) set calorie burning goals c) set calorie intake/energy balance goals d) set weight loss goal e) set sleep goal

iii) Social facilitators
a) participate in competition through leader boards b) participate in challenges with group c) connect/interact with other users in app, d) connect/interact with other social media users via app.

iv) Rewards

a) obtain extra credit b) obtain extra level c) obtain tangible or desirable items d) obtain badges/rewards

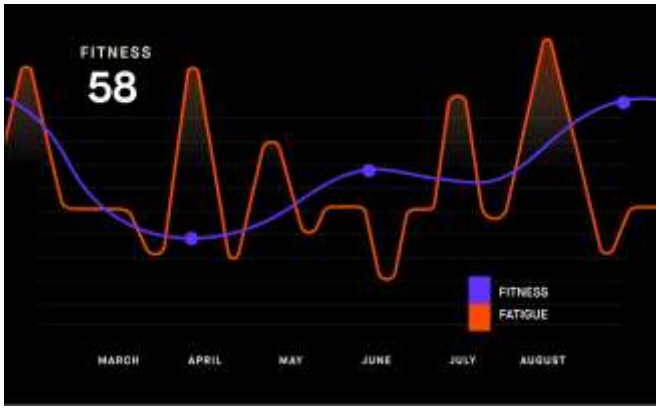
2. Have you ever paid for Fitness Apps, including download or in-app purchase?
a) Yes b) No

Exposure to Others' Fitness Postings

1. Have you ever SEEN others' fitness postings on social media (such as Instagram, Facebook, Twitter, YouTube, Snapchat, etc.)?
a) Yes b) No c) Not sure d) Decline

2. How often have you… (1=never to 7=very often)

a) Seen others' fitness information on social media? (e.g., running/walking routes, graphs, charts)



b) Seen others' numerical fitness records on social media? (e.g., steps, calories, distances)

c) Seen others' fitness scenes on social media? (e.g., any pictures describing their fitness experience including selfie in the gym, marathon, athletic outfits: a commemorative photo for exercise)

3. In what types of social media have you seen others' fitness postings? (Check all that apply)

a) Instagram b) Facebook c) Twitter d) Snapchat e) TikTok f) LinkedIn g) YouTube h) Google+ i) Pinterest j) Tumblr k) Flickr l) Reddit m) WhatsApp n) Quora o) Vine p) Periscope q) Bizsugar r) StumbleUpon s) Delicious t) Digg u) Viber v) Other

Next we'd like to know about your viewing experience on others' fitness postings.

The items below describe different ways you may respond when you see others' fitness postings on social media. Please indicate the extent to which you agree or disagree with each item.

Social Comparison (adapted from O'Brien et al., 2009)

1. To what extent do you agree or disagree? (1=strongly disagree to 7=strongly agree)

a) I compare myself to others who have BETTER fitness performance/habits/behaviors than me rather than those who do not.

b) I tend to compare my fitness performance/habits/behaviors to that of people with EXCELLENT fitness.
c) I find myself thinking about whether my own fitness performance/habits/behaviors compare well with the fitness of HIGHLY SKILLED or PROFESSIONAL athletes.
d) I tend to compare myself to people I think have BETTER fitness performance/habits/ behaviors than me.
e) When I see a person with GREAT fitness performance/habits/behaviors, I tend to wonder how I 'match up' with them.
f) When I see a person who has EXCELLENT fitness performance/habits/behaviors, I wonder how I compare to them.
g) I find myself comparing my fitness with people who have BETTER fitness performance/habits/behaviors than me.
h) I compare my fitness performance/habits/behaviors to people who have BETTER fitness than me.
i) When I see a person who has below average fitness performance/habits/behaviors, I think about how my fitness compares to theirs.
j) I tend to compare myself to those whose fitness performance/habits/behaviors are below average.
k) I compare my fitness performance/habits/behaviors to those with less athletic fitness than me.
l) I compare myself to people with lower fitness performance/habits/behaviors than me.
m) I think about how competitive my fitness performance/habits/behaviors are compared to people who are not physically active.
n) I often compare my fitness performance/habits/behaviors to people are less physically active than me.
o) I often compare myself to those who are less physically fit.
p) I tend to compare my fitness performance/habits/behaviors with people who are not as physically fit.

Next we'd like to know about your fitness posting experience.

2. Do you post your physical activities on social media?
   a) Yes b) No c) Not sure d) Decline

3. If so, what kinds of your physical activities do you post about? (open-ended)

4. What types of social media do you use to post about your fitness? (Check all that apply)

   a) Instagram b) Facebook c) Twitter d) Snapchat e) TikTok f) LinkedIn g) YouTube h) Google+ i) Pinterest j) Tumblr k) Flickr l) Reddit m) WhatsApp n) Quora o) Vine p) Periscope q) Bizsugar r) StumbleUpon s) Delicious t) Digg u) Viber v) Other

Own Fitness Postings and Self-presentation

1. How often do you… (1=never to 7=almost always)

a) Post your fitness information on social media? (e.g., running/walking routes, graphs, charts)
b) Post your numerical fitness records on social media? (e.g., steps, calories, distances)
c) Post your fitness scenes on social media? (e.g., any pictures describing your fitness experience including selfie in the gym, marathon, athletic outfits: a commemorative photo for exercise)

Fitness Self-Presentation (adapted from Yang & Brown, 2016; Yang, Holden, & Carter, 2017)

2. To what extent do you agree or disagree? (1=strongly disagree to 7=strongly agree)

a) On social media, I usually reveal more undesirable things about my fitness then desirable things. (adapted from Yang et al., 2017: a-e) (N)
b) On social media, I share things about my fitness that could lead to negative judgments of me. (N)
c) On social media, I share negative things (e.g. frustrations, struggles) about my fitness. (N)
d) I normally reveal good feelings about my fitness on social media. (P)
e) On social media, I normally reveal more desirable things about my fitness then undesirable things. (P)
f) I usually disclose positive things about my fitness on social media. (adapted from Yang & Brown, 2016) (P)

Feedback from Others

The next set of questions ask about how others respond to your fitness postings.

1. When you post, who usually responds? (Check all that apply)
   Close friends
   Casual friends
   Acquaintances
   Strangers
   Family
   People who have common interests in physical activity
   Others_____

2. When you post about your fitness… (1 = none to 7 = a great deal)

a) how much feedback do you typically receive overall?

b) How much positive/supportive feedback do you tend to receive?

c) How much negative/critical feedback do you tend to receive?

Supportive Feedback (adapted from Freeman et al., 2011; Oh et al., 2013)

Think about feedback that you may receive on your fitness postings to social media. To what extent do you agree or disagree that other users… (1=strongly disagree to 7=strongly agree)

1. When I post about my fitness, other users…
a) Reinforce the positives of your physical activities (esteem)
b) Enhance your self-esteem (esteem)
c) Instill you with confidence (esteem)
d) Boost your sense of competence at physical activities (esteem)
e) Provide you with comfort and support (emotional)
f) Show concern for you (emotional)
g) Provide encouragement to you (emotional) (Oh et al., 2013)
h) Show you empathy (emotional) (Oh et al., 2013)
i) Give you constructive feedback (information)
j) Give you fitness-related information (information)
k) Give you fitness-related advice (information)
l) Give you advice on your performance (information)

Self-efficacy for PA (adapted from Oh et al., 2013)

The next set of questions ask about your perception of your physical activities.

1. Please read the items below about your beliefs in fitness, and indicate to the extent to which you\ agree or disagree with each item. (1 = strongly disagree to 7 = strongly agree)
a) I am confident I can have a positive effect on my fitness or health
b) I can set some definite goals to improve my fitness or health
c) I can meet the goals I set for myself to improve my fitness or health
d) I can actively work to improve my fitness or health

PA Motivation

Physical activity motivation (adapted from Lowe et al., 2002)

On the following five items, please rate your THOUGHTS and FEELINGS about engaging in physical activities over the next month.

1. For me, taking part in physical activities regularly over the next month is:

a) (1 = extremely dull to 7 = extremely stimulating)
b) (1 = extremely harmful to 7 = extremely beneficial)
c) (1 = extremely unimportant to 7 = extremely important)

d) (1 = extremely bad to 7 = extremely good)

PA Participation (adapted from Godin, 2011)

1**.** During a typical 7-day period (a week), how many times on the average do you do the following kinds of physical activity for more than 15 minutes? (Godin & Shephard, 1985)

i) Strenuous physical activity (heart beats rapidly)
(e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long-distance bicycling)

ii) Moderate physical activity (not exhausting)
(e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)

iii) Mild physical activity (minimal effort)
(e.g., yoga, archery, fishing from river bank, bowling, horseshoeing, golf without using a cart, snow-mobiling, easy walking)

Social Media Use (adapted from Hou, 2017)

1. What types of social media accounts do you use? (Check all that apply)

a) Instagram b) Facebook c) Twitter d) Snapchat e) TikTok f) LinkedIn g) YouTube h) Google+ i) Pinterest j) Tumblr k) Flickr l) Reddit m) WhatsApp n) Quora o) Vine p) Periscope q) Bizsugar r) StumbleUpon s) Delicious t) Digg u) Viber v) Other

Next we'd like to know about your social media uses and behaviors.

2. How often each DAY, on average, do you... (1 = never to 7 = multiple times a day)

a) use social media?
b) read others' posts?
c) post or share your own photos, messages, or videos?
d) "like" others' posts?
e) "follow" or "friend" someone?
f) comment on others' posts?
g) respond to your own posts?
h) share others' posts?

Demographic Measures

1. What is your gender?

Female Male Other_____

2. In what year were you born?

3. In what country do you currently live?

4. What is the highest degree or level of school you have completed?

8th grade or less
Some high school, no diploma
High school graduate, diploma or the equivalent (for example: GED)
Some college credit, no degree
Trade/technical/vocational training
Associate degree
Bachelor's degree
Master's degree
Professional degree (e.g., law degree)
Doctorate degree

5. What is/are racial or ethnic group(s)? (Check all that apply)

African-American/Black
Asian/Pacific Islander
Hispanic/Latino(a)
Native American
White/Caucasian
Other _____

6. What kinds of physical activities do you usually do? (Check all that apply)

Aerobic/Cardio exercise
Badminton
Baseball
Basketball
Bicycling
Bowling
Climbing
CrossFit
Cycling
Dancing
Dog Walk
Elliptical
Football
Golf
Gymnastics
Hike
Hockey
Lacrosse
Martial arts (i.e., judo, taekwondo, boxing)
Pilates
Roller skating
Rowing
Running

Skiing
Snowboarding
Soccer
Softball
Spin
Squash
Swimming
Tennis
Track and field
Volleyball
Walking
Weightlifting
Wrestling
Yoga
Other _____

5. Body Measurement Index (BMI)

a) What is your height? ____(feet) ____(inches)

b) What is your weight? ____(pounds)