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## **An Investigation of Social Support Features of Digital Health Applications**

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# An Investigation of Social Support Features of Digital Health Applications

## Research-in-progress

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## Abstract

Using digital health applications for health behaviour intervention is becoming popular. Among all application features designed for nudging users' behaviour changes, social support features have received great attention, as social support is shown to reduce patients' uncertainty and improve health behaviour engagement. A variety of social support features have been implemented, but how they are related to app performance, such as app ratings, downloads and review numbers, is unknown. This paper aims to understand the relationship between social support features and these app performance indicators, and identify common ways of providing social support. Three types of social support features have been identified through a review of selected health apps: the support from social networks, from in-app communities, and from health professionals. Apps with social support features are found to have higher review numbers, although not correlate with ratings or download numbers. Potential theoretical and practical implications are discussed, together with the future research plan.

**Keywords** Digital health apps, social support features, app performance

## 1 Introduction

The popularity of smartphones and people's increasing willingness to health self-management promote the rapid development of mobile health applications (apps) (Mendiola et al. 2015). In 2017, there were 325,000 health apps available in the app markets (Pohl 2017). A significant goal of these apps is to influence healthy behaviour, and one of the essential techniques for behaviour changes is social support (Flores Mateo et al. 2015; Yang et al. 2015). Social support is to provide emotional, informational or instrumental support from personal social networks or strangers (Heaney and Israel 2008). It can generate motivation and encouragement that benefit behaviour changes (Verheijden et al. 2005). Family members and friends can provide long-term support that helps people maintain a positive attitude (Heaney and Israel 2008), while support from other patients with similar concerns was found to reduce people's uncertainty in illness (Liu et al. 2020). Therefore, an increasing number of social support features have been developed in health apps.

Not many studies have investigated the types of social support features from an app feature design perspective. There are also limited studies on how different feature designs influence overall app performance, which can be measured by app ratings, download numbers and review numbers.

To address the gap in the literature, we have conducted a systematic review of top health applications on obesity and weight management in both Apple Store and Google Play. Obesity is a significant public health problem in Australia, which has a severe impact on health outcomes and economic development (Australian Institute of Health and Welfare 2017). Specified scope provides a balance between the amounts of apps to be reviewed and the significance of the findings.

Three common types of social support features have been identified through a review of selected health apps: the support from social networks, from in-app communities, and from health professionals. Apps with social support features are found to have higher review numbers, although not correlate with app ratings or download numbers.

## 2 Literature Review

### 2.1 Social Support Features

Social support can take the form of emotional support, instrumental support, informational support, and appraisal support (Heaney and Israel 2008). The source of social support can be family, friends, colleagues, clinicians, and even strangers (Verheijden et al. 2005).

Social interaction is an important way that can highly embody social support. Social interaction is a complex phenomenon which can be defined differently in different contexts (De Jaegher et al. 2010). Therefore, in this study, social interaction is defined as dynamic conversational exchanges made by different individuals in terms of joint health topics (Hall 2018). Social interaction is mainly about mutual communication via different ways such as text messages, social media share and chats (Hall 2018). Interaction can motivate people to change their unhealthy behaviour, such as inactivity (Hwang et al. 2010; Ploderer et al. 2014). Sharing success or failure experience, healthy recipes, physical activity methods is also beneficial to improve other users' health literacy and confidence (Cohen et al. 2000). Due to these benefits, social interaction becomes one of the most commonly used features of health apps for weight management (Conroy et al. 2014; Tong and Laranjo 2018).

Social interaction is designed into health apps in the form of various online communication platforms (Hales et al. 2016; Turner-McGrievy and Tate 2013). Health apps can integrate with social media such as Facebook, Instagram and Twitter where user goals and achievements can be shared (Dahl et al. 2016). Besides, apps can set up the chatroom, message board and community where they can communicate with other users (Khaylis et al. 2010). These platforms effectively connect users with common goals or similar experiences, and they are more likely to understand each other and receive inspiration (Pagoto and Bennett 2013).

### 2.2 Mobile Health App Performance Assessment

Health application evaluation is still in its infancy, and there is no consensus on comprehensive evaluation (Turner-McGrievy and Tate 2013). Although some evaluation tools such as MARS and Health-ITUES have been proposed, they have considerable heterogeneity and may not be suitable for ordinary users (Nouri et al. 2018).

However, methods for choosing high-quality apps are essential because low app quality can negatively influence user experience. From the users' perspective, app ratings, the number of reviews and

downloads can be intuitive performance indicators (Fu et al. 2013). Ratings are a quantitative indicator that reflects the satisfaction and overall quality, while review numbers can represent the popularity to a certain extent. Only users who have downloaded and used the app will share their reviews. Besides, writing reviews is not as simple as ratings, so those who have extraordinary use experience are more likely to provide reviews, regardless of whether the experience is good or bad. Similarly, download numbers are a direct reflection of app popularity. Consequently, these indicators can be applied for app performance evaluation (Pagoto and Bennett 2013).

### 3 Research Method

#### 3.1 App Selection Criteria

The weight management apps were selected as the subject of this study. Obesity becomes a public health issue but can be managed through mobile apps, so various apps have been developed for weight management. The search for the apps was conducted between December 2019 and March 2020, on Apple Store and Google Play markets.

The search keywords included "obesity" or "weight loss" or "weight management" or "lose weight" or "weight" or "Body Mass Index (BMI)". The app descriptions provided in the markets were used for initial screening. The criteria for app selection were: (1) with weight management as a key target, which may include features on physical activity, diet or weight/Body Mass Index (BMI) measurement, (2) English-language user interface, (3) with at least 500 reviews, (4) with at least 10,000 download numbers (only applicable to apps in Google Play). Review numbers were published in both Apple Store and Google Play, but download numbers were only provided in Google Play. So apps in Apple Store were filtered based on the first three criteria. Apps that were similar to those that met the criteria and were recommended by the markets were also included. App features, ratings, the number of reviews and downloads were indexed. The endpoint of app review was that the number of apps that meet the criteria reached 200. IBM SPSS (version 26) was used for statistical analysis.

#### 3.2 Measurement of Social Support Features

As mentioned above, there are various forms of social support, and social interaction is mainly considered. Features that allow users to share information and to communicate with their social relationships via message boards, chat rooms, social media or internal communities were classified as social support features. Apps with these features were coded as 1, and other apps were marked with 0. Two coders rated the features independently, and the inter-rater reliability was 100%. We performed descriptive analyses for these features and calculated the frequency.

#### 3.3 Measurement of App Performance

For apps from both Apple Store and Google Play markets, the ratings were calculated by averaging the ratings from both markets, and the total review numbers were obtained by summing the total review numbers of two markets. Download numbers were only available for Google Play in the form of different categories such as '10,000+', '50,000+'. We converted categories into numerical variables after removing the outliers. Eight download categories, namely, '10,000+', '50,000+', '100,000+', '500,000+', '1,000,000+', '5,000,000+', '10,000,000+', '50,000,000+', were replaced with '1' to '8' respectively for analysis.

To test whether the means of three performance indicators of the apps with or without social support features were the same, we conducted the analysis of variance (ANOVA) tests.

## 4 Results

We reviewed more than a total of 500 apps from Apple Store and Google Play before we got 200 apps that met the selection criteria. 117 apps were available from both markets, with 22 exclusively to Apple Store, and 61 exclusively for Google Play. There were only 67 apps with social support features. Table 1 summarises the market distribution of the apps.

	Apple Store only	Google Play only	Both	Total
Number of Apps	22	61	117	200
Social support features	3	4	60	67

Table 1. Market Distribution of Selected Apps

## 4.1 Descriptive Statistics

The descriptive statistics of the ratings and review numbers are displayed in Table 2. The average rating of all included apps reached 4.499 of 5. The total review number had a skewed distribution, and its median number was 16,364. The median of converted download number was 5 (Table 3), indicating that the median of the original download number in Google Play was 1,000,000+.

	Min	Median	Mean	Max	Standard Deviation
Average Rating (N=200)	2.4	4.6	4.499	5	0.33
Total Review Number (N=200)	515	16,364	123,226	3,152,935	310,936.3

Table 2. Ratings and review numbers of apps in both app markets

	Min	Median	Mean	Max	Standard Deviation
Downloads (Converted) (N=178 [Google Play])	1	5	4.43	8	1.8

Table 3. Converted download numbers of apps in Google Play

The comparison of the variables for the apps with and without social support features are summarised in Table 4-5. The average review numbers of the apps with social support features were much larger than those without, while the average download numbers and ratings were similar.

Social support	Number of Reviews				Ratings			
	Min	Mean	Max	Standard Deviation	Min	Mean	Max	Standard Deviation
Yes	788	237,301	3,152,935	484,303	3.4	4.48	4.85	0.29
No	515	65,759	1,001,795	136,188	2.4	4.51	5.0	0.35

Table 4. Social support and ratings, review numbers of apps in both app markets

Social support	Downloads (Converted) (N=178 [Google Play])			
	Min	Mean	Max	Standard Deviation
Yes	1	4.52	8	1.97
No	1	4.39	8	1.71

Table 5. Social support and converted download numbers of apps in Google Play

## 4.2 Data Analysis

ANOVA analysis was performed to examine the effects of social support features on the selected apps' performance. According to the results of the homogeneity of variance test in ANOVA analysis, the review numbers did not follow a normal distribution ( $F = 33.01, p < 0.0001$ ), so we perform a logarithmic transformation. The results of ANOVA analyses were displayed in Table 6. Strong evidence showed that total review numbers between the apps with and without social support features were different ( $F=7.756, p = 0.006$ ). Moreover, the mean of total review numbers between three social support types also had a difference ( $F=3.212, p = 0.047$ ). However, the p-value of ratings ( $F=0.864, p = 0.486$ ,) and download numbers ( $F=0.208, p = 0.649$ ) indicated there is no real difference of ratings and download numbers between the apps with and without social support features.

	F	P
Social support -> Total review numbers (Log)(N=200)	7.756	0.006 ***
Social support -> Ratings (N=200)	0.864	0.486
Social support -> Download numbers (N=178)	0.208	0.649
Social support types -> Total review numbers (Log) (N=67)	3.212	0.047*

Table 6. ANOVA outcomes

Different types of social support features have been identified in the literature, so we have coded the social support features into three categories based on their provision of support, as in Table 7. If apps allowed users to share their information via social media platforms, they were considered as

facilitating social support exchange with existing social networks. If apps let users communicate with other app users, it was considered as in-app support. An equal number of apps was identified for both categories. Only seven apps provided the features related to support from health professionals.

Social support features	Number
External social network support: users share with their social networks via social media	30
In-app community support: users can share with other users in the app community	30
Health professionals support: users communicate with fitness professionals or nutritionists	7
Total	67

Table 7. Social Support features

The results of multiple mean comparisons showed that only the support from in-app community and the support from health professionals differed in the total number of reviews ( $p=0.043$ ) (Table 8).

Bonfer roni	Social support types	Mean Differe nce	Std.Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
App community	Social media	0.12	0.23	1.00	-0.45	0.68
	Health professionals	0.94	0.37	0.043*	0.022	1.86
Social media	App community	-0.12	0.23	1.00	-0.68	0.45
	Health professionals	0.83	0.37	0.93	-0.093	1.74

Table 8. Post Hoc Tests of Social Support Types

## 5 Discussion

Our preliminary analyses discover a significant difference in review numbers between the apps with social support features and those without any. The average review numbers of apps with social support is 237,000, which is nearly four times that of apps with no such features (mean = 65,759). This result is consistent with prior findings that apps with social support provide users with better experiences and those users are more likely to share their feedback (Ventola 2014). Another possible explanation is that those who download the apps are keen on social interaction, so they are more likely to share their feelings.

No difference is found in the mean of ratings between apps with social support features and those without any. This result might be affected by the uneven sample size. The number of apps without social support (N=133) was about twice the figure for apps with social support (N=67). A balanced dataset with larger sample sizes is beneficial for further analysis and more robust outcomes.

No evidence is found that the download numbers of apps with and without social support are different, but more analyses are needed before making a robust conclusion. The original download variable is categorical values ('10,000+', '50,000+') that only provide limited information. Although they were transformed into numeric values (1 - 8) for analysis, the converted data were inconsistent with the exact scale of downloads, which can affect the result accuracy.

Our current analyses also identify three types of social support features widely adopted by most digital health apps, including the support from social media network, from health professionals, and from in-app communities. The effectiveness of those features varies in different contexts. The social media support that mainly provides long-term emotional support has a more substantial effect on behaviour changes compared to the support from healthcare providers (Verheijden et al. 2005). Although health providers can also force patients' behaviour changes, they only have a weak impact due to the mutual benefit with patients (Verheijden et al. 2005). On the other hand, support from like-minded strangers in the communities has a mixed effect on the users' disease uncertainty reduction (Liu et al. 2020).

## 6 Future Research and Intended Contributions

The study plans to investigate the relationship between social support features and app performance. More data will be collected to provide a comprehensive measurement of app performance. For example, sentiment and content analyses will be performed on the reviews. The study will contribute to the

literature on how app feature design would be associated with the ratings, downloads, and usage of digital health apps. The extant research on social support has investigated the types of social support exchanged within onsite communities. Our study can also contribute to the literature by identifying the different types of social support embedded to health apps as well as revealing the role of social support features in those apps.

There are several limitations to this study. Ratings, downloads and review numbers were used to measure the popularity of health apps in this study, but some researchers argued that they are biased (Stoyanov et al. 2015). Not all reviews are positive, so the judgment of app popularity based solely on review numbers can be unstable. On the other hand, the release time of apps, which is an important confounding factor, was not included. This is because the release time is not published. However, it is closely related to the review numbers and downloads. These numbers are accumulative, so apps releases earlier can have larger review numbers and downloads (Mcilroy et al. 2017).

## 7 Conclusion

Social interaction features are not associated with the app ratings and downloads. Although sufficient evidence shows that there is an increase of review numbers in apps with social interaction features, the impact of these features on app popularity remains to be further studied, because review numbers are not directly linked to the popularity. Future research will focus on sentiment and content analyses of reviews and examine potential theoretical and practical implications.

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