Scientific Publications

Current Research in Public Health, 2023, 3, 768
www.scipublications.org/journal/index.php/crph
DOI: 10.31586/crph.2023.768

Systematic Review

A Systematic Review of Observational Studies Focusing on Impact of Telehealth Consultation in Osteoporosis Management during the Pandemic

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Abstract: Background: The COVID-19 pandemic disrupted routine osteoporosis care due to clinic closures and limited in-person consultations. Telehealth emerged as an alternative model enabling remote care delivery and monitoring. However, previous reviews on telehealth either did not include the pandemic period or had a limited focus in scope. Evidence synthesized specifically for osteoporosis care during the pandemic is needed but lacking. **Methods:** We systematically searched PubMed, MEDLINE, EMBASE, PsycINFO, Web of Science, and CINAHL for studies on telehealth for osteoporosis published between January 2021 and March 2023. Five studies met the inclusion criteria of: osteoporosis population, telehealth intervention, and COVID-19 pandemic timeframe. Data was extracted on study characteristics, COVID-19 outcomes, osteoporosis status, telehealth purpose, patient satisfaction, and clinical outcomes. **Result:** The five studies showed telehealth was used for monitoring data, delivering test results, adjusting medications, and assessments. Osteoporosis prevalence among telehealth users ranged 30-100%. High patient satisfaction was reported with telehealth versus in-person care. No major differences occurred in medication delays or fractures between telehealth and in-person groups. **Conclusion:** This review found telehealth enables effective osteoporosis care and monitoring during the pandemic, with high patient and provider satisfaction. However, more robust randomized controlled trials are needed to establish stronger evidence around telehealth's impacts on clinical osteoporosis outcomes. **Implications:** Though promising, further high-quality studies will help clarify telehealth's role in improving osteoporosis care and outcomes. Findings inform guidelines on integrating telehealth into routine management. Evidence on user perspectives optimizes telehealth implementation policies.

Keywords: Covid-19; Osteoporosis; Satisfaction; Telehealth

How to cite this paper:
Amin, S., Barua, O. ., Masud, F. ., Monjur, S. ., Munajja, T. ., & Joshi, A. . (2023). A Systematic Review of Observational Studies Focusing on Impact of Telehealth Consultation in Osteoporosis Management during the Pandemic. *Current Research in Public Health*, *3*(2), 119–127. Retrieved from https://www.scipublications.com/journal/index.php/crph/article/view/768

Academic Editor:
Yibo Wu

Received: July 16, 2023
Revised: August 30, 2023
Accepted: September 05, 2023
Published: October 07, 2023

1. Introduction

Osteoporosis is a chronic metabolic bone disease characterized by low bone density and deterioration of bone tissue, resulting in increased skeletal fragility and fracture risk [1] that needs long term monitoring [2]. According to the National Osteoporosis Foundation recommendation, (Bone Mineral Density (BMD) needs to be assessed every 2 years in osteoporotic patients [3]. The global prevalence of osteoporosis is rising, as it is estimated to affect over 200 million people worldwide, with more than 8.9 million osteoporotic fractures annually [4]. In developed countries, the prevalence of osteoporosis

ranges from 2 to 8 % among males and 9 to 38 % among females [5]. Key risk factors include aging, female gender, family history, hormonal changes, low calcium intake, smoking, alcohol use, and low physical activity [6]. Osteoporosis is also associated with diabetes, causing osteoporosis-associated fracture in diabetic patients, which leads to impaired new bone formation interfering the healing process [7, 8]. Fragility fractures are the primary complication, often occurring in the hip, spine, or wrist, and resulting in long term physical disability, diminished quality of life, and increased mortality risk [9, 10]. Furthermore, it has been found that an osteoporotic fracture occurs every 3 seconds, with the most common fractures occurring at the hip, spine, and wrist [11].

The COVID-19 pandemic caused major disruptions in delivery of routine medical care for chronic conditions like osteoporosis [12]. Widespread lockdowns, clinic closures, and fear of virus exposure limited in-person consultations and treatment [13]. This highlighted the need for alternative models of care like telehealth to enable remote delivery of medical care and monitoring. Telehealth uses technology including videoconferencing, remote monitoring devices, and mobile health apps to facilitate virtual provider-patient consults [14]. Through telemedicine, we can now reach many underserved and underprivileged communities which can ensure remote consultation and patient education [15]. Telehealth can also be used for home-based palliative care and ensure the patient's comfort and improve quality of life [16]. However, existing reviews on telehealth excluded the pandemic period or were limited to specific interventions or outcomes [17]. Evidence synthesized specifically for osteoporosis care during the pandemic is lacking but urgently needed.

There is a lack of synthesized evidence on the effectiveness, patient experience, and medical provider satisfaction with telehealth for osteoporosis care during the COVID-19 pandemic. The abrupt shift to telehealth consultations for chronic disease management warrants investigation into its utility and impact on outcomes. This review synthesizes evidence on telehealth for osteoporosis care during the pandemic. The findings will inform guidelines on integrating telehealth into routine osteoporosis management. Evidence on patient and provider perspectives will shape policies to optimize telehealth implementation. The objective of this systematic review is to examine the effectiveness, patient experience, and medical provider satisfaction with telehealth for osteoporosis care during the COVID-19 pandemic.

2. Methods

2.1. Literature search

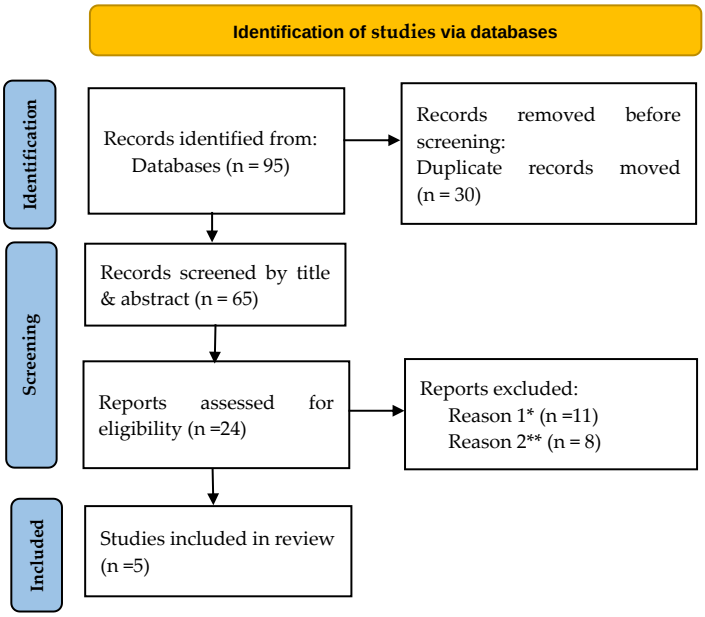
A systematic search of the literature was performed using PubMed. MEDLINE, EMBASE, PsycINFO, Web of Science, and CINAHL with several combinations of the following and related search words: Osteopenia, bone disease, osteoporosis, osteoarthritis, rheumatology, telehealth, teleconsultation, remote consultation, digital health, mobile health, Covid-19, pandemic, and/or lockdown. Sample PubMed database search was "osteoporosis"[MeSH Terms] OR "bone diseases"[MeSH Terms] OR "bone"[All Fields] OR "metabolic bone diseases"[All Fields] OR "osteopenia"[All Fields] AND "telehealth s"[All Fields] OR "telemedicine" [MeSH Terms] OR "telemedicine"[All Fields] AND "covid 19"[All Fields] OR "covid 19"[MeSH Terms]. We identified relevant studies published between January 2021 and March 2023. This review focuses on the role of telehealth or teleconsultation or digital health or mobile health technology in osteoporosis management.

2.2. Study selection and eligibility criteria

Studies were included if they met the following criteria: (1) If the study population has osteoporosis or any medical professionals who were involved in osteoporosis management. (2) used telehealth or teleconsultation or digital health or mobile health

technology; and (3) studies during and post Covid-19 lockdown (January 2021 until March 2023). Articles were excluded if they were not written in English, or if they were not peer-reviewed. The duplicate articles were also excluded. The reference lists of all relevant articles were also screened to ensure all eligible studies were included.

The search identified 95 studies (Figure 1). All papers from the automated database searches were collated using the Endnote reference management software. After duplicates were deleted, screening was conducted to ensure that studies fulfilled the eligibility criteria. A total of 65 papers were screened on title and abstract and the 24 remaining papers were screened on full text. A total of 5 studies were eligible for inclusion in this review. Five reviewers independently assessed the included studies, discrepancies were discussed and resolved by discussion. Inter-coder agreement was measured by K statistic. Clear reasons for exclusion were documented by each reviewer.



*Reason 1: Not using any digital technology.
**Reason 2: Incomplete information.

Figure 1. Prisma flowchart of the included studies

2.3. Data extraction and reporting method

The following details were extracted using a structured form: (1) General characteristics of the study (Author, publication year, study design, study setting, recruitment characteristics and recruitment methods); (2) sample size (3) Covid-19 outcome (4) Osteoporosis status (5) Patient satisfaction and (6) outcome. As outcome measures varied across the studies, we were unable to perform meta-analysis; instead, narrative synthesis was conducted. Each study was described, followed by comparative analysis and synthesis.

3. Results

3.1. Study and participants characteristics

A total of 5 studies [18-22] were included in this review. Table 1 summarizes characteristics of five studies.

Three studies were longitudinal (retrospective) designs conducted in hospital settings [18, 20, 22]. These studies recruited participants from March-September 2020 or January-

April 2022 and followed them for 6-7 months. Participants were physicians/medical doctors treating patients.

One study was cross-sectional, conducted in a hospital in April-May 2020 [21]. This study surveyed 892 patients to examine COVID-19 outcomes. Another cross-sectional study was conducted via a survey of 77 healthcare professionals (physicians, nurses, nurse practitioners, physician assistants) in May 2020 [19]. Sample sizes went from 77 [19] to 892 [21]. Most participants were middle-aged to elderly adults, with more women than men.

3.2. COVID-19 characteristics

Two studies reported COVID-19 infection rates, which ranged from 1.2% to 29.1% [18, 21]. One study examined fever (5.1%) and death (0.9%) as COVID-19 outcomes [21]. Three studies did not report COVID-19 outcomes [19, 20, 22].

Table 1. Study characteristics of the included studies

Author, Year and Country	Study design	Recruitment methods Study setting, data collection process; follow-up	Study participants N (total); age range (years); mean age (years) ± SD; gender	Healthcare professional monitoring	Covid-19 outcome
Alsadhan et al 2022 Saudi Arabia	Longitudinal (Retrospective)	Clinic setting Mar - Sep 2021 Follow-up: 6 months	N (Total): 258 65.8 ± 11.1 Male: Female: 27(10.5%):231 (89.5%) Survey Population: Patient	Physician	Covid-19 positive infection: 75 (29.1%) Covid-19 vaccination status: 216 (83.7%)
Peeters et al 2021 Netherlands	Cross-sectional	Healthcare setting May 11-May 26, 2020. Follow-up: NR	N (Total): 77 Age range: NR Male: Female: NR Survey population: Physician, Nurse, NP, and PA	Physicians and Nonphysicians (Nurse, NP, PA)	N/R
Pongiglione et al. 2023 Italy	Longitudinal (Retrospective)	Hospital setting January-April 2022 Follow-up: 7 months	N (Total): 80 Age Range: <50 - 75+ Male: Female: 12(15%):68(85%) Survey Population: Patient	Physician (Osteoporosis specialists)	N/R
Salvio et al. 2022 Italy	Cross-sectional	Hospital setting April -May 2020 Follow-up: N/R	N (Total): 892 70.9 ± 11.4 Male: Female: 107 (12%):785 (88%) Survey population : Patients	N/R	Diagnosed Covid case: 10 (1.2%) Fever: 44 (5.1%) Death: 8 (0.9%)
Tornero-Molina et al 2021 Spain	Longitudinal (Retrospective)	Hospital setting March - May 2020 Follow-up: N/R	N (Total): 467 60.8 ± 19.8 Male: Female: 141(30%): 326 (70%) Survey population: Physician and patient	Physician/ medical doctor	N/R

NP: Nurse Practitioner; PA: Physician Assistant

3.3. Osteoporosis status

Studies by Alsadhan et al. (2022), Peeters et al. (2021) and Pongiglione et al. (2023) found that 100% of their telehealth population had osteoporosis [18-20]. Another study by

Salvio et al. (2022) reported 45.7% of their cohort had severe osteoporosis based on bone density criteria and fragility fractures [21]. The percentage of osteoporosis patients was lower in Tornero-Molina et al. (2021) study at 30.4%, while the same study had osteoarthritis patients at 42.6% [22].

3.4. Telehealth for osteoporosis care

Telehealth consultations were shorter compared to in-person, ranging from 3-30 minutes [22]. However, across studies, a high percentage of patients were satisfied with telehealth for osteoporosis care, with satisfaction scores ranging from 5.2-8.6 out of 10 [20-22]. Telehealth was used for monitoring patients' bone health data, adherence to osteoporosis medications, delivering test results, adjusting treatment, and providing clinical assessments [18-20, 22]. No major differences were seen in new fractures or delays in getting osteoporosis medications between telehealth and in-person care groups [18 19]. Telehealth use was higher during the COVID-19 post-emergency phase compared to the emergency phase [20].

Osteoporosis medications were prescribed to a high proportion of patients via telehealth, including bisphosphonates (47-49%) and denosumab (33-54%) [19, 20]. One study found no significant difference in anti-osteoporosis medication delays between telehealth and in-person care [18]. Fracture rates during the study periods ranged from 1.9-44.8% [18-21]. Vitamin D supplementation was high (94.6%) via telehealth [21].

3.5. Patient experience and medical professional satisfaction

Included studies found patient as well as medical professionals including doctors were highly satisfied with telehealth for osteoporosis care and monitoring.

Patient satisfaction with telehealth osteoporosis care was high across studies, with scores ranging from 5.2-8.6 out of 10 [20-22]. One study found 56.4% were extremely satisfied with telehealth vs. 24.6% satisfied with in-person care [18]. Patients with higher education and IT skills reported greater telehealth satisfaction [22]. In another study, 30.7% reported delayed treatment start and 32% started treatment after major fracture with telehealth [19]. Privacy concerns and technology substitution were associated with lower satisfaction scores in one study [20].

Doctors overall reported high satisfaction with telehealth, especially those with greater IT skills [22]. Doctors with higher IT skills had 3.22 times higher odds of satisfaction with telehealth [22]. Consultations involving lab/test results and treatment adjustment were associated with 2.25 times higher doctor satisfaction [22]. All the outcomes of the included studies are summarized in Table 2.

Table 2. Main outcome of the included studies

Author	Osteoporosis status	Outcome	Patient satisfaction
Alsadhan et al 2022	100%	Telehealth Purpose: ▪ Patients' bone health data ▪ Adherence to osteoporosis treatment Patients' bone health data: ▪ Exercise: Telemedicine 195(75.6%) vs In-person 63(24.4%); p: 0.004 ▪ New fragility fracture: Yes 5 (1.9) vs No 253 (98.1); p: 0.65 Delay in getting therapy from the pharmacy: Denosumab: Telemedicine 5 (23.8) vs In-person 0; p: 0.88 Anti-osteoporosis therapy: Denosumab: 64 (45.4); Alendronate: 30 (21.3)	Patient satisfaction: Extremely satisfied vs Satisfied: 56.4% vs 24.6%; p: 0.56

Peeters et al 2021	100%	Telehealth Purpose: ▪ BMD ▪ Outpatient clinic visit ▪ Prescription of medication Consultation: New vs Controlled patients: 48(62.3%) vs 62(81.7%) Patients with fracture (remote consultation): 14(18.2%) Treatment with bisphosphonate: Unchanged (hospital vs home infusion): 15 (19.5%) vs 20 (26.0%) Treatment with denosumab: Unchanged (injectable vs GP): 32 (33.4%) vs 47 (49.0%)	Patient satisfaction (remote consultation): Delay in start of treatment: 23 (30.7%) Start treatment with major fracture: 24 (32.0%)
Pongiglione et al. 2023	100%	TC Interval: every 6-7 months. TC Purpose: ▪ Laboratory results ▪ Clinical visits ▪ Treatment TC domains: ▪ Privacy and discomfort: ➢ Male: -0.50* (-1.03—0.04) ➢ Retired: -0.54* (-1.17—0.10) ▪ Care personnel concerns (unemployed): -0.99* (-2.10—0.12) ▪ Substitution (Treatment length): -0.09** (-0.17—-0.01) Pattern of TC Use: ▪ During Emergency vs Post-emergency phase: 30.96(38.7%) vs 49.04(61.3%) ▪ On patient's request: 10(12.5%) ▪ For chronic conditions: 8(10%) Anti-osteoporosis therapy: Oral bisphosphonate: 6(7.5%); Denosumab: 43.04(53.8%) Bone fractures during TC: 6(7.5%)	Patients' satisfaction with TC: 5.2 out of 6 No. of telehealth before study: 0.22** (0.00—0.43) Treatment length: -0.04* (-0.10—0.01)
Salvio et al. 2022	Severe Osteoporosis[1]: 408 (45.7%)	Telehealth purpose: ▪ Osteoporosis-related medication: 688(77.9%) ▪ Vitamin D: 833 (94.6%) ▪ Comorbidities: ➢ Diabetes: 80 (9.4%) ➢ Hypertension: 454 (52.8%) ➢ Heart disease: 140 (16.3%) ➢ Hormone therapy for cancer: 336 (38.4%) ➢ Kidney transplant: 71 (8%) ➢ Fractures (any): 396 (44.8%) ▪ Hospitalization: 3.9% Vitamin D & hospitalization: Vitamin D supplementation have a protective role against the risk of hospitalization among the osteoporosis patient (OR:0.271, CI: 0.098–0.750, p = 0.01)	N/R
Tornero-Molina et al 2021	Osteoporosis: 141 (30.4%) Osteoarthritis: 199 (42.6%)	Duration of the RTC (minutes), mean (range): 9.64 (3–30) TC purpose: ▪ Clinical assessment: 354(75%) ▪ Delivery of laboratory results: 338(72%) ▪ Adjustment to treatment: 38(8%) Doctor satisfaction with TC: ▪ Higher ICTs skills (OR: 3.22, 95% CI: 1.84–5.64, p:.000) ▪ RTC with provision of lab/test results + adjustment to treatment (OR: 2.25, 95% CI: 1.45–3.48, p:.000)	Mean ± SD: 8.62 (4) [2] Patient satisfaction with TC: Higher education (OR: 4.33, 95% CI: 1.89–9.91; p:.001) Higher ICTs skills (OR: 2.02, 95% CI: 1.14–3.57; p:.016)

*** p < 0.05, * p < 0.1*

[1]Severe Osteoporosis: bone density value below the − 2.5 SDS of T-score and the presence of one or more fragility fractures.

[2]Verbal numerical scale (between 0–10, where 0 = highly dissatisfied up to 10 = fully satisfied)

TC: Tele-consultation

RTC: Rheumatology Teleconsultation

BMD: Bone Mineral Density

ICTs: Information and Communication Technologies

Emergency phase (June 2020-March 2021)

Post-emergency phase (April 2021-November 2021)

4. Discussion

This review found that telehealth was an effective platform for providing osteoporosis care and monitoring during the COVID-19 pandemic, with high satisfaction reported by both patients and doctors. Telehealth facilitated various aspects of osteoporosis management including monitoring, test result reviews, medication adjustments, and assessments. It was effective across diverse severities of osteoporosis. Patients and doctors, especially those with stronger IT skills, reported greater satisfaction with telehealth compared to in-person care. There were no major differences in clinical outcomes like fractures or medication delays between telehealth and in-person groups. These findings indicate telehealth enables quality monitoring and treatment of osteoporosis.

The effectiveness of telehealth for monitoring and treating osteoporosis shown here reflects outcomes from prior research on chronic disease like diabetes or heart failure. Multiple studies have reported high satisfaction with telehealth among diabetes patients, related to improved access and self-management support [23, 24]. Telehealth interventions have demonstrated equivalent or improved HbA1c levels and other diabetes markers compared to standard care [25]. This aligns with this review showing telehealth's capacity to facilitate effective osteoporosis monitoring and treatment. In heart failure, a meta-analysis found telehealth interventions significantly reduced mortality and hospitalizations compared to usual care [26]. Other studies highlighted convenience and closer provider communication as drivers of heart failure patient satisfaction with telehealth [27]. As with the current review findings, telehealth demonstrates advantages for managing heart failure and other chronic conditions. The high satisfaction coupled with positive impacts on medication management and clinical outcomes seen here reflects conclusions from across telehealth literature. Telehealth models have been shown effective for delivering care in diabetes, heart failure, and other chronic illnesses. Findings from this review further reinforce telehealth as an enabler of accessible, quality care for lifelong conditions like osteoporosis.

The COVID-19 outcomes in this review echo data on reduced transmission and improved disease control with telehealth across diverse medical fields during the pandemic. For example, a study found a lower risk of COVID transmission for telehealth visits versus office visits among patients in a respiratory assessment clinic [28]. Similarly, a trial in COPD patients reported a significant drop in emergency department admissions for COPD exacerbations with telehealth monitoring versus usual care during lockdowns [29]. This adds further evidence that telehealth protected vulnerable patients against COVID-19 while enabling safe continuity of chronic disease care.

This review aligns with extensive literature demonstrating major advantages of telehealth in user experience and satisfaction for both osteoporosis patients and doctors. Overall, paralleling this osteoporosis review, telehealth demonstrates high patient and provider satisfaction for chronic disease [25, 26]. Multiple studies reported satisfaction

among diabetes patients using telehealth services, relating to improved access, communication, and self-management support [23, 24]. Overall, telehealth consultations offer advantages such as improved access and communication, but limitations such as technological barriers and challenges with follow-up need to be considered for effective osteoporosis management. Although it facilitates team-based care expansion, potentially improving the efficiency of services, however, suboptimal patient-clinician relationship building process can be a challenge.

Strengths of this review include the comprehensive literature search across multiple databases to identify relevant studies on telehealth for osteoporosis care during and after the COVID-19 pandemic. The review had clear eligibility criteria and a systematic process for screening and reviewing studies. It synthesized evidence across different study designs to provide a broad perspective on this emerging field. It also highlight to consider an approach which can simultaneously address the evolving patient population, as well as long term patient monitoring. In this context, telehealth is an efficient and an optimal tool for management and monitoring of such a chronic disease that is associated with many comorbidities. This study provides a comprehensive review of the role of telehealth consultation in managing osteoporosis during the pandemic, and thus will help in filling the existing gap in the literature. Limitations are the small number of studies included (only 5) and the lack of meta-analysis due to heterogeneity in outcomes. The review only examined literature from the past few years during the pandemic and did not include earlier telehealth research. There was also limited data reported on actual COVID-19 outcomes among the populations. Additionally, the review relied on non-randomized and observational data, with inherent biases. Further high-quality randomized controlled trials are needed to establish stronger conclusions about telehealth for osteoporosis care and related COVID-19 impacts.

5. Conclusions

In conclusion, this review found telehealth is an effective platform for osteoporosis care and monitoring during the COVID-19 pandemic, with high patient and provider satisfaction. However, more robust randomized controlled trials are needed to establish stronger evidence around telehealth's impacts on hard clinical outcomes in osteoporosis. Future research should examine long-term results from telehealth interventions, like effects on fracture rates, medication adherence, and healthcare utilization. Cost-effectiveness studies are also important to understand the value of scaled telehealth implementation. Additionally, more research is needed on best practices to optimize telehealth delivery among diverse patient populations. Though promising, further high-quality studies will help clarify telehealth's role in improving osteoporosis care and outcomes.

Author Contributions: Conceptualization, S. A; methodology, S.A and O.B; formal analysis, S.A and O.B; writing—original draft preparation, S.A and O.B; writing—review and editing, F.M, S.M, T. M and A. J; supervision, S.A.

Funding: None.

Data Availability Statement: On request.

Conflicts of Interest: The authors declare no conflict of interest.

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