

Review article

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MENTAL HEALTH IN SMART CITIES: THE ROLE OF TECHNOLOGY DURING COVID-19 PANDEMIC



ABSTRACT

Introduction. COVID-19 outbreak has changed human life and activity [1], especially in urban areas forcing citizens to stay for large periods of time in lockdowns. Protective measures (social distancing and isolation) that have been globally implemented has caused the isolation of millions. Preliminary findings (Moreno et al, 2021) suggest adverse mental health effects in previously healthy people and especially in people with pre-existing mental health disorders. Extended lockdowns come at the expense of mental health, psychophysical conditions, wellbeing, and social relations within societies (Campion et al., 2020).

Before COVID-19 outbreak, city centers offered a high-quality life with a wide range of services, utilities, public and green spaces, as well as city parks (Sharifi & Khavarian-Garmsird, 2020). Living in a small apartment with a minimal private space in the city center was balanced by the high level of socialization in public spaces, outdoor activities and events, intense interactions among inhabitants, allowing them to maintain relations (Portegijs et al., 2021). With COVID-19 outbreak, this modern urban standard of living was challenged. Social distancing took place at several levels: at home and at work, and, in the city, in the street and on public transport. Everything created for urban life changed and became uncertain. Societies got used to sharing common spaces, often crowded, and everyone was cut off from everyday socialisation. The isolation forced millions of individuals and families to remain at home, causing them to change their routines, rituals, and habits (McCay, 2020). In dense urban areas, this mostly meant locking people in cramped apartments, cut off from everyday physical activity outside the home (Portegijs et al, 2021; Bil et al, 2021).

Smart cities are instrumented, interconnected, and intelligent urban areas (Harrison et al., 2010) that pursue shared growth through an integrated set of technologies that shape interactions between actors (Nam & Pardo, 2011). A smart city can be defined as complex set of technology (infrastructures of hardware and software), people (creativity, diversity, and education), and institutions

(governance and policy) (Nam & Pardo, 2011). Smart cities aim is to create an environment that drives innovation from a technological, managerial, and organizational point of view by fostering environmental and social wellbeing (Karvonen et al., 2018; Polese et al., 2021].

The aim of this study is the literature review of the role of technology for citizens mental health during Covid-19 pandemic lockdowns in Smart Cities and to investigate if there is a relation between digital tools provided to the citizens of Pafos Municipality to use during quarantine, and their mental health status.

Methodology\design\approach. A review of the literature and an additional critical review were conducted in the fields of smart cities and mental health with a focus on the latest research concerning COVID-19 influence on ICT, mental health and wellbeing. For the purposes of this article, a thorough database search has been made. The database used was mostly Google Scholar and Science Direct. Selection criteria included full-text publications and consisted of the following keywords: COVID-19, post-COVID-19, mental health, wellbeing, lockdown, isolation, anxiety, infection rates, density, smart city, digital technology, ICT and Virtual Reality. Author focused on qualitative research available until April 2022.

Further than this, field research was conducted through a qualitative method in the particular case of Paphos Municipality in Cyprus, the introduction of various ICT technology solutions during the pandemic lockdowns and their impact on citizens mental health. ICT tools were briefly analyzed and their contributions towards citizens mental health was evaluated based on questionnaires distributed to the citizens before and after the use of these tools. Now the key question that needs an answer is “Did smart cities impact on citizens mental health during the pandemic?”

During the pandemic, Pafos Municipality introduced to its citizens various ICT solutions that despite initially they were targeting foreign tourists visiting the district, they ended up as entertainment tools that ease the lockdown period during the quarantine phase. As part of the E.U. co-funded by European Union program “Smart Cities – Interreg: Greece – Cyprus” the municipality implemented the “Collection, Documentation and Digitization of Cultural and Tourist material, Development of Digital Tourism / Culture and Entrepreneurship Platform and Development of digital applications of e-democracy and participation in the Municipality of Pafos” project. The result of this project was the creation of 3 websites: 1. Explore Pafos <https://www.explorepafos.org/> with multimedia information (text, photos, videos, 360-pictures, interactive map with points of interest etc.) about the province's major points of interest sorted by category: Culture, Environment, Tourism and Services. 2. Historical Timeline <https://xronologio.explorepafos.org/> with information about the history of the city in a chronological order. 3. Electronic Participation <https://diavouleusi.explorepafos.org/> offering User Registration, Consultation, Online Citizens Community (forum), Civil Council Decisions, Online Polls, News and Announcements. Further than these 2 mobile applications for iOS and Android devices were developed, Explore Pafos with various important information about the city of Pafos and Pafos AR which contain Augmented Reality representation of various significant cultural and historical sightseeing in the district. The websites and mobile applications were available in 5 languages (Greek, English, Russian, Hebrew and German).

These platforms were presented to the citizens of Pafos Municipality on the 27th of February 2020, slightly earlier than the first lockdown. After the first strict lockdown, the administrators of the website reported a significant increase in the traffic of the website among local citizens compared to pre-pandemic. This led the creators of the platforms among which is the author of this article to provide online questionnaires to people using the digital platforms on their leisure time during COVID-19 lockdowns to answer various questions regarding the impact of these digital tools in their mental health status during COVID-19 lockdown.

A questionnaire containing 5-point Likert scale questions and questions about qualitative and quantitative use of the ICT tools and their mental health during COVID-19 lockdowns was completed by citizens of Pafos Municipality.

Due to this study objective, two main criteria were established for sample selection. First, respondents should be citizens of Pafos Municipality from various areas over at least the past 5 years. Additionally, respondents must have been present during COVID-19 outbreak and lockdowns in the city. To verify this criterion, an initial survey question asked whether respondents were staying in the city during the COVID-19 outbreak.

The questionnaire was constructed in three parts. Its first one aimed at collecting descriptive variables (demographic information) of respondents' location, and professional profile. The second part asked citizens about their mental health status before and after COVID-19 outbreak and lockdowns. Each question was assessed according to a 5-point Likert scale (1 referred to 'not used' and 5 denoted 'fully used'). The last section of the questionnaire examined the adoption level of the ICT tools introduced by the Municipality as supporting tools for their mental status during the COVID-19 outbreak. For that, all 6 ICT tools were listed and evaluated based upon a similar Likert scale that ranged from 1 (not used) to 5 (fully used).

Results. The online questionnaire had its link firstly sent by e-mail to 480 citizens that registered in the platform in December 2020. A follow-up message was sent two weeks later. 215 responses returned but only 206 of them were actually from citizens that met our selection criteria, which resulted in 42.9% valid response rate,

For analyzing data, two distinctive procedures were carried out using the SPSS® Statistics 23 software to identify differences in levels of each characteristic related to ICT tools, device available (PC, mobile phone, tablet), and content (Cultural, Environmental, Social, Multimedia Content) when considering the degree of how they impact their mental health during COVID-19 lockdowns.

Our respondents were half men and half women. Moreover, 10% are aged between 20 and 25, 34% between 26 and 35, 36% between 36 and 45, 14% in the interval of 46 till 55 and only 6% are older than 55. 36% are single, 59% being married and almost 5% under another non-defined situation. Most respondents were living in a house (56%), with their family (54%), and had 1 or more kids (44%). 75% of the respondents mentioned that they use more often their mobile/laptops to access the internet compared to before. The majority of respondents (62%) mentioned that they used ICT tools provide 1 or more times per week to remind them of their daily habits while 56% mentioned that they used the platforms to navigate at their favorite place at least once. The largest majority (82%) accessed the services from their mobile phone while the smallest percent (12% accessed the services from their PC/Laptop. Regarding COVID-19 lockdowns, 86% stated that it is very stressful to stay at home in another lockdown while 36% said they wouldn't comply if they were forced to stay at home in another lockdown. 65% mentioned that they found the ICT tools useful to keep them mentally active and 72% mentioned that they wouldn't be able to stay in quarantine without access to internet. 68% of the people using the platforms declared that using the platforms helped to remain mentally active during the quarantine and 70% said they would use the platforms again in case there is a new lockdown.

Discussion. The present work was done having as basis 206 questionnaires applied to citizens of a Municipality in Cyprus, namely Pafos Municipality, in order to assess citizens mental health during lockdowns, and the impact of the use of ICT tools for their mental health. The survey collected data from 3 sections, namely demographics, mental health status before and after the COVID-19 pandemic and ICT tools usage during the lockdowns. The average respondents' sample shows that our interviewees are aged between 26 and 45 years old, half are men and the other women, married, qualified with college education. Citizens living in smaller apartments accessed the platforms more times per week compared to people living in the rural areas in houses and their conceived percentage of ICT tools contribution towards their mental health was higher compared to people leaving in rural areas. Citizens' inclusion and digital literacy are relevant issues that were affecting the use of ICT tools that do not apply only to urban contexts and should be addressed to solve societal, economic, technological, and political problems worldwide. COVID-19 restrictions and lockdown increased people's acceptance and use of ICT solutions.

Other studies are in line with the above findings (Troisi et al., 2022) where their key theoretical contribution of their study is the building of a framework that detects the main psychological, rational, social, and cultural determinants that can foster or prevent the acceptance of the changes forced by the pandemic, the adhesion to digitalization, and the transactional distance processes launched in the public sectors. These results are more evident in vulnerable groups (Dai et al., 2020; Ammar et al., 2021) which will require further development and usage of e-health solutions.

Finally, two other studies targeting different populations investigated the effectiveness of interventions by considering, as primary outcomes, not mental illness indicators (e.g., depression and anxiety symptoms), but positive mental health indicators (positive affect and positive mental health). Vara et al. (2020) provided us with a secondary analysis of a randomized controlled trial that assessed the efficacy of a low-intensity internet intervention aimed to promote positive affect in depressive patients in primary care, as an adjunct therapy to improved treatment as usual (Fonseca & Osma, 2021).

Scientific value / practical value. Another report (Fonseca & Osma, 2021) highlighted the urgent need for research to help improve our understanding of the pandemic's mental health consequences on the general public (Mahase, 2020). In order to help characterize the psychosocial effects of the COVID19 crisis as well as the moderators of these effects, a research group launched a multi-language, multi-center anonymous online survey to assess the "Effects of home Confinement on psychosocial health status and multiple Lifestyle Behaviors" during the COVID-19 outbreak. Preliminary findings from this project revealed that the COVID-19 home confinement resulted in significant negative effects on mental wellbeing and emotional status, with more people experiencing psychosocial and emotional distress compared to before the pandemic (Ammar et al. 2020; Ammar et al, 2021a; Fonseca & Osma, 2021). This research results highlight the importance of introducing ICT tools to provide a virtual tour of citizens to their favorite city spots and remain mentally active during quarantine period.

Conclusions. ICT tools offer citizens the opportunity to remember their pre COVID-19 lockdown habits as highlighted in this article and they contribute towards the improvement of their mental health during quarantine. This study aimed at (i) identifying wither ICT tools use increased during COVID-19 outbreak; (ii) investigating the effect of the tools use and the impact on mental health of their users; and (iii) examining the relationship between the adoption of ICT tools and the demographics of citizens using them most during COVID-19 outbreak. Our findings provided arguments to answer these three research questions raised from existing gaps in both theory and practice.



KEYWORDS

COVID-19; Smart City; Mental Health; ICT; Technology.



ІНФОРМАЦІЯ ПРО ГОЛОВНОГО АВТОРА

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INTRODUCTION

COVID-19 outbreak has changed human life and activity [1], especially in urban areas forcing citizens to stay for large periods of time in lockdowns. Protective measures (social distancing and isolation) that have been globally implemented has caused the isolation of millions. Preliminary findings (Moreno et al, 2021) suggest adverse mental health effects in previously healthy people and especially in people with pre-existing mental health disorders. Extended lockdowns come at the expense of mental health, psycho-physical conditions, wellbeing, and social relations within societies (Campion et al., 2020).

Before COVID-19 outbreak, city centers offered a high-quality life with a wide range of services, utilities, public and green spaces, as well as city

parks (Sharifi & Khavarian-Garmsird, 2020). Living in a small apartment with a minimal private space in the city center was balanced by the high level of socialization in public spaces, outdoor activities and events, intense interactions among inhabitants, allowing them to maintain relations (Portegijs et al., 2021). With COVID-19 outbreak, this modern urban standard of living was challenged. Social distancing took place at several levels: at home and at work, and, in the city, in the street and on public transport. Everything created for urban life changed and became uncertain. Societies got used to sharing common spaces, often crowded, and everyone was cut off from everyday socialisation. The isolation forced millions of individuals and families to remain at home, causing them to change their routines, rituals, and habits (McCay, 2020). In dense urban areas, this mostly meant locking people in cramped apartments, cut off from everyday physical activity outside the home (Portegijs et al, 2021; Bil et al, 2021).



Smart cities are instrumented, interconnected, and intelligent urban areas (Harrison et al., 2010) that pursue shared growth through an integrated set of technologies that shape interactions between actors (Nam & Pardo, 2011). A smart city can be defined as complex set of technology (infrastructures of hardware and software), people (creativity, diversity, and education), and institutions (governance and policy) (Nam & Pardo, 2011). Smart cities aim is to create an environment that drives innovation from a technological, managerial, and organizational point of view by fostering environmental and social wellbeing (Karvonen et al., 2018; Polese et al., 2021].



PURPOSE

The aim of this study is the literature review of the role of technology for citizens mental health during Covid-19 pandemic lockdowns in Smart Cities and to investigate if there is a relation between digital tools provided to the citizens of Pafos Municipality to use during quarantine, and their mental health status.



METHODOLOGY

A review of the literature and an additional critical review were conducted in the fields of smart cities and mental health with a focus on the latest research concerning COVID-19 influence on ICT, mental health and wellbeing. For the purposes of this article, a thorough database search has been made. The database used was mostly Google Scholar and Science Direct. Selection criteria included full-text publications and consisted of the following keywords: COVID-19, post-COVID-19,

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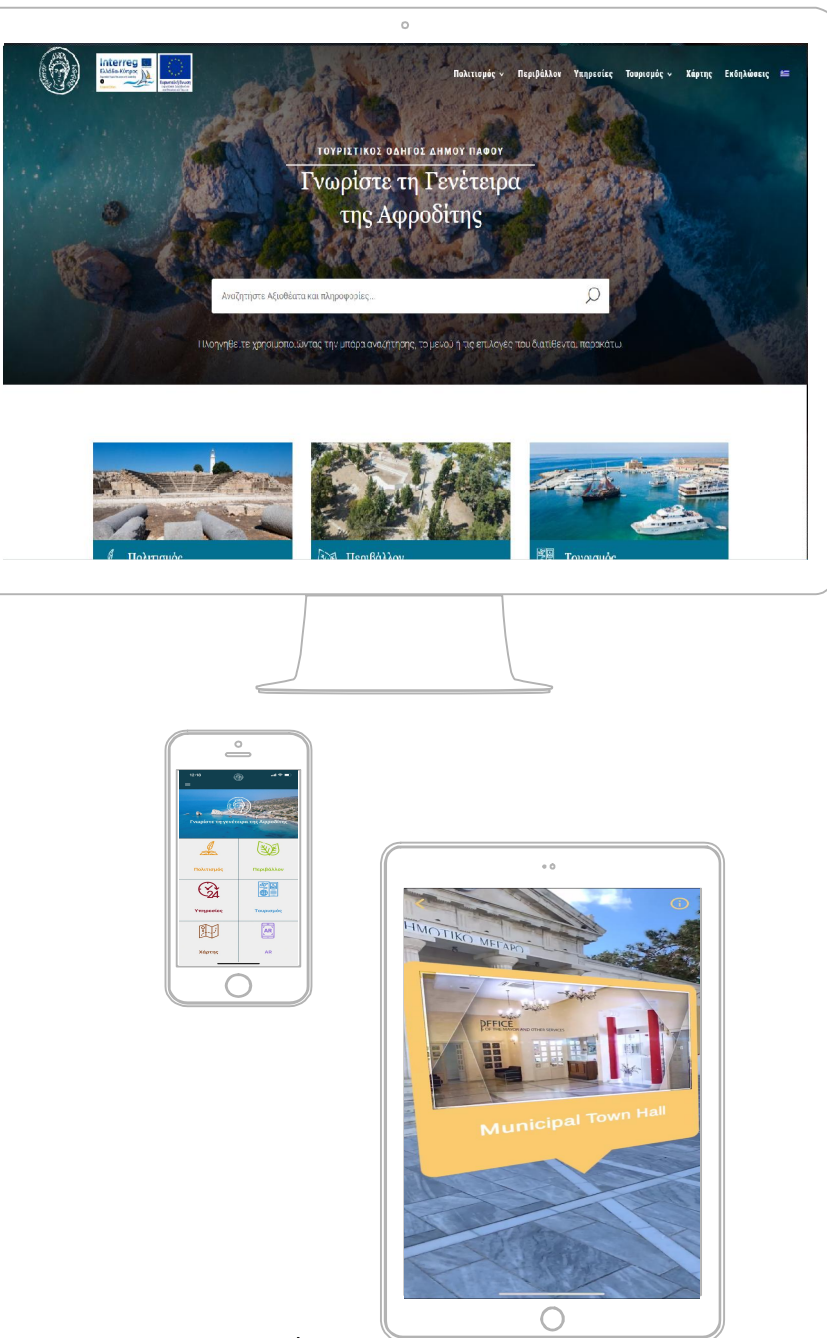


Figure 1: Multimedia Information provided in various platforms



RESULTS

The online questionnaire had its link firstly sent by e-mail to 480 citizens that registered in the platform in December 2020. A follow-up message was sent two weeks later. 215 responses returned but only 206 of them were actually from citizens that met our selection criteria, which resulted in 42.9% valid response rate,

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in another lockdown. 65% mentioned that they found the ICT tools useful to keep them mentally active and 72% mentioned that they wouldn't be able to stay in quarantine without access to internet. 68% of the people using the platforms declared that using the platforms helped to remain mentally active during the quarantine and 70% said they would use the platforms again in case there is a new lockdown.



DISCUSSION

The present work was done having as basis 206 questionnaires applied to citizens of a Municipality in Cyprus, namely Pafos Municipality, in order to assess citizens mental health during lockdowns, and the impact of the use of ICT tools for their mental health. The survey collected data from 3 sections, namely demographics, mental health status before and after the COVID-19 pandemic and ICT tools usage during the lockdowns. The average respondents' sample shows that our interviewees are aged between 26 and 45 years old, half are men and the other women, married, qualified with college education. Citizens living in smaller apartments accessed the platforms more times per week compared to people living in the rural areas in houses and their conceived percentage of ICT tools contribution towards their mental health was higher compared to people leaving in rural areas. Citizens' inclusion and digital literacy are relevant issues that were affecting the use of ICT tools that do not apply only to urban contexts and should be addressed to solve societal, economic, technological, and political problems worldwide. COVID-19 restrictions and lockdown increased people's acceptance and use of ICT solutions.

Other studies are in line with the above findings (Troisi et al., 2022) where their key theoretical contribution of their study is the building of a framework that detects the main psychological,



rational, social, and cultural determinants that can foster or prevent the acceptance of the changes forced by the pandemic, the adhesion to digitalization, and the transactional distance processes launched in the public sectors. These results are more evident in vulnerable groups (Dai et al., 2020; Ammar et al., 2021) which will require further development and usage of e-health solutions.

Finally, two other studies targeting different populations investigated the effectiveness of interventions by considering, as primary outcomes, not mental illness indicators (e.g., depression and anxiety symptoms), but positive mental health indicators (positive affect and positive mental health). Vara et al. (2020) provided us with a secondary analysis of a randomized controlled trial that assessed the efficacy of a low-intensity internet intervention aimed to promote positive affect in depressive patients in primary care, as an adjunct therapy to improved treatment as usual (Fonseca & Osma, 2021).



RESEARCH/PRACTICAL VALUE

Another report (Fonseca & Osma, 2021) highlighted the urgent need for research to help improve our understanding of the pandemic's mental health consequences on the general public (Mahase, 2020). In order to help characterize the psychosocial effects of the COVID-19 crisis as well as the moderators of these effects, a research group launched a multi-language, multi-center anonymous online survey to assess the "Effects of home Confinement on psychosocial health status and multiple Lifestyle Behaviors" during the COVID-19 outbreak. Preliminary findings from this project revealed that the COVID-19 home confinement resulted in significant negative effects on mental wellbeing and emotional status, with more people



experiencing psychosocial and emotional distress compared to before the pandemic (Ammar et al. 2020; Ammar et al, 2021a; Fonseca & Osma, 2021). This research results highlight the importance of introducing ICT tools to provide a virtual tour of citizens to their favorite city spots and remain mentally active during quarantine period.



CONCLUSIONS

ICT tools offer citizens the opportunity to remember their pre COVID-19 lockdown habits as highlighted in this article and they contribute towards the improvement of their mental health during quarantine. This study aimed at (i) identifying wither ICT tools use increased during COVID-19 outbreak; (ii) investigating the effect of the tools use and the impact on mental health of their users; and (iii) examining the relationship between the adoption of ICT tools and the demographics of citizens using them most during COVID-19 outbreak. Our findings provided arguments to answer these three research questions raised from existing gaps in both theory and practice.



Conflict of interests

The Authors declare no conflict of interest.



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УДК

Янніс Хризостому

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ПСИХІЧНЕ ЗДОРОВ'Я В СМАРТ-МІСТАХ: РОЛЬ ТЕХНОЛОГІЙ ПІД ЧАС ПАНДЕМІЇ COVID-19



АНОТАЦІЯ

Актуальність. COVID-19 змінив повсякденне життя громадян у всьому світі та виявив уразливість життя та функціонування міст. Пандемія змусила громадян адаптуватися до нових моделей дистанційної роботи під час карантину та доступу до сервісів на основі смарт-технологій. Стаття має на меті оцінити сприйняття громадянами технологічних рішень, забезпечених смарт-містами і, зокрема, муніципалітетом Пафоса до та після виникнення пандемії Covid-19, а також оцінити їх вплив на психічне здоров'я громадян. Результати дослідження сприяють розумінню переваг в сфері психічного здоров'я для громадян, які живуть у смарт-містах порівняно з людьми, які проживають у низькотехнологічних районах, виявляючи потенційні позитивні ефекти смарт-технологій, а також зміну у прийнятті людьми цифрових рішень до та після пандемії.



КЛЮЧОВІ СЛОВА

COVID-19; смарт-місто; психічне здоров'я; ІКТ; технології.



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