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Long-Term Care Facilities for
Elderly and COVID-19
Outcomes: A Systematic
Literature Review**

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Department of Political Science

University of Gothenburg

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Structural Characteristics of Long-Term Care Facilities for Elderly and COVID-19 Outcomes: A Systematic Literature Review*

Marina Nistotskaya[†] Carl Dahlström[‡]

Abstract

In many countries, elder citizens residing in long-term care facilities (LTCFs) were disproportionately affected by the SARS-Cov-2. However, The risk of contracting the virus, the incidence of infection, and mortality rates varied greatly between different facilities. This variation has motivated a growing literature examining the association between structural characteristics of LTCFs and COVID-19 outcomes. This paper present the findings of a rapid review of empirical studies investigating the link between ownership status, facility size and staffing, on the one hand, characteristics with COVID-19 outcomes among LTCFs, on the other. The reviewed literature is characterised by the lack of consensus. The review reveals a lack of consensus in the literature. Variation in COVID-19 outcomes is not systematically linked to ownership type, and factors related to facility size and staffing characteristics also show inconsistent associations with the presence of infection cases, infection rates, and mortality.

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[†]University of Gothenburg, marina.nistotskaya@gu.se

[‡]University of Gothenburg, carl.dahlstrom@pol.gu.se

1 Introduction

Elderly residents in long-term care facilities (LTCF) or nursing homes were disproportionately affected by SARS-CoV-2 in countries as diverse as the USA, the UK or Sweden. This impact can be partly attributed to the characteristics of LTCF residents, such as advanced age and multiple morbidities (Najar et al., 2023). However, the structural characteristics of LTCFs also appear to play a significant role, given the considerable spatial variation in infection and mortality rates within nursing homes in the same country (Broms et al., 2024a; Liu et al., 2020; Wong et al., 2023).

This review aims to identify, systematize, and critically evaluate the findings of large-N empirical research on the impact of key structural characteristics of LTCFs – ownership type, facility size, and staffing characteristics – on three COVID-19 outcomes: the presence of COVID-19 cases, infection rates (outbreaks), and mortality rates.¹

This literature review primarily focuses on ownership, aligning with the broader objectives of the project within which it is situated (Broms et al., 2024a,b, 2021b). However, other factors such as chain status, staffing characteristics (including staffing levels, the presence of different types of care staff, and their employment conditions), and facility size are also considered. Other structural factors with the potential to influence COVID-19 outcomes in LTCFs – such as facility design (e.g. single vs. multiple room occupancy, living area per bed, ventilation, or hand hygiene stations, see (Benbow, 2022; Houben et al., 2023; Zhu et al., 2022)) or quality rating – were not the focus of this review. Nonetheless, we address the findings from the reviewed studies related to facility design in Section 4, while Appendix B briefly discusses the findings concerning the effects of quality ratings on the outcomes of interest.

To expedite the review process, a rapid literature review was conducted (Tricco et al., 2015), focusing on relevant empirical studies published in English in the online databases Google Scholar, Scopus, and Web of Science between June 2020 and January 31, 2021. We performed forward and backward citation tracking to identify relevant studies. The PICOT (Population, Intervention, Com-

¹‘Presence’ refers to at least one confirmed COVID-19 case among LTCF residents. ‘Outbreaks’ refer to the cumulative number of COVID-19 infections among LTCF residents, typically measured as a ratio per beds, but also as a count (Stall et al., 2020), or a binary variable (Gorges & Konetzka, 2020).

parators, Outcome, and Timeframe) framework served as the basis for the rapid literature review. Empirical studies were included if they examined the population of a LTCF during the COVID-19 pandemic, addressed one of the previously discussed COVID-19 outcomes, and considered at least one of the aforementioned structural characteristics of LTCFs as an explanatory variable. Additional relevant publications were identified through snowballing and searches in medical databases, including PubMed, Medline, and the Cochrane Library, up until the end of 2023. This search maintained a focus on publications covering the first year of the pandemic, prior to mass vaccination, which significantly altered the conditions affecting all COVID-19 outcomes (Herrera et al., 2014).

Data extraction was conducted by a single author and subsequently audited by another. A quality and risk of bias assessment was applied to all empirical studies that included ownership as either the primary explanatory factor for COVID-19 outcomes or as a control variable. Pairs of student research interns evaluated the studies across the following domains, using a three-point scale (high, average, low): content validity, selection bias, confounding bias, measurement bias, rigor of empirical analysis, and reliability.

2 Ownership

COVID-19 pandemic revealed that LTCFs were inadequately prepared for a crisis of such magnitude, and the structural characteristics of nursing homes that may have contributed to this crisis remain understudied. The marketization of social care – in the form of both privatization and outsourcing – has prompted studies examining the association between ownership type and quality of care (Bach-Mortensen & Montgomery, 2019; Barron & West, 2017; Bos et al., 2017; Broms et al., 2024b; Comondore et al., 2009; Grabowski et al., 2013; Gupta et al., 2024; Harrington et al., 2012, 2001; Hillmer et al., 2005; Ronald et al., 2016). Although many of these studies, including systematic reviews (Comondore et al., 2009; Hillmer et al., 2005), have found that LTCFs providers operating on a for-profit basis tend to deliver lower quality of care compared to facilities run by not-for-profit organizations, including charities, or by central or local governments, there is no clear consensus that for-profit ownership inherently worsens care and outcomes for LTCF residents (Bach-Mortensen

et al., 2021, p. 948). This ambiguity raises the question of whether the for-profit ownership model was a contributing factor to the adverse effects of COVID-19 on LTCF residents (Visontay et al., 2020).

2.1 Types of Ownership

Countries differ in how they regulate and finance long-term care. Consequently, the distribution of the ownership of LTCFs looks different in different countries. An LTCF can be owned and/or operated by public (government), nonprofit or for-profit organizations. Public/government (GOV) ownership implies full funding and delivery of care by government organizations. LTCFs under for-profit (FP) ownership operate as businesses aiming to generate a profit for their owners, meaning that the profits they make are distributed to the owners. Within the FP category, there are publicly traded companies – whose ownership is organized via shares of equity traded on stock exchanges – and privately held companies. The latter may take a form of large institutional owners (such as private equity firms) or small family-owned businesses. In contrast, not-for-profit (NFP) organizations are entities that are neither formed nor organized to generate profit; instead, they are dedicated to pursuing mission-oriented goals through the collective actions of citizens (Besley & Ghatak, 2005). This means that any revenue in excess of expenses can only be used to further the organization’s purposes (Hansmann, 1980), which, in the case of long-term care, is the benefits of the cared for. Public and private actors in elder care often operate within so-called quasi-markets, where the delivery of services is managed by private actors, but the financing remains public.

2.2 Results from Early Studies

Empirical research on the effects of LTCF ownership during the pandemic remains relatively limited. We identified 38 empirical studies published in 2020-2021, however several were excluded from the review primarily on methodological grounds.²

²Chatterjee et al. (2020) and Bagchi (2021) were excluded as they only performed descriptive analyses. Gandhi et al. (2020) remains not peer-reviewed as of September 2024. Kennelly et al. (2021) and Nambisan et al. (2021) were excluded because they only performed a chi-square test. Kumar et al. (2021), (Gmehlin et al., 2021), McElhaney (2020), Khairat et al. (2021) and Mattingly et al. (2021) were excluded for not reporting the estimates for ownership in multivariate

Early studies predominantly focused on the USA (Abrams et al., 2020; Bowblis & Applebaum, 2020; Braun et al., 2020; Bui et al., 2020; Cai et al., 2021; Dean et al., 2020; Gmehlin et al., 2021; Gorges & Konetzka, 2020, 2021; Harrington et al., 2020; He et al., 2020; Khairat et al., 2021; Kumar et al., 2021; Li et al., 2020a,b; Lord et al., 2021; Nambisan et al., 2021; Sugg et al., 2021; Unruh et al., 2020; Weech-Maldonado et al., 2021; Xu et al., 2020), with some research emerging from England (Mattingly et al., 2021; Morciano et al., 2021; Shallcross et al., 2021), Canada (Brown et al., 2021; Fisman et al., 2020; Stall et al., 2020), France (Rolland et al., 2020), Australia (Ibrahim et al., 2021) and Ireland (Kennelly et al., 2021). Only a limited number of these studies utilized nationwide data (Braun et al., 2020; Gorges & Konetzka, 2020; Li et al., 2020a; Lord et al., 2021; Morciano et al., 2021; Shallcross et al., 2021; Sugg et al., 2021; Weech-Maldonado et al., 2021), and the vast majority relied predominantly on facility-level data, thus overlooking broader environmental contexts and, in particular, individual-level factors. In most studies, ownership is treated as a control variable, with only a few focusing on ownership type as the primary explanatory factor (Braun et al., 2020; Stall et al., 2020).

Most of the research has operationalized ownership as government (GOV), for-profit (FP) and non-profit (NFP), using one of the categories as a reference in the analysis (Abrams et al., 2020; Bowblis & Applebaum, 2020; Brown et al., 2021; Cai et al., 2021; Gorges & Konetzka, 2020; Ibrahim et al., 2021; Kumar et al., 2021; Li et al., 2020a,b; Sugg et al., 2021), while others used a dichotomized indicator of ownership either as public/private (Lord et al., 2021; Rolland et al., 2020; Weech-Maldonado et al., 2021) or as for-profit or not (Dean et al., 2020; Gopal et al., 2021; Harrington et al., 2020; He et al., 2020; Li et al., 2020b; Morciano et al., 2021; Shallcross et al., 2021). The former operationalization treats FP and NFP as one category (private ownership), while the latter treats NFP and GOV as one category (not-for-profit ownership). Fisman et al. (2020) distinguished between charitable and other NFP facilities. Some later studies, such as (Broms et al., 2024a), disaggregate the FP category further onto publicly traded and privately-held companies.

The early literature presents varied findings: some studies identify consistent associations between ownership and at least one of the COVID-19 outcomes in question (He et al., 2020; Lord et al., 2021; Rolland et al., 2020; Shallcross et al., 2021; Stall et al., 2020; Weech-Maldonado et al., 2021), while

analyses. Lord et al. (2021) use data beyond the pre-vaccination period, up to July 11, 2021.

others report no significant relationship (Bowblis & Applebaum, 2020; Braun et al., 2020; Dean et al., 2020; Harrington et al., 2020; Morciano et al., 2021). However, most studies report mixed results (Abrams et al., 2020; Cai et al., 2021; Gopal et al., 2021; Gorges & Konetzka, 2020; Ibrahim et al., 2021; Li et al., 2020a,b; Stall et al., 2020; Sugg et al., 2021; Unruh et al., 2020). While Appendix A provides a detailed discussion of the early literature's findings for each outcome of interest, we illustrate below the mixed results from studies where ownership is a key explanatory variable.

Braun et al. (2020) is one of the earlier nation-wide studies from the USA that focus specifically on the relationship between ownership and COVID-19 prevalence and mortality rates.³ The authors distinguish four forms of ownership – private equity for profit, for-profit other, non-profit and government – and test the effect of the PE ownership against other forms. In multivariate analyses with confirmed COVID-19 cases and confirmed deaths as outcomes, they found no statistically significant difference between the ownership types, except for government-owned facilities being associated with fewer confirmed cases. Like many other early U.S.-based studies, Braun et al. (2020) uses the U.S. CDC NHSM data COVID-19 outcomes, as well as on the availability of staff and personal protective equipment (PPE).⁴ However, this data is likely to contain measurement errors, as reporting was voluntary prior to May 2020. Given these potential measurement errors, the results from studies analyzing COVID-19 outcomes using NHSM data should be interpreted with caution.

Another high-quality study where the ownership is the key explanatory factor is Stall et al. (2020), who leverage the ownership status (FP and GOV, the reference group of NFP) against data on at least one COVID-19 case, and the extent of outbreaks and mortality in all nursing homes of the Canadian province of Ontario.⁵ The authors found no relationship between FP ownership and the likelihood of having a case, but reported statistically significant relationship between the FP ownership and more severe outbreaks and higher mortality, mediated by the higher number of for-profit homes with outdated design standards and chain ownership.

Our assessment the early body of evidence indicates that FP ownership was identified as a potential risk factor for LTCFs experiencing COVID-19 cases, as well as higher infection and mortality rates.

³11470 facilities over the period from May 17, 2020 to July 2, 2020, USA. Method: Poisson and logistic regressions.

⁴CDC NHSN stands for the U.S. Centers for Disease Control and Prevention's National Healthcare Safety Network.

⁵623 facilities over the period of 29 March, 2020 to 20 May, 2020.

However, in studies where ownership was included as an explanatory variable, it was often treated as a control variable with limited theoretical justification, leading to insufficient exploration of its underlying mechanisms. Although ownership frequently appears as a statistically significant factor in bivariate analyses, its relationship with COVID-19 outcomes often weakens or disappears altogether when controlling for relevant variables, such as facility size and staffing characteristics – factors that may act as mediators in the relationship between ownership and COVID-19 outcomes.

Similarly to our conclusions, a systematic review examining the relationship between nursing home ownership and COVID-19 outcomes, which included 18 empirical studies, (Kruse et al., 2021) found that the evidence for an association between ownership and COVID-19 outcomes is inconclusive.⁶ Another systematic review on this topic, published in October 2021, included 32 studies covering data from the first year of the pandemic across five countries (Bach-Mortensen et al., 2021). In line with our conclusions on the early body of evidence, it found that variation in COVID-19 outcomes was not primarily driven by ownership status, but by factors related to facility staffing, size, and resident characteristics. However, Bach-Mortensen et al. (2021) also emphasized that there was evidence linking the characteristics typically associated with FP facilities – and thus FP status itself – to worse COVID-19 outcomes.⁷

2.3 Results from Later Studies

The later literature includes studies from the same countries as the earlier literature – such as the USA (Chen et al., 2021; Hege et al., 2022; Iyanda & Boakye, 2022; Kim et al., 2022; Lane et al., 2022; Olson et al., 2022; Shen, 2022; Song et al., 2024; Young et al., 2023; Zhu et al., 2022), Canada (Akhtar-Danesh et al., 2022; Cox et al., 2023; Lu et al., 2022; Zhu et al., 2022), and France (Piet et al., 2021; Rabilloud et al., 2023) as well as from new empirical contexts like Germany (Evers & Geraedts, 2023; Preuß et al., 2022), Spain (Arnedo-Pena et al., 2022; Torres et al., 2022; Zunzunegui

⁶Initially published as a working paper in 2020, the study was peer-reviewed and published in 2021. It includes the study we excluded due to quality concerns (Chatterjee et al., 2020), but omits several others, such as (Gopal et al., 2021; Morciano et al., 2021; Shallcross et al., 2021).

⁷Another systematic review, published in September 2021 (Konetzka et al., 2021), examined the link between LTCF characteristics and COVID-19 outcomes, but only effectively reviewed two studies where ownership status was either key predictor (Braun et al. (2020) and Gandhi et al. (2020) (not peer-reviewed at that point), omitting the majority of studies covered in our review and by Kruse et al. (2021) and Bach-Mortensen et al. (2021).

et al., 2022), or Sweden (Broms et al., 2024a).⁸

The findings from this literature remain mixed: while some studies have identified a systematic association between the FP ownership status and adverse COVID-19 outcomes (Akhtar-Danesh et al., 2022; Chen et al., 2021; Cox et al., 2023; Hege et al., 2022; Kim et al., 2022; Lu et al., 2022; Rabilloud et al., 2023; Song et al., 2024; Zhu et al., 2022), others reported no, inconsistent, or only indirect associations (Arnedo-Pena et al., 2022; Broms et al., 2024a; Evers & Geraedts, 2023; Iyanda & Boakye, 2022; Lane et al., 2022; Preuß et al., 2022; Shen, 2022; Torres et al., 2022; Zunzunegui et al., 2022).

To illustrate, Cox et al. (2023) conducted a multivariate statistical analysis using eleven months of facility-level data from the first year of the pandemic in British Columbia, Canada. The analysis suggests that – even under the influence of powerful control such as community incidence of infection, total nursing hours per resident-day, facility age, number of facility beds and facilities with beds – COVID-19 outbreaks occurred more frequently in both FP and NFP facilities compared to government-operated (GOV) facilities.⁹

Conversely, Song et al. (2024) found that both GOV and NFP facilities in the USA experienced lower infection rates during the first year of the pandemic than FPs, though only NFP facilities had lower mortality rates compared to FPs. Rabilloud et al. (2023) reported similar findings for Auvergne-Rhône-Alpes region of France during the second wave of the pandemic.¹⁰ However, Broms et al. (2024a), using data from Sweden on LTCF residents, facility characteristics and controlling for the municipality of the facility, found that ownership type was not directly associated with COVID-19-related mortality during the pre-vaccination stage of the pandemic, but the association was likely mediated by facility size and staffing characteristics, which impacted COVID-19 outcomes. Similarly, Evers & Geraedts (2023) found that in Germany's region Hesse LTCFs with private equity ownership had substantially fewer outbreaks in number, but longer and larger outbreaks among nursing home

⁸The following studies include data extending beyond the first year of the pandemic (Evers & Geraedts, 2023; Iyanda & Boakye, 2022; Kim et al., 2022; Lane et al., 2022; Olson et al., 2022; Preuß et al., 2022; Scanferla et al., 2023; Young et al., 2023), and were therefore given less attention in the overall assessment of the findings. The study by Piet et al. (2021) was excluded because they conducted only univariate and bivariate regression analyses.

⁹Data on 293 facilities for the period from March 1, 2020 to January 31, 2021. Outbreaks operationalized as one or more residents tested positive for SARS-CoV-2 during the period.

¹⁰Data on 937 facilities for two periods: March 1, 2020 to July 31, 2020 and from August 1, 2020 to 31 December 2020.

residents, as well as a markedly increased proportion of deceased residents.¹¹

Three regional studies from Spain found markedly different results. Thus, (Zunzunegui et al., 2022) found that neither NFP facilities, nor publicly owned and/or administered facilities performed better on outbreaks and mortality than FP facilities.¹² However, Arnedo-Pena et al. (2022) found that private ownership was associated with the increased outbreaks, but not with the increased likelihood of a COVID-19 case or mortality.¹³ On the other hands, Torres et al. (2022) found that GOV-owned LTCFs had a 15% higher risk of outbreaks than those of FP, but the relationship with NFPs was not significant. GOV facilities had a 30% higher risk of elevated mortality, and NFPs had a 19% higher risk, compared to FPs.¹⁴

Similar to earlier studies, this body of literature includes only a few nationwide studies, which limits the ability to draw generalized conclusions. The number of observations also varies from a few tend (for example, 27 facilities in (Evers & Geraedts, 2023), 28 in (Kennelly et al., 2021) and 32 facilities in (Arnedo-Pena et al., 2022)) to several hundreds (Akhtar-Danesh et al., 2022; Preuß et al., 2022; Rabilloud et al., 2023) and even thousands (Broms et al., 2024a; Iyanda & Boakye, 2022). Compared to the early literature, research has advanced in terms of modeling choices and techniques. An increasing number of studies now integrate individual, organizational, and community/broader environment data into their analyses (Akhtar-Danesh et al., 2022; Broms et al., 2024a; Kim et al., 2022; Lane et al., 2022; Lu et al., 2022; Piet et al., 2021; Zhu et al., 2022). However, individual data is still typically incorporated in aggregate form, such as the proportion of residents with certain socio-economic characteristics or specific morbidities, rather than at the individual level. An exception is Broms et al. (2024a), who combine individual-level data on LTCF residents with facility and community-level data, allowing for a more rigorous analysis.¹⁵ Researches also began employing longitudinal data (Lane et al., 2022; Rabilloud et al., 2023), and applying advanced statistical techniques, such as structural equation modeling (SEM), helping to clarify causal pathways, and non-linear models Kim et al. (2022); Preuß et al. (2022); Rabilloud et al. (2023). For instance, using SEM, Kim et al.

¹¹Data 32 facilities for the period from March 20, 2020 to January 5, 2022.

¹²965 facilities over the period of March to April, 2020 in Barcelona, Spain.

¹³Data on 27 facilities for the period from March 2020 to January 2021 on 27 LTCFs in Castellon region.

¹⁴232 facilities over the period of March to June, 2020 in Barcelona, Spain.

¹⁵Data on 51,576 residents (62% of the total population of LTCF residents) is matched with 2,085 nursing homes, in 290 municipalities in Sweden for the period of March 2020 to late December 2020.

(2022) found that for-profit ownership was linked to lower facility quality ratings and increases in staff COVID-19 cases, which in turn led to higher resident infection rates and deaths. However, the study's scope was limited to one county in Illinois and the first wave of the pandemic,¹⁶ reducing the ability to generalize the findings more broadly.

In summary, although FP ownership has frequently been considered as a potential risk factor for adverse COVID-19 outcomes in LTCFs for the elderly, the evidence from two waves of research remains inconsistent. Studies differ in data sources, operational definitions of key factors and their measurement, as well as in modelling choices. These differences complicate direct comparisons and limit the generalizability of the findings.

To strengthen future research, there is a clear need for more and better data, rigorous modeling techniques, and greater attention to confounding factors such as local COVID-19 prevalence and the structural and organizational differences between facilities. The observed variations in findings across studies emphasize the importance of identifying a core set of structural and organizational characteristics of facilities, while also developing stronger theoretical frameworks to understand the relationship between ownership and other structural characteristics.

3 Chain Status

LTCFs owned by FP and NFP organizations may either be part of a chain or operate independently. The impact of chain affiliation on COVID-19 outcomes remains debated. On one hand, chains can pool resources, such as testing capabilities, potentially improving their pandemic response. On the other hand, one of the resources that chains regularly share is personnel, which may facilitate the spread of infection (Bowblis & Applebaum, 2020). The empirical literature offers no consistent support for either perspective.

Regarding the likelihood of experiencing a COVID-19 case, some earlier research identified chain affiliation as a risk factor (Bowblis & Applebaum, 2020; Cai et al., 2021; Gorges & Konetzka, 2020;

¹⁶Data for 177 skilled nursing facilities in Cook County, Illinois, USA, housing 6270 residents over the period from January 1 through September 30, 2020.

Ibrahim et al., 2021; McGregor & Harrington, 2020), while Abrams et al. (2020) found the opposite. Other studies reported no evidence of any association Li et al. (2020a,b).

The evidence is more consistent regarding the chain status being a risk factor for the spread of infections within facilities (outbreaks), though the effect sizes are generally modest (Abrams et al., 2020; Bowblis & Applebaum, 2020; Braun et al., 2020; Brown et al., 2021; Gorges & Konetzka, 2020; Ibrahim et al., 2021; Li et al., 2020a,b; Lord et al., 2021; Shallcross et al., 2021; Stall et al., 2020) (but see (Gorges & Konetzka, 2020) who reported no statistically significant relationship).

The most common finding regarding chain status and COVID-19 deaths is a lack of robust association (Braun et al., 2020; Gorges & Konetzka, 2020, 2021; Li et al., 2020a; Shallcross et al., 2021; Unruh et al., 2020; Weech-Maldonado et al., 2021). However, some studies identified chain status as a risk factor for higher deaths (Cai et al., 2021; Dean et al., 2020; Ibrahim et al., 2021; Morciano et al., 2021; Shen, 2022; Stall et al., 2020), while others found it to be associated with fewer deaths (Li et al., 2020b).¹⁷

Overall, the impact of chain affiliation on COVID-19 outcomes in LTCFs is inconclusive. While some studies identify chain status as a risk factor for cases, outbreaks and deaths, others find no significant association. Chain affiliation alone is likely insufficient to explain variations in COVID-19 outcomes, as factors such as ownership type, facility size, and staffing characteristics also play contributing roles.

4 Facility Size

The size of LTCFs has frequently been used as an explanatory variable in empirical studies examining variations in COVID-19 outcomes. Size matters for several reasons. First, larger facilities house more residents and, typically, employ more staff, which, in turn, increases the movement of people between the facility and the surrounding community. In areas with high SARS-CoV-2 infection rates, care personnel can be a source of COVID-19 transmission, and more personnel (in larger LTCFs)

¹⁷Notably, Ibrahim et al. (2021) found that larger outbreaks were associated with privately owned homes operating 11 or more facilities, while the highest fatality rates were observed in NFP homes with multiple facilities.

increase the risk of infection at the facility (McGarry et al., 2021). However, larger LTCFs often have more financial and human resources, which may minimize risk for COVID-19 infections (Figueroa et al., 2020; Gopal et al., 2021). Furthermore, it has been argued that implementing effective infection control measures, such as social distancing and staff cohorting, is more challenging in smaller facilities, high-occupancy facilities and in facilities with multi-bed room design (Abrams et al., 2020). Below, we provide a brief overview of the empirical literature on the relationship between facility size and COVID-19 outcomes.

4.1 Facility Size and Likelihood of Having a Case

The majority of studies examining the associated between the facility's number of beds and the likelihood of having at least one case of COVID-19 indicate that larger facilities face a higher risk (Abrams et al., 2020; Bui et al., 2020; Gopal et al., 2021; Gorges & Konetzka, 2020; Harrington et al., 2020; Li et al., 2020b; White et al., 2020). However, there are also studies that found no association between these two variables Cazzoletti et al. (2021).

The impact of size, when measured by occupancy – the ratio of occupied to total beds – is less clear. While some studies have reported a statistically significant association between higher occupancy and an increased likelihood of COVID-19 cases (He et al., 2020; Li et al., 2020b), others have found no such relationship (Gopal et al., 2021; Li et al., 2020a).

Similarly, evidence regarding the role of facility design features related to facility size remains mixed and inconclusive. For example, Zhu et al. (2022) found that a higher percentage of private rooms and larger living spaces per bed were significantly associated with reductions in COVID-19 cases, transmission rates, and resident mortality. However, two other studies that use the same dataset reached conflicting conclusions: Stall et al. (2020) reported that facilities with multi-bed rooms and shared bathrooms were linked to a higher risk of COVID-19, while Brown et al. (2021) found no significant relationship between crowding indices and the likelihood of infection. These inconsistencies highlight the importance of methodological factors, such as measurement choices, modeling techniques, and estimation strategies, in shaping study outcomes.

4.2 Facility Size and Infection Rates

Numerous studies across various empirical settings have identified a positive association between a larger number of beds and higher infection rates in LTCFs (Abrams et al., 2020; Bowblis & Applebaum, 2020; Chen et al., 2021; Gmehlin et al., 2021; Gorges & Konetzka, 2021; Lane et al., 2022; Li et al., 2020a; Shallcross et al., 2021; White et al., 2020). For example, in a multivariate regression analysis, predicting COVID-19 mortality as a function of LTCF racial composition, controlling for organizational characteristics (like staffing and Five Star Rating (5SR)) and community spread, Gorges & Konetzka (2021) found that differences in resident deaths by race were robustly associated only with facility size and county virus prevalence.

The null result is the second most frequently occurred finding (Bowblis & Applebaum, 2020; Braun et al., 2020; Brown et al., 2021; Gopal et al., 2021; Gorges & Konetzka, 2020; Li et al., 2020b; Walsh et al., 2023), but there are also studies that found a large number of beds was linked with fewer outbreaks. For example, Bowblis & Applebaum (2020) examined the association between bed count and COVID-19 outbreaks (operationalized as having a cumulative number of cases that exceeds 20% of total beds) over three distinct periods during the first wave of the pandemic in Ohio, to find that facilities with more beds were less likely to report a high number of cases in two out of three time period, including the entire first wave of the pandemic.

Lower occupancy rates have been seen as protective to the spread of infection within houses, as the availability of free beds permits more effective isolation measures, but the empirical evidence is not fully supportive of this proposition. While both He et al. (2020) and Shallcross et al. (2021) provide some supportive evidence, there are also studies that found that higher occupancy was associated with lower spread of infection among residents (Braun et al., 2020; Li et al., 2020b) and those that reported null results (Gopal et al., 2021; Li et al., 2020a).

There is more agreement regarding evidence on the link between multi-bed rooms/shared bathroom and the spread of the infection (Broms et al., 2021a; Brown et al., 2021; Zhu et al., 2022). For example, both Brown et al. (2021) and Stall et al. (2020) report (despite notable methodological difference between the two studies) that more crowded homes in Canada's Ontario experienced higher

infection rates and mortality.

Additionally, the importance of facility size appears to vary across different time periods. Thus, a study from the Netherlands (Houben et al., 2023) reported that during periods of the Alpha variant, ward size (21 beds) was associated with increased odds of a outbreak, but not during the classic variant.

4.3 Facility Size and Mortality

There is conflicting evidence on the effect of the LTCF's size on COVID-19 attributable deaths. While many studies found large facilities had experienced higher mortality (Broms et al., 2024a; Gopal et al., 2021; Gorges & Konetzka, 2020, 2021; Morciano et al., 2021; Shen, 2022; Unruh et al., 2020), some the larger number of beds – lower mortality association Li et al. (2020a) or no association at all (Braun et al., 2020; Brown et al., 2021; Li et al., 2020b). Furthermore, Zunzunegui et al. (2022) found that both very small and large nursing homes had higher COVID-19 mortality, whereas LTCHs with 30 to 70 places had the lowest level.

The picture is not clearer when it comes to the occupancy rate, two studies found higher occupancy to be systematically associated with higher deaths (He et al., 2020; Unruh et al., 2020), but Braun et al. (2020) and Li et al. (2020b) found the opposite, and Dean et al. (2020) found no relationship between these two factors. Li et al. (2020a) and Li et al. (2020b) found that higher occupancy rates are predictive of a probability of at least one death from SARS-CoV-2.

Research also points that multibed design is likely to lead to more deaths (Brown et al., 2021; Stall et al., 2020). It is worth noting that in many studies, multibed/single bed design and other design features associated with the facility size, are statistically significant predictors of the outcomes of interests in bivariate, but not multivariate analyses. For example, in a study from two Swiss cantons Scanferla et al. (2023) found that lower resident mortality was associated with the proportion of single rooms in bivariate regression, but not in the multivariate analysis.¹⁸.

In summary, facility size, operationalized in several different ways, appears to play a role in COVID-

¹⁸56 facilities over the period of the year 2020

19 outcomes. In their systematic review of studies on long-term care facility characteristics associated with COVID-19 outcomes with a particular focus on facility size, (Gorges & Konetzka, 2021, 2766) concluded that larger studies, with better data and more rigorous methods and modelling choices “are fairly consistent” in their assessment that larger bed size was one of two “strongest and most consistent predictors” of facilities having more COVID-19 cases and deaths (the other one LTFC location in an area with high COVID-19 prevalence).

However, most findings stem from studies that rely on limited datasets, either spatially or temporally and are susceptible to measurement error, which may constrain both the generalizability of the results and their reliability. Furthermore, many studies likely suffer from omitted variable bias as there is considerable variation in the number and type of control variables employed, complicating the interpretation of the findings. Notably, a large number of studies that identify facility size as a key predictor, do not control for ownership. This is surprising, frequently assumed causal relationship between ownership and the structural/organizational characteristics of LTCFs (see, for example, (Braun et al., 2020; Cronin & Evans, 2022; Harrington et al., 2020; Williams et al., 2021)). Thus, the inclusion of ownership as a control variable is essential for studies aiming to accurately assess the impact of facility size on COVID-19 outcomes.

5 Staffing and COVID-19 outcomes

The association between personnel characteristics and quality of care is a well-established area of research within the public health literature (Bostick et al., 2006; Castle & Engberg, 2008; Dellefield et al., 2015; Harrington et al., 2012; Kim et al., 2009a,b; Lin, 2014; Schnelle et al., 2004; Spilsbury et al., 2011). The field, however, lacks full consensus, as besides evidence for positive relationships between staffing levels and quality, there are also studies with null (Rantz et al., 2004) and mixed results (Backhaus et al., 2014; Konetzka et al., 2008; Lin, 2014). Two recent literature reviews contrasting conclusions: while Tuinman et al. (2021) attest to the positive association between nursing staff levels (nursing hours per resident per day) and quality of care is largely supported, Armijo-Olivo et al. (2020) conclude that evidence is inconsistent. This literature has faced criticism for method-

ological deficiencies, namely the lack of theoretical justification of the link between staffing and care outcomes, narrow scope (the overwhelming majority of the studies are U.S.-based) and limited use of panel data, small sample sizes, and a failure to explore the effect of such staffing dimensions as skills mix, staff stability and the use of the outsourced (the so-called agency) staff (Backhaus et al., 2014; Castle & Engberg, 2008; Spilsbury et al., 2011). Many of these deficiencies have travelled to the literature addressing personnel and COVID-19 outcomes.

5.1 Why does Staffing Matter for COVID-19 Outcomes?

Under the broad argument “staffing matters”, there are several specific mechanisms linking personnel characteristics to COVID-19 outcomes. First, it is argued that the overall staffing quality is consequential for how nursing homes have responded to the pandemic. Those who empirically tested this argument, most often used the staffing score from the standard government ratings of residential homes, such as the U.S. 5-Star Rating (5SR), as a measurement of staffing quality (Figueroa et al., 2020; White et al., 2020).

Second, some scholars underscore the importance of staffing levels – usually proxied through the number of hours per resident/day – for managing COVID-19 response (Gopal et al., 2021; Gorges & Konetzka, 2020; Harrington et al., 2020). Staffing levels may work differently for different COVID-19 outcomes. High staffing levels may increase the likelihood of a facility experiencing a COVID-19 case, especially in areas with high community transmission. However, higher staffing levels are generally believed to improve the management of infection rates and mortality. For example, (Gorges & Konetzka, 2020, p.2466) argue that “Implementing measures to stem transmission, such as regular testing and cohorting of both residents and staff, is difficult without sufficient staffing levels.”

Third, the optimal mix of personnel – such as the ratios of registered nurses (RNs), licensed practical nurses or licensed vocational nurses (LPN/LVNs), certified nurse assistants (CNAs), nurse aides (NAs), and healthcare assistants (HCAs) – is also considered crucial for effective pandemic management. Some scholars highlight the importance of registered nurses because management of infection control and prevention practices in nursing homes is their prime responsibility. Consequently, the RN-

to-total-staff ratio is often employed as an explanatory factor of COVID-19 outcomes. Conversely, other researchers highlight the importance of the nursing personnel with day-to-day care duties, like LPN/LVNs and CNAs due to the fact that a lion share of care outcomes in long-term care facilities is classified as nursing outcomes, i.e. outcomes responding to nursing interventions (Moorhead et al., 2018).

Finally, the use of non-permanent personnel – those on hourly contracts or provided by specialized staffing agencies – who move from facility to facility, has emerged as one of the most frequently cited channels thorough which COVID-19 is transmitted in elder care facilities Bowblis & Applebaum (2020); Chen et al. (2021); Jones et al. (2021); Ladhani et al. (2020); Shallcross et al. (2021). Recognizing that personnel was a key vector of infection transmission, some authorities, such as the government of British Columbia in Canada, implemented measures already in the first wave of the pandemic to restrict “the movement of staff between facilities by ensuring that staff only work at one facility” and by mandating the same (higher) wages and working conditions to all staff working in long-term care regardless of the form of ownership (British Colombia, 2020). Low pay, which often compels many workers to hold second jobs or take on multiple caregiving roles and unsatisfactory working conditions in many countries were well-documented issues even before the pandemic (Ladhani et al., 2020; Leskovic et al., 2020; Van Houtven et al., 2020),

5.2 Staffing and Likelihood of having a Case

Broad “staffing quality” has been probed as an explanatory factor for the likelihood of having a SARS-CoV-2 case at LTCF in several empirical studies, where the quality of operationalized through the 5SR staffing component. Harrington et al. (2020) found that in California’s nursing homes higher scores for 5SR overall staffing and, particularly, the quality of their registered nurses (RN) were associated with lower probability of having a COVID-19 case.¹⁹ However, other studies found no statistically significant associations between the variables of interest (Gopal et al., 2021; White et al., 2020).

¹⁹1,091 facilities over the period from March to May 4, 2020 in one U.S. state. Method: multivariate regression. Multiple sources of COVID-19 case counts that may affect the quality of data. No control for the spread of virus in the LTCF community.

When it comes to the staffing levels, Harrington et al. (2020) found that homes with the RNs level below the recommended minimum (0.75 hours per resident/day) are twice as likely to have a case of coronavirus infection than homes where RNs spend on average more time with residents than the recommended minimum. On the other hand, homes that did not meet the minimum requirement of total nursing hours per resident/day (4.1) were as likely to get a SARS-CoV-2 case as those homes that did not meet this requirement. However, other studies reported the levels of nursing staffing to be unrelated to the risk of getting a case (Gorges & Konetzka, 2020; Li et al., 2020a,b). For instance, Gorges & Konetzka (2020) conducted a rigorous examination of the effect of the staff composition on the probability of having a COVID-19 case using the nation-wide data from the USA during the first wave of the pandemic.²⁰

The findings on the optimal personnel mix present a complex and inconclusive picture. For example, Gorges & Konetzka (2020) found that while higher LPNs and NAs hours are not predictive of the probability of a COVID-19 case, higher levels of RNs were associated with higher likelihood of a case. In contrast, Li et al. (2020a) and Li et al. (2020b) did not concur the Gorges & Konetzka (2020)'s results about the optimal staff composition. In a nation-wide study, LTCFs with higher RN hours were less likely to experience a COVID-19 case (Li et al., 2020b),²¹ but Connecticut's nursing homes with higher RN hours in 2019 were similar to homes with lower RN hours in terms of their likelihood of having a coronavirus case (Li et al., 2020a). Further complicating the picture, Bowblis & Applebaum (2020) found that higher RN and LPN hours, but not CNA hours, were associated with the increased probability of having a COVID-19 case. Additionally, Stall et al. (2020), using an indicator for total full-time staff (normalized by the number of beds), regardless whether it was nursing personnel or not, found no relationship between staffing levels and the probability of contracting a COVID-19 case.

Research has also explored the link between the use of the agency staff and probability of a COVID-19 case. Having employed several measures of the agency staff use (both dichotomized and as a ratio of agency to total staff), Bowblis & Applebaum (2020) reported highly inconsistent estimates

²⁰ 13,167 facilities over the period ending June 2020, USA. CDC NHSM data on outcomes, which is likely to contain measurement error. Method: logistic regression and hurdle negative binominal regression.

²¹ 12,576 facilities over the period of one week from May 25, 2020 to May 31, 2020, in the USA. Method: multivariate regression.

in terms of both significance levels and the direction of the impact. In contrast, a nation-wide study of LTCFs in England found that facilities employing more temporary nursing and care personnel were more likely to have at least one case of COVID-19 (Shallcross et al., 2021). The same study also found that having staff working at multiple LTCFs did not increase the risk of COVID-19 cases, challenging prior assumptions about cross-facility employment as a transmission risk.

5.3 Staffing and Infection Rates

Several studies employed the staffing score from the 5SR as predictor of the infection rates at facilities with highly diverging results. For example, while both Figueroa et al. (2020) and Gopal et al. (2021) found that homes with higher 5SR score on staffing quality exhibited fewer number of cases among residents, Gopal et al. (2021) also found that higher staffing ratings are associated with more cases among staff. Sugg et al. (2021) found that that homes with differing staffing ratings were not statistically different with regard to number of confirmed coronavirus cases.

Gorges & Konetzka (2020) found that LTCFs with higher total nursing hours had lower infection rates. However, when considering staff composition, only higher hours worked by nurse aides (NAs) were significantly associated with a reduction in outbreaks.

In another U.S.-based nationwide study, lower total nurse staffing, but also higher LPN staffing were identified as a statistically significant predictor of more confirmed COVID-19 cases (Sugg et al., 2021).²²

In Connecticut's nursing homes, Li et al. (2020a) found that higher registered nurse (RN) hours were predictive of lower infection rates, with every 20-minute increase in RN staffing associated with 22% fewer confirmed cases. Yet, their nationwide study, albeit limited to one week of data, found no such evidence (Li et al., 2020b).

Similarly, Bowlis & Applebaum (2020) found no consistent pattern of association between different staffing levels (RNs, LRNs and CNAs hours per resident/day or the use of agency personnel) and the

²²13,709 facilities over the period ending by June 2020. CDC NHSN data, which is likely to contain measurement error. Method: multivariate regression.

probability of more than 20% of residents having coronavirus. Chen et al. (2021) demonstrated that inter-facility movements of people, measured through geolocation data from 50 million smartphones, is highly predictive of the number of cases in the US's LTCFs. But the survey data from the UK showed that having staff working at other locations led to the increase of infected staff, but not residents (Shallcross et al., 2021). These scholars also showed that paying staff at least statutory sick pay led to lower number of infected residents and staff.

5.4 Staffing and Mortality

In terms of the staffing levels, Unruh et al. (2020) showed that nursing homes with higher hours of direct care per resident/day are at a lower risk of 6+ COVID-19 deaths. In a study from Connecticut, Li et al. (2020a) found that the total nursing levels of a home are uncorrelated with the probability of having a COVID-19 death and with the number of such deaths. However, every extra 20 minutes that register nurses spent with residents was associated with 26% of fewer deaths.

As with other outcomes, the evidence on the role of personnel mix for mortality outcome is inconclusive. A large US-based study (Gorges & Konetzka, 2020) found that LTCFs with high total nursing hours and high NA hours experienced fewer number of COVID-19 attributed deaths among residents and staff, but the RN or LPN hours were unrelated to this outcome. Similarly, a smaller study by Dean et al. (2020).²³ reported that RNs and LPNs staffing levels were not systematically associated with COVID-19 mortality, but the CNAs hours were a statistically significant predictor of reduced mortality. Notably, this study also highlighted the protective effect of unionization, finding that care homes with a higher proportion of unionized staff experienced fewer COVID-19 deaths.

Weech-Maldonado et al. (2021) found that a shortage of nursing staff and was systematically related to elevated mortality, but shortages of clinical staff or aids were not.²⁴

Research has also explored the influence of the characteristics of the neighborhoods where LTCF staff reside. Thus, Shen (2022) found that staff neighborhood characteristics – such as, higher population

²³255 facilities over the period ending on May 31, 2020 in one U.S. state. Method: multivariate regression.

²⁴12,914 facilities over the period if January 1, 2020 to October 25, 2020, in the USA. Method: multivariate regression. NHSM data is used, which is likely to contain measurement error. Not controlling for community spread.

density, higher public transportation use, and larger non-white population – were associated with higher COVID-19 deaths. These effects were larger than the effect of LTCF neighborhood and facility attributes, except for the size).

5.5 Ownership, Staffing and COVID-19 Outcomes

Long before the COVID-19 pandemic staffing has been identified as a plausible causal mechanism that links ownership with the quality of care. For example, several studies pointed to a systematic difference in the number of nursing hours between for-profit, non-profit and publicly owned facilities (Castle & Engberg, 2006; Harrington et al., 2012; Hsu et al., 2016; McGregor et al., 2010), suggesting that the causal link may run through the personnel quality and management. The argument that the staffing factor primarily drives variation in COVID-19 outcomes between LTCFs has become widely accepted within the academia and policy circles, as illustrated by McGregor & Harrington (2020), who said: “ownership matters when it comes to staffing, and staffing matters when it comes to managing outbreaks of COVID-19 in LTC [long-term care – authors] facilities.”

This argument is certainly plausible, but there is a dearth of empirical studies that directly test it. In a large study from the USA Xu et al. (2020) leveraged the type of ownership and the chain status (also controlling for a set covariates) on the self-reported shortage of 1) registered nurses and licensed practiced nurses; 2) certified nursing assistants and nursing aids and 3) clinical staff (physicians and advanced practice nurses) and 4) non-care staff. They found that compared to for-profit nursing homes, government-owned facilities were less likely to experience shortages of RNs/LPNs and non-care staff, but were similar to FP in relations to other personnel. Non-profits, on the other hand, were short on clinical staff, compared to for-profits. LTCFs that were members of a chain, were more likely to experience shortages only of CNAs/NAs personnel, but being similar with respect to other staff categories to non-chain facilities.

To summarize, the reviewed literature provides no clear-cut evidence supporting a widely-held idea that staffing levels, personnel composition and its stability are the key organizational factors driving the variation in COVID-19 outcomes between LTCFs. Neither has the literature corroborated a

postulated link between the type of ownership and COVID-19 outcomes via staffing quality. While the staffing literature has produced fewer null results than studies on the ownership, size and quality, it lacks robust evidence regarding which categories of personnel are most critical for effectively managing the coronavirus pandemic within LTCFs.

6 Conclusion

This review reveals a lack of consensus in the literature regarding the effects of ownership on COVID-19 outcomes in LTCFs for the elderly. While for-profit ownership is frequently regarded as a potential risk factor for poorer outcomes, evidence from two waves of research does not establish a systematic link between variations in the presence of COVID-19 cases, infection rates, and mortality among facilities and ownership type. Additionally, factors related to facility size and staffing characteristics exhibit inconsistent associations with these COVID-19 outcomes.

The review highlights that empirical studies on the facility-level determinants of COVID-19 outcomes vary considerably in their data sources, the operationalization and measurement of key factors, and modelling choices. Existing research is heavily U.S.-centric, with only a handful of studies from countries like the UK, France, Spain, Italy, and Sweden, and even fewer nationwide studies that offer robust grounds for generalization. Moreover, many empirical studies primarily rely on data collected during the first wave of the pandemic, which was marked by incompleteness and a tendency for errors. The absence of data from different periods also leaves significant gaps in our understanding of how these determinants evolved over time. Additionally, most studies lack a clear theoretical framework linking ownership, other structural characteristics, and COVID-19 outcomes. Cumulatively, these deficiencies complicate direct comparisons, limit the generalizability of results, and hinder the accumulation of knowledge in this field.

To strengthen future research, there is a clear need for more and better data, and greater attention to confounding factors such as regional COVID-19 prevalence and structural and organizational differences between facilities. Identifying a core set of structural and organizational characteristics of facilities is crucial, as is the development of a more robust theoretical framework to elucidate the

relationship between ownership and these other structural factors.

To advance the knowledge, future studies must expand both the geographical and temporal scope of research, incorporating data from subsequent waves and underrepresented regions. Comprehensive, longitudinal analyses are needed to better capture the dynamic effects of facility-level factors on COVID-19 outcomes across different healthcare systems and pandemic phases.

The reviewed studies predominantly rely on facility-level data, sometimes including aggregate data on residents (see, for example, (Abrams et al., 2020; Akhtar-Danesh et al., 2022; Chen et al., 2021; Dean et al., 2020; Gorges & Konetzka, 2020; He et al., 2020; Hege et al., 2022; Li et al., 2020a,b; Morciano et al., 2021; Shallcross et al., 2021)). However, this approach has limitations, as individual characteristics – such as health status, gender, and age – are well-established predictors of COVID-19 outcomes (Najar et al., 2023). To address this shortcoming, future research should employ multi-level empirical analysis that incorporates individual, facility, and community-level covariates. Initial efforts in this direction have already been made (Broms et al., 2024a), but further research is necessary to provide a more comprehensive understanding of the complex interplay of factors influencing COVID-19 outcomes in LTCFs.

Moreover, there is a strong, albeit often implicit, suggestion in the literature that LTCF characteristics such as size, chain status, design standards and especially staffing variables mediate the relationship between ownership and COVID-19 outcomes. However, this argument remains empirically understudied (but see Broms et al. (2024a)). Thus, future research should prioritize disentangling these complex relationships by investigating how ownership influences COVID-19 outcomes through mediating factors, such as staffing, facility design, and size, while also accounting for external influences such as community transmission. Empirical studies aiming to clarify the role of the structural factors should also ensure the thoughtful integration of ownership data in their analyses.

The existing literature presents a complex picture of ownership's impact on COVID-19 outcomes in LTCFs, indicating that different ownership models can yield both protective and detrimental effects. To be better prepared for future public health challenges, it is essential to comprehend the mechanisms of these effects. This necessitates an examination of first-order structural factors, such as ownership, and second-order structural factors, like staffing, as well as interactions between them. Addressing

these issues will not only deepen our understanding but also inform policy prescriptions aimed at enhancing the resilience of LTCFs in times of crisis.

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Appendices

A Ownership and COVID-19 Outcomes: Discussion of Empirical Studies

Below is a detailed discussion of the results of empirical research based on multivariate statistical analysis regarding the link between the ownership types and four Covid-related outcomes: probability of experiencing a COVID-19 case, infection rate (outbreaks), and mortality rate.

A.1 Ownership and Probability of Having a Case

A.1.1 FP Ownership

Three studies directly compared for-profit (FP) ownership with other forms of ownership (grouped together) in relation to the likelihood of having at least one case of infection (Harrington et al., 2020; He et al., 2020; Shallcross et al., 2021). While (Harrington et al., 2020) found no statistically significant association between FP ownership and infection rates, the other two studies reported a higher likelihood of infection in FP facilities, though the significance of FP ownership was only at the 90% confidence level.

The findings from two studies (Li et al., 2020b; Rolland et al., 2020), which treat GOV ownership as a comparison category and non-GOV as a reference group, suggest that government ownership is associated with a lower probability of having a COVID-19 case, compared to other forms of ownership, despite differences in the reference groups. Thus a small regional study from France (Rolland et al., 2020) found that government ownership was linked to a lower probability of having a case compared to all other ownership types,²⁵ while (Li et al., 2020b) reported a similar association, specifically when comparing government and FP ownership.²⁶

²⁵124 facilities over the period from March 23, 2020 to May 6, 2020 in Haute-Garonne, Occitania region.

²⁶216 facilities over the period ending by April 16, 2020, in Connecticut, USA.

In a multivariate regression analysis incorporating facility and community-level variables, conducted on a large sample of U.S. long-term care facilities (LTCFs), Gorges & Konetzka (2020) compared the performance of FP and GOV facilities with that of non-profits (NFPs). The study found that while FP facilities had a lower likelihood of experiencing a case compared to NFPs, they were associated with higher odds of outbreaks and were more likely to have elevated mortality rates. In contrast, GOV facilities were linked to lower odds of having a case, but no significant differences were observed in relation to outbreaks or mortality.

Other studies have not found a significant relationship between FP ownership (compared to the reference category, defined differently in different studies) and the likelihood of having a Covid-19 case (Abrams et al., 2020; Brown et al., 2021; Gopal et al., 2021; Li et al., 2020a; Morciano et al., 2021; Stall et al., 2020).

A.1.2 GOV and NFP Ownership

Concerning the link between GOV ownership and the likelihood of having a COVID-19 case, the picture is also mixed. While Gorges & Konetzka (2020) found government-owned homes to have a lower probability of experiencing a case compared to NFP homes, Bowblis & Applebaum (2020) found that GOV-owned homes do not perform better in terms of the likelihood of having a case than FP LTCFs. Abrams et al. (2020); Brown et al. (2021) found no difference between government-owned and NFP homes Abrams et al. (2020); Brown et al. (2021), and Bowblis & Applebaum (2020) found no difference between the GOV and FP homes in relation to the likelihood of having a case.

Cai et al. (2021) analysed weekly data²⁷ of any new COVID-19 cases and any new deaths on the minority status of LTCFs, controlling for a number of facility and community-level factors. They found that, compared to FPs, both NFP and GOV facilities performed better in terms of new COVID-19 cases in LTCFs in high-minority communities, but not in the low-minority communities. However, they did not find comparable results concerning new deaths.

²⁷13,123 facilities over the period from June 7, 2020 to August 23, 2020, in USA. Method: stratified multivariate regression. Early NHSN data is not included.

A.2 Ownership and COVID-19 Prevalence

A.2.1 FP Ownership

Empirical evidence from several high-quality studies points to the higher number of COVID-19 cases in FP facilities. A large study from LTCFs in England found a robust association between the FP status (in comparison to other forms) and higher levels of infection in residents, staff and also a higher probability of a large outbreak (Shallcross et al., 2021). Two large studies from the USA (Abrams et al., 2020; Gorges & Konetzka, 2020) report a higher probability of FP nursing homes to have an outbreak (in comparison to NFP).²⁸

Two regional studies from Canada point to the same direction. Brown et al. (2021) found that FP is associated with higher Covid incidents (per 100 residents). Using the same dataset, but different operationalization of the outbreak (count variable), Stall et al. (2020) found that FP-owned homes have larger number of COVID-19 cases, although the association disappears when the multi-bed room design is added into the model. Stall et al. (2020) suggest that the association between ownership and COVID-19 outbreaks is mediated by a higher prevalence of older design standards in for-profit LTCFs. Finally, in a large (N=13,772) nation-wide study from the USA over the period from January 1, 2000 to July 11, 2021, Lord et al. (2021) found that that FP ownership had 17% higher rate of COVID-19 infection rates.

Other studies present a more ambiguous picture. Gopal et al. (2021) found PE status to be related to larger case count among residents, but not among staff, and not related to large outbreaks. Li et al. (2020b) showed that NFP/GOV-owned nursing homes in the U.S. state of Connecticut had more confirmed cases than FP facilities, but in a nation-wide study (restricted to one week data, May 25-31, 2020) no difference was found between FP and GOV-owned homes regarding this particular outcome (Li et al., 2020a).

²⁸In Gorges & Konetzka (2020) outbreak is defined as confirmed cases/certified beds $\geq 10\%$ or total confirmed and suspected cases/beds $\geq 20\%$ or ≥ 10 deaths.

A.2.2 GOV and NFP Ownership

Prevalence of COVID-19 cases was the only outcomes on which government-owned homes outperformed private equality owned facilities in a study dedicated to the COVID-19 effects of ownership types (Broun et al 2020). On the other hand, Sugg et al (2020) found that compared to FP facilities, government-owned nursing homes have more confirmed cases of COVID-19 ($p=.051$), but there no statistically significant difference was found between NFP and FP homes. Similarly, Bowblis and Applebaum (2020) found that neither NFP, no GOV-owned homes perform better in terms of the outbreaks than FP facilities. Abrams et al. (2020), Braun et al. (2020), Brown et al. (2021) and Gorges & Konetzka (2020) found no statistically significant difference between NFPs and GOV-owned homes in terms of the severity of COVID-19 outbreaks

A.3 Ownership and COVID-19 Mortality

Five studies found a positive association between FP ownership status and higher mortality rates (Brown et al., 2021; Gorges & Konetzka, 2020; He et al., 2020; Stall et al., 2020; Unruh et al., 2020). Using a regional US data and a dichotomized variable of ownership (FP or not), both He et al. (2020) and (Unruh et al., 2020) found an association (at the 90% confidence level) between the FP status and higher COVID-19 mortality. Gorges and Konetzka (2020) compared FP nursing homes with those owned by non-profit organizations and found FP homes to experience higher number of death attributable to COVID-19 among both residents and staff. Brown et al (2020) and Stall et al (2020) use the same data on nursing homes in Canada's Ontario, but operationalize mortality and ownership differently, and report the FP status to be associated with higher COVID-19 mortality.

At the same time, several studies found no robust association between FR ownership COVID-19 mortality (Dean et al., 2020; Gorges & Konetzka, 2021; Morciano et al., 2021). For example, a high-quality study by Gorges & Konetzka (2021), which used the number of deaths as their outcome of interest (count variable), found no statistically significant different in the performance of FP and NFP (reference group) facilities.²⁹ Although the coefficient for GOV facilities was statistically sig-

²⁹13,312 facilities over the period from January 1, 2020 to September 13, 2020 in the U.S.A.

nificant in some models, this effect disappeared in the full model when structural characteristics and community prevalence of COVID-19 were included.

B Quality Ratings and COVID-19 Outcomes

Quality of care has been one of the most frequently used predictors of variation in COVID-19 outcomes among LTCFs.

Even before the COVID-19 pandemic, a link between the quality of care and tangible well-being outcomes was supported by both compelling theoretical frameworks and an increasing body of empirical evidence. Many studies found robust associations between lower care quality and such important outcomes as higher risk of infections (Gucwa et al., 2016), worst post-surgery outcomes and higher readmission rates after hospitalization (Kimball et al., 2018; Paredes et al., 2019; Snyder et al., 2019), while some studies found no such a link (Neuman et al 2014; Ogunneye et al., 2015) or reported mixed evidence (Xu et al., 2019).

The most commonly used indicators of quality of care in LTCFs are those developed by governments for regulatory purposes. In studies with data from the U.S., which dominate the literature, the overall Five Star Rating (5SR) and its individual components serve as the primary measures of nursing home quality. The 5SR evaluates a nursing home's performance across three domains: health inspections, quality measures (QMs), and staffing.

In England, Care Quality Commission – an independent regulator of health and social care – utilizes a comparable 4-star rating system for LTCFs, which has been used as an explanatory variable for COVID-19 outcomes (Shallcross et al., 2021). In Sweden, government-designed care quality indicators have been previously utilized (Broms et al., 2020; Winblad et al., 2017); however, they have yet to be analyzed in the context of COVID-19 outcomes.

Although variations in COVID-19 outcomes might be expected due to differences in the quality of care among LTCFs, research has revealed a weak association between nursing home quality ratings and COVID-19 cases and deaths (Abrams et al., 2020; Gorges & Konetzka, 2020; White et al., 2020).

The discussion below offers a brief overview of the main findings from this literature with regard to three specific outcomes.

B.1 5SR Quality Indicators and Probability of a COVID-19 case

The effect of the overall 5SR quality on the likelihood of getting at least one case of COVID-19 was examined in a large number of studies, most of which found no statistically significant association (Abrams et al., 2020; Bowblis & Applebaum, 2020; Bui et al., 2020; Figueroa et al., 2020; Li et al., 2020a; White et al., 2020). In one of the earlier studies, Bowblis & Applebaum (2020) found that that in Ohio LTCFs having any resident case (as well as having a high caseload of residents with the virus) is not more likely in nursing homes with lower overall 5SR quality rating.³⁰ Similarly, a later study by Cronin & Evans (2022) found no systematic relations between overall 5SR and any of its components to likelihood of experiencing 1+ case.³¹

However, some studies found systematic relationships (Bui et al., 2020; Harrington et al., 2020; He et al., 2020), although the direction of the associations varied across studies. Similar finding was reported by He et al. (2020) and Harrington et al. (2020). While both Harrington et al. (2020) and He et al. (2020) report the higher 5SR – lower likelihood to have a case, Bui et al. (2020) found that 4-5 and 3 star facilities had higher odds of 2+ resident or staff cases than 1 star facilities.³² Similar finding was reported by He et al. (2020) and Harrington et al. (2020).

The picture regarding the individual components of the 5SR also remains unclear. For example, while He et al. (2020) reported the QMs score were associated with a lower probability of having a confirmed case in California's nursing homes, Sugg et al. (2021) established that the relation was not statistically significant if all U.S. nursing homes are considered. Furthermore, having examined the link between three individual components of the 5SR, Gopal et al. (2021) found no association between either of the three quality measures on the one hand and the likelihood of getting a case

³⁰Max of 286 facilities over the period ending by April 28, May 14 and June 17, 2020, in one U.S. state. Data from the compulsory reporting to the State of Ohio Department of Health by LTCFs. Method: Multivariate regression.

³¹15,421 facilities over the period from May 25th, 2020 to July 18th, 2021 in the U.S. Method: Multivariate regression. Multiple data sources on outcomes, allowing to show significant under-reporting of cases and deaths in NHSN data.

³²123 facilities, over the period ending by June 11, 2020 in one U.S. state. Data is likely to contain measurement error. Method: multivariate regression predicting the probability of 2+ residents or personnel cases in 14 days with a limited number of control variables.

among residents or staff on another.

Several studies, such as Abrams et al. (2020), White et al. (2020) utilized the information from the 5SR on infection violations in the year preceding the pandemic and found that higher number of prior infection violations was not predictive of a probability of getting a COVID-19 case. However, Harrington et al. (2020) found that California’s nursing homes with a higher number of prior total health deficiencies were more likely to have a COVID-19 cases than homes without deficiencies. Having used the total number of cited deficiencies and the number of substantiated complaints, Bowblis & Applebaum (2020) found that both of these measures were not systematically associated with the probability of having a case.³³

B.2 5SR Quality Indicators and COVID-19 Prevalence

The first study linking the 5SR with the prevalence of the COVID-19 cases was performed by the Centers for Medicare and Medicaid Services — the U.S federal agency responsible for design and administration of the 5SR. Based on the data on confirmed COVID-19 cases and deaths from about 80% of all nursing homes as of the end of May 2020, the CMS concluded that “facilities with a one-star quality rating were more likely to have large numbers of COVID-19 cases than facilities with a five-star quality rating” (for Medicare & Medicaid Services et al., 2020). Since that report, numerous studies have investigated whether quality measures from the 5SR are associated with the prevalence of COVID-19 cases. However, the evidence that emerges from these studies is mixed.

Similarly to the for Medicare & Medicaid Services et al. (2020), some studies found that a lower overall quality rating was associated with more cases (He et al., 2020; Li et al., 2020a; Williams et al., 2021). For example, Cronin & Evans (2022) showed that higher-quality LTCFs were more successfully prevented the spread of the disease among residents. They also showed that higher-quality facilities experienced fewer staff shortages, which may have helped with patient monitoring and isolation, and tested staff more frequently. However, others reported no statistically significant association between the variables of interest (Abrams et al., 2020; Bowblis & Applebaum, 2020;

³³The studies that have examined the 5SR’s staffing scores and COVID-19 outcomes (Figuerola et al., 2020; Sugg et al., 2021) are discussed in the section on staffing.

Chen et al., 2021; White et al., 2020).

Figueroa et al. (2020) examined the link between individual components of the 5SR and the number of cases in more than 4,000 nursing homes in eight US states over the period from January 1, 2020 to June 30, 2020. They found no statistically significant relations between the health inspections or QMs on the one hand and the number of SARS-CoV-2 infections, on the other. The QMs score emerged as not statistically significant also in the study by Sugg et al. (2021). Contrary to these findings, Williams et al. (2021) reported facilities with lower 5SR component ratings (health inspections, nurse staffing and quality measured (QM)) on average had higher cumulative resident incidence and weeks with high incidence. Gopal et al. (2021) found that higher health inspection ratings were predictive of lower number of cases among residents and also among staff, but the higher QMs rating was associated with more cases for both residents and staff. Gopal et al. (2021) suggested that the observed difference in the performance of different quality indicators could be due to the self-reporting bias in QMs and staffing scores of the 5SR. To investigate this proposition, they calculated the inflation score, capturing the difference between health inspection scores, based on the observations by health care officials and the QMs and staffing scores, based on the data self-reported by nursing homes. The inflation score emerged as a strong predictor for higher number of cases among residents and staff, but not for the probability of getting a case.

Having examined the association between prior infection violations and the prevalence of COVID-19 cases, Abrams et al. (2020) and Bianchetti et al. (2020) found no association between the two variables. However, Sugg et al. (2021) found that nursing homes that received a larger number of fines in 2020 exhibited an increased risk of COVID-19 transmission in nursing homes. Bowblis & Applebaum (2020) found that the total number of cited deficiencies and the number of substantiated complaints were not systematically associated with outbreaks of COVID-19.

B.3 5SR Quality Indicators and Mortality

There are only a few publications on the association between 5SR quality indicators and COVID-19 deaths. Those who examined the overall 5SR indicator, found it to be unrelated to the probability of

having either a SARS-CoV-2 attributed death (Li et al., 2020a,b) or higher number of deaths (Cronin & Evans, 2022; Dean et al., 2020; Li et al., 2020a,b; Shen, 2022; White et al., 2020).

Similarly, studies that examined the effect of the components of 5SR on the likelihood of COVID-19 attributable deaths or mortality, found no association between the variables of interest (Cronin & Evans, 2022; He et al., 2020; Williams et al., 2021). For example, while Williams et al. (2021) identified a strong correlation between 5SR component ratings and higher infection rates, they reported much weaker or statistically insignificant relationships between staffing levels, health inspection scores, and quality measures (QMs) on one hand, and COVID-19 mortality on the other.

The only known to us study that examined the link between LTCF quality indicators and COVID-19 outcomes outside the USA is Shallcross et al. (2021)'s research on all LTCFs in England. The authors focused on the quality of management score from England's equivalent of the 5-Star Rating (5SR), considering it most relevant to COVID-19 outcomes. However, their findings did not support this proposition: LTCFs that were not deemed *well-led* appeared to be similar to those whose leadership was rated as outstanding or good on all but one outcome. Specifically, management leadership appeared to have no significant impact on the spread of COVID-19 among residents or the occurrence of small and large outbreaks of SARS-CoV-2 in LTCFs, but paradoxically inadequately led facilities showed fewer number of COVID-19 cases among the staff.

In summary, the reviewed studies that analyzed the link between quality evaluations and COVID-19 outcomes present fairly mixed evidence. The majority of them found some quality measures to be predictive of COVID-19 outcomes, but not others (Bowblis & Applebaum, 2020; Figueroa et al., 2020; Li et al., 2020a; Sugg et al., 2021). Furthermore, there is also somewhat counter-intuitive evidence linking higher quality indicators to worse COVID-19 outcomes (Bowblis & Applebaum, 2020; Gopal et al., 2021; Shallcross et al., 2021). Finally, some scholars found no association between any quality measures and COVID-19 outcomes (Abrams et al., 2020; Chen et al., 2021; Li et al., 2020b). A serious problem associated with this literature is the quality of quality indicators that are not only broad, but also a subject of the ongoing critique regarding self-reporting and other biases (Gopal et al., 2021; Silver-Greenberg & Gebeloff, 2020).