

Research Report

The Impact of a Mental Health Game (eQuoo) on the Resilience of Young Adults: A Case Series Study

Philip Jefferies*, Alina Dixon¹ and Michael Ungar²
Resilience Research Centre, Dalhousie University, Canada

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Abstract.

Background: mHealth apps are showing promise as an accessible means to improve mental health and wellbeing. However, there is limited evidence for their efficacy, particularly in periods after their initial usage, and in non-Western cultures.

Objective: In this study, we explored the impact of *eQuoo*, an emotional fitness application which gamifies self-reflection and learning, in terms of its ability to build resilience in a sample of young people in Vietnam.

Materials and Methods: Individuals ($n = 264$, $M = 25.65$ years, $SD = 4.84$; 52% female) completed self-reports consisting of three different measures of resilience (the Rugged Resilience Measure, Adult Resilience Measure, Brief Resilience Scale). Assessments were taken at the start and end of a five-week use period, and also three months after baseline.

Results: Comparison tests indicated various improvements in resilience between baseline and five weeks and at three months, depending on the subgroup of participants (whether male or female or younger or older), as well as in terms of the way resilience was operationalised (e.g., ability to ‘bounce back’ or the protective factors associated with managing adversity).

Conclusion: The study indicates that *eQuoo* can build resilience and can therefore provide a convenient means of supporting the mental health and wellbeing of young adults.

Keywords: Mental health, resilience, case series, mHealth, gamification

INTRODUCTION

The prevalence of mental health disorders in young people has been steadily rising over the past decade, with around 20% of the world’s young people currently living with a mental health condition [1]. In

2019 it was estimated that one in seven adolescents, or 166 million young women and men around the world experienced some form of mental disorder [2]. Depression, anxiety, and behavioural disorders are among the leading causes of illness and disability for young people globally [1]. Recent events such as the COVID-19 pandemic have further exacerbated this problem by contributing to levels of anxiety and depression while simultaneously decreasing young people’s ability to access in-person support [3, 4].

Mental health apps (herein referred to as mHealth apps) are a potentially beneficial resource for young

*Correspondence to: Philip Jefferies, Resilience Research Centre, Dalhousie University, Canada. Tel.: +1 902 494 3050; E-mail: Philip.jefferies@dal.ca; ORCID: 0000-0003-4477-9012.

¹0000-0001-8960-3227

²0000-0003-0431-347X

people to both recover from disorder and maintain good mental wellbeing. Such apps are accessible for young people, who typically have high levels of cell phone use across a variety of sociodemographic domains [5]. They also have the potential to circumvent significant barriers such as stigma associated with seeking psychological help, a desire to manage symptoms on one's own, and circumvent negative perceptions of treatment [6]. As pharmacological treatments can cause adverse effects and therefore are not suitable for everyone, mHealth apps as a nonpharmacological treatment may stand to serve a wide population of affected individuals [7].

While many mental health apps directly target symptoms of mental health issues, such as those that explore emotions and anxiety levels for individuals affected by anxiety [8] and those challenging beliefs and tracking mood for depression [9], an alternative approach to improving mental health is by building resilience. More than half of individuals under 18 years have reported experiencing at least one form of adversity [10–12], and over a quarter of all mental health problems are said to result from adverse events in childhood, such as neglect or abuse [12]. Resilience is the ability to overcome or adapt to adversity [13–15] and is receiving increasing interest due to the link between resilience and mental health [16, 17]. In sum, if many individuals experience adversity and these are linked to mental health problems, then building resilience as a means to help manage and overcome adversity can contribute to better mental health.

The way that resilience has been conceptualised, however, has implications for mHealth apps. Far from days when resilience was associated with innate personality traits [18], it is generally now considered a process of drawing on resources to overcome or adapt to adversity [19]. These resources, otherwise known as protective factors or resilience-enablers [20, 21] may be found within individuals (e.g., self-efficacy, self-regulation, future orientation) but also in the individual's environment (e.g., community cohesion, safety, access to employment). As all of these factors, both internal and external, have been shown by resilience researchers to be modifiable [see, for example, 22], mHealth apps can work to improve a number of factors at once.

One particularly innovative mHealth app that builds resilience is eQuoo (<https://www.equoo.com/>). eQuoo gamifies elements of psychoeducation, storytelling, Cognitive-Behavioural Therapy (CBT), and positive psychology to help users improve their

mental health [6]. It differentiates itself from many other mHealth apps by presenting itself predominantly as an online quest (further details about the app given later), which increases the likelihood of uptake (especially among young people) and may also lead to continuing engagement, which is a problem for all forms of psychological services including apps [see 23, 24]. eQuoo is now in its second iteration and includes modules specifically addressing resilience factors. In addition to strengthening psychological resilience, eQuoo now promotes social-ecological resilience such as engaging with one's community, exploration of culture and traditions, and seeking opportunities to use one's talents.

Initial trials of the effectiveness of eQuoo have garnered positive results. A recent randomised controlled trial in the UK lasting five weeks found that users of the app significantly reduced self-reported levels of anxiety while increasing their resilience, positive growth, and social relationships, when compared to a control group and participants who used a non-gamified mental health app [6]. Furthermore, the 90% level of continuous engagement by participants over the intervention period was 21% higher than the rates of attrition in the control groups. Although promising, further testing is still required, including exploration of the longer-term impact of the app and its effect among populations residing in low- and middle-income countries (LMIC), as a large portion of mHealth studies have taken place only in high-income countries (HIC) in North America and Europe [7, 25].

The purpose of this study, then, was to examine the longer-term resilience-building capacity of the eQuoo mHealth app in a LMIC. An opportunity to conduct such a study arose when CLEAR (a Unilever brand of hair care products) adopted eQuoo as part of their initiative to address the mental health challenges of young people in a number of Asian countries. Specifically, the company launched an awareness campaign aimed at young people across their target markets, one of which was Vietnam. This was supported by data-gathering efforts to help further evaluate the app. Rates of youth mental illness in Vietnam are significant, with several studies indicating high levels of depression, suicidal behaviour, and associated risk-taking such as alcohol abuse [26]. Access to mental health support also remains low in the country, with poor geographic distribution of trained professionals, a lack of adequate training to screen and diagnose mental illness, shortages of psychotropic medications, and only 1.01 psy-

chiatrists per 100,000 people (compared to 15.6 in OECD countries) [26]. mHealth interventions such as eQuoo therefore offer a potential means to address the treatment gap in Vietnam. Furthermore, in response to the COVID-19 pandemic, the government of Vietnam invested heavily in mHealth applications, which aligns with findings that indicate a readiness by Vietnamese to accept and utilize mHealth apps [27].

In this exploratory study, we expected levels of resilience to improve over time for participants who used the app. Specifically, we anticipated that there would be an improvement in resilience scores between baseline (T1) and the end of the app use period five weeks later (T2). To explore the longer-term impact of the app, we also compared baseline scores (T1) to scores taken three months later (T3), and compared scores at T2 and T3 to determine whether any improvements remained stable.

MATERIALS AND METHOD

Design

This study involved secondary analyses of a dataset compiled by a research and analytics company Asia Monitor (<http://www.asiamonitor.com.my/>) on behalf of CLEAR. CLEAR had sought to independently evaluate the impact of the eQuoo app, and so released the dataset to Dalhousie University's Resilience Research Centre (RRC) which had the capacity and experience to analyse the data. The study adopted a repeated measures design, where participants used the eQuoo app over the course of five weeks (a week for each module) and completed a survey at baseline (T1; prior to using the app), at the end of the five-week period (T2), and then again three months after baseline (T3).

The study conforms to guidelines for nonrandomized studies of treatment effects using secondary data sources [28], as registered with the EQUATOR network [29]. As a case series study, it also conforms to the PROCESS guidelines [30]. The original data collection process conducted by Asia Monitor complied with the Market Research Society Professional Code of Conduct and data protection laws in Vietnam. The secondary analyses of the dataset were approved by Dalhousie's Research Ethics Board (#2021-5516) and were registered at the Research Registry (UIN: researchregistry8504).

eQuoo

The eQuoo app is a five-week course taught by an avatar, Dr. Joy, and two associate avatars. After completion of the introductory course, players are invited to build their own avatar and begin a choose-your-own-adventure story in which they practice the skills they learned during the five-week course. The plot is based on a fictional world in which greed, corruption and pain have brought the world to a place of darkness known as "The Quavering". Players are tasked with collecting five gems (each representing one dimension of emotional health: personal growth, anti-depression, anti-anxiety, relationship skills, and resilience) which they use to fight The Quavering.

Participants and procedure

There were 300 individuals initially recruited for the trial. However, Asia Monitor had excluded 25 (8%) who did not complete all three assessments. As our analyses involved grouping individuals by sex (see below), 11 individuals who did not indicate being male or female were also excluded as there were too few to constitute another group. The study sample therefore comprised 264 individuals (aged $M = 25.65$ years, $SD = 4.84$; 52% female) who were selected from four of the five tier one cities in Vietnam (Cantho, Danang, Hanoi, Ho Chi Minh City; Table 1). As per the normal market research functions Asia Monitor carries out for its clients, each city was divided into sections and landmarks where there was known to be considerable foot traffic. At these locations, participants were convenience sampled by being approached on the street by project assistants who invited the individual to take part in the study. At this initial point of contact, participants gave consent for their data to be analysed for research purposes and then completed the baseline survey. They were then given the link to the app, downloaded it to their phone, and were asked to complete the first unit by the end of the week. The project assistants re-contacted the participants to verify they had completed each unit. After five weeks, they were contacted again to request they complete the survey again, and again three months after baseline.

Measures

We drew on three measures which assess different aspects of resilience, reflecting the complex and multisystemic nature of the construct [e.g., 14, 15]. The

Table 1
Participant characteristics

Characteristic	N	%
<i>Sex</i>		
Female	127	48
Male	137	52
<i>Age</i>		
19–25	138	52
26–34	126	48
<i>Location</i>		
Ho Chi Minh City	70	27
Hanoi	93	35
Danang	53	20
Cantho	48	18
<i>Education level</i>		
Some secondary school or equivalent	9	3
Vocational school/technical college	94	36
Some university/higher education	47	18
University degree	107	41
Postgraduate degree	1	<1
Prefer not to say	6	2
<i>Employment status</i>		
Working full-time	149	56
Working part-time	26	10
Studying full-time	66	25
Studying part-time	7	3
Unemployed	7	3
Other/prefer not to say	9	3
<i>Household income</i>		
<15 million VND	99	38
=>15 million VND	164	62
Total	264	100

first was a modified version of the Brief Resilience Scale [BRS; 31], which is a six-item measure (score range 6–30) prompting participants to reflect on past experiences in terms of their ability to ‘bounce back’ following experiences of adversity. The measure’s items had been modified to make the BRS prospective, such that individuals were prompted to consider how likely they believed they would be to bounce back if they experienced adversity in the future (e.g., “I usually come through difficult times with little trouble” had been modified to read “If I encountered difficult times in the future, I would probably come through them with little trouble”) (present study reliability: $\alpha = 0.74$, $\omega = 0.74$). The modification was made to intervention testing since the original wording of the items could lead participants to consider a period of time prior to the intervention, meaning that their scores at T2 and T3 may not reflect changes attributable to the app. The second resilience measure was the Rugged Resilience Measure [RRM; 32], which contains 10 items (score range 10–50) and reflects psychological skills and strengths that are considered protective factors that facilitate resilience following experiences of

adversity (e.g., problem-solving ability, emotion regulation) ($\alpha = 0.93$, $\omega = 0.93$). Similarly, the Adult Resilience Measure-Revised [33, 34] is a 17-item measure (score range 17–85) of resilience which assesses the availability and accessibility of social-ecological resources (e.g., community belonging, peer support) which facilitate resilience ($\alpha = 0.94$, $\omega = 0.94$). For the three measures, higher scores indicate higher levels of resilience. All the survey measures had been professionally translated from English to Vietnamese by Asia Monitor.

Analyses

There was a small amount of missing data across the study variables (T1=0.38%, T2=2.27%, T3=3.41%) thus no imputation was required. We specified individual linear mixed effects models for each of the outcomes, involving time (T1-T3), sex (male/female), and age group (19-24/26-34) as fixed factors (plus interactions), and we specified random intercepts for participants. We used planned comparisons to examine changes in the outcomes between time points. All *p*-values were Tukey corrected. Effect sizes were produced and interpreted using standard benchmarks (small: $d = 0.2$; medium: $d = 0.5$; large: $d = 0.8$; Cohen, 1988). All analyses were performed in R (v4.0.0) using *lme4* (v4.1.1–27.1) and *emmeans* (v1.7.2) for pairwise comparisons and the calculation of effect sizes. The data and code for replicating analyses can be found at <https://osf.io/yhjgc/>.

RESULTS

Changes in BRS scores

There were no significant differences when contrasting BRS scores between baseline and the five-week end-of-app-use period, for males or females of either age group (Table 2). However, when comparing scores at baseline and the three-month time point, scores of 26-34-year-old males and females were found to significantly improve (males: $M_{T1} = 19.68$, $SE_{T1} = 0.42$, $M_{T3} = 21.45$, $SE_{T3} = 0.42$, $p = 0.001$; females: $M_{T1} = 19.45$, $SE_{T1} = 0.42$, $M_{T3} = 20.61$, $SE_{T3} = 0.42$, $p = 0.038$). The effect sizes for these improvements were medium ($d = 0.668$) and small to medium ($d = 0.435$; respectively). BRS scores for 16-25-year-old males and females did not significantly differ between baseline and five weeks, or between five weeks and three months.

Table 2
Average resilience scores at each time point with paired comparison tests

	M (SE)			T1 vs T2				T1 vs T3				T2 vs T3				
	T1	T2	T3	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>	
<i>BRS</i>																
Males, 19–25	19.15 (0.41)	19.54 (0.41)	19.74 (0.41)	0.825	515	0.688	–	1.254	515	0.422	–	0.429	515	0.904	–	
Females, 19–25	19.67 (0.39)	19.48 (0.39)	19.44 (0.40)	0.423	521	0.906	–	0.517	522	0.862	–	0.096	517	0.904	–	
Males, 26–34	19.68 (0.42)	20.61 (0.42)	21.45 (0.42)	1.960	515	0.123	–	3.717	515	0.001	0.668	1.757	515	0.185	–	
Females, 26–34	19.45 (0.42)	20.30 (0.42)	20.61 (0.42)	1.796	515	0.172	–	2.461	515	0.038	0.435	0.665	515	0.784	–	
<i>RRM</i>																
Males, 19–25	34.52 (0.83)	36.05 (0.82)	39.22 (0.82)	1.643	516	0.229	–	50.062	516	<0.001	0.892	30.436	514	0.002	0.603	
Females, 19–25	34.68 (0.78)	37.69 (0.79)	38.92 (0.79)	3.422	520	0.002	0.572	4.795	521	<0.001	0.805	1.384	516	0.350	–	
Males, 26–34	36.82 (0.84)	37.61 (0.84)	39.39 (0.84)	0.837	514	0.680	–	2.716	514	0.019	0.488	1.879	514	0.146	–	
Females, 26–34	35.97 (0.83)	39.38 (0.83)	39.78 (0.83)	3.665	514	0.001	0.648	4.102	514	<0.001	0.725	0.437	514	0.900	–	
<i>ARM</i>																
Males, 19–25	63.14 (1.23)	64.69 (1.23)	67.28 (1.23)	1.166	515	0.474	–	3.104	515	0.006	0.545	1.939	515	0.129	–	
Females, 19–25	64.32 (1.16)	67.17 (1.17)	68.70 (1.18)	2.245	520	0.065	–	3.439	522	0.002	0.578	1.200	517	0.454	–	
Males, 26–34	64.94 (1.26)	66.90 (1.26)	67.24 (1.26)	1.442	515	0.320	–	1.690	515	0.210	–	0.0248	515	0.967	–	
Females, 26–34	66.91 (1.24)	70.22 (1.24)	69.86 (1.24)	2.465	515	0.037	0.436	2.198	515	0.073	–	0.267	515	0.961	–	

Note: Shaded cells foreground significant results. Effect sizes are only given for significant findings. M = Mean, SE = Standard Error, *t* = *t*-ratio, *df* = degrees of freedom, *p* = *p*-value, *d* = Cohen's *d* effect size. *p*-values are Tukey corrected.

Changes in RRM scores

RRM scores for both age groups of females significantly improved during the app use period (16-25-year-old females: $M_{T1} = 34.68$, $SE_{T1} = 0.78$, $M_{T2} = 37.69$, $SE_{T2} = 0.79$, $p = 0.002$; 26-34-year-old females: $M_{T1} = 35.97$, $SE_{T1} = 0.83$, $M_{T2} = 39.38$, $SE_{T2} = 0.83$, $p = 0.001$), both with medium effect sizes ($d = 0.572$ and 0.648 , respectively). These improvements remained stable, with no significant differences observed between the five-week and three-month time points (Fig. 1).

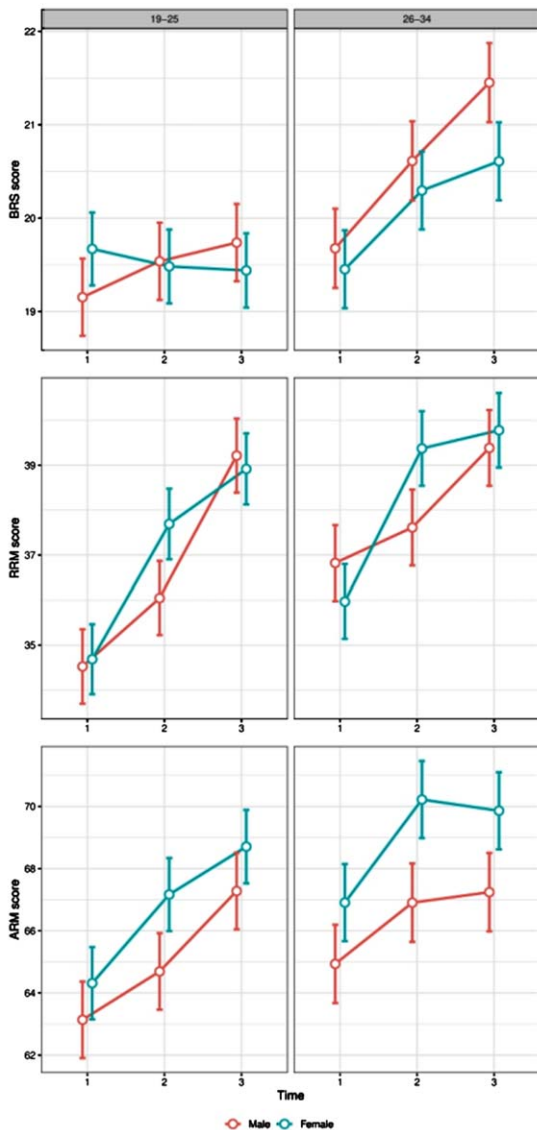


Fig. 1. Changes in average resilience scores over time for 16-25-year-old and 26-34-year-old males and females. Note: Error bars represent standard error.

Although the RRM scores of 16-25-year-old male participants did not improve during the app use period, there was a significant improvement (large effect size) when comparing their baseline and three-month scores ($M_{T1} = 34.52$, $SE_{T1} = 0.83$, $M_{T3} = 39.22$, $SE_{T3} = 0.82$, $p < 0.001$, $d = 0.892$). A significant improvement (medium effect size) was also observed between the five-week and three-month time points ($M_{T1} = 34.68$, $SE_{T1} = 0.78$, $M_{T2} = 37.69$, $SE_{T2} = 0.79$, $p = 0.002$, $d = 0.603$).

A similar result was found for RRM scores of 26-34-year-old male participants, which also did not significantly improve between baseline and five weeks, but did show a small to medium effect size between baseline and three months ($M_{T1} = 36.82$, $SE_{T1} = 0.84$, $M_{T3} = 39.39$, $SE_{T3} = 0.84$, $p = 0.019$, $d = 0.488$).

Changes in ARM scores

Only the ARM scores of 26-34-year-old female participants significantly improved (small to medium effect size) during the app use period ($M_{T1} = 66.91$, $SE_{T1} = 1.24$, $M_{T2} = 70.22$, $SE_{T2} = 1.24$, $p = 0.002$, $d = 0.436$). This improvement remained stable, with no significant changes observed between the five-week and three-month time points. However, like with the RRM scores of male participants, ARM scores for both 16-25-year-old males and females that had not significantly improved between baseline and five weeks did so between baseline and three months (16-25-year-old males: $M_{T1} = 63.14$, $SE_{T1} = 1.23$, $M_{T3} = 67.28$, $SE_{T3} = 1.23$, $p = 0.006$, $d = 0.545$; 16-25-year-old females: $M_{T1} = 64.32$, $SE_{T1} = 1.16$, $M_{T3} = 68.70$, $SE_{T3} = 1.18$, $p = 0.002$, $d = 0.578$). No changes in scores were observed for 26-34-year-old male participants.

DISCUSSION

This study found that there are some short- and long-term improvements to resilience associated with using the mHealth app, eQuoo. Specifically, there were significant short-term increases in some resilience scores for female participants, while scores for both male and female participants continued to improve up to the three-month measurement point. This contributes to the body of evidence supporting the effectiveness of mHealth apps such as eQuoo [7, 36–39].

In particular, the findings of this study extend those of Litvin and colleagues [6] in their evaluation of the eQuoo app. That study found that resilience scores increased over the course of a five-week period while using the app when using the ARM to measure resilience. In the current study reported here, however, we only detected an increase in ARM scores for 26-34-year-old females during the five-week app-use period. Improvements for 16-25-year-old participants (both male and female) were only observed when comparing baseline to three-month time points. The discrepancy may be due to the different versions of the app under evaluation (Litvin and colleagues used an earlier version, which contained training on just ten psychological skills; for further details see Litvin et al., 2020) but may also be a feature of the sample. Litvin et al.'s sample were from the UK and included a broader age range ("16-24+"). Where culture and age have been accounted for in studies of resilience, there is always the possibility of finding distinctly local or age-related patterns to positive development even if the same themes (like the need for self-efficacy, empathy and sense of belonging) vary in how these aspects of positive development are expressed [40, 41].

Furthermore, the findings in this study are based on results from data collected over a longer period of time than in Litvin's earlier evaluation of eQuoo. The longer time frame (three months) may be necessary to detect change in social-ecological resources associated with resilience, like relationships with family members and one's community, factors measured by the ARM. Therefore, although use of the app may lead to individuals feeling more capable in terms of their ability to improve their resilience, actual improvements (as measured by the ARM) may require opportunities to build new resources or make better use of the resources already available, such as a broader social network or finding opportunities to use one's talents [42].

Relatedly, RRM scores improved during the app use period for female participants, but improvements for male participants were only significant when comparing baseline to three-month scores. The RRM focuses on psychological protective factors associated with resilience, which may explain why scores for female participants improved during the app-use period while males took longer to integrate the learning. This pattern will need further investigation to understand better the link between sex, gender and cultural norms regarding how males and females in

a LMIC like Vietnam perceive and express personal resilience.

Interestingly, perceptions of one's ability to bounce back, as measured by the BRS, only showed improvement for 26-34-year-old participants when their baseline and three-month scores were used in the analysis. No significant improvements were detected for 16-25-year-old participants. Here again we see the need to, first, conduct an assessment of app effectiveness by including a number of different measures of positive outcomes if one is to detect the nuances of changes in individual and social resources associated with psychological growth. Second, we suspect that an app like eQuoo has a differential impact in different cultural spaces depending on the intersection of participant qualities like age, sex, gender, and cultural values and beliefs. Therefore, research exploring the impact of mHealth apps on resilience should take care to operationalise the construct appropriately and match measures accordingly (whether the capacity to bounce back, levels of psychological protective factors, or levels of social-ecological protective factors). Future studies should also include populations from more than one country context and use multiple measures of resilience if they are to inform a deeper understanding of which populations benefit most from apps like eQuoo that gamify lessons in positive development.

Furthermore, after reviewing recent meta-analysis studies, we did not encounter any that explored the potential differing impact of mobile interventions for mental health between older and younger individuals, or between sexes (e.g., [43-47]). Our findings, some of which varied depending on the age and sex of the individual, suggest that different groups may respond to apps in different ways, which may be an important focus for future research (i.e., to discover how and why) as well as promoting the importance of outcome analyses involving these subgroups.

Despite the nuances to our study's results, overall, the findings indicate improvements to resilience as a result of using eQuoo. Furthermore, none of the improvements occurring by the end of the app-use period significantly declined at the three-month time point, indicating that improvements, when they occurred, were sustained. However, there was much heterogeneity in terms of the particular groups that benefited (males vs females, 26-34-year-olds vs. 16-25-year-olds), when improvements occurred, and depending on the particular resilience measure used.

Limitations and future directions

A clear limitation of this study was the lack of a control group. Without such a comparison, it is not possible to confirm whether improvements in scores were due to the app or another influence. Although this research study was exploratory, further hypothesis-testing research using a randomised control trial design would be important to confirm improvements in resilience as a result of using eQuoo.

Conclusion

There is growing interest in using apps to provide mental health care to populations under stress. While most of the effectiveness trials for these apps are taking place in HIC, there is growing interest in their use from many countries that lack a well-developed mental health care system. Who benefits most from their use, and which kinds of apps are likely to engage different populations most is still not known. This current study suggests that apps like eQuoo could have a positive effect on resilience, though a great many questions remain regarding measurement design, dose effects and contextual factors which influence participant outcomes. Future research will need to address these issues if these apps are to be relevant to culturally diverse populations.

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Conflict of interests

The authors have no conflict of interest to report.

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AUTHORS' CONTRIBUTIONS

PJ: Conceptualization (equal); methodology (equal); formal analysis (lead); writing – original draft (lead); writing – review and editing (equal).

AD: Writing – original draft (supporting); review and editing (equal).

MU: Conceptualization (equal); methodology (equal); writing – original draft (supporting); writing – review and editing (equal).

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