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Review Article

Interventions to enhance mental health outcomes of persons with schizophrenia during the COVID-19 pandemic: A systematic review

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ABSTRACT

Background & Aim: Schizophrenia is a chronic mental disorder requiring continuous care. During the COVID-19 pandemic, people with schizophrenia (PLWS) faced disproportionate challenges due to healthcare disruptions. Ensuring continuity of care is essential, and understanding the types of interventions implemented during this period can inform future support strategies. This systematic review aimed to identify, describe, and synthesize reported outcomes of interventions implemented to support the mental health of PLWS during the COVID-19 pandemic.

Methods & Materials: The protocol was registered on PROSPERO. A comprehensive search was conducted in MEDLINE, Embase, CINAHL, and ScienceDirect for studies published between 2019 and 2023. Eligible studies included experimental (randomized controlled trials and quasi-experimental studies) and non-experimental (observational) designs investigating the effects of interventions on mental health outcomes in PLWS aged 18 years and older. A narrative synthesis was used to report findings, and the quality of included studies was assessed.

Results: Of the 1,738 records screened, eleven studies met the inclusion criteria, comprising seven experimental and four non-experimental studies. Interventions included virtual and in-person guided walking, smartphone apps, animated audio-visual videos, animal-assisted therapy, nutritional programs, and incentivized community health worker models. Non-experimental studies reported on telehealth-delivered psychotherapies, vitamin D supplementation, and dietary interventions. These interventions were associated with reported improvements in physical activity, cognitive and social functioning, quality of life, and health behaviors, along with reductions in illness severity, self-stigma, and metabolic risk.

Conclusion: This review highlights a range of interventions reported to support the mental health of PLWS during the COVID-19 pandemic. While experimental studies suggest promising outcomes, findings from non-experimental designs require cautious interpretation. These insights may inform the development of flexible, evidence-informed strategies for PLWS in future public health crises.

Introduction

Schizophrenia is a chronic mental disorder affecting approximately 20 million people worldwide (1). This condition not only impacts the health and well-being of affected individuals but also has a significant impact on society (1). People living with schizophrenia (PLWS) have a higher rate of mortality due to long-lasting negative health habits and treatment-related metabolic disorders (2). The burden is even greater for those with co-occurring depression, cognitive impairments, or social dysfunction (2). Additionally, schizophrenia poses a significant economic burden, estimated to range from 0.02% to 1.65% of the gross domestic product (3).

Beyond these existing challenges, the COVID-19 pandemic has further exacerbated difficulties for PLWS. These individuals are at a higher risk of contracting the virus and experiencing severe COVID-19-related outcomes, including increased mortality rates (4). The pandemic has also led to higher relapse rates of psychosis and more severe negative symptoms in PLWS (5). Furthermore, many individuals have faced disruptions in mental health care, with reduced access to essential treatment and support services (6).

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Before the COVID-19 pandemic, mental health interventions for PLWS were primarily delivered through in-person modalities such as outpatient psychiatric consultations, psychosocial rehabilitation programs, day hospitals, and group therapy. These services relied heavily on regular face-to-face interactions between patients and providers and were generally structured within institutional or community-based mental health systems (7).

Ensuring continuity of care is essential for reducing the burden of schizophrenia and preventing relapse (8). However, the COVID-19 pandemic disrupted the established models of mental health services significantly. Social distancing mandates and health system strain led to a rapid shift to virtual or limited in-person care, often without adequate infrastructure or provider training. Particularly, many outpatient programs have been cancelled or transitioned to virtual formats (9). Phone and video consultations have been rapidly adopted as alternatives to in-person clinical care, but their effectiveness in maintaining mental health stability in PLWS remains uncertain (10). These shifts raised critical concerns regarding the continuity, accessibility, and effectiveness of mental health interventions for this vulnerable population during the pandemic.

Monitoring mental health outcomes is a critical approach to evaluating the effectiveness of mental health services. Good mental health is defined as an individual's ability to cope with daily stresses and function productively (11). There are nineteen core domains that define good mental health, for example, mental health literacy, attitudes toward mental disorders, and self-perceptions and values (11). Additionally, a scoping review identified mental health outcomes as encompassing symptoms such as fear, stress, poor sleep, anxiety, and depression (12). For this systematic review, mental health outcomes encompass the signs, symptoms, and behavioral manifestations of schizophrenia, as well as related physical health indicators.

Understanding how mental health services were modified, delivered, and what outcomes were reported during the pandemic is essential for future preparedness. While existing literature has primarily focused on the impact of the COVID-19 pandemic on PLWS (4, 13) or the association between schizophrenia and COVID-19-related complications (5). Few studies have synthesized the specific interventions implemented to support the mental health of PLWS during this period. This systematic review aims to address this gap by identifying and describing interventions implemented to support the mental health of PLWS during the COVID-19 pandemic and synthesizing the outcomes reported in the included studies. By mapping both experimental and descriptive evidence, the review provides insights into how mental health care was adapted during a global crisis and highlights strategies that may inform future clinical practice.

Methods

The review protocol was registered with PROSPERO (CRD42023448936) and was reported following the Preferred Reporting for Items of Systematic Reviews and Meta-Analyses (Appendix 1) (14).

Eligibility criteria

This systematic review included studies conducted among individuals aged 18 years or older diagnosed with schizophrenia or schizophrenia spectrum disorders. Studies with mixed populations were also considered if PLWS comprised more than 50% of the sample.

Both experimental (randomized controlled trials, quasi-experimental studies) and non-experimental studies (case reports, case series, and cohort studies) were eligible if they reported on interventions implemented to support mental health outcomes in PLWS during the COVID-19 pandemic.

Interventions were defined as any activity aimed at improving mental health outcomes in PLWS during the pandemic. Mental health outcomes encompass signs, symptoms, and behaviors related to schizophrenia and overall well-being, as measured through standardized clinical scales, self-reported questionnaires, or behavioral observations. Eligible studies included interventions delivered in clinical settings,

community settings, or via telehealth platforms. Both pharmacological and psychosocial interventions were considered.

Studies published within the last five years (2019-2023) were included. To be eligible, studies had to explicitly describe or assess interventions aiming to support mental health outcomes of PLWS in the context of the COVID-19 pandemic, rather than simply being conducted during this period. Studies were excluded if they were conference abstracts, letters to the editor, or not published in English. Qualitative studies were excluded unless they provided measurable mental health outcomes. Systematic reviews and meta-analyses were also excluded.

Search strategy

Searches were conducted in MEDLINE, Embase, CINAHL, and ScienceDirect. The PICO framework (Population, Intervention, Comparison, and Outcome) was defined as follows: P= individuals diagnosed with schizophrenia or schizophrenia spectrum disorders; I= interventions aimed at improving the mental health outcomes of PLWS during the COVID-19 pandemic; C = any comparison; O = mental health outcomes. The full search strategy is detailed in Table 1.

Although the search approach was PICO-informed, the primary aim of this review was to describe the characteristics and reported outcomes of interventions, rather than evaluate their effectiveness in a comparative or meta-analytic sense. Given the evolving nature of the pandemic, a wide range of study designs (including case reports and case series) was included to capture timely and innovative responses.

Table 1. The search term

Population	Intervention	Outcome	Setting
1. schizo*	2. intervention* OR treatment* OR program* OR therap* OR educat*	3. symptom* OR behavio* OR adherence OR "quality of life" OR "well-being"	4. "COVID-19" OR COVID19

The search syntaxes and results are presented in Appendix 2. For instance, in MEDLINE, the search syntax was formed as follows: (schizo*) AND (intervention* OR treatment* OR program* OR therap* OR educat*) AND (symptom* OR behavio* OR adherence OR "quality of life" OR "well-being") AND ("COVID-19" OR COVID19). The filters were 2019-2023, humans, and the English language.

The selection of studies

All studies from the search strategy were imported into EndNote 20, and duplicated studies were removed. Study selection followed a three-step screening process (Figure 1). First, titles and abstracts were screened, and irrelevant studies were excluded. Second, full-text articles were retrieved, with inaccessible studies excluded. Finally, full-text articles were assessed to determine eligibility based on the inclusion criteria. This process was independently completed by two authors (TN and SS). A discussion with the third author was required (PU) to resolve any disagreement.

Risk of bias assessment

Joanna Briggs Institute (JBI) Critical Appraisal Checklist (15) was used based on study design: RCT (5 studies), quasi-experimental (2 studies), case report (1 study), and case series (2 studies). For Zhang, Wang (16), a retrospective self-controlled study, the case series checklist was applied due to its descriptive focus, with results interpreted cautiously given tool limitations.

The quality of the included studies was defined as a total JBI score greater than 70% was considered high quality, those with a total score between 50% and 70% were considered medium quality, and those with a total score of less than 50% were considered low quality (17, 18). The quality assessment was independently conducted by two reviewers (TN and SS). A discussion with the third author was required (PU) to resolve any disagreement. The results of the quality assessment were summarized in a table.

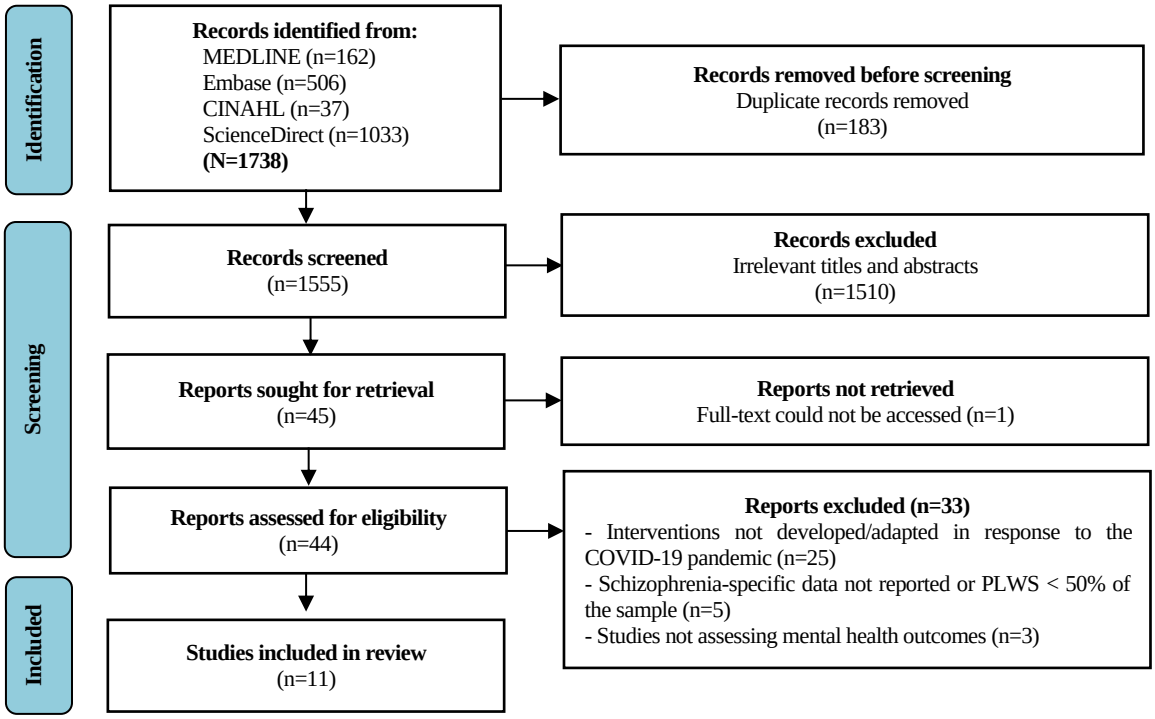

Figure 1. The PRISMA flow diagram of included studies

Data extraction

An Excel spreadsheet was used to summarize the characteristics of the included studies, including study design, country, setting, participants, age, sample size, intervention and comparison, intervention duration, and intervention type. A separate Excel spreadsheet was used to document the interventions on mental health outcomes in PLWS. This spreadsheet captured information related to the name of the intervention, outcome measures, outcome domains (aimed at improving signs, symptoms, or behaviors of PLWS), and the reported outcomes. Data extraction was independently conducted by two authors (TN and SS). Any disagreements were resolved through discussion with a third author (PU).

Data synthesis

A narrative summary was used to identify and summarize interventions aimed at supporting the mental health outcomes of PLWS during the COVID-19 pandemic. Meta-analysis was not conducted in this study. The Synthesis Without Meta-analysis (SWiM) guideline was followed to guide the synthesis process (Appendix 3) (19).

The included studies were categorized into two groups: Experimental studies, including randomized controlled trials (RCTs) and non-RCTs; Non-experimental studies, including cohort studies, case series, and case reports.

Within each group, findings were further classified based on two main outcome categories: Outcomes related to signs and symptoms and outcomes related to health behaviors.

All outcomes were reported as presented in the primary studies, with no transformation methods applied.

Results

The selection of the included studies

A total of 1,738 potentially relevant records were identified from MEDLINE, Embase, CINAHL, and ScienceDirect. After removing 183 duplicate records, 1,555 unique records remained for title and abstract screening. Of these, 1,510 were excluded due to irrelevance.

The full texts of the remaining 45 reports were retrieved, but one report could not be accessed. Thus, 44 reports were assessed for

eligibility. Following further screening, 33 reports were excluded, resulting in 11 studies being included in this systematic review (Figure 1). A list of excluded full-text articles and reasons for exclusion is provided in Appendix 4. The reasons for exclusion were studies with interventions not developed or adapted in response to the COVID-19 pandemic (n=25), studies with fewer than 50% PLWS in the sample (n=5), and studies that did not assess mental health outcomes (n=3).

Characteristics of included articles

Table 2 provides a summary of the key characteristics of the included studies. In terms of research design, seven studies were experimental (five RCTs and two non-RCTs), while four studies were non-experimental (one case report, two case series, and one retrospective self-controlled study).

Geographically, the majority of studies were conducted in the USA (four studies), followed by Taiwan (2 studies), and Spain, Italy, India, Israel, and China (one study each). Regarding study settings, six studies took place in mental health centers, four in referral psychiatry services, psychiatric rehabilitation centers, Veterans Affairs hospitals, and outpatient clinics. Meanwhile, only one study was conducted in the community.

In terms of the study population, six studies focused on individuals with schizophrenia, while five studies included participants with schizophrenia spectrum disorders. The mean age of participants in experimental studies ranged from 38.9 to 51.0 years, whereas in non-experimental studies, it varied from the mid-20s to mid-80s. The sample size for experimental studies ranged from 32 to 143 participants, while non-experimental studies included between 2 and 90 participants.

Table 2. The characteristics of the included studies

Authors (Reference)	Study design	Country (Setting)	Participants	Mean age (SD)	The sample size for analysis	Intervention/ comparison	Duration of intervention	Types of intervention
Browne, Battaglini (20)	Two-arm parallel pilot randomized controlled trial	The USA (Local outpatient community mental health centers)	Adults with SSD	IG=41.76 (11.72) CG= 41.05 (13.64)	37 (IG=17; CG=20)	Virtual Physical Activity Can Enhance Life/Fitbit Alone	16 weeks	A live, video-delivered intervention
Chen, Hsu (21)	Single-blind randomized controlled trial	Taiwan (psychiatric daycare centers)	Patients diagnosed with schizophrenia	IG: 41.29 (10.5), CG: 50.45 (11.4)	94 (IG=35; CG=59)	MedAdhere app + usual care/usual care only	12 weeks	Smartphone app
Kopelowic, Lopez (22)	A longitudinal, randomized control trial	The USA (A community mental health center)	Latinx adults with SSD	IG=40.7 (14.3) CG= 38.9 (14.6)	95 (IG=47; CG=48)	A 12 min animated, Spanish-language audio-visual Novela/ A non-COVID video	12 minutes	In-person
Sevillano-Jimenez, Romero-Saldana (23)	Two-arm, double-blind, balanced-block, six-month intervention	Spain (The referral Psychiatry Service)	Psychiatric patients diagnosed with SSD	49.2 (11.9)	46 (IG= 23, CG=21)	An individual nutritional education program/ Conventional dietary counseling	6 months	In-person
Shih and Yang (24)	Longitudinal, single-blind experimental study	Taiwan (Psychiatric rehabilitation)	Patients diagnosed with schizophrenia	IG= 49.5 (9.5) CG= 51.0 (9.7)	90 (IG=45; CG=45	Animal-assisted therapy/ Routine discussion groups and watched short films about animals	12 weeks	In-person
Mandini, Morelli (25)	Non-randomized trial	Italia (Public Mental Health Department)	Patients diagnosed with schizophrenia	46.4 (9.6)	32 (IG=20, CG=12)	Guided walking program/ Cognitive rehabilitation program	1 year	In-person
Sivakumar, Basavarajappa (26)	Non-randomized trial	India (Rural community)	Adults with schizophrenia spectrum disorders or	Overall: 47.22 (13.38) overall	143	Incentivized Accredited Social Health Activists (ASHA) for follow-	12 months	In-person - Community health

Authors (Reference)	Study design	Country (Setting)	Participants	Mean age (SD)	The sample size for analysis	Intervention/ comparison	Duration of intervention	Types of intervention
			bipolar disorder			ups and support/no control group		worker (ASHA)
Faith, Zou (27)	Cases report	The USA (Veterans Affairs Hospital)	Adults with Schizophrenia	mid-40s and mid-20s	2	Metacognitive Reflection and Insight Therapy	NA	Telehealth
Joseph, de Andino (28)	A case series	The USA (Outpatient clinic)	People with a diagnosis of a serious behavioral disorder or schizophrenia spectrum	NA	2	Cognitive Behavioral Social Skills Training	6-8 weeks	Telehealth
Shelef, Dahan (29)	A case series	Israel (Mental Health Center)	Elderly psychiatric inpatients including Schizophrenia	82.8 (7.2)	14	Vitamin D long-term supplementation	20 months	In-person
Zhang, Wang (16)	A retrospective self-controlled study	China (Mental Health Center)	Patients with schizophrenia	median age = 44 (33-50.5)	90	Diet-alone interventions	3 months	In-person

SSD=Schizophrenia spectrum disorders; NA=Not available; IG=Intervention group; CG=Control group

The majority of the interventions were non-pharmacological, with only one study describing a pharmacological approach, specifically examining the association between pre-existing vitamin D supplementation and the severity of COVID-19 infection (29). The duration of the interventions ranged from 12 minutes to 1 year.

In terms of delivery methods, among the experimental studies, one intervention was video-delivered, one was a smartphone app, and the remaining five were in-person interventions. Among the non-experimental studies, two interventions utilized telehealth approaches, while the other two were delivered in person.

Regarding study quality, six experimental studies and one non-experimental study were classified as high quality, while another experimental study, two case series studies, and the retrospective self-controlled study were rated as moderate quality (Table 3).

Table 3. JBI critical appraisal checklist

Authors (Reference)	Design	Checklist Used	Total score	Quality
Browne, Battaglini (20)	Randomized controlled trial	JBI Checklist for RCTs	12/13	High
Chen, Hsu (21)	Randomized controlled trial	JBI Checklist for RCTs	10/13	High
Kopelowicz, Lopez (22)	Randomized controlled trial	JBI Checklist for RCTs	10/13	High
Sevillano-Jimenez, Romero-Saldana (23)	Randomized controlled trial	JBI Checklist for RCTs	9/13	High
Shih and Yang (24)	Randomized controlled trial	JBI Checklist for RCTs	10/13	High
Mandini, Morelli (25)	Non-randomized controlled trial	JBI Checklist for Quasi-Experimental	9/9	High
Sivakumar, Basavarajappa (26)	Non-randomized controlled trial	JBI Checklist for Quasi-Experimental	5/9	Medium
Faith, Zou (27)	Case reports study	JBI Checklist for Case Reports	6/8	High
Joseph, de Andino (28)	Case series studies	JBI Checklist for Case Series	6/10	Medium
Shelef, Dahan (29)	Case series studies	JBI Checklist for Case Series	6/10	Medium
Zhang, Wang (16)	Retrospective self-controlled study	JBI Checklist for Case Series	7/10	Medium

Reported mental health outcomes associated with interventions

Table 4 summarizes the reported outcomes of the intervention on mental health among PLWS, which were classified into 2 groups as follows.

* *Experimental studies*

Three out of the five studies aimed at enhancing the behavioural outcomes, yielding positive outcomes. Notably, a live and video-delivered exercise program for adults with schizophrenia demonstrated improvements in daily steps among participants who attended at least 50% of the walking sessions (20). Similarly, individuals who viewed a brief 12-minute COVID-19 video were more likely to receive the COVID-19 vaccine (22). Moreover, participants undergoing animal-assisted therapy exhibited significantly enhanced social functioning and quality of life compared to the control group (24).

The other two experimental studies targeted interventions aimed at improving the signs and symptoms of PLWS. One study focused on a nutritional program designed to increase the consumption of prebiotic and probiotic foods. Results showed significant reductions in weight, Body Mass Index (BMI), waist circumference, and waist-to-height ratio (WHtR) among participants in the intervention group. Moreover, the program led to a decrease in the prevalence of metabolic syndrome risk factors (23). Another intervention involved a guided walking program, which yielded significant improvements in cognitive functions, along with reductions in body weight, BMI, systolic and diastolic blood pressure, and enhancements in cardiovascular function among participants (25).

In addition, the last two experimental studies implemented interventions aimed at improving the signs, symptoms, and behaviors of people living with schizophrenia (PLWS). One randomized controlled trial (RCT) evaluated the effectiveness of MedAdhere, a smartphone application used in a daycare center setting. After 12 weeks, participants in the intervention group demonstrated improved medication adherence, reduced psychotic symptoms (including positive, negative, and general psychopathology symptoms), and enhanced cognitive functioning (specifically in memory, language, and executive function) compared to the control group (21). Similarly, a non-randomized study assessed the impact of incentivizing Accredited Social Health Activists (ASHAs) in a rural area. At the one-year follow-up, the intervention group showed significant reductions in disability, illness severity, and self-stigma, along with improved work performance (26).

Table 4. Reported mental health outcomes associated with interventions for PLWS during the COVID-19 pandemic

Authors (Design)	Intervention	Outcome measures	Outcome domains	Reported outcomes
Browne, Battaglini (20) (RCT)	Virtual Physical Activity Can Enhance Life	- Steps/day and minutes spent walking - Cardiorespiratory fitness	Health behavior	- Increased physical activity
Kopelowicz, Lopez (22) (RCT)	An animated, Spanish-language audio-visual Novela	Knowledge, attitudes, and behaviors regarding COVID-19	Health behavior	- Increased the likelihood of seeking a COVID-19 vaccine
Shih and Yang (24) (RCT)	Animal-assisted therapy	-Social function -Social adaptive function - Quality of life	Health behavior	- Improved social function - Improved quality of life
Sevillano-Jimenez, Romero-Saldana (23)	An individual nutritional education program	-Biochemical profile - Anthropometric Profile - Cardiovascular Profile - Therapeutic Variables	Signs and symptoms	- Improved anthropometric profile - Reduced the prevalence of metabolic syndrome risk factors - Decreased cardiovascular risk
Mandini, Morelli (25) (A non-RCT)	Guided walking program	- In both groups: cognitive and executive functions, blood pressure, anthropometric measurements - Only in the IG: VO2 peak determination	Signs and symptoms	- Improved anthropometric profile - Improved cardiovascular function - Improved cognitive function

Authors (Design)	Intervention	Outcome measures	Outcome domains	Reported outcomes
Faith, Zou (27) (Cases report)	Metacognitive Reflection and Insight Therapy	Metacognitive capacity (self-reflectivity, understanding of the other, decentration, and mastery)	Signs and symptoms	- Improved metacognitive capacity
Shelef, Dahan (29) (A case series)	Vitamin D long-term supplementation	Symptomatic severity and complications of COVID-19 infection	Signs and symptoms	- Decreased symptoms of COVID-19 infection
Zhang, Wang (16) (A retrospective self-controlled study)	Diet-alone interventions	Body weight and BMI	Signs and symptoms	- Decreased body weight and BMI
Joseph, de Andino (28) (A case series)	Cognitive Behavioral Social Skills Training	Treatment progress	Both signs, symptoms, and behavior	- Improved progress toward the treatment goal - Increased proficiency in cognitive, social, and problem-solving skills
Chen, Hsu (21) (RCT)	MedAdhere smartphone app	- Medication adherence rate - Positive and Negative Syndrome Scale - Mini-Mental State Examination	Both signs, symptoms, and behavior	- Improved medication adherence - Reduced psychotic symptoms (positive, negative, and general psychopathology symptoms) - Improved cognitive functions (memory, language, and executive function)
Sivakumar, Basavarajappa (26) (A non-RCT)	Incentivized ASHAs to support care and follow-up for persons with SMI	- Disability due to mental illness - Health status - Illness severity - Internalized stigma of mental illness	Both signs, symptoms, and behavior	- Significant reduction in disability, illness severity, self-stigma - Improved work performance

** Non-experimental studies*

Three of the non-experimental studies reported outcomes related to signs and symptoms of PLWS, while another study addressed signs and symptoms, as well as behaviors. Firstly, a case report study reported that metacognitive reflection and insight therapy (MRIT) delivered via telehealth improved self-reflectivity, understanding of others, decentration, and mastery (27). Additionally, a study on preexisting vitamin D supplementation during COVID-19 infection revealed that most participants either remained asymptomatic or experienced minimal symptoms, with no need for intensive care unit intervention or fatalities (29).

Furthermore, a retrospective self-controlled study on a diet-alone intervention reported significant reductions in body weight and BMI (16). Lastly, Cognitive Behavioral Social Skills Training (CBSST) delivered via telehealth in a case series study, improved both signs and symptoms (enhanced cognitive proficiency) and behaviors (social and problem-solving skills) (28).

Discussion

This systematic review highlights the implementation of multidisciplinary approaches aimed at supporting the mental health outcomes of PLWS during the COVID-19 pandemic. The findings indicate significant improvements in symptoms, behaviors, and overall well-being. While some results were based on non-experimental studies with methodological limitations, any progress in the mental health of PLWS is valuable, particularly given their heightened vulnerability. The details are discussed below.

Characteristics of included articles

All five randomized controlled trials (RCTs) (20-24) were rated as high quality, suggesting that their findings provide reliable evidence to inform practice. Among the non-randomized studies, one was rated as high quality (25), while another was of medium quality (26). In contrast, most non-experimental studies were classified as medium quality (16, 28, 29), with only one study rated as high quality (27). These results highlight the need for more rigorous research to strengthen the evidence

base, particularly among non-randomized and non-experimental studies.

All included studies were conducted in high-income or upper-middle-income countries such as the USA (20, 22, 27, 28), Spain (23), Italy (25), India (26), Israel (29), Taiwan (24), and China (16). No studies were conducted in low-income countries, indicating potential limitations in access to care for PLWS in these settings, particularly during the COVID-19 pandemic.

Regarding the setting, the majority of studies were conducted at a mental health center (16, 20-22, 25, 29), psychiatric rehabilitation (24), or Veterans Affairs hospital (27). Only one intervention was conducted at the outpatient clinic (28) and one study was conducted in a community setting (26). This finding highlights a lack of community-based support for PLWS during the pandemic.

Regarding the platforms used to deliver interventions, only one study employed an online intervention (20). One utilized a smartphone application (21), and two implemented telehealth-based approaches (27, 28). Meanwhile, in contrast, the remaining studies were delivered in person (16, 22-26, 29). This indicates that online and telehealth interventions were not widely adopted, even during the COVID-19 pandemic, likely due to various implementation challenges.

The change in mental health outcomes in people living with Schizophrenia during the COVID-19 pandemic

**Among experimental studies*

During the COVID-19 pandemic, experimental interventions for PLWS addressed behavioral, clinical, and physical health outcomes. Virtual walking, audiovisual education, and animal-assisted therapy showed benefits in physical activity, vaccination uptake, and social functioning. Dietary programs and smartphone apps helped reduce metabolic risk and improve medication adherence. Task-sharing with community health workers like ASHAs demonstrated effectiveness in reducing symptoms and improving functioning. These findings align with and extend prior research. The details are discussed below.

Most of the experimental studies conducted during the COVID-19 pandemic have focused on improving health behaviors among PLWS. Firstly, a virtual walking intervention reported an improvement in steps per day (20). This finding suggests that virtual exercise programs can serve as feasible alternatives to promote physical activity, particularly when in-person sessions are restricted. Since PLWS are a vulnerable population, any improvement in physical activities is beneficial. These findings are consistent with other research in PLWS. Especially, a systematic review and meta-analysis of 28 studies found that exercise interventions significantly improved muscle strength and self-reported disability (30). However, virtual interventions may pose challenges. For instance, participants in the included study attended only 55.8% of the virtual sessions (20), potentially due to limited opportunities for social interaction and difficulties engaging with remote formats (31). These factors can undermine the effectiveness and sustainability of virtual interventions. Therefore, future research should focus on optimizing the design and delivery of remote programs, such as by incorporating social or peer support features to ensure they meet the unique needs of PLWS during pandemic conditions.

Secondly, a COVID-19 educational video using animation and audiovisual elements led to a higher vaccination uptake (22). This supports the effectiveness of entertainment-education strategies in promoting health behaviors among PLWS, particularly given the communication barriers that can impact information retention and decision-making (32). The findings of this study are consistent with previous research among PLWS. A randomized clinical trial found that educational interventions led to improvements in quality of life and functional ability, suggesting that alternative methods of patient education can be beneficial (33). Furthermore, a comprehensive review of psychoeducational interventions concluded that such approaches can enhance social functioning (34). However, while audiovisual interventions

show promise, their effectiveness may be influenced by individual engagement levels, cultural relevance, and technological accessibility (35). These factors are especially critical during crises like the COVID-19 pandemic which can amplify health disparities. Future studies should focus on adapting audiovisual tools to be culturally sensitive and digitally inclusive to ensure their effectiveness across diverse settings.

Lastly, a randomized controlled trial applied animal-assisted therapy (AAT) reported significant improvements in social interactions and quality of life (24). It suggests that having a relationship with animals can help motivate and engage PLWS, ultimately leading to improved social interaction. This is especially important because human interactions have decreased significantly since the outbreak of the COVID-19 pandemic, worsening the social isolation of PLWS. These findings are reinforced by a scoping review and a systematic review of AAT in schizophrenia and related disorders. Both reviews concluded that AAT can improve negative and emotional symptoms, enhance social functioning, and support positive self-perceptions (36, 37). Additionally, AAT has been associated with better treatment adherence and patient engagement, which are crucial for managing long-term outcomes in schizophrenia (36). Given the exacerbation of social isolation during the COVID-19 pandemic, integrating AAT into community-based rehabilitation programs could serve as a valuable strategy to mitigate loneliness and promote social engagement among PLWS. Future research should explore the long-term effects of AAT and identify factors that can sustain its benefits beyond the intervention period.

In addition to behavioral interventions, some experimental studies targeted clinical symptoms and physical health outcomes. A nutritional program aimed at increasing the consumption of prebiotic and probiotic foods, along with a guided walking program, had a positive impact. Specifically, they led to improvements in anthropometric variables, a reduction in cardiovascular risk, and a decreased risk of metabolic syndrome (23, 25). Moreover, the guided walking intervention could improve cognitive function (25). These findings are notable given the increased risk of metabolic syndrome and cardiovascular disease among PLWS (38). Moreover, during the COVID-19 pandemic, reduced physical activity and hyper-caloric diets may have exacerbated metabolic health risks. A recent review reported that one-third of PLWS met the criteria for metabolic syndrome during the pandemic (5). These results suggest that psychiatric treatment facilities should incorporate lifestyle interventions alongside conventional treatments to address physical health disparities in PLWS. Future research should focus on the long-term sustainability of these benefits and explore strategies to enhance adherence and accessibility in diverse settings.

In addition to behavioral interventions, one randomized controlled trial included in this review evaluated the MedAdhere smartphone application, which aimed to enhance medication adherence among PLWS in a daycare setting (21). After 12 weeks, the intervention group demonstrated improved adherence, reduced psychotic symptoms, and enhanced cognitive functioning. These findings are consistent with pre-pandemic evidence from systematic reviews, which highlight that well-designed digital health tools can effectively support medication adherence and symptom management in schizophrenia (39). Similarly, a systematic review on smartphone apps for schizophrenia further demonstrated high retention rates (92%) and frequent engagement, with users interacting with apps on over 85% of days during study periods (40). Participants also reported various psychological and functional benefits, and the overall user experience was positive. These findings collectively support the feasibility and potential of mobile health (mHealth) interventions for PLWS, particularly in the context of the COVID-19 pandemic, which has limited access to in-person services. Future research should examine scalable strategies for integrating smartphone-based interventions into routine care, with a focus on long-term engagement and equity of access.

Another promising intervention involved task-sharing through the incentivization of Accredited Social Health

Activists (ASHAs) in rural India to provide support for PLWS (26). After one year, the intervention group showed significant improvements, including reductions in disability, illness severity, and self-stigma, along with enhanced work performance. These findings align with pre-pandemic evidence supporting the effectiveness of community-based and task-shifted models of care. A 2018 meta-analysis concluded that early-stage community interventions can significantly reduce schizophrenia symptoms compared to standard care (41). The COVID-19 pandemic highlighted critical gaps in centralized mental health services, reinforcing the need for decentralized, community-driven care models. ASHAs, who are embedded within local health systems and trusted by the community, represent a scalable and culturally appropriate workforce to bridge service delivery gaps. Future research should rigorously assess the cost-effectiveness and scalability of such task-sharing approaches, especially in under-resourced settings where human resource shortages persist.

**Among non-experimental studies*

Non-experimental studies during the COVID-19 pandemic highlighted both the potential and limitations of telehealth and in-person interventions for PLWS. Telehealth-delivered therapies like Metacognitive Reflection and Insight Therapy and Cognitive Behavioral Social Skills Training improved metacognition, social skills, and cognitive function. In-person interventions such as vitamin D supplementation and dietary changes showed benefits for infection severity and weight management. The details are discussed below.

Most of the non-experimental studies reported the improvement in the signs and symptoms of PLWS. Specifically, a case report study among two PLWS found that Metacognitive Reflection and Insight Therapy (MRIT) delivered via telehealth was convenient and associated with enhancing metacognitive capacity (27). However, the study also reported that teletherapy lacks privacy for some individuals, making in-person care irreplaceable for certain populations. These findings align with previous literature suggesting that while telemedicine can be beneficial, face-to-face interactions remain essential in some cases (4). Therefore, hybrid care models that combine digital and face-to-face interactions have been proposed. Such approaches can enhance accessibility while preserving the depth of in-person communication. Future research should explore the efficacy of these models and develop strategies to ensure privacy and engagement in teletherapy, particularly for vulnerable populations like PLWS.

A case series study examining Cognitive Behavioral Social Skills Training (CBSST) via telehealth reported improvements in cognitive function, social skills, and problem-solving abilities (28). Given that limited social interaction during the pandemic may have led to a decline in social and problem-solving skills, this finding reinforces the potential utility of teletherapy for PLWS. The findings of this study are consistent with previous research. Notably, CBSST, which combines cognitive-behavioral therapy with social skills and problem-solving training, has demonstrated efficacy in improving functioning and reducing negative symptoms in schizophrenia in pre-pandemic randomized controlled trials (42). However, privacy concerns remain a key barrier to effective telehealth implementation. In conclusion, while telehealth-delivered CBSST offers a promising avenue for supporting PLWS, especially during periods of limited in-person interaction, addressing privacy and security concerns is crucial for maximizing its effectiveness and patient trust.

In addition to telehealth approaches, the other two non-experimental studies were conducted in an in-person approach. Firstly, a retrospective case series indicated that vitamin D supplementation was associated with reduced severity of the COVID-19 infection among elderly patients (29). This finding aligns with a quasi-experimental study, which reported that regular vitamin D3 supplementation prior to or during COVID-19 was linked to better 3-month survival rates in hospitalized geriatric patients. However, the applicability of these results to the broader PLWS population remains uncertain, underscoring the need for further research across diverse demographic groups (43). Therefore,

further research is needed with different populations to gain a comprehensive understanding.

Secondly, a retrospective self-controlled study tested the effect of a diet-alone intervention on the body weight and BMI of PLWS (16). Given that PLWS are at high risk for weight gain, this study provides evidence that dietary interventions could serve as a viable strategy for weight management. Supporting this, a randomized controlled trial demonstrated that calorie-restricted diets significantly improved body weight, body composition, and metabolic status in people with schizophrenia (44). Moreover, a systematic review found that dietary and lifestyle modifications effectively reduced weight and improved physical health parameters in patients with schizophrenia (45). These findings highlight the importance of integrating nutritional strategies into comprehensive care plans for PLWS. However, implementing such interventions requires consideration of factors like dietary adherence, cultural preferences, and potential barriers to access. Therefore, future research tailoring a dietary program for PLWS is needed.

Limitations

This systematic review has several limitations. First, only published studies in English were included, which may introduce selection bias and limit the generalizability of the findings. Second, the included studies examined a variety of interventions, making it difficult to assess the consistency of results or draw firm conclusions about the overall quality of evidence. Additionally, the reliance on non-experimental designs in many studies limits the strength of causal inferences.

Implications

This systematic review provides evidence supporting the positive effects of various interventions on the mental health outcomes of PLWS, offering valuable insights for healthcare professionals in clinical practice. However, the review also highlights key research gaps. Many of the included studies relied on non-experimental designs, such as case reports and case-control studies, underscoring the need for more rigorous experimental research. Additionally, there is a notable lack of studies conducted in low-income countries, as well as limited research on community-based interventions.

Finally, this review emphasizes the potential benefits of teletherapy for PLWS during the COVID-19 pandemic. While teletherapy appears to be a promising approach, further research is needed to evaluate its long-term effectiveness, accessibility, and suitability for different populations.

Conclusion

This review identified a range of behavioral and clinical interventions implemented to support the mental health of PLWS during the COVID-19 pandemic. Experimental studies primarily featured structured programs such as physical activity, health education, animal-assisted therapy, nutritional interventions, and incentivized community health worker models, while non-experimental studies described emerging approaches including telehealth-based therapies and dietary modifications.

Although these interventions show promise in addressing both mental and physical health challenges, most were conducted in institutional settings within high-income countries, with limited application in community contexts or low-resource environments. Notably, telehealth and digital approaches, despite their relevance during the pandemic, were not widely utilized. These findings highlight the importance of developing more accessible, community-based, and contextually appropriate interventions to support PLWS, particularly during public health emergencies.

Acknowledgments

Not applicable.

Author contributions

Sudaporn Stithyudhakarn contributed to the conceptualization, methodology, investigation, formal analysis, original draft writing, and review and editing of the manuscript. *Penpaktr Uthis* was involved in the conceptualization, methodology, investigation,

formal analysis, and contributed to the review and editing of the manuscript. *Trieu Van Nhat* contributed to the methodology, investigation, formal analysis, and original draft writing.

Conflict of interest

The authors declare no conflict of interest.

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Supplementary files

Appendix 1: Preferred Reporting Items for Systematic Review and Meta-Analyses Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Page 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Page 1-2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Page 2-4
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 4
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 4-5
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Page 5
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Page 5-6
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Page 6
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Page 7
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Page 7
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	NA
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 6
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	NA
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Page 7-8
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Page 7-8
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Page 7-8
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	NA
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	NA
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	NA
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	NA

Section and Topic	Item #	Checklist item	Location where item is reported
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	NA
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Page 8
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	NA
Study characteristics	17	Cite each included study and present its characteristics.	Page 9-12
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Page 12
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g., confidence/credible interval), ideally using structured tables or plots.	Page 12-16
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Page 12-16
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g., confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Page 12-16
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	NA
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	NA
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	NA
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	NA
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Page 16-23
	23b	Discuss any limitations of the evidence included in the review.	Page 23
	23c	Discuss any limitations of the review processes used.	Page 23
	23d	Discuss implications of the results for practice, policy, and future research.	Page 24
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Page 4
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	NA
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	NA
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Page 25
Competing interests	26	Declare any competing interests of review authors.	Page 25
Availability of data, code, and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	NA

Appendix 2: Searching strategy

Database	Syntax	Date of searching	Results
MEDLINE	(schizo*) AND (intervention* OR treatment* OR program* OR therap* OR educat*) AND (symptom* OR behavio* OR adherence OR "quality of life" OR "well-being") AND ("COVID-19" OR COVID19) ***Filtered:*** 2019-2023, humans, English language	December 31, 2023	**162**
Embase	(schizo*) AND (intervention* OR treatment* OR program* OR therap* OR educat*) AND (symptom* OR behavio* OR adherence OR "quality of life" OR "well-being") AND ("COVID-19" OR COVID19) ***Filtered:*** humans	December 31, 2023	**506**
CINAHL	(schizo*) AND (intervention* OR treatment* OR program* OR therap* OR educat*) AND (symptom* OR behavio* OR adherence OR "quality of life" OR "well-being") AND ("COVID-19" OR COVID19) ***Filtered:*** past 5 years, English language	December 31, 2023	**37**
ScienceDirect	("schizophrenia") AND ("intervention" OR "treatment" OR "program" OR therapy" OR "education") AND ("COVID-19" OR "COVID19") ***Filtered:*** English language	December 31, 2023	**1033**
Total			**1738**

Appendix 3: Prefer Synthesis without Meta-analysis Reporting Items

SWiM is intended to complement and be used as an extension to PRISMA		
Reporting item	**Item description**	**Reported on Page #**
Methods		
1. Grouping studies for synthesis	1a) Provide a description of, and rationale for, the groups used in the synthesis (e.g., groupings of populations, interventions, outcomes, study design)	7
	1b) Detail and provide rationale for any changes made subsequent to the protocol in the groups used in the synthesis	NA
2. Describe the standardised metric and transformation methods used	Describe the standardised metric for each outcome. Explain why the metric(s) were chosen, and describe any methods used to transform the intervention effects, as reported in the study, to the standardised metric, citing any methodological guidance consulted	7-8
3. Describe the synthesis methods	Describe and justify the methods used to synthesise the effects for each outcome when it was not possible to undertake a meta-analysis of effect estimates	7-8
4. Criteria used to prioritise results for summary and synthesis	Where applicable, provide the criteria used, with supporting justification, to select the particular studies, or a particular study, for the main synthesis or to draw conclusions from the synthesis (e.g., based on study design, risk of bias assessments, directness in relation to the review question)	NA
5. Investigation of heterogeneity in reported effects	State the method(s) used to examine heterogeneity in reported effects when it was not possible to undertake a meta-analysis of effect estimates, and their extensions to investigate heterogeneity	NA
6. Certainty of evidence	Describe the methods used to assess the certainty of the synthesis findings	NA
7. Data presentation methods	Describe the graphical and tabular methods used to present the effects (e.g., tables, forest plots, harvest plots). Specify key study characteristics (e.g., study design, risk of bias) used to order the studies, in the text and any tables or graphs, clearly referencing the studies included	7-8
Results		
8. Reporting results	For each comparison and outcome, provide a description of the synthesised findings and the certainty of the findings. Describe the result in language that is consistent with the question the synthesis addresses, and indicate which studies contribute to the synthesis	12-16
Discussion		
9. Limitations of the synthesis	Report the limitations of the synthesis methods used and/or the groupings used in the synthesis, and how these affect the conclusions that can be drawn in relation to the original review question	23

Campbell M, McKenzie JE, Sowden A, Katikireddi SV, Brennan SE, Ellis S, Hartmann-Boyce J, Ryan R, Shepperd S, Thomas J, Welch V, Thomson H. Synthesis without meta-analysis (SWiM) in systematic reviews: Reporting guideline. BMJ 2020;368:l6890.

Appendix 4: List of excluded full-text articles

Authors (Reference)	Title	Reason for exclusion
Anthenelli, McKenna (1)	Combining varenicline preloading with Acceptance and Commitment Therapy (ACT) in persons with serious mental illness who smoke: The randomized ACTSLow pilot feasibility trial	The intervention was not tailored to support PLWS in the context of the COVID-19 pandemic.
Ben-Zeev, Chander (2)	A Smartphone Intervention for People with Serious Mental Illness: Fully Remote Randomized Controlled Trial of CORE	PLWS made up only 21.6% of the sample (below the 50% threshold).
Bhatia, Kumari (3)	Feasibility, acceptability, and evaluation of meditation to augment yoga practice among persons diagnosed with schizophrenia	No intervention intended to improve mental health outcomes; purely feasibility of data collection.
Birabwa-Oketcho, Nakasujja (4)	The effectiveness of a solution-focused approach (DIALOG+) for patients with severe mental illness and epilepsy in Uganda: A randomised controlled trial	Schizophrenia-specific data not reported; PLWS likely <50% of sample.
Browne, Battaglini (5)	Targeting Physical Health in Schizophrenia: Results from the Physical Activity Can Enhance Life (PACE-Life) 24-Week Open Trial	The study does not explicitly describe the intervention in the context of the COVID-19 pandemic.
de Pinho, Sequeira (6)	Assessing the efficacy and feasibility of providing metacognitive training for patients with schizophrenia by mental health nurses: A randomized controlled trial	The study does not explicitly describe the intervention in the context of the COVID-19 pandemic.
Fisher, Etter (7)	The Effects of Remote Cognitive Training Combined with a Mobile App Intervention on Psychosis: Double-Blind Randomized Controlled Trial	The intervention was not tailored to support PLWS in the context of the COVID-19 pandemic.
Freeman, Lambe (8)	Automated virtual reality therapy to treat agoraphobic avoidance and distress in patients with psychosis (gameChange): a multicentre, parallel-group, single-blind, randomised, controlled trial in England with mediation and moderation analyses	Intervention not evaluated in the context of the COVID-19 pandemic, despite being conducted during that period.
Gibbons, Duong (9)	Randomized Controlled Trial Evaluating Feedback to Community-Based Therapists Based on Patient Reports of Trust and Respect	Schizophrenia-specific data not reported; PLWS likely <50% of sample
Han, Lee (10)	Effects of a Metacognitive Smartphone Intervention with Weekly Mentoring Sessions for Individuals with Schizophrenia: A Quasi-Experimental Study	The intervention program was suspended due to the rising number of confirmed COVID-19 cases.
Herpertz, Richter (11)	Symptom monitoring based on digital data collection during inpatient treatment of schizophrenia spectrum disorders - A feasibility study	Did not assess the outcomes of an intervention specifically for people living with schizophrenia (PLWS) during the COVID-19 pandemic (a feasibility).
Jankowski, Klemenhagen (12)	Integration of primary care and mental health in a community health center: A quality improvement project to improve the health of patients with serious and persistent mental illness	Schizophrenia-specific data not reported; PLWS likely <50% of sample.
Jin, Tong (13)	Effectiveness of accelerated intermittent theta burst stimulation for social cognition and negative symptoms among individuals with schizophrenia: A randomized controlled trial	The study does not explicitly describe the intervention in the context of the COVID-19 pandemic.
Karbalaee, Jameie (14)	Efficacy and safety of adjunctive therapy with fingolimod in patients with schizophrenia: A randomized, double-blind, placebo-controlled clinical trial	The study does not explicitly describe or assess outcomes of the intervention in the context of the COVID-19 pandemic.
Köktaş, Yiğitoğlu (15)	The effect of interpersonal relations theory-based motivational interviews on functional remission and insight levels of patients with schizophrenia: A randomized controlled trial	This study does not explicitly state that the intervention was developed or adapted due to the COVID-19 pandemic.
Kumari, Joseph (16)	Nurse-led brief psycho-education on self-stigma among clients with schizophrenia and affective disorders: Solomon four-group design	This study does not explicitly state that the intervention was developed or adapted due to the COVID-19 pandemic.
Ma, Fan (17)	Effects of smoking cessation on plasma clozapine concentrations in male patients with schizophrenia during the COVID-19 pandemic	No intervention aiming to enhance mental health outcomes: The study investigates the pharmacokinetic effects of smoking cessation on clozapine levels, not a structured mental health intervention.
Mendelson, Thibaudeau (18)	Remote group therapies for cognitive health in schizophrenia-spectrum disorders: Feasible, acceptable, engaging	A feasibility study (it does not explicitly assess or describe outcomes of the intervention in the context of the COVID-19 pandemic).

Authors (Reference)	Title	Reason for exclusion
Moncrieff, Crellin (19)	Antipsychotic dose reduction and discontinuation versus maintenance treatment in people with schizophrenia and other recurrent psychotic disorders in England (the RADAR trial): an open, parallel-group, randomised controlled trial	This study does not explicitly state that the intervention was developed or adapted due to the COVID-19 pandemic.
Mow, Gard (20)	Smartphone-based mobility metrics capture daily social motivation and behavior in schizophrenia	This study does not explicitly state that the intervention was developed or adapted due to the COVID-19 pandemic.
Munson, Jaccard (21)	Impact of a brief intervention to improve engagement in a recovery program for young adults with serious mental illness	This study does not explicitly state that the intervention was developed or adapted due to the COVID-19 pandemic.
Munson, Jaccard (22)	Outcomes of a Metaintervention to Improve Treatment Engagement Among Young Adults with Serious Mental Illnesses: Application of a Pilot Randomized Explanatory Design	This study does not explicitly state that the intervention was developed or adapted due to the COVID-19 pandemic.
Ng, El-Den (23)	Evaluation of a training program to support the implementation of a community pharmacist-led support service for people living with severe and persistent mental illness	The study evaluates provider-focused training outcomes (pharmacists) rather than mental health outcomes in PLWS.
Orleans-Pobee, Browne (24)	Physical Activity Can Enhance Life (PACE-Life): results from a 10-Week walking intervention for individuals with schizophrenia spectrum disorders	This study does not explicitly state that the intervention was developed or adapted due to the COVID-19 pandemic.
Puspitasari, Heredia (25)	Feasibility and initial outcomes of a group-based teletherapy psychiatric day program for adults with serious mental illness: Open, nonrandomized trial in the context of COVID-19	Schizophrenia-specific data not reported; PLWS likely <50% of sample.
Putra and Fithriyah (26)	Psychoeducation on adherence to treatment of schizophrenia patients during the COVID-19 pandemic era	The outcome measured is primarily focused on adherence to treatment rather than mental health outcomes.
Riedl, Nagels (27)	Multimodal speech-gesture training in patients with schizophrenia spectrum disorder: Effects on quality of life and neural processing	This study does not explicitly state that the intervention was developed or adapted due to the COVID-19 pandemic.
Rodriguez-Villa, Camacho (28)	Psychiatric rehabilitation through teaching smartphone skills to improve functional outcomes in serious mental illness	This study does not explicitly state that the intervention was developed or adapted due to the COVID-19 pandemic.
Sampedro, Ibarretxe-Bilbao (29)	Analyzing structural and functional brain changes related to an integrative cognitive remediation program for schizophrenia: A randomized controlled trial	The study was not designed as a pandemic-specific intervention or to examine mental health outcomes due to the pandemic.
Sampedro, Peña (30)	Moderators of functional improvement after integrative cognitive remediation in schizophrenia: Toward a personalized treatment approach	This study does not explicitly state that the intervention was developed or adapted due to the COVID-19 pandemic.
Simião, Santana (31)	Early intervention program for psychosis in a Portuguese hospital: The first results of the open program	This study does not explicitly state that the intervention was developed or adapted due to the COVID-19 pandemic.
Vogel, Bruins (32)	Effects of an eating club for people with a psychotic disorder on personal recovery: Results of a randomized controlled trial	The intervention program was suspended due to the rising number of confirmed COVID-19 cases.
Wang, Chong (33)	The Efficacy of Extended Metacognitive Training on Neurocognitive Function in Schizophrenia: A Randomized Controlled Trial	This study does not explicitly state that the intervention was developed or adapted due to the COVID-19 pandemic.

List of excluded articles:

1. Anthenelli RM, McKenna BS, Giannini J, Attaluri SV, Rubin M, O'Crowley E, et al. Combining varenicline preloading with acceptance and commitment therapy (ACT) in persons with serious mental illness who smoke: The randomized ACTSLow pilot feasibility trial. Drug and Alcohol Dependence. 2023;253:111012. https://doi.org/10.1016/j.drugalcdep.2023.111012

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3. Bhatia T, Kumari N, Yadav A, Beniwal RP, Shah G, Joel W, et al. Feasibility, acceptability and evaluation of meditation to augment yoga practice among persons diagnosed with schizophrenia. Acta Neuropsychiatrica. 2022;34(6):330-43. https://doi.org/10.1017/neu.2022.14

4. Birabwa-Oketcho H, Nakasujja N, Alinaitwe R, Bird V, Priebe S, Sewankambo N. The effectiveness of a solution-focused approach (DIALOG+) for patients with severe mental illness and epilepsy in Uganda: A randomized controlled trial. Psychiatry Research Communications. 2023;3(1):100097. https://doi.org/10.1016/j.psycom.2022.100097

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6. de Pinho LMG, Sequeira C, Sampaio FMC, Rocha NB, Ozaslan Z, Ferre-Grau C. Assessing the efficacy and feasibility of providing metacognitive training for patients with schizophrenia by mental health nurses: A randomized controlled trial. Journal of Advanced Nursing. 2021;77(2):999-1012. https://doi.org/10.1111/jan.14627
7. Fisher M, Etter K, Murray A, Ghiasi N, LaCross K, Ramsay I, et al. The effects of remote cognitive training combined with a mobile app intervention on psychosis: Double-blind randomized controlled trial. Journal of Medical Internet Research. 2023;25:e48634. https://doi.org/10.2196/48634
8. Freeman D, Lambe S, Kabir T, Petit A, Rosebrock L, Yu L-M, et al. Automated virtual reality therapy to treat agoraphobic avoidance and distress in patients with psychosis (gameChange): A multicentre, parallel-group, single-blind, randomized, controlled trial in England with mediation and moderation analyses. The Lancet Psychiatry. 2022;9(5):375-88. https://doi.org/10.1016/S2215-0366(22)00060-8
9. Gibbons MBC, Duong L, Zoupou E, Kashden J, Fisher J, Crits-Christoph P. Randomized controlled trial evaluating feedback to community-based therapists based on patient reports of trust and respect. Journal of Consulting and Clinical Psychology. 2023;91(6):337-49. https://doi.org/10.1037/ccp0000807
10. Han M, Lee K, Kim M, Heo Y, Choi H. Effects of a metacognitive smartphone intervention with weekly mentoring sessions for individuals with schizophrenia: A quasi-experimental study. Journal of Psychosocial Nursing and Mental Health Services. 2023;61(2):27-37. https://doi.org/10.3928/02793695-20220706-01
11. Herpertz J, Richter MF, Barkhau C, Storck M, Blitz R, Steinmann LA, et al. Symptom monitoring based on digital data collection during inpatient treatment of schizophrenia spectrum disorders - A feasibility study. Psychiatry Research. 2022;316:114773. https://doi.org/10.1016/j.psychres.2022.114773
12. Jankowski K, Klemenhagen K, Dwivedi R. Integration of primary care and mental health in a community health center: A quality improvement project to improve the health of patients with serious and persistent mental illness. Journal of Interprofessional Education & Practice. 2023;32:100646. https://doi.org/10.1016/j.xjep.2023.100646
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24. Orleans-Pobee M, Browne J, Ludwig K, Merritt C, Battaglini CL, Jarskog LF, et al. Physical activity can enhance life (PACE-Life): Results from a 10-week walking intervention for individuals with schizophrenia spectrum disorders. Journal of Mental Health. 2022;31(3):357-65. https://doi.org/10.1080/09638237.2021.1875403
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28. Rodriguez-Villa E, Camacho E, Torous J. Psychiatric rehabilitation through teaching smartphone skills to improve functional outcomes in serious mental illness. Internet Interventions. 2021;23:100366. https://doi.org/10.1016/j.invent.2021.100366
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