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Scientific Publication Patterns of Cognitive-Behavioral Therapy and Interactive Mobile Technologies for Treatment Eating Disorders: A Bibliometric Analysis

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Abstract

The development of interactive mobile technologies (IMTs) as a supportive tool for psychological treatment of eating disorders has been enhanced significantly throughout the past 10 years. Thus, to investigate how research on those techniques is reflected in the current literature, the author analyzed peer-reviewed publications to determine the existing patterns of research domains in cognitive-behavioral therapy (CBT) applying IMTs and eating disorder treatments and suggested future research directions in this research area. Bibliometric analysis was employed to identify publication patterns, frequent keywords, and tendencies for the fields during 2010 and 2021. The author focused on highly ranked sources to find the answers for research questions.

A total of 875 relevant studies were retrieved from the LENS database. The study found a significant increase in research domains during the past decade, indicating General Medicine, Psychiatry and Mental Health as leading subject areas. Among the most productive journals are Health Technology Assessment, Journal of Medical Internet Research, and JMIR mHealth and uHealth, which published papers in Medicine, Psychology and Psychological Intervention. This current study indicated that IMT, in combination with in-person CBT increases the efficiency of health intervention for eating disorders, reduces essential symptoms and improves overall well-being. IMT proved its efficiency as a supportive tool in managing diet, body image, stress, and sleeping disorders. This study will be beneficial for researchers to obtain an overview of the publication trends in research domains for further studies, and it indicates the potential gaps in explored fields.

Keywords: eating disorders; interactive mobile technologies; cognitive-behavioral therapy; bibliometric.

Introduction

The effectiveness of various psychological and technology-based treatments for patients with eating disorders and its related chronic symptoms is a major research interests that scientists and practitioners are experiencing today. Cognitive-behavioral therapy (CBT) is recognized as one of

the most effective psychological approaches in the psychological treatment of eating disorders (ED). Mobile technologies have been found to be useful in supporting treatment for patients with ED (Van Lippevelde et al. 2016; ter Huurne et. al, 2015).

Interactive mobile technologies (IMTs) appeared to be accessible as a cost-effective tool to assist in a global health perspective, but they can create challenges as well as opportunities at global and local levels (Prescott et al., 2019). Enrique et al. (2018) explored efficiency of positive technology application among individuals with eating disorders. A similar study (Yim & Schmidt, 2019) presented an analysis of the contemporary state of research on self-help interventions for various types of ED. Factors influencing readiness for use of digital interventions supporting weight management were recognized as significant for psychological intervention (Sharpe, Karasouli & Meyer, 2017). It has been suggested that considering various factors at the early stages of the development of digital intervention might reinforce its effects. Musetti et al. (2018) focused on exploring the motivational drives in CBT among patients with obesity, considering them as a key point in the treatment's efficiency. A study by Riva et al. (2016) provides analysis of the potential of virtual reality for enhancing the individuals' external experience generated by emotional engagement and sense of presence.

A study on the effects of a web-based CBT in improving the psychopathology of eating disorders and reducing body dissatisfaction among female patients stated that CBT, supported with technology, results in improving eating disorder psychopathology among females (ter Huurne et. al, 2015). A trial on the effectiveness of acceptance and commitment therapy suggested the need for more research on applying psychological therapy among individuals with obesity (Järvelä-Reijonen et al., 2020).

A group of studies has examined the use of IMTs in psychological treatments of various ED in different age groups. An online self-help CBT package was recognized as desirable and acceptable in therapy for patients with bulimia nervosa and other specified eating disorders in a study by McClay et al (2013). A similar study (Torres-McGehee and Olgetree-Cusaac, 2011) investigated the existing approaches in treating eating disorders and provides a prognosis for preventive strategies in relation to bulimia nervosa among athletes. Intrapersonal, interpersonal, and physical spatiality among individuals with anorexia nervosa was explored by Cipolletta et al. (2017).

A recent systematic review (Hollis et al., 2016) analyzed the current state of research and practice on digital health for children and youth with ED and other mental health problems. Similarly, another systematic review (Dalton et al., 2018) focused on the effects of neurostimulation in clinical and sub-clinical treatments for ED. A study by Jones et al. (2018) analyzed online intervention as a way of preventing obesity and other ED among adolescents in school. Stensland et al. (2015) stated that there is a strong correlation between being overweight and psychosocial factors. A similar study (Emirtekin er al., 2019) explored the impact of childhood emotional abuse and neglect on body image dissatisfaction, anxiety, and depression in problematic smartphone use among adolescents. McCaig et al. (2019) conducted research on methodology of mental health-related forums and commentators on other related forums. Griffiths et al. (2018) focused on the influence of social media on body dissatisfaction and eating disorder symptoms among men, while Bellard et al. (2021) indicated the importance of perceptual distortion in actual and ideal body size among females. Tan et al. (2016) measured the effects of a 6-month diet on sleep disturbance among overweight men. Another study aimed to develop a nutritional treatment for weight problems with virtual reality technology Fuster-Guilló et al. (2020). A study by Van Lippevelde et al. (2016) suggested that the developed app is an attractive and effective technology in behavioral change.

Nezami, Lytle & Tate (2016) conducted a randomized trial on feasibility of interactive technology to involve mothers in interventions on reducing the intake of sugar-sweetened drinks among preschool-age children. A similar study by Lisón et al. (2020) measured the short- and long-term efficacy of a web-based intervention promoting lifestyle changes among individuals with obesity and hypertension.

Purpose of the Study and Research Questions Targeting Research Domains

The primary aim of this article is to investigate scientific publication patterns in the chosen research domains of "cognitive behavioral therapy applying interactive mobile technologies" concerning "eating disorders." The paper also determines the impact on scientific knowledge by underlining the gaps and indicating potential development areas for further studies. Based on the mentioned above study objectives and scope, research questions were formulated as below.

RQ1 What are the descriptive characteristic of publication results on "mobile technologies and applications" concerning "eating disorders" between 2010 and 2021?

RQ2 Who are the most productive authors/co-authors, and what are their countries of origin? What are the citation results of these authors?

RQ3 In which journals were the papers published most frequently? Which universities/organizations contribute to the research area and where are they located?

RQ4 What are the keyword/MeSH Heading analysis results of the publications?

IMT as an effective tool in psychological treatment of eating disorders has been studied by researchers from different perspectives (e.g. mobile apps, digital health, web-based programs, and virtual reality). However, more empirical focus is required to investigate the essential benefits of IMTs as supporting tools in the prevention and psychological treatment of various types of eating disorders [4, 19]. This study is the first bibliometric analysis that aims to give a snapshot of published studies on psychological treatment of eating disorders with support of IMT from 2010 to 2021.

Method

Bibliometric Study

The bibliometric study enables researchers to explore patterns, trends, associations, and scientific developments in searched domains, as well as in interrelated fields, using publication data. It requires a structured bibliometric database to analyze the appropriate data (e.g. conference proceedings, peer-reviewed journal articles, reviews, periodicals, and reports) to answer research questions (Kulakli & Shubina, 2020a, 2020b; Aria & Cuccurullo, 2017; Jalali et al., 2019; Müller et al., 2018; Li et al., 2015; Esfahani, Tavasoli & Jabbarzadeh, 2019). Researchers can employ descriptive publication characteristics, author/co-author productivity, sources, and keyword analysis (Kulakli & Shubina, 2020a, 2020b; Esfahani, Tavasoli & Jabbarzadeh, 2019).

Data Collection and Extraction

A bibliometric study requires a structured database to analyze the publication data. A valid search query to retrieve as many papers as possible with minimum irrelevant results was the challenge. In the current study, the author reviewed papers published within the studied field to build a search query for CBT and IMT for ED. In the current study, the author used an extensive and comprehensive search query to retrieve all relevant papers focusing on CBT and IMT for treatment of eating disorders in LENS. The analyzed bibliometric databases are Crossref, Microsoft Academic, PubMed, PubMed Central, and Core.

Search criteria and strategy:

Scholarly Works (875) = 'cbt OR (cognitive-behavioral AND (therapy' AND ('eating AND (disorder' AND ('interactive AND (mobile AND technology'))))))

Year Published = (2010 - 2021)

External ID Type = (Core, Crossref, Microsoft Academic, PubMed, PubMed Central)

* 875 papers found.

The above-mentioned search was conducted, and the data was retrieved in text (.txt) and Excel (.csv) file formats for further analysis. The Microsoft Excel and LENS platform (version 7.4) software with "bibliometrix" package was used for descriptive and bibliometric data analysis. The bibliometric analysis allowed for retrieval and for describing subject areas, fields of study, years of

publishing, citations, keywords, and the most productive authors, journals, organizations, and countries.

Results

Publication profile and descriptive publication results

A total of 875 publications for the research domain were retrieved from the LENS database. Crossref provided 865 results, Microsoft Academic 787, PubMed 422, PubMed Central 307 and Core 875. The same papers were found in a few data sets, so as a result 875 papers were selected. The majority of analyzed articles were written in the English language by 100 authors/co-authors from 70 different countries, led by the United Kingdom, followed by the United States, Australia, Spain, Germany, and Sweden. Descriptive characteristics of the publications show a significant increase in their numbers in 2016 (n=118), 2017 (n=140), 2018 and 2019 (n=120 each).

According to the review, related fields of study are categorized under the top 10 fields with publications [n] and percent (%) value in Table 1. The data show that the 2 leading fields are Medicine, with 320 published papers (36.5%), and Psychology, with 251 papers (28.6%), followed by Psychological Intervention (n=178, 20.3%), Mental Health (n=127, 14.5%), and Intervention (n=90, 10.2%).

Table 1

Top 10 fields of study by publications count (2010-2021)

Field of Study	Publications (n)	Percent n=875 (%)
Medicine	320	36.5
Psychology	251	28.6
Psychological Intervention	178	20.3
Mental Health	127	14.5
Intervention (Counseling)	90	10.2
RCT	88	10
Health Care	75	8.5
Computer Science	75	8.5
Applied Psychology	69	7.8
Nursing	60	6.8

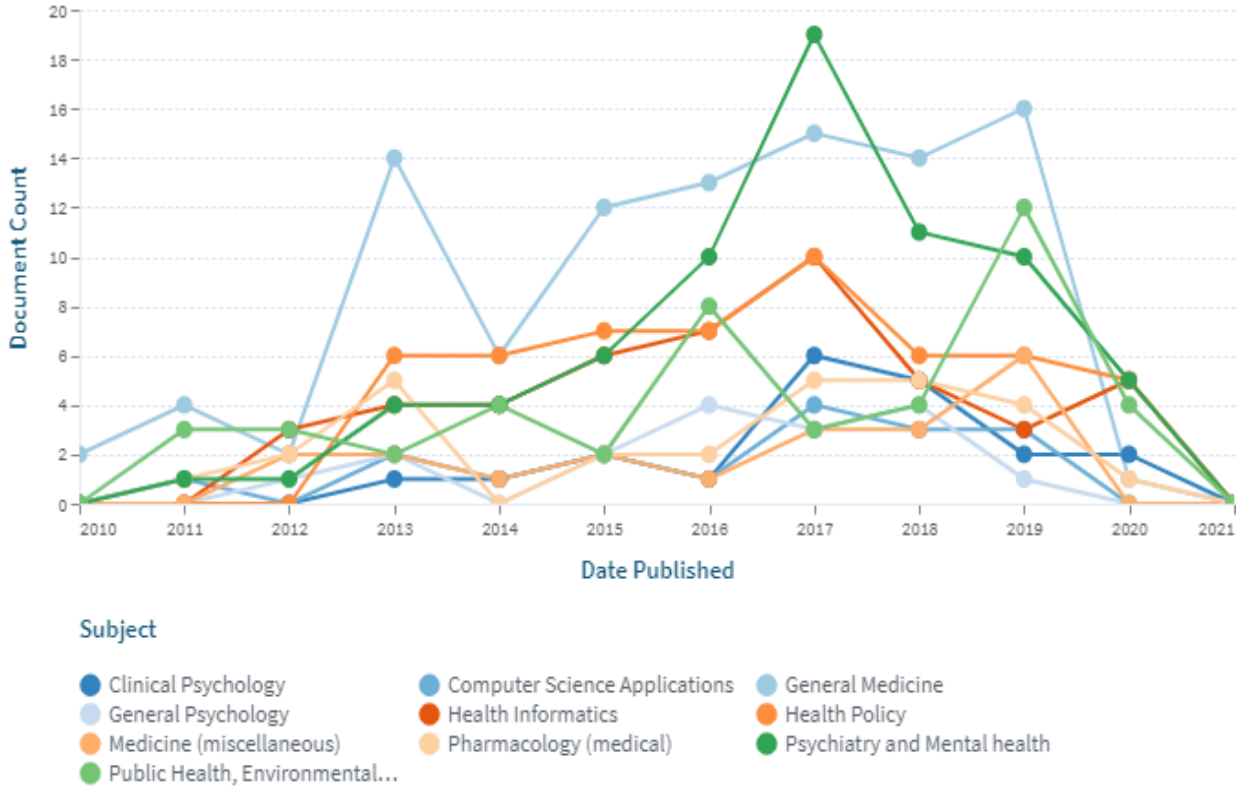
Distribution of publications by subject and date of publishing

Figure 1 presents the publication records by year, beginning in 2010 to 2021. Records start with n=2 in 2010 in General Medicine, then significantly increase in 2013 in the other 5 fields (n=14 in Medicine, n=6 in Health Policy, n=4 in Psychiatry and Mental Health, n=2 in Public Health, and n=1 in Clinical Psychology). In 2014 records decreased sharply in 7 fields (n=6 in General Medicine and Health Informatics, n=4 in Psychiatry and Mental Health and in Public Health, n=1 in Clinical Psychology and Medicine). In 2017 the publication records rise sharply in 5 fields (n=19 in Psychiatry and Mental Health, n=15 in Medicine, n=10 in Health Policy and Health Informatics, and n=6 in Clinical Psychology). They decrease after 2019 in all 8 leading fields (n=5 in Psychiatry and Mental

Health, n=4 in Public Health, n=2 in Clinical Psychology, and n=2 in Pharmacology). The most productive subject in 2013, 2015, 2016, 2018, and 2019 was General Medicine, while in 2017 it was Psychiatry and Mental Health. Clinical Psychology published 6 papers in 2017, while General Psychology published 4 papers only in 2016 and 2018.

Figure 1

Changes in document counts by subject and date of publishing between 2010 and 2021



Most productive authors/co-authors

Figure 2 presents the top 10 most productive authors. Christina Botella (n=12) is the leading author, followed by Andrea Gaggioli (n=5) and Adriana Mira, Alan Simpson, Azucena Garcia-Palacios, Claire Henderson, Giuseppe Riva, and Rosa M Banios (n=4 records each). Andrew Farmer and Anita Patel published 3 papers each.

Figure 2

Most productive authors/co-authors by document count (2020-2021)

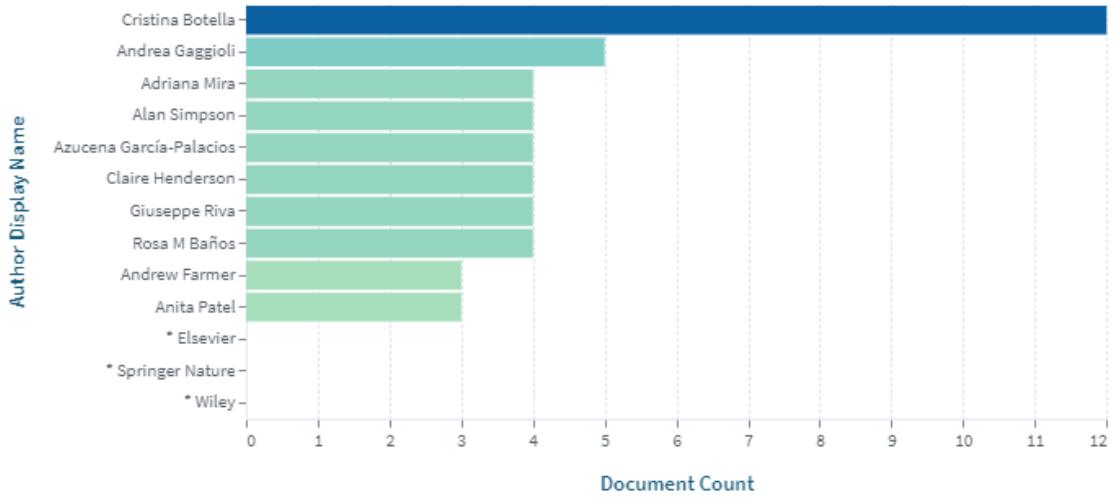


Figure 3 shows the most productive (top 10) countries by corresponding authors who contributed to the research domain fields. The studied domain was mainly explored by European researchers. The 2 top countries are the United Kingdom (n=17) and New Zealand (n=14), followed by the Netherlands (n=7.5), the United States (n=7), Spain (n=6), Canada and Switzerland (n=5.5), and England, Germany, and Hungary (n=4.5).

Figure 3

Most relevant countries by corresponding author (2020-2021)

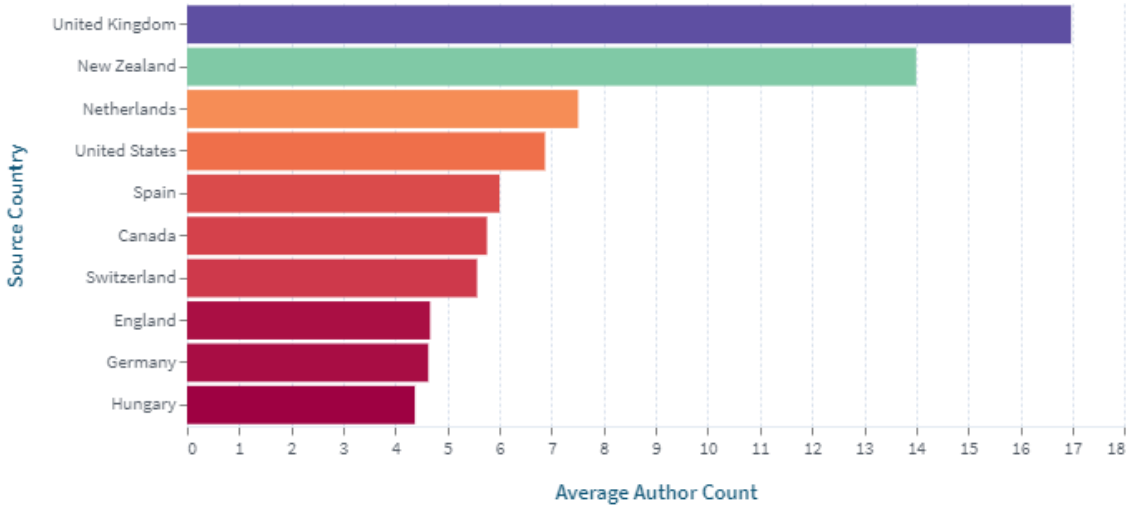
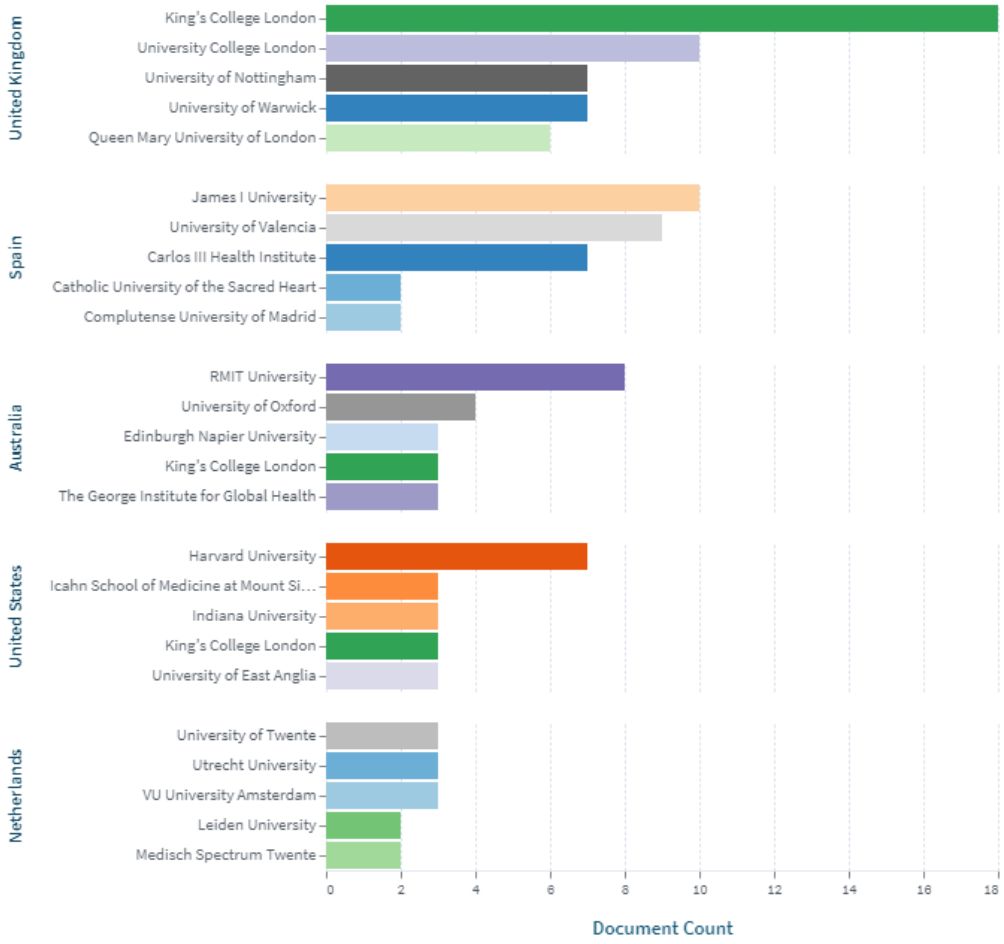


Figure 4

Most productive organizations by publication count and country (2020-2021)



Citation Results

Table 2 presents the top 10 cited articles most related to the search criteria by citation count. Altena et al's (May 2020) publication leads and has the highest citation score, with 226 out of 531, which is 42.5% during the search period. The other top 10 articles by citation results ranged from 10 to 37 (175) of 531, which is 32.9% of total citations (for published papers starting from May 2020 to May 2021). Although citations started from May 2020, the citation count showed the importance of researched subjects.

There are no leading journals, since every paper is published in different sources. However, the highest number of citations was found in Journal of Sleep, followed by The International Journal of Eating Disorders, BMC Public Health, and Journal of Eating. The papers with highest citation score studied mental health, CBT, and some other psychological disorders.

Table 2

Top 10 articles by citation results (2010-2021)

	Title	Author	Published	Journal / Source	Citations
1	Mental Health Smartphone Apps: Review and Evidence-Based Recommendations for Future Developments	David Bakker , Nikolaos Kazantzis , Debra Rickwood , Nikki S Rickard	1-Mar-16	JMIR mental health, Issue: 1, Volume: 3, Pages: 1-31.	Citing Works: 414 References: 277
2	Transforming Experience: The Potential of Augmented Reality and Virtual Reality for Enhancing Personal and Clinical Change	Giuseppe Riva , Rosa M Baños , Cristina Botella , Fabrizia Mantovani , Andrea Gaggioli	30-Sep-16	Frontiers in psychiatry, Issue: 7, Volume: 7, Pages: 164-164.	Citing Works: 144 References: 159
3	The Contribution of Social Media to Body Dissatisfaction, Eating Disorder Symptoms, and Anabolic Steroid Use Among Sexual Minority Men.	Scott Griffiths , Stuart B Murray , Isabel Krug , Siân A McLean	24-Jan-18	Cyberpsychology, behavior and social networking, Issue: 3, Volume: 21, Pages: 149-156.	Citing Works: 60 References: 44
4	Web-Based Cognitive Behavioral Therapy for Female Patients With Eating Disorders: Randomized Controlled Trial	Elke D ter Huurne , Hein A de Haan , Marloes G Postel , Job van der Palen , Joanneke E L VanDerNagel Cornelis A J DeJong	18-Jun-15	Journal of medical Internet research, Issue: 6, Volume: 17,	Citing Works: 36 References: 43
5	The Pros and Cons of Getting Engaged in an Online Social Community Embedded Within Digital Cognitive Behavioral Therapy for Insomnia: Survey Among Users	Neil S Coulson , Richard M Smedley , Sophie Bostock , Simon D Kyle , Rosie Gollancz Annemarie I Luik , Peter Hames , Colin A Espie	25-Apr-16	Journal of medical Internet research, Issue: 4, Volume: 18,	Citing Works: 30 References: 37
6	The role of childhood emotional maltreatment and body image dissatisfaction in problematic smartphone use among adolescents.	Emrah Emirtekin , Sabah Balta , Irfan Sural , Kagan Kircaburun , Mark D Griffiths Joël Billieux	10-Dec-18	Psychiatry research, Volume: 271, Pages: 634-639.	Citing Works: 26 References: 59
7	Effect of Six-Month Diet Intervention on Sleep among Overweight and Obese Men with Chronic Insomnia Symptoms: A Randomized Controlled Trial	Xiao Tan , Markku Alen , Kun Wang , Jarkko Tenhunen , Petri Wiklund Markku Partinen , Sulin Cheng	23-Nov-16	Nutrients, Issue: 11, Volume: 8, Pages: 751.	Citing Works: 16 References: 44
8	Examining Factors of Engagement With Digital Interventions for Weight Management: Rapid Review	E Sharpe , Eleni Karasouli , Caroline Meyer	23-Oct-17	JMIR research protocols, Issue: 10, Volume: 6,	Citing Works: 16 References: 63
9	Interpersonal violence and overweight in adolescents: the HUNT Study	Synne Øien Stensland , Siri Thoresen , Tore Wentzel-Larsen , Grete Dyb	12-Nov-14	Scandinavian journal of public health, Issue: 1, Volume: 43, Pages: 18-26.	Citing Works: 16 References: 29
10	A randomized trial to reduce sugar-sweetened beverage and juice intake in preschool-aged children: description of the Smart Moms intervention trial	Brooke T Nezami , Leslie A Lytle , Deborah F Tate	19-Aug-16	BMC public health, Issue: 1, Volume: 16, Pages: 837-837.	Citing Works: 14 References: 47

Journal and productivity

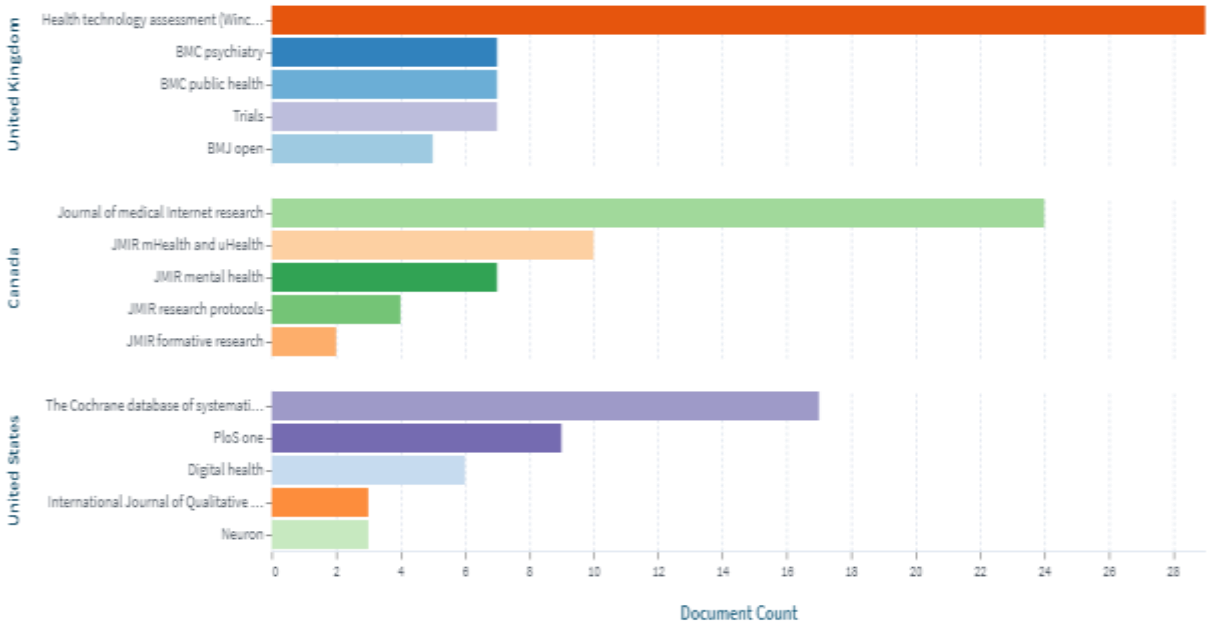
Figure 5 shows publication frequency in the most relevant journals and countries. The top five publication sources sorted from the highest, (with 29 records) are Health Technology Assessment as the leading UK journal, followed by 24 records in Journal of Medical Internet Research and 10 in JMIR mHealth and uHealth (Canada), 17 in The Cochran Database of Systematic Review and 9 in PloS one (United States).

Findings also show that other journals published between 2 and 9 papers (n=66) in the data set retrieved. Those are BMC Psychiatry, BMC Public Health, Trials, BMJ Open (United Kingdom); JMIR Mental Health, JMIR Research Protocols, JMIR Formative Research (Canada);

and Digital Health, International Journal of Qualitative Research, and Neuron (United States).

Figure 5

Most productive journal by publication count and country



Keyword Analysis

Keyword analysis showed the frequency of the keywords used in publications.

Table 3

Most relevant keywords according to PubMed (top 10)

	Author Keywords	Article Counts
1	Mental Health	19
2	Depression	15
3	Ehealth	15
4	Mhealth	12
5	Internet	11
6	Anxiety	8
7	Eating Disorder	7
8	Obesity	7
9	Bulimia	6

Table 3 shows the most relevant keywords used in the publications associated with CBT for eating disorders with the application of IMTs. The first column represents author keywords, with Mental Health, Depression, Ehealth, and Mhealth as higher frequency keywords.The scatterplot presented in Figure 1 illustrates the relation between SET scores and response rate. Although the correlation between SET scores and response rate was small and not statistically significant, $r(362) = .07$, visual inspection of the plot of SET scores suggests that SET ratings became less variable as response rate increased. We conducted Levene's test to evaluate the variability of SET scores above and below the 60% response rate, which several researchers have recommended as an acceptable threshold for response rates (Berk, 2012, 2013; Nulty, 2008). The variability of scores above and below the 60% threshold was not statistically reliable, $F(1, 362) = 1.53$, $p = .22$.

Discussion

Principal Results

This study was conducted to give an overview of research on the psychological treatment of eating disorders, with an emphasis on IMT. The current study demonstrated a very large number of publications on the research domain during 2010-2021. By analyzing the results of the data set regarding IMT and psychological treatment of eating disorders, the publication pattern shows that there is a rapid growth of interest in the subject. The tendency has increased sharply in recent years (from 2016 to 2019). This increase of interest could reflect the development of mobile technology functionality; therefore, those technologies took a significant place in human life, providing opportunities to address their potential benefits. Despite the low motivation and sometimes emotional resistance to the use of such technologies, it seems to be a promising way for individuals to adapt their unhealthy behaviors. IMTs have been recognized as an effective, supportive tool when combined with traditional psychological treatments (ter Huurne et. al, 2015). Cooperation between experts involved in the development and adjustments of IMT to the treatment of ED (e.g. clinical experts, app designers, and technology providers) is essential to make it possible to focus on the patient's needs and expectations (Sharpe, Karasouli & Meyer, 2017).

The bibliometric analysis was carried out to emphasize the most frequent subject fields, along with frequent keywords. This research aimed to discover the patterns of publication and determine the critical areas in the data set, to outline insights and future research directions for academics and practitioners involved in the treatment of ED. The retrieved and analyzed data addressed the research questions raised in current bibliometric study.

According to data retrieved and analyzed (n=875), most of the papers were written in English, and the mean publications per year was n=79.5 for the years 2010 to 2021. According to the results for authorship, the top two authors in the field are Christina Botella and Andrea Gaggioli. The most productive countries by corresponding author were the United Kingdom, followed by the United States, Australia, and Spain. The reason for these results could be a significant increase in the numbers of people diagnosed with eating disorders within the explored time frame [3]. This might enhance research interest in the effective use of IMT in treating eating disorders among various age groups.

The data also represents the distribution of the publications, with Health Technology Assessment, Journal of Medical Internet Research, JMIR mHealth and uHealth, The Cochran Database of Systematic Review, and PloS one among the most popular journals. The JMIR group of journals are a leading source (n=24) when compared to other sources. The data also show three following leading subject categories: General Medicine (99 papers), 70 Mental Health (70 papers) and Health Policy (50 papers). Among the top institutions categorized by the 5 top countries, the leading is King's College London, followed by University College London,

James University, the University of Valencia, RMIT University, and Harvard University.

Keyword analysis showed that the most significant terms are "mental health," "depression." "ehealth," "mhealth," "internet," "anxiety," "eating disorder," "obesity," "bulimia," and "digital health."

Supporting the principal results above, some of the research findings were highlighted as follows. Mobile apps are recognized as effective in supporting patients with eating disorders in their treatment (Van Lippevelde et al. 2016; Nezami, Lytle & Tate, 2016; Lisón et al., 2020). The forums and profiles allow determination of subtypes of mental health-related descriptions (McCaig et al., 2019). Virtual reality helps to develop more effective nutritional treatment of weight problems (Tan et al., 2016). IMT in treatment for individuals with ED was stated as feasible (Järvelä-Reijonen et al., 2016; Hollis et al., 2016). Engagement with digital interventions supports weight management (Sharpe, Karasouli & Meyer, 2017), while an increase in motivation toward its use increases the efficiency of CBT among patients with obesity (Musetti et al., 2018). The mobile apps were considered a useful supportive tool in the treatment of bulimia nervosa (McClay et al., 2013; Torres-McGehee & Olgetree-Cusaac, 2011), anorexia (Tan et al., 2016), sleep disturbance (Kulakli & Shubina, 2020a), distress (Järvelä-Reijonen et al., 2016), anxiety and depression (Emirtekin et al., 2019), unhealthy diet (Van Lippevelde et al. 2016; Tan et al., 2016; Fuster-Guilló et al., 2020) and lifestyle (Lisón et al., 2020), and body dissatisfaction (Griffiths et al., 2018; Bellard et al., 2021).

Strengths and Limitations

Despite the significant increase of interest in the explored research domains, no publication has yet explored the area with the help of a bibliometric analysis. Therefore, the strength of this study is the uniqueness of the research itself. The study's input indicates to both academics and practitioners, the scientific patterns, future research needs and essential research scopes and directions.

The current study has some limitations. One is that the documents selected for analysis were in the English language. Journals publishing non-English research might be impactful if included. The citation analysis did not distinguish self-citations, which could create a bias in the number of citations for countries, journals, and authors. Finally, the search query was developed to concentrate on CBT, ED and IMT. The definition and scope of psychological treatment and use of interactive technology for eating disorders are broad and complex. Therefore, it is almost impossible to guarantee a full incorporation of literature on both topics. However, the study attempted to minimize the number of irrelevant papers, including all relevant sources.

Future Research Suggestions

Further research could be conducted on various aspects of bibliometric analysis. More empirical studies combined with the improvement of IMT, adjusted for the clinical conditions required.

Analyzed research findings indicate the need in further exploration and analysis in order to make IMT for treatment of eating disorders more relevant and feasible.

1. More empirical studies need to be conducted on the benefits of IMT as a supporting tool in the psychological prevention and treatment of eating disorders (Enrique et al., 2018).

2. Additional studies are required to explore the distinctive features of adaptive and maladaptive social media use in the relation to ED and the body dissatisfaction (Griffiths et al., 2018).

3. Interventions combining IMTs and traditional CBT should be supported with preliminary research about the relationship between emotional maltreatment and trauma (Emirtekin et al., 2019).

Conclusion

This paper focused on exploring and analyzing the scientific patterns and connections between IMT and treatment of eating disorders based on 875 papers published between 2010 and 2021. In this

study, the author provided a general view of keyword analysis of research domains and fields of study. Various forms of bibliometric methods were employed, and findings were illustrated with the data visualization approach to establish a clear picture.

Results presented the most frequent field categories, popular keywords, organizations, and sources within sub-domain searches. This research attempted to investigate the patterns of research domain to outline insights, gaps and further research ideas for academics and practitioners, who consider collaboration in the future. Data indicated the significance of further explorations in this field to improve the use of IMT for CBT of eating disorders.

Acknowledgments

Authorship contribution statement as follows:

Ivanna Shubina: conceptualization, literature review (background), methodology, data extraction and analysis, writing - original draft, writing - review & editing.

Author read and approved the final manuscript.

Abbreviations

CBT: Cognitive-behavioral therapy

IMT: Interactive mobile technology

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