

Review article

Physical Activity and Mental Health During the COVID-19 Pandemic

^{1*}Saša Kovačević, ²Jovana Popović , ³Miloš Milošević , ¹Darko Paspalj,

¹Nenad Rađenović, ¹Lazar Vulin

¹ University of East Sarajevo, Faculty of Physical Education and Sport, Doctoral Studies

² Community health care center Rakovica, Belgrade, Serbia

³ Faculty of Physical Education and Sports Management, Singidunum University, Belgrade, Serbia

*Correspondence: sasagim@yahoo.com

Abstract

Objective: This review explores the complex relationship between physical activity, mental health, and specific challenges arising from the COVID-19 pandemic. The aim is to analyze changes in physical activity patterns, psychological effects of restrictions, and explore innovative approaches to maintaining an active lifestyle during the pandemic. A systematic literature review of five databases (PubMed, Embase, CINAHL, SPORTDiscus, and Web of Science) was conducted against inclusion criteria. Inclusion criteria involved research providing relevant insights into changes in physical activity and their impact on mental health. This review identified increased awareness of the importance of maintaining physical activity during the pandemic. Changes in exercise patterns and their impact on mental health have been observed. The analyzed research consistently indicates a link between physical activity and mental health during the COVID-19 pandemic, emphasizing the importance of promoting physical activity as a means of preserving mental health during periods of social distancing and lifestyle changes. Further research and implementation of targeted public health interventions are crucial to supporting population health during the pandemic. Research clearly demonstrates the importance of physical activity in maintaining mental health during the COVID-19 pandemic and in daily life. Further promotion of physical activity and the development of tailored public health strategies are essential to support population well-being.

Keywords: Physical activity, mental health, COVID-19 pandemic, isolation

Introduction

The relationship between physical activity and general health and well-being and therefore mental health as well, is a topic that has occupied the attention of scientists for long time (e.g., Smith. & Brandt. 1979; Taylor et al., 1985; Raglin, 1990). Physical activity has a positive effect in the prevention but also the therapy of various diseases such as heart diseases (Morris, 1990), hypertension (Pescatello et al., 2004), diabetes (Manson et al., 1992), osteoporosis (Carter et al., 2002), and similarly. Not only does it contribute to an increased quality of life through the described positive effect on health status, physical activity has a positive effect in the prevention and treatment of psychiatric diseases such as depression or anxiety (Dimeo et al., 2001; Dunn et al., 2001; Leppämäki, 2002). More over physical activity helps in the relief symptoms of various associated with frequent changes or consistently low mood levels such as conditions fibromyalgia (Gowans et al., 2001;), nicotine abstinence (Masiero et al., 2020) or menopause (Slaven, & Lee, 1997). Physical activity has a positive effect on mental health throughout the entire life course, from children and adolescents (Biddle, & Asare, 2011; Herbert, 2022) to adults (Paluska, & Schwenk, 2000) and the elderly (Hemmeter, & Ngamsri, 2022) populations. Therefore, regular physical activity is recommended as a means of improving the overall level of public health and mental health as well (Pate et al., 1995) by the most reputable institutions dealing with the preservation and improvement of public health.

However, the vast majority of mentioned studies deal with the relationship between physical activity and mental health in everyday life. Within the challenges posed by the COVID-19 pandemic (Hanaei et al., 2022) the relationship between physical activity and mental health takes on new dimensions to explore. The global crisis, marked by uncertainty, restrictions, fear and changes in daily life, represents a radical change in circumstances in relation to the daily routine. For our topic, the increased level of stress and pressure on mental health brought by the pandemic (Chen, et al., 2021) is primarily important. Furthermore, impact of the measures to fight the pandemic, the lockdown above all, on the reduced possibility of movement and physical activity (Wunsch et al., 2022) is also an important new factor. Finally, one of the main factors by which physical activity has a beneficial effect on mental health is actually the social interaction and support that physical activity brings with it (Ransford, 1982; Peluso & Guerra de Andrade, 2005), which was also significantly reduced during the pandemic. Because of the entire above, Covid 19 pandemic revived the question of the relationship between physical activity and mental health in such specific conditions, which resulted in increased activity of researchers when it comes to this topic. This is why space for systematization of the results of current studies, as well as their comparison with studies of the connection between physical activity and mental health before the pandemic is wide open. Understanding this dynamic is not only challenging from a scientific perspective but also holds practical significance for the development of strategies and interventions aimed at preserving mental health in the context of pandemic conditions.

Through a systematic review of available literature and relevant empirical data, this review aims not only to expand theoretical understanding of their interconnection but also to identify key implications that can contribute to improving individuals' well-being in these challenging times. Through critical review, key findings are expected to be discovered to inform further support strategies and adaptations for preserving integral health during and after the pandemic period.

Methods

Design and participants

In the process of collecting relevant literature for this review, researchers utilized carefully selected internet search engines, including PubMed, Embase, CINAHL, SPORTDiscus, and Web of Science, to access information on the connection between physical activity and mental health during the COVID-19 pandemic. Additionally, available sources in the form of books and scientific journals were

analyzed, focusing on various studies that have explored this topic to identify the connection between different aspects during the pandemic period.

During the research process, special attention was given to internet search engines as a means of identifying relevant information on the connection between physical activity and mental health during the COVID-19 pandemic. Online search engines have proven to be key tools in finding relevant articles, research, and recommendations stemming from conducted studies on preserving mental health through physical activity during the pandemic period. By synthesizing theoretical concepts with concrete examples from the literature, this review provides a comprehensive insight into the current state and future perspectives on the connection between physical activity and mental health in the specific context of the COVID-19 pandemic. Special emphasis was placed on analyzing conducted research to thoroughly understand the link between these two key aspects, providing relevant insights and guidelines for further research and interventions.

Inclusion criteria for the research were selected to precisely explore the connection between physical activity and mental health during the COVID-19 pandemic. The following criteria were applied in the study selection process:

Inclusion Criteria

- Peer-reviewed research articles: Only research articles that have undergone the peer-review process were included in this analysis, ensuring the reliability and quality of the research.
- Focus on physical activity and mental health: Studies investigating the direct link between physical activity and mental health, especially during the COVID-19 pandemic, were included, regardless of other aspects.
- Availability of full articles: Only studies with available full articles were included in this review, enabling a more thorough insight into the research.

Criteria for exclusion

- Irrelevant interventions: Studies that did not directly investigate the relationship between physical activity and mental health during the COVID-19 pandemic were excluded from the review.
- Abstracts, conferences, and review articles: Abstracts, conference papers, and review articles were intentionally excluded from the analysis to ensure that the review focused solely on primary research studies.
- Studies published before 2019: It was decided to exclude studies published before 2019 to focus attention on relevant research reflecting contemporary circumstances and challenges related to the COVID-19 pandemic.

The initial search was focused on predetermined key terms, resulting in an extensive set of literature. Subsequently, a thorough evaluation of titles, abstracts, and overall article content was conducted to assess whether they met the criteria for inclusion in this analysis. Studies that were found to be relevant and met the established criteria were retained for further detailed analysis, while those that did not meet the specified criteria were excluded from the review.

Results

After the initial search in electronic databases, a total of 2,443 potentially relevant research papers were identified. After careful analysis, 2,048 papers were excluded. Of that number, 974 were duplicate papers or did not comply with the defined time period, while 1,074 did not meet the previously defined criteria for inclusion or matched the exclusion criteria. Of the remaining 395 papers, 302 were systematic reviews, which, although useful for providing context to the research, did not fit the scope of analyzing individual studies. After the initial review, 93 studies remained for further detailed analysis. Finally, 15 studies were

identified as meeting the criteria for inclusion in this literature analysis (Figure 1). More details about the selected papers is shown in Table 1.

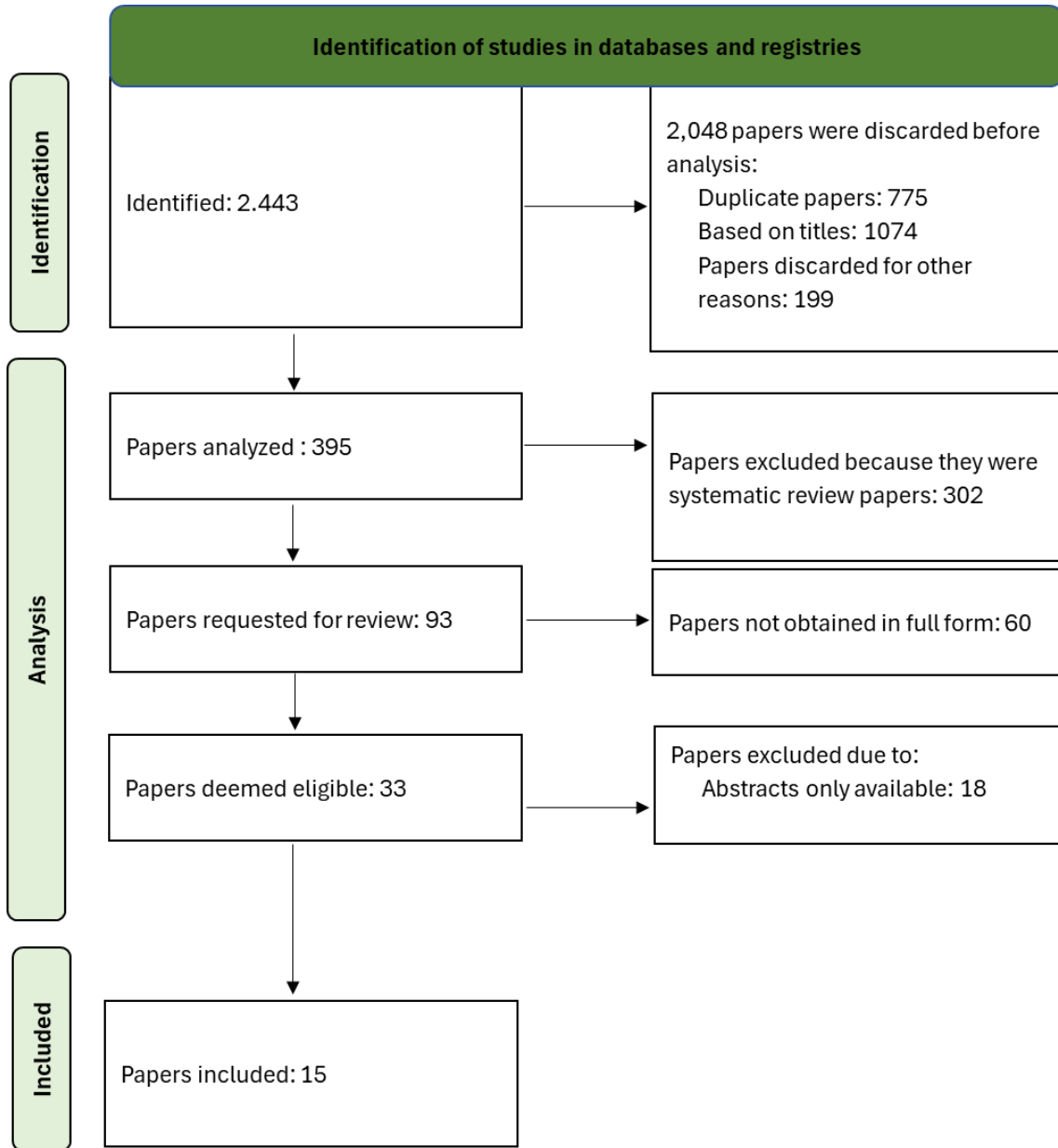


Figure 1. Selection Process for Papers (Origin: Prisma 2020 Flow Diagram for New Systematic Review).

Table 1. Selected studies for analysis.

Reference	Participants			Country	Intervention	Variables, Results
	N	Sex	Age			
Meyer J. et al. (2020)	3.052	M/F	18-75	SAD	APP, S4S, SPS, MAIL, AOU, SS Stata	FA -: DEP+, ANKS+, ST+ FA+: DEP-, ANKS-, ST- SIZ: DEP+, ANKS+, ST+, FA- FA -:DEP+, ANKS+, ST+, TM+
Stanton R. et al. (2020)	1491	M/F	50.5 ± 14.9	/	COVID-A; ANK: HZS, DEP, ANKS, ST, FA, FZN, S, P, ALK; AAS; DASS 21; AUDIT-C	FA+: DEP-, ANKS-, ST-, P-, ALK- MFA(COVID)= 322,5 ± 36,5 min/w
Fei Q. et al. (2020)	12.107	M/F	18-80	/	IU: FA, ES; VPE, ANOVA, χ^2 -T, SKK OA: DI, ZS, MZ; FA-S; GSD; GSA;	FA -: VPE+ (261.3 ± 189.8 min/d), ES- FA +: ES+, VPE-, FA -: DEP+, ANKS+, ST+ FA+: DEP-, ANKS-, ST-
Callow D.D. et al. (2020)	1.046	M/F	50 - 95	SAD; CA	OA, BU-FA, BU-MZ, UOZ-12, DS, VS, VPE	FA -: MZ-, VS+, VPE+ FA+: MZ+, VS-, VPE- DS-
Kramerias et al. (2021)	2.541	M/F	42.5 51.2 37.7 40.7	AU, GB, FR, SAD	OA: SSP, IPAQ, IDWHO, DASS 21	FA -: MZ-; DEPR+, ANKS+ FA+: MZ+, DEPR-, ANKS-
Faulkner J. et al. (2021)	8.425	M/F	44.5± 14.8	UK, AU, IR, NZ	ANK: MZ, FZ, COVID-10-rest., PZU	FA -: MZ-, FZ-,
Bailey L. et al. (2021)	105	M/F	78.8–80.8	IR	OA, IPAQ, ES, MWU-T, KW-T	ES(M) > ES(F) FA+: ES+ FA+ = FS+ = MZ+
Kang S. et al. (2021)	4.898	M/F	16 ± 1.3	CN	LG, χ^2 : FA, MZ, FZ, LP, KP, OP, MZ, RO, RP, HO, RU, FS	FA -: MZ-; DEPR+, ANKS+, ST+ FA+: MZ+, DEPR-, ANKS-, ST-
Yijing X. et al. (2021)	988	M/F	40.9	/	MDA: FA, DEP, ANKS, ST, MZ	FA -: DEPR+, ANKS+, ST+, SAS-SV+, FCV-19S+ FA+: DEPR-, ANKS-, ST-, ES+, SAS-SV-, FCV-19S-
Kua Z. et al. (2022)	707	M/F	37.4	SG	ANK: IPAQ, PHQ-9, FCV-19S, GAD-7, SAS-SV, FA, ANKS, DEP	FA -: MZ- FA+: MZ+ FA+: ST+,DEP-, ANKS-,
Yufei W., Youqiang L. (2022)	376	M/F	/	CN	MMR: MZ, FA OA: FA, MZ, SEF	FA+: SP+,DEP- FA -: SP-, DEP+ FA+: MZ+
Andersen J.A. (2022)	754	M/F	47.4 ± 16.3	SAD	ANCOVA: MZ, MCS, SF-12	FA+: MZ+ FA+: ST+,DEP-, ANKS-,
Petersen C.B. et al. (2023)	2.280	M/F	26 ± 5.8	DK	IU, PS, KOFA, SP, DEP, ANKS, MZ; EXCEL	FA+: MZ+ FA+: MZ+ FA+: ST+,DEP-, ANKS-,
Maharaja et al. (2023)	308	M/F	42.2	ID	VIDEO-INT., EXCEL, TA.	MOT+, RV+ = FS + MOT-, RV- = FS - FA -: TM+, ES-, MZ- FA+= SI+
Wut T.M. et al. (2023)	109	M/F	18-65	CN		
Ambrosio L. et al. (2023)	26	M/F	38-79	UK		

Table legend: **AAS** - Active Australia Survey; **ALK** - Alcohol consumption; **ANK** - Survey; **ANKS** - Anxiety; **ANCOVA** - Analysis of Covariance; **ANOVA** - Analysis of Variance; **APP** - Analysis of cross-sectional data; **AUDIT-C** - Alcohol Use Disorders Identification Test; **AU** - Australia; **BU** - Brunel questionnaire; **CA** - Canada; **COVID-A** - COVID-19 Survey; **COVID-10-rest.** - Attitudes towards COVID-19 restrictions; **CN** - China; **D** - diverse; **DASS 21** - Depression, Anxiety and Stress Scale with 21 items; **DEP** - Depression; **DK** - Denmark; **DS** - daily step count; **ES** - emotional state; **FA** - physical activity; **FA-S** - Physical Activity Scale; **F** - Female; **FCV-19S** - Fear of COVID-19 Scale; **FR** - France; **FS** - physical condition; **FZ** - physical health; **FZN** - physical health habits; **GAD-7** - Generalized Anxiety Disorder Scale; **GB** - Great Britain; **GSA** - Geriatric Anxiety Scale; **GSD** - Geriatric Depression Scale; **HO** - work from home; **HZS** - chronic health conditions; **ID** - Indonesia; **IDWHO** - World Health Organization Well-being Index; **IND** - disability; **IPAQ** - International Physical Activity Questionnaire; **IR** - Ireland; **IU** - internet questionnaire; **KOFA** - amount of physical activity; **KP** - categorical questions; **KW-T** - Kruskal-Wallis test; **LP** - Likert questions; **M** - Male; **MAIL** - email address; **MDA** - multidomain survey; **MCS** - mental component summary; **min/d** - minutes per day; **min/w** - minutes per week; **MOT** - motivation; **MMR** - multivariate regression models; **MWU-T** - Mann-Whitney U-Test; **MZ** - mental health; **NZ** - New Zealand; **OA** - online survey; **OP** - open-ended questions; **P** - smoking; **PHQ-9** - Patient Health Questionnaire-9; **PMZ** - positive mental health; **PZU** - access to health services; **RO** - work environment; **RP** - workspace; **RU** - work performance; **RV** - exercise resources; **S** - sleep; **SAD** - United States of America; **SAS-SV** - Smartphone Addiction Scale; **SDG** - social distancing guidelines; **SEF** - Socioeconomic factors; **SF-12** - 12-item Short Form Health Survey; **SG** - Singapore; **SI** - social interaction; **SIZ** - self-isolation; **SKK** - Spearman's rank correlation coefficient; **SP** - self-confidence; **SPS** - perceived stress scale; **SSP** - Stages of Change Scale; **SS-Stata** - Stata Statistical Software; **S4S** - 4-item scale; **T** - test; **TA** - thematic analysis; **TM** - body mass; **UOZ-12** - 12-item health questionnaire; **VIDEO-INT** - video interviews; **VPE** - screen time; **VS** - sitting time; χ^2 - Chi-square test; **Z** - health; **ZS** - health status.

Discussion

Analyzing the available data, significant variability in the number of participants is observed, ranging from a minimum of 26 to a maximum of 12,107 participants. However, variations in sample size are a consequence of research design and all studies meet the criteria for reliable statistical inference. Regarding the age structure of participants, the range varies from 16 to 95 years. The gender distribution of data shows the presence of both genders in the studies, suggesting that both men and women are included in the analyses. These results indicate a wide range of participants involved in the studies, highlighting the need for diverse approaches to studying the effects of physical activity on different demographic groups and pandemic-related contexts. Taking into account the differences in the place of residence, it could be said that the processed studies refer to a wide global population, but also that children were not the subject of research. Research encompassing diverse populations and different measures of physical activity as well as mental and physical health during the COVID-19 pandemic provides deep insights into the impact of this global health event on the physical and mental health of people worldwide.

Meyer et al. (2020) investigated the effects of public health guidelines on levels of physical activity, sedentary behavior, and mental health. Their results indicate a significant reduction in physical activity among those who were previously active, while among previously inactive participants, physical activity remained largely unchanged. Additionally, increased screen time and non-adherence to physical activity guidelines were associated with depression, loneliness, and stress. This study emphasizes the importance of maintaining and enhancing physical activity while limiting screen time to mitigate the negative effects on mental health during the social changes brought about by the pandemic.

Stanton et al. (2020) provided similar findings, highlighting the significant association between changes in physical activity and mental health. Their results show that higher levels of physical activity are associated with reduced symptoms of depression and anxiety, while changes in behavior are associated with increased stress and anxiety. This underscores the importance of promoting physical activity as a means of preserving mental health during the pandemic.

Fei et al. (2020) highlight the concerning prevalence of insufficient physical activity and prolonged screen time during the COVID-19 pandemic. Their findings indicate the need for targeted interventions to promote healthier lifestyle routines, especially among vulnerable groups such as women, young adults, and residents of remote regions.

Callow et al. (2020) investigated the impact of current social distancing guidelines on the mental health of older adults. Their results show that higher levels of physical activity are associated with reduced symptoms resembling depression in older adults. This emphasizes the importance of maintaining physical activity as a means of preserving mental health, especially among the older population who may experience greater stress during isolation.

As a contribution to this context, Faulkner et al. (2021) examined the impact of initial restrictions on physical activity habits in four different countries. Their findings indicate variations in the impact of restrictions on physical activity habits depending on age and gender. This underscores the need for tailored public health interventions targeting specific population groups.

In the study by Kua et al. (2022), an analysis of the relationship between physical activity and mental health during the pandemic was conducted. Their findings show that higher levels of physical activity are associated with lower incidence of depressive symptoms and greater resilience to stress. This research confirms the importance of maintaining regular physical activity as a means of preserving mental health, especially during periods of increased stress and isolation.

Swimming is a natural form of physical activity that has a very positive impact on the human body and organism, enabling significant preventive, corrective, and therapeutic results (Trivun M., Tošić J., Marković V., 2013.). Not only does it positively affect the body, but swimming and diving can also have a beneficial effect on mental health, especially during the COVID-19 pandemic as shown in the study by Maharaj et al. (2023). This study highlighted the significant benefits of swimming in the sea or diving with a mask and snorkel in tropical coastal blue spaces during the COVID-19 pandemic. It was found that individuals who regularly practice swimming or diving showed better mental well-being compared to those who did not participate in this activity. This study clearly indicates a positive correlation between mental health and activities in tropical coastal blue spaces. Additionally, a connection between human health and nature was discovered, emphasizing the importance of access to these natural resources for maintaining mental health. These findings highlight that swimming in natural waters can be an invaluable resource for maintaining mental well-being, while also emphasizing the need to preserve and promote access to these environments, especially for the local population.

The study by Wut et al. (2023) showed that even low to moderate levels of physical activity are positively associated with perceived self-confidence and mental state, while moderate levels of physical activity influenced the improvement of symptoms related to depression and anxiety. These findings underscore the importance and effects of physical activity on mental health, especially among working adults.

Ambrosio et al. (2023) conducted a qualitative study to explore the impact of lockdown during the COVID-19 pandemic on physical activity among people living with chronic conditions in the United Kingdom. Their findings highlight the importance of tailored support for physical activity to preserve the health of this population, especially considering challenges such as loss of social interaction and fear of infection. This study provides useful insights into how people with chronic conditions manage their health during the pandemic, emphasizing the need for adequate support strategies and interventions.

Overall, results of the studies are consistent in many ways. The reduced level of physical activity was accompanied by negative phenomena such as increasing in the body mass (Ambrosio et al., 2023; Stanton et al., 2020), increased smartphone addiction (Yufei, & Youqiang, 2022), more time spent in front of the screen (Fei et al., 2020; Kramerias et al., 2021), more sitting time (Kramerias et al., 2021), increased Fear of COVID (Yufei, & Youqiang, 2022), and less self-confidence (Maharaja et al. 2023). On the other side a higher level of physical activity was accompanied by positive phenomena such as reduction of alcohol and tobacco consumption (Stanton et al., 2020), less smartphone addiction (Yufei, & Youqiang, 2022), less time spent in front of the screen (Fei et al., 2020; Kramerias et al., 2021), less sitting time (Kramerias et al., 2021), and more

self-confidence (Maharaja et al. 2023). It is important to note that a higher level of physical activity was associated with higher level of Social Interaction (Ambrosio et al., 2023), while a lower level of physical activity was associated with self-isolation (Meyer et al., 2020). Therefore, it is not surprising that the most consistent obtained findings characteristic for almost all the processed studies are that higher level of physical activity has been shown to be associated with a reduction in depression (Callow et al., 2020; Faulkner et al., 2021, Kua et al., 2022; Maharaja et al. 2023; Meyer et al., 2020; Petersen et al., 2023; Stanton et al. 2020; Yufei, & Youqiang, 2022) and anxiety (Callow et al., 2020; Faulkner et al., 2021, Kua et al., 2022; Meyer et al., 2020; Petersen et al., 2023; Stanton et al. 2020; Yufei, & Youqiang, 2022) while a reduced level of physical activity had the opposite effect. All of this resulted in observations that a higher level of emotional stability (Ambrosio et al., 2023; Fei et al., 2020; Kang et al., 2021; Yufei, & Youqiang, 2022) and overall mental (Ambrosio et al., 2023; Andersen, 2022; Bailey et al. 2021; Faulkner et al., 2021; Kramerias et al., 2021; Kua et al., 2022; Yijing et al., 2021; Wut et al., 2023) as well as physical health (Bailey et al. 2021; Yijing et al., 2021) are positively associated with physical activity.

All the studies provide consistent findings on the relationship between physical activity and mental health during COVID-19 pandemic. These findings underscore the importance of promoting physical activity as a means of preserving mental health during periods of social distancing and changes in daily life. Further research and implementation of targeted public health interventions are crucial to supporting population health during the pandemic.

Conclusion

Analysing the combined results of multiple studies focused on the relationship between physical activity and mental health in the context of the COVID-19 pandemic, relevant conclusions emerge. Maintaining adequate levels of physical activity during periods of social distancing and restrictions has proven necessary to prevent negative effects on mental health.

The research results indicate a complex dynamic between levels of physical activity and mental health during pandemic measures. Reducing physical activity, especially during lockdowns, has been associated with increased symptoms of depression, stress, and anxiety. On the other hand, even moderate levels of physical activity have a positive impact on mental health, emphasizing the importance of continuous support for this aspect of healthcare.

Additionally, studies have identified specific population groups that are particularly vulnerable to the negative consequences of insufficient physical activity, such as people with chronic conditions or students. Therefore, tailored interventions and support for these groups are crucial for preserving their mental health.

In conclusion, the findings of these studies emphasize the necessity of a comprehensive approach to promoting physical activity for the protection of mental health, not only in extraordinary situations such as pandemics but also in everyday life. It is important to understand that physical activity is more than just disease prevention or maintaining physical fitness; it plays a crucial role in supporting emotional well-being and psychological resilience. Furthermore, further research is needed to better understand the mechanisms behind the relationship between physical activity and mental health, especially in the context of global health challenges. The development of targeted public health strategies, which encompass different population groups and adapt to their specific needs, is a key step towards creating societies that support healthy lifestyles.

Conflict of interest: All authors declare that they have no conflict of interest relevant to the content of this article.

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