The Relationship between Ownership of Nursing Homes and their Response to the COVID-19 Pandemic: a Systematic Review

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Abstract

Introduction: The nursing home sector has been disproportionally affected by the 2019 coronavirus disease (COVID-19) and pandemic. Nursing home residents are particularly vulnerable to the virus, resulting in a high number of outbreaks and deaths. However, some nursing homes fared better than others; organisational characteristics to some extent may mediate the effect of the COVID-19 pandemic. The aim of this literature review is to evaluate the relationship between ownership structure of nursing homes and their performance during the COVID-19 crisis.

Methods: A rapid literature review was conducted in PubMed and Web of Science. This literature review followed a systematic approach including a risk of bias assessment. Articles were selected based on a pre-defined set of PICOT criteria that included studies which compared for-profit nursing homes to non-profit and public nursing homes with regard to the effectiveness in response to the COVID-19 pandemic, measured in terms of number of COVID-19 cases and deaths.

Results: In total, eighteen papers were included in this systematic review. The majority of papers found a significant relationship in the unadjusted statistics between ownership status and effectiveness in response to the COVID-19 pandemic. However, the adjusted figures paint a more nuanced picture. The relationship seems to be mediated by other organisational (e.g. size), process (e.g. access to personal protective equipment) and contextual factors (e.g. regional spread of COVID-19).

Conclusion: Ownership matters, but mainly because of the underlying organisational, process and contextual factors. The policy implications of these findings are timely: policymakers can either disincentivise for-profit entities (or favour non-profit providers), or improve the regulation of underlying factors that relate to COVID-19 outcomes. Even as discussions are undertaken about the values that underlie the future of nursing home ownership, steps can be taken now within existing ownership structures to address the factors most closely associated with outcomes. In the short-term it is better to address these mediating factors, but for the long-term, this review is in keeping with previous literature suggesting policymakers should be wary of for-profit nursing homes.

Keywords

Ownership, for-profit, nursing homes, long-term care facilities, COVID-19 pandemic, coronavirus

Background

The coronavirus disease 2019 (COVID-19) pandemic has exposed the cracks in our healthcare systems. The nursing home sector, in particular, has been disproportionally affected by this virus (1). In 21 countries, on average, an alarming 46% of COVID-19 related deaths occurred in nursing homes (2). Nursing home residents are typically frail older adults with high levels of chronic illness and functional impairment and are susceptible to severe complications and mortality as a result of a COVID-19 infection (3, 4). While the frailty of individuals living in nursing homes play a role, the environment of long-term care (LTC) facilities also complicates prevention and spread of infections (5, 6). Nursing homes represent congregate living facilities, which may experience challenges adhering to appropriate physical distancing or limiting spread from visitors or staff. Effective responsiveness to managing COVID-19 outbreaks in nursing homes depends on a variety of factors: infection prevention, infection control, adequate staffing and training, personal protective equipment (PPE) and testing capacity (7). Some of these factors are out of the control of the nursing homes (e.g. testing capacity and access to PPE); but other factors are under remit of the nursing home itself.

It is difficult, however, to understand what drives the variation between nursing homes with regards to how they have responded to the pandemic. One hypothesis is related to the organisational characteristics of the nursing home. Ownership has specifically been one organisational characteristic scrutinised during this pandemic (8-10). In recent decades, various countries have introduced market-based principles to control growing LTC expenditure (11, 12); this itself is underpinned in the neo-liberal and New Public Management paradigm (13). This paradigm upholds values such as individualism, free market principles and austerity via privatisation, and decentralisation (14). For-profit nursing homes gained significant market share of the LTC sector in many countries (11, 15, 16); although ownership structures differ significantly between countries (11, 16). For example, the nursing home market in the United Kingdom largely contains for-profit nursing homes (82%) (17), whereas the majority of Dutch nursing homes are owned by the non-profit sector (88%) (18).

In the present study, ownership of nursing homes is categorised as for-profit, non-profit or public. For-profit organisations are defined as organisations that operate with the objective of creating profits; the business holder owns these generated profits. Non-profit organisations are expected to serve a social cause, and these kind of organisations are prohibited from distributing their profits to other parties (19, 20). Public organisations are owned and controlled by (a part of) the government, and often paid for by public taxation (21). The distinction between ownership types appears to be clearly defined, but in reality, the boundaries are somewhat blurred (22).

The relationship between ownership status and performance has been under investigation for a long time (23-25). It is hypothesised that the internal motives vary between these different

ownership structures, which may lead to differences in outcomes and quality. A key difference between ownership structures is differentiating who possesses ultimate control over the governance of a nursing home: owners in for-profit institutions versus boards of trustees in the non-profit institutions (20, 26). The profit motive may drive organisations to operate efficiently and respond to the wishes of clients in order to secure their revenue, which may mean they compete on price and quality of care (27). The alternative is that for-profit nursing homes, in order to make favourable financial returns, devalue resident and employee wellbeing in deference to profits (28).

Systematic reviews have previously reported that for-profit providers provide worse quality of care (28-30), worse employee satisfaction (28), but offer better outcomes with regard to efficiency (28), compared to non-profit and public care homes. With that in mind, this paper builds on existing literature and examines whether previous findings remain consistent in the face of an exogenous shock (the pandemic). Said in another way, the question is whether these performance differences have influenced COVID-19 related outcomes during this pandemic with the implications to direct current pandemic relief efforts. This literature study will focus on the relationship between ownership structure of nursing homes (i.e. private for-profit, private non-profit and public) and their performance to the COVID-19 crisis.

Methods

A rapid literature review of primary studies was conducted following a systematic strategy to find relevant articles on the relationship between ownership structure of nursing homes and their response in effectiveness to the COVID-19 pandemic.

The exact definition and phrasing of the term 'nursing home' differs worldwide. There are several equivalents to the term nursing home, such as LTC facility, residential facility or care home. Sanford et al. propose a general definition of the term nursing home which reads as follows: "a facility with a domestic-styled environment that provides 24-hour functional support and care for persons who require assistance with activities of daily living and who often have complex health needs and increased vulnerability" (31).

Population, Intervention, Comparators, Outcome and Timeframe (PICOT) used in this study are further specified in Table 1. We include outcomes that reflect the effectiveness in response to the pandemic in terms of Donabedian's outcomes (32). Hence, we include outcomes such as excess mortality or whether there is at least one COVID-19 confirmed case or death among residents or staff members.

Table 1. Description of Population, Intervention, Comparators, Outcome and Timeframe.

Population	Nursing homes
Interventions	For-profit ownership
Comparators	Other ownership types (Private non-profit, public)
Outcomes	Effectiveness in response to the pandemic
Time	During the COVID-19 pandemic

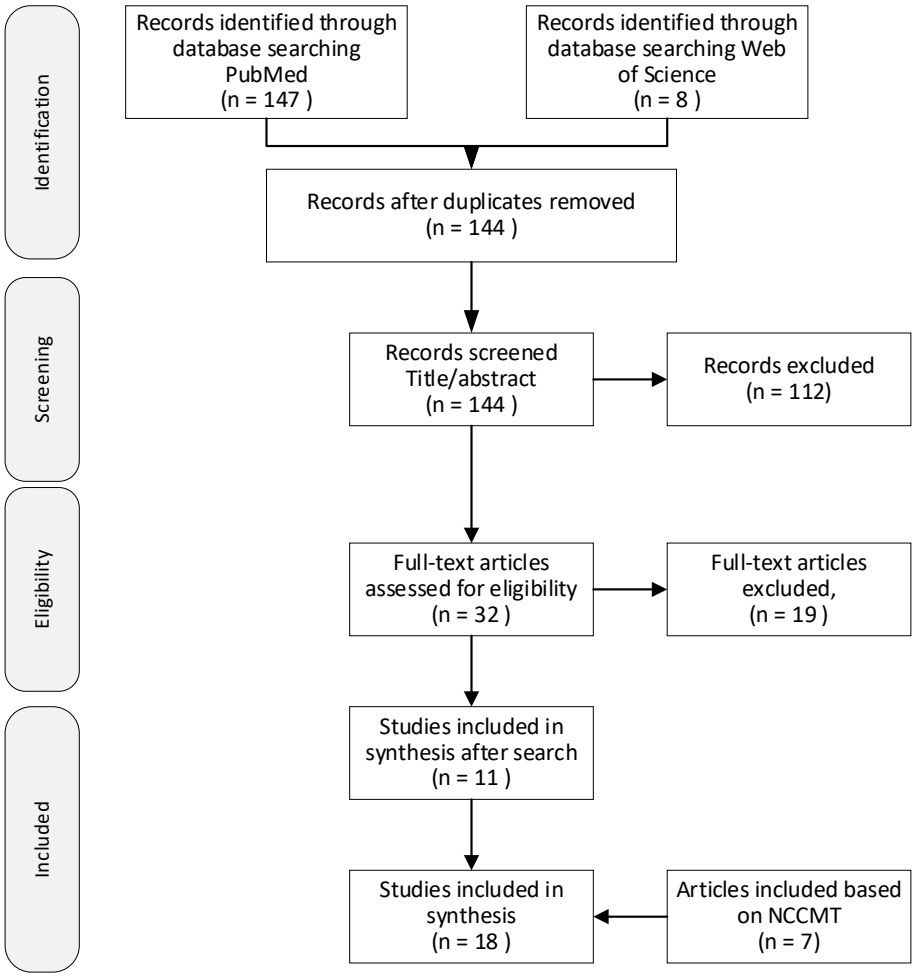
Data sources and search strategy

The search was conducted in October 2020 and updated in December 2020. Two different databases were consulted to search for relevant articles: PubMed and Web of Science. The specific search strings for each database can be found in the Appendix, table A1. EndNote X9 and Microsoft Office Excel 2016 were used for data management.

Selection procedure

The selected articles were screened for duplicates and year of publication. Publications were only included if published during the pandemic and written in English. We only include peer-reviewed published articles. Articles were primarily screened based on title and abstract and subsequently the full-text was appraised based on relevance by two of the authors. Conflicts in screening and eligibility were resolved by consensus. Initially, we found 11 articles via our search that were consistent with the PICOT criteria. In addition, we included 7 articles from the literature review of the National Collaborating Centre for Methods and Tools (NCCMT). These articles also met the PICOT criteria (33). The flow chart of the systematic selection procedure, in accordance with the PRISMA guidelines, is shown in Figure 1 (34).

Figure 1. Flow Diagram of article selection process.



Data extraction

A data extraction sheet was created using Microsoft Excel, in which all relevant data from the selected articles was collected and summarised. Most outcome measures were described as percentages, odds ratios or relative risks. The data extraction was first performed by a single reviewer using a piloted form, after which a second reviewer checked for correctness and completeness of the extracted data.

Risk of Bias assessment

A quality and risk of bias assessment was performed. For this evaluation, a tool was used which was created based on multiple other validated quality assessment tools (35-44). Several domains were reviewed: content validity, selection bias, confounding bias, measurement bias and reliability. Two reviewers independently performed the risk of bias assessment and collaboratively defined the risk of bias scores.

Results

Eighteen papers were included in this systematic review (see Table 2). These studies present findings on the relationship between ownership and the effectiveness in response to the COVID-19 pandemic in the nursing home sector, either as primary focus or as control variable.

Most studies were situated in the United States (US) (45-58). Some studies looked at data from specific states such as California (52, 53) and West Virginia (48). The US based studies show a great overlap with the data sources they used – using sources from the Centers for Medicare & Medicaid Services (CMS), LTCFocus and Certification and Survey Provider Enhanced Reporting (CASPER) system (45-47, 50, 53-59). Three studies were from Canada (60-62), all focused on the province of Ontario (61, 62). One study originates from France (63).

The overall risk of bias assessment shows great variety between the studies. None of the included studies received a high-quality assessment. Since this review was conducted in the midst of the COVID-19 pandemic, it was expected that all the included studies would be observational cross-sectional studies; this was found to be true, which is understandable in order to study this pandemic in a timely fashion. The sample size ranges from 123 nursing homes (48) to 13,709 nursing homes (56). Table A2 in the Appendix shows the evaluation of the risk of bias per study, in which each component is scored on a 4-point scale.

Eight studies report that, according to the unadjusted statistics, for-profit providers are more likely to have at least one COVID-19 case (45, 52, 58, 63), at least one COVID-19 death (50), an outbreak of COVID-19 cases (53), or an outbreak of COVID-19 deaths (53). Four studies show mixed performance (47, 51, 58, 62). Two studies did not find a significant relationship between ownership types when using unadjusted statistics (48, 61). These two studies were situated in West Virginia (US) and Ontario (Canada) and both use a regional dataset. The remaining four studies did not report unadjusted figures (46, 54, 57, 60), did not perform a significance test (49, 55), or classified ownership into too many categories that transcended for-profit, non-profit and public ownership structures (56).

Table 2. Brief version of the summary of findings table (full version in table A2).

Authors	Outcome measure	Region, Country	Unadjusted (descriptive) statistics – for-profit NHs compared to non-profit and/or public	Adjusted statistics – for-profit NHs compared to non-profit and/or public (95% confidence interval)
Abrams et al. (45)	(i) Having at least one COVID-19 case among residents; (ii) Number of cases among residents	United States	(i) Higher share (ii) Higher share	(i) No significant relationship (ii) Higher likelihood
Bowblis & Applebaum (46)	(i) Having at least one COVID-19 case among residents (ii) Having a high number of COVID-19 cases (greater than 20% of the number of licensed beds)	Ohio, United States	n/p	All outcomes: not significantly different
Braun et al. (47)	(i) Number of COVID-19 cases and deaths among residents; (ii) Deaths by any cause per 1000 residents; (iii) Shortage 1-week supply of PPE (multiple measures);	United States	(i) Higher share (ii) Higher share (iii) Lower share and no significant difference	(i) Higher likelihood (compared to public not non-profits) (ii) Not significantly different (iii) Mixed. For some measures lower likelihood
Brown et al. (60)	(i) Having at least one COVID-19 case; (ii) Number of cases among residents; (iii) Number of deaths among residents.	Ontario, Canada	(i) No significant difference (ii) Higher share (iii) Higher share	(i) No significant difference (ii) Higher share (iii) Higher share
Bui et al. (48)	Covid-19 outbreaks (two or more cases within 14 days)	West Virginia, United States	No significant difference	n/p
Chatterjee et al. (49)	Having at least one COVID-19 case	20 states in the United States	n/s	n/p
Dean, Venkataramani & Kimmel (50)	Number of COVID-19 rated deaths	New York, United States	Higher share	Not significantly different
Fisman et al. (61)	COVID-19 mortality rates among residents	Ontario, Canada	No significant difference	n/p
Gorges & Konetzka (51)	(i) Having at least one COVID-19 case; (ii) Outbreak: 10% confirmed cases/beds or 20% confirmed and suspected cases/beds or 10+ deaths; (iii) Number of deaths.	United States	(i) Lower share (ii) Higher share (ii) Not provided	(i) Lower likelihood (ii) Higher likelihood (iii) Higher likelihood
Harrington et al. (52)	Having at least one COVID-19 case among residents	California, United States	Higher share	Not significantly different
He, Li & Fang (53)	(i) Number of COVID-19 cases among residents; (ii) Number of COVID-19 deaths among residents	California, United States	All outcomes: Higher share	Not significantly different
Li, Cen, Cai & Temkin-Greener (54)	(i) Having at least one case among residents; (ii) Number of COVID-19 cases among residents; (iii) Having at least one death among residents, (iv) Number of deaths among residents (v) Having at least one case among staff	United States	n/p	(i) Higher likelihood (compared to public not non-profits) (ii; iii; iv; v) Not significantly different

Li, Temkin-Greener, Shan & Cai (55)	(i) Having at least one case among residents; (ii) Number of COVID-19 cases among residents; (iii) Having at least one death among residents, (iv) Number of deaths among residents,	Connecticut, United States	n/s	(i) No significant difference (ii) Higher likelihood (iii) No significant difference (iv) No significant difference
Rolland et al. (63)	Having at least one COVID-19 infection among resident or caregiver	Haute-Garonne, Occitania, France	Higher share	Higher likelihood
Stall et al. (62)	(i) Having at least one COVID-19 case; (ii) Number of COVID-19 cases; (ii) Number of COVID-19 related deaths	Ontario, Canada	(i) No significant difference (ii) Higher share (iii) Higher share	All measurements: No significant difference
Sugg et al. (56)	Number of COVID-19 cases among residents and staff;	United States	c/d	Not significantly different
Unruh et al. (57)	Occurrence of 6 or More COVID-19 Deaths	Connecticut, New Jersey, and New York – United States	n/p	Higher likelihood(although mixed picture across states)
Xu, Intrator & Bowblis (58)	Staff with & without COVID-19	United States	Mixed (Higher share compared to public, lower share compare to non-profit)	n/p

n/s No significant test performed
n/p Not provided
c/d cannot be distinguished

The adjusted figures paint a slightly different picture than the unadjusted figures. Four studies show that the significant relationship disappears as soon as the figures are adjusted for (50, 52, 53, 62). Only one study found a robust relationship for all indicators (63), while other studies show a more mixed outcome (45, 47, 51, 54, 55, 57, 60).

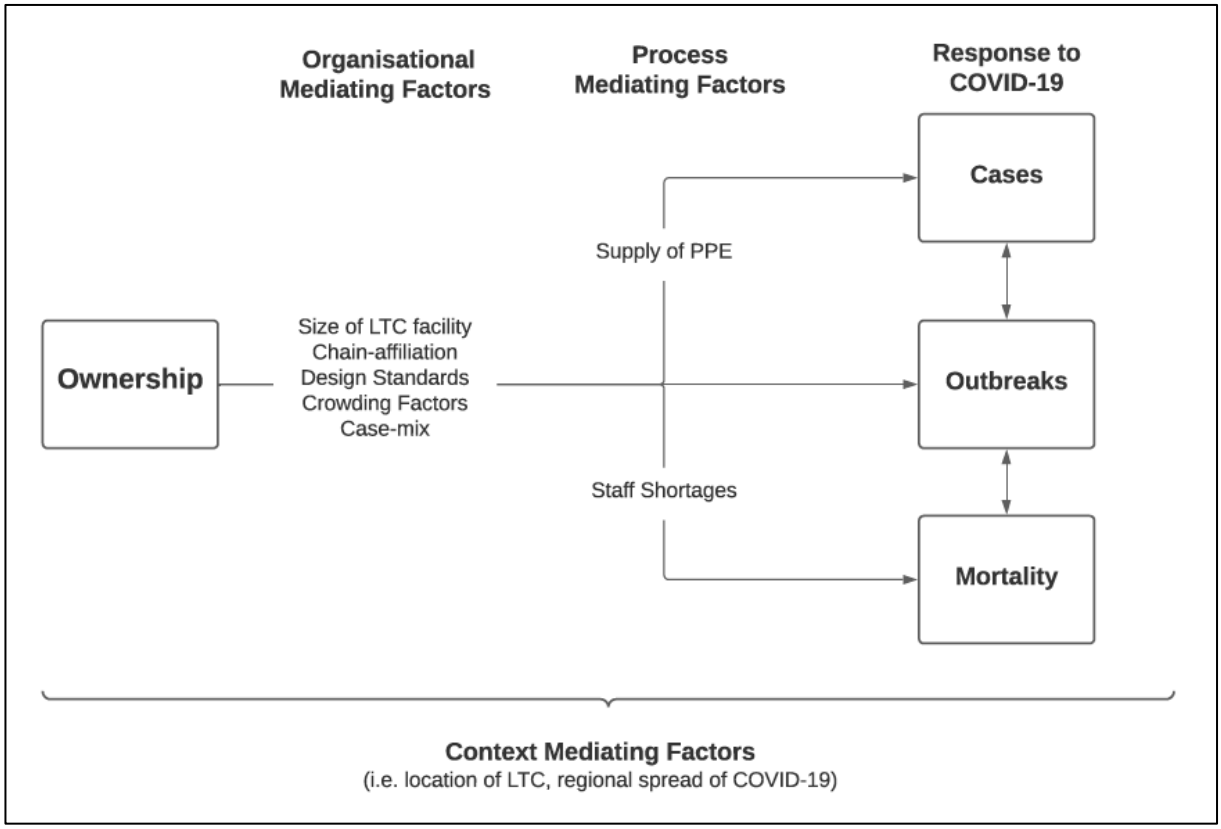
Of the nine studies analysing whether – keeping other covariates constant – for-profits were more likely to have at least one case among residents, only three studies found such a relationship (47, 54, 63). One study found the opposite (51). The other studies did not find a significant relationship (45, 46, 52, 55, 60, 62). Unruh et al. analysed the occurrence of six or more COVID-19 deaths (57). They find that, for all nursing homes combined from Connecticut, New Jersey, and New York, for-profit nursing homes were significantly more likely to have six or more COVID-19 deaths compared to non-profit or public counterparts (57). However, statistics per state present a more mixed picture: the significant relationship disappears for for-profit homes in New York and Connecticut (57).

Three studies find that the adjusted number of COVID-19 cases and deaths among residents was higher in for-profit homes (45, 51, 60). Five studies found no such relationship (50, 53, 54, 56, 62) or found mixed evidence (47, 55). (Common factors that were included in the adjusted models are discussed in the next section, but a full list of co-variables is described per study in Appendix Table A3.) Bowblis and Applebaum approached this slightly differently to other studies and analysed the likelihood of having a high number of COVID-19 cases (greater than 20% of the number of licensed beds) (46). They found no significant difference between ownership types in the adjusted figures (46). Braun et al. also provided a different perspective and focused specifically on private equity-owned nursing homes (47), which are specific types of for-profit homes (64). They found that private-equity owned homes had more cases per 1000 residents than public-owned nursing homes (47). They, however, did not find a significant relationship between non-profits and private-equity homes (47).

Mediating factors

Several factors could mediate the relationship between ownership structure of nursing homes and how well they have responded to the COVID-19 pandemic. After adjusting for these factors, the relationship between for-profit nursing homes and COVID-19 cases, outbreaks and mortality disappeared in the majority of the studies. This review identified three categories of mediating factors: organisational, process and contextual (Figure 2). Due to the observational study designs and types of statistical analyses of the studies in this review, it is difficult to pinpoint which mediating factors are driving the change in association between ownership and COVID-19 outcomes. However, these factors have to be considered to enhance our understanding of the association between ownership type and COVID-19 related outcomes. Table A3 in the appendices provides a list of relevant co-variables explored by each of the studies in this review.

Figure 2. Mechanism underlying how nursing home ownership and associated mediating factors influences COVID-19 response



Organisational Mediating Factors

We identified five organisational factors, related to the institutional attributes or conditions within the nursing home, that influence the relationship between ownership and COVID-19 outcomes. Firstly, larger nursing homes (the number of residents or beds in one location) were more likely to have a COVID-case compared to smaller-sized nursing homes (45, 52, 53). One study, however, did not find a relationship (60). Two studies suggested that the probability of having an outbreak was higher among smaller nursing home locations (45, 55). They argue that while smaller facilities are less likely to have outbreaks, outbreaks at small facilities affect relatively more patients (45). Secondly, some studies found that chain-affiliated entities were associated with worse COVID-19 outcomes (50, 55). In contrast, according to one study, sole proprietorship homes had a higher probability of having a COVID-19 case than chain-affiliated homes (45). Thirdly, outdated design standards (defined as structural age of the home's design, dichotomised to pre and post year of regional design reforms) were an important risk factor for transmission of COVID-19 after an outbreak has occurred (62). Outdated design standards often occurred in for-profit nursing homes (62). Fourthly, and connected to the former, higher crowding was associated with higher risk of outbreaks (60, 62). Lastly, several studies in this systematic review showed that case-mix (e.g. comorbidities and age) and socioeconomic status are

important to account for in the relationship between ownership and their response to the pandemic. A more complex case-mix increases the risk of mortality (65) and the likelihood of having more residents from a lower socioeconomic status increases the likelihood of having one or more cases of COVID-19 infections (52, 55). For-profit nursing homes were also associated with more health deficiencies compared with non-profit and government facilities (52).

Process Mediating Factors

Process mediating factors, the factors that impact execution of infection prevention and control, include staffing ratios, PPE shortages and testing capacity. Staff shortages increased the likelihood of having worse COVID-19 outcomes (51, 52). Two studies in our systemic review painted a mixed picture as to whether for-profit nursing homes are more likely to have staff shortages (47, 58). Another important process mediating factor was availability of PPE. Having enough PPE was associated to limit the risk of COVID-19 contraction and transmission in nursing homes (51, 61). One study measured shortages of 1-week supply of PPE and showed mixed results; whether for-profits compared to non-profits in PPE supply depended on the type of PPE (i.e. masks, gowns, eye protection, etc.) (47). Lastly, access to testing, while not measured, was mentioned by one study as being available earlier to private for-profits than public institutions (63).

Contextual Factors

The location where the nursing home is situated is related to COVID-19 cases (45, 56). Most importantly, high community rates of COVID-19 also significantly increased risks of COVID-19 outbreaks in nursing homes (56, 62). It remains unclear whether for-profit nursing homes are randomly spread across the regions and whether this may explain certain outcomes. Other contextual factors examined included: surrounding population size, urban versus rural location, and degree of competitiveness in the nursing home market.

Discussion

This systematic review aimed to synthesize the literature about the relationship between ownership structure of nursing homes and their response in effectiveness to the COVID-19 pandemic. Our findings suggest that ownership matters, at least at first sight. However, the relationship is much more complex. As such, a substantial share of this relationship is due to underlying (mediating) factors. Three categories of mediating factors came through in this literature review: organisational (such as size, chain affiliation or design standards), process (staff and PPE) and contextual factors. After controlling for relevant covariables, a large proportion of the studies show that the relationship disappears, attenuates or provides a mix picture. Given that the relationship between for-profit ownership status

changes after correcting for other mediating factors, this raises the question whether it is the for-profit status, or the underlying characteristics of the for-profit nursing homes, that connect to increased chance of COVID-19 related outcomes.

Nonetheless, it is also possible to argue that the specific characteristics of the mediating factors linked to worse COVID-19 outcomes are also known to be associated with for-profit nursing homes. For example, for-profit nursing homes are more likely to be larger (66). Another subject related to both nursing home ownership and response to COVID-19 is chain affiliation. Chain-affiliated nursing homes may be more susceptible to the occurrence of a coronavirus case or outbreak, because staff are able to work in different nursing home locations and could facilitate transmission (67). As expected, multiple studies in our review found that larger nursing homes had a higher likelihood to have a COVID-19 case or death (52, 53). In addition, for-profit nursing homes are frequently chain-affiliated (62, 68). Therefore, ownership status certainly remains influential. In particular, for profit ownership status remains relevant as only one paper (out of eighteen) found an adjusted negative relationship between for-profit ownership status and COVID-19 outcomes (63). It is interesting to note that this one paper is the only non-North American study, suggesting between country differences may have a role in the relationship between ownership and COVID-19 outcomes. In addition, this study was the only study for which the authors gathered data themselves instead of using national/local statistics.

Process mediating factors are particularly interesting. The results showed that staffing shortages were related to increased COVID-19 cases or outbreaks (51, 52, 58). This could be explained by the limited time, or decreased number of nursing and care staff, left to focus on infection prevention, hygiene and safety. Staffing shortages have been associated with for-profit entities as the profit motive promotes savings by reducing labour costs in previous literature (69), and this is reflected in one study in our review (58). Moreover, during the first wave of the COVID-19 pandemic, it was problematic for the majority of nursing homes to obtain PPE, which could be another mediating factor. Supply chains within and across countries were disrupted and hospitals had higher priority to receive supplies (70). While our review found mixed results with access to PPE and profit motive, two other multivariate analyses studies found more PPE supply shortages in the for-profit sector than in the non-profit and public sector (71, 72). One study found significant shortages for N95 masks and gowns among for-profit private equity-owned nursing homes compared to non-profit and public homes, but they did not find a difference in shortages for the other types of PPE supply measures (e.g. surgical masks and eye protection) (47). Possible explanations are that for-profit providers had lower PPE stock at the start of the pandemic in keeping with their efficiency maximising behaviour, for-profits may be less likely to actively seek PPE supply during high pandemic prices, or for-profit homes had more cases overall which intensified the situation, which caused these performance differences later as the pandemic evolved.

The surrounding contextual environment of nursing homes is an important factor that may explain the severity of the COVID-19 outbreaks. Location, area and the local number of cases all affect the probability of a nursing home having a COVID-19 case or outbreak (56).

Strengths and weaknesses of present study

To the best of our knowledge, this literature review was the first that specifically synthesised literature on the relationship between ownership status and COVID-19 outcomes in the nursing home sector. Other reviews have analysed the organisational characteristics as a whole (33). In contrast to most literature, which is often used after the occurrence of an event to inform future work, this rapid review was performed during a time of crisis and can be used to guide future policy and research within that same crisis.

Our literature review also has its limitations. Firstly, the majority of the included studies were performed in the United Stated and Canada. Only one study came from the European Union (i.e. France). This means that we could only include three different healthcare systems. These findings are context-dependent and not necessarily generalisable. Secondly, the authors are aware that we had to exclude emerging literature (i.e. upcoming papers from England) because these studies have not been peer-reviewed at the time of writing (e.g., 73, 74). Thirdly, the majority of the included studies were of low or medium quality, which is absolutely understandable in order to study this pandemic in a timely fashion. However, we hope that future studies will use advanced data (e.g. longitudinal) and methodologies (e.g. Instrumental Variable approach) to study this phenomenon.

Policy implications

The findings of this study have a number of important implications for future practice. Our findings suggest that policy makers should be wary about for-profit nursing homes. Even though mediating factors such as staffing levels may explain a large share of the relationship, these factors are likely to still be related to ownership structures. For example, staff shortages are related to outbreaks but are also more likely among for-profit nursing homes. Hence there are two approaches: (a) disincentivise for-profit ownership structures or favour non-profit or public nursing homes; (b) or, regulate the underlying factors that directly relate to COVID-19 outcomes and in most cases quality of care more widely; for example, recommendations on the adoption of higher minimum staffing standards (75).

Implications for research

Further research is required on this subject. For example, we know too little how generalisable these findings are to other contexts. Hence, we recommend research that analyse this subject in Europe and Asia. In addition, we need more high-quality studies on this matter. This relates to the fact that we

should invest in better public data. One question remains unanswered and that is whether there is an interaction between the medicating factors and ownership status. None of the studies included an interaction term such as chain-affiliation and ownership. We recommend including these in future studies.

Conclusion

This systematic review has found that most studies demonstrate a relationship between for-profit ownership and increased COVID-19 cases, outbreaks and/or mortality. According to unadjusted figures, for-profit owned nursing homes had worse COVID-19 outcomes (e.g. number of COVID-19 deaths among residents). However, as soon as the models control for other variables, the relationship disappears, attenuates or provides a mixed picture. Characteristics such as case-mix of residents, staffing and PPE were significantly associated with for-profit status on one hand; and COVID-19 cases and outbreaks on the other. This provides a more complex picture of the relationship between ownership and response to the COVID-19 pandemic. It also presents a way forward from a policy perspective. Even as discussions are undertaken about the values that underlie the future of LTC funding models, and whether to move away from for-profit models, steps can be taken now within existing ownership structures to address the factors most closely associated with outcomes. Although COVID-19 has been a wake-up call on the need for reform in the LTC sector over the longer-term, measures (such as stable staffing models and employment standards, secure PPE supply, and avoidance of over-crowding) must be implemented now in the short-term in order to reduce the terrible impact of COVID-19 in LTC facilities.

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Appendix

Table A1 Search strings used in PubMed and Web of Science.

Database	Search string
PubMed	((nursing homes[Title]) OR (nursing home[Title])OR (nursing homes[MeSH Terms]) OR (care homes[Title]) OR (care home[Title]) OR (long-term care homes[Title]) OR (long-term care home[Title]) OR (long-term care facilities[Title]) OR (long-term care facility[Title]) OR (long term care[MeSH Terms]) OR (residential care[Title]) OR (aged care[Title])) AND ((Ownership[MeSH terms]) OR (Ownership structure) OR (ownership) OR (Ownership status) OR (for-profit) OR (for profit) OR (profit) OR (private) OR (public) OR (nonprofit) OR (non-profit) OR (privatization) OR (privatisation) OR (nonprofit organizations[MeSH Terms])) AND ((COVID-19[Title/Abstract]) OR (SARS-COV-2[Title/Abstract]) OR (coronavirus, sars[MeSH Terms]) OR (coronavirus infections[MeSH Terms]) OR coronavirus[Title/Abstract]) OR corona[Title/Abstract]) OR (2019-ncov[Title/Abstract]) OR (sars-cov-2[Title/Abstract]) OR (cov-19[Title/Abstract]))
Web of Science	(TI=(nursing homes OR nursing home OR care homes OR care home OR long-term care OR long-term care facilities OR long-term care facility OR long-term care homes OR long-term care home OR residential care OR aged care)) AND (TI=(coronavirus OR covid-19 OR cov-19 OR sars-cov-2 OR corona OR 2019-ncov OR sars-cov-2)) AND (ALL=(ownership structure OR ownership OR ownership status OR profit OR for-profit OR for-profit organizations OR private OR "public w/3 ownership" OR privatization OR privatization))

Table A2. Summary of findings table plus risk of bias (in alphabetic order).

Authors	**Outcome measure**	**Region, Country**	**Size of the database** (number of facilities)	**Effect**	**Risk of bias assessment.** 1 (poor quality) to 4 (high quality)				
					Cv	**sb**	**Cb**	**Mb**	**R**
Abrams et al. (45)	(i) Having at least one COVID-19 case among residents; (ii) Number of cases among residents	United States	9,395	(i) aOR: 1.07, p>0.5 (ii) % change: 1.88, p<0.5 Ref = NFP	3	2	2	3	2
Bowblis & Applebaum (46)	(i) Having at least one COVID-19 case among residents (ii) Having a high number of COVID-19 cases (greater than 20% of the number of licensed beds)	Ohio, United States	921	(i) Public: MEs 0.31, SD 0.14, NP: MEs -0.05, SD 0.04 Ref: FP [Model June 17th, spec 2] (ii) Public: MEs 0.30, SE 0.20, NP: -0.08, SE 0.08 Ref: FP [Model June 17th, spec 2]	2	1	3	3	4
Braun et al. (47)	(i) Number of COVID-19 cases and deaths among residents; (ii) Deaths by any cause per 1000 residents; (iii) Possessing 1-week supplies of PPE (multiple measures);	United States	11,470	(i) % change cases: NFP: -25.6, p=0.20, Public: -35.5, p=0.3 % change deaths: NFP: - 8.9, p>0.99 Public: -6.7, p>0.99 (ii) % change all deaths: NFP: -0.46, p>0.99, Public: -8.9, p=0.89	1	3	2	3	3
Brown et al. (60)	(i) Having at least one COVID-19 case; (ii) Number of cases among residents; (iii) Number of deaths among residents.	Ontario, Canada	618	(i) aOR: 1.07, CI: 0.59, 1.96 (ii) aRR: 2.49, CI: 1.14, 5.45 (iii)aRR: 2.67, CI: 1.04, 6.83 Ref: Public	3	4	4	3	3
Bui et al. (48)	COVID-19 outbreaks (two or more cases within 14 days)	West Virginia, United States	123	Of NHs without outbreaks, 75.2% were FPs. Of NHs with outbreaks, 92.9% were FPs. P=0.19	3	3	1	4	3
Chatterjee et al. (49)	Having at least one COVID-19 case	20 states in the United States	8,943	Descriptive only: Of NHs without cases, 69.1% were FPs. Of NHs with cases, 78.9% were FPs.	1	3	1	3	2

Dean, Venkataramani & Kimmel (50)	Number of COVID-19 rated deaths	New York, United States	355	Coefficient: -0.46, p>0.05 Ref: n/d	3	2	4	2	4
Fisman et al. (61)	COVID-19 case (confirmed or suspected)	Ontario, Canada	627	Of NHs without cases, 54.3% were FPs. Of NHs with cases, 45.7% were FPs. P=0.55.	3	4	1	3	3
Gorges & Konetzka (51)	(i) Having at least one COVID-19 case; (ii) Outbreak: 10% confirmed cases or 20% confirmed + suspected or 10+ deaths; (iii) Number of deaths	United States	13,167	(i) aOR: 0.84, p<0.01 (ii) aOR: 1.29, p<0.01 (iii) MEs: 0.60, p<0.01	2	2	3	2	4
Harrington et al. (52)	Having at least one COVID-19 case among residents	California, United States	1,091	Models 1: aOR 1.23, CI: 0.75, 2.010 (similar results, all non-significant, for all four models with varying staffing co-variates). Ref: NFP and Public	2	4	1	3	1
He, Li & Fang (53)	(i) Number of COVID-19 cases among residents; (ii) Number of COVID-19 deaths among residents	California, United States	1,223	(i) aOR 1.49, CI: 0.97, 2.34, p<0.10 (ii) aOR 1.69, CI: 1.01, 3.00, p<0.10 Ref:NP	2	2	1	2	2
Li, Cen, Cai & Temkin-Greener (54)	(i) Having at least one case among residents; (ii) Number of COVID-19 cases among residents; (iii) Having at least one death among residents, (iv) Number of deaths among residents (v) Having at least one case among staff	United States	12,576	(i) NP Coeff: -0.05, CI: -0.21, 0.12, p=0.598 Public Coeff: -0.58, CI: -0.96, -0.20 p=0.003 (ii) NP Coeff: 0.10, CI -0.19, 0.39 p=0.495 Public Coeff: 0.26, CI -0.24, 0.76 p=0.309 (iii) NP Coeff: -0.03, CI -0.23, 0.18, p=0.807 Public Coeff: -0.09, CI -0.47, 0.30, p=0.653 (iv) NP Coeff: 0.05, CI -0.16, 0.25, p=0.645 Public Coeff: 0.25, CI -0.25, 0.76, p=0.324 (v) NP Coeff: 0.05, CI -0.11, 0.21, p=0.53	3	3	4	3	3

				Public Coeff: -0.15, CI -0.47, 0.16, p=0.341 Ref: FP					
Li, Temkin-Greener, Shan & Cai (55)	(i) Having at least one case among residents; (ii) Number of COVID-19 cases among residents; (iii) Having at least one death among residents; (iv) Number of deaths among residents	Connecticut, United States	215	(i) Coef: -0.11, CI: -1.17, 0.96, p=0.844 (ii) Coeff: 0.31, CI: 0.10, 0.52, p=0.004 (iii) Coeff: 0.13, CI:-1.01, 1.27, p=0.826 (iv) Coeff: 0.03, CI: -0.41, 0.46 p=0.910 Ref: FP (Coef are NP and public)	1	4	3	3	3
Rolland et al. (63)	Having at least one COVID-19 infection among resident or caregiver	Haute-Garonne, Occitania region, France	124	aOR: 0.32, CI: 0.15, 0.67, p=0.002 (similar in smaller model) Ref: Private (aOR is for public)	2	3	2	1	2
Stall et al. (62)	(i) Having at least one COVID-19 case; (ii) Number of COVID-19 cases; (ii) Number of COVID-19 related deaths	Ontario, Canada	623	(i) aOR 0.71, CI: 0.40, 1.25 (ii) aRR 0.96, CI: 0.57, 1.61) (iii) aRR: 0.82, CI: 0.44, 1.54 Ref: NP (all aOR or aRR from 3rd model)	3	4	3	4	3
Sugg et al. (56)	Number of COVID-19 cases among residents and staff;	United States	13,709	aIRR (NP): 1.02, CI: 0.89, 1.17, p=0.78 aIRR (Public): 1.26, CI: 1.00-1.60, p=0.05 Ref: FP	3	3	4	3	4
Unruh et al. (57)	Occurrence of 6 or More COVID-19 Deaths	Connecticut, New Jersey, and New York – United States	1,162	Estimate: 4.8, CI: 0.8, 8.8, p=0.19 Ref: Unclear, but presumably NP and public.	1	3	2	1	3
Xu, Intrator & Bowblis (58)	Staff with & without COVID-19	United States	11,920	Unadjusted only: Of those nursing homes that had staff with COVID-19, 71.4% were FP, 4.3% were public and 24.3% were non-profit. NP had relatively more while public have relatively fewer cases.	2	2	1	3	2

Cv: content validity, Sb: Selection bias; Cb: confounding bias; Mb: measurement bias; R: reliability
FP: for-profit, NP: non-profit, PE: Private Equity, n/d: not defined
MEs: marginal effects, SD: standard deviation, RR: Relative Risk, aOR: adjusted Odds Ratio, IRR: Rate Ratio
All CI are 95%

Table A3. Included control variables

Authors	Organisational factors	Process factors	Contextual factors
Abrams et al. (45)	Chain membership, Deficiencies (prior infection violation) Five-star rating (CMS overall) Resident characteristics (% African-American), SES (% Medicaid), Size (number of beds)		Location (urban), State
Bowblis & Applebaum (46)	Chain membership, Continuing Care Retirement Community, Occupancy (rate), Deficiencies (Number of substantiated complaints & deficiency score) Resident characteristics (Case-mix includes: ADL Score and % of BIPOC, Dementia, Depression, Intellectual Disability, Serious Mental Illness), SES (% Medicaid and Medicare), Size (number of beds), Special Care Units (Dementia & Other)	Staff measures (Registered Nurse HPRD, Licensed Nurse HPRD, Certified Nursing Aids HPRD, Agency Registered Nurses, Agency Licensed Practical Nurses, Agency Certified Nurse Aids)	Location (micropolitan, rural)
Braun et al. (47)	Chain membership, Resident characteristics (ADL score, age, % female, % white), SES (% Medicaid and Medicare), Size (total beds)	PPE supply (1 week supply of eye protection, hand sanitizer, gloves, gowns, N95 marks, surgical masks), Staff measures (% shortage of aides, clinical staff, nursing staff, other staff)	Location (rural)
Brown et al. (60)	Crowding index, Design standard (pre and post 1999), Occupancy (room by single, double, quad) Resident characteristics (ADL long score, age≥85 years, comorbidities [cancer, COPD, CHF, count of comorbidities, diabetes, dementia, kidney failure], education), Size (beds)	Staff measures (full time equivalent : bed ratio)	COVID-19 incidence (regional), Population size (community), SES (% neighbourhood foreign born residents)
Bui et al. (48)	n/a		
Chatterjee et al. (49)	n/a		
Dean, Venkatarama ni & Kimmel (50)	Chain membership, Five-star rating (CMS overall), Occupancy (rate), Resident characteristics (acuity, age, % obese, % white), SES (% Medicaid and Medicare as primary payer), Size (number of occupied beds)	Staff measures (ratio of RNs, LPNs, CNAs to residents), Union presence (health care worker)	COVID-19 cases (per capita per county), Population size (county)
Fisman et al. (61)	n/a		
Gorges & Konetzka (51)	Chain membership, Resident characteristics (% white) SES (% Medicaid) Size (number of certified beds)	Staff measures (hours for NA, CNA, LPN, RN, total nursing, & ratio of RN:total nursing hours)	COVID-19 cases (per 1,000 residents) Location (metropolitan status)
Harrington et al. (52)	Deficiencies (total health), Five-star rating (for Medicare nursing/RN staffing), Size (total beds)	Staff measures (RN staffing less than 0.75hprd and total staffing less than 4.1 hprd)	
He, Li & Fang (53)	Design (facility age), Five-star quality rating (NHC),		

	Occupancy (bed), Resident characteristics (% white),		
Li, Cen, Cai & Temkin-Greener (54)	Chain membership, Five-star quality rating (NHC), Hospital affiliated, Resident characteristics (case-mix index, % racial/ethnic minority), SES (% Medicaid & Medicare), Size (total beds & number residents)	Staff measures (RN hours per resident day, total nurse hours per resident day)	County characteristics (% ≥65 years, % high school graduation, median household income), COVID-19 cases (per county), COVID-19 deaths (per county), Market characteristics (competition for nursing home care) Population size (county), State indicators
Li, Temkin-Greener, Shan & Cai (55)	Chain membership, Five-star quality rating (NHC), Resident characteristics (case-mix index, % minority SES (% Medicaid & Medicare), Size (number of certified beds & number of residents)	Staff measures (RN staffing hrs/resident day & total nurse staffing hrs/resident day)	COVID-19 cases (per county), COVID-19 deaths (per county), Population size (county)
Rolland et al. (63)		PPE supply (supply & access to masks, supply of hydro-alcoholic solute) Staff measures (coordinating doctor, compartmentalization of staff & residents within zones, containment in residents' room, group activities, organising of meals, procedures for dressing & masking at door, professional interim, self-assessment score overall, training on hygiene)	
Stall et al. (63)	Chain membership, Design standard (pre and post 1972), Size (number of residents)	Staff measures (full time equivalent : bed ratio)	COVID-19 cumulative incidence (per public health unit region), Population size (community & rural)
Sugg et al. (56)	Five-star quality rating (CMS & staffing rating), Deficiencies (number of fines for 2020),	Staff measures (levels of LPN and total staff)	County characteristics (% labour force ≥16 years, household size, income per capita, % racial/ethnic minority [African American, Native American, Asian]), COVID-19 rate (per county), Population (per sq. mile per county)
Unruh et al. (57)	Chain membership, Occupancy (rate), Resident characteristics (ADL score, age, case-mix index, % female, % restrained patients, % white), SES (% Medicaid & Medicare), Size (total beds), Special Care Units (Alzheimer's)	Staff measures (direct care hours per patient day, presence of physician extender)	States (CT, NJ, NY)
Xu, Intrator & Bowblis (58)	n/a		

CHF = congestive heart failure, CNA = certified nursing assistant, COPD = chronic obstructive lung disease, CT = Connecticut, LPN = licensed practical nurse, NA = nursing aid, NHC = Nursing Home Compare, NJ = New Jersey, NY = New York, PPE = Personal protective equipment, RN = registered nurse, SES = socioeconomic status
n/a Not applicable