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Working paper:

Staffing Ratios Effect on Childcare Quality and Child Outcomes in the Light of Denmark's Minimum Standards: A Meta-Systematic Literature Review of International and Scandinavian Evidence

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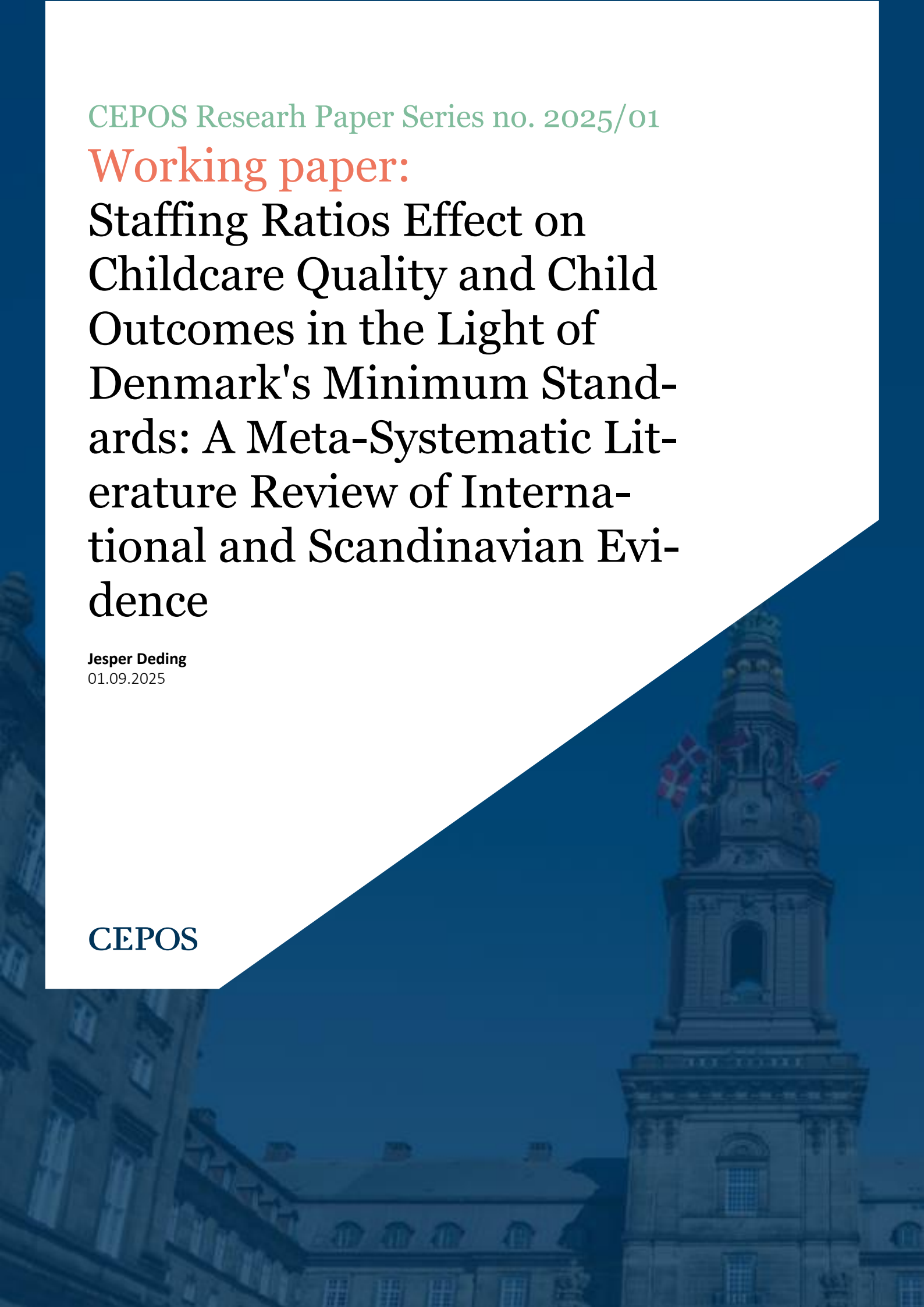

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Abstract

Early Childhood Education and Care (ECEC) is widely recognized for its developmental, economic, and social benefits, especially in addressing socio-economic disparities and promoting skill development. Denmark leads in ECEC with high enrollment rates and significant investment, including reforms, now mandating minimum standards for staff-to-child ratios. Research highlights the importance of adequate ratios for ECEC quality and child outcomes, yet both Scandinavian and international studies challenge the notion that lower ratios consistently yield better results, pointing to a more complex interplay of structural and processual factors.

This review synthesizes findings from systematic reviews, meta-analyses, and scoping reviews on the impact of staff-child ratios on ECEC quality and children's cognitive, socio-emotional, and academic outcomes. Although some studies suggest lower ratios improve developmental outcomes, the evidence is inconsistent, with context-specific variations. Methodological challenges, such as heterogeneity, ecological validity, and the lack of causal estimates, hinder definitive conclusions. Researchers call for more experimental studies, particularly on younger children, optimal ratios, and perspectives beyond ECEC staff.

A cross-sectional analysis of Scandinavian and international studies reveals discrepancies: Danish researchers generally support lower ratios, while international studies show mixed results. Qualitative studies highlight negative effects of insufficient ratios, but quantitative evidence remains inconclusive. The analysis underscores the urgent need for more empirically robust research to guide evidence-based ratio policies - particularly studies that explore the interaction between ratios, staff qualifications, and pedagogical practices in shaping ECEC quality and child development. As ECEC policy reforms unfold, future research should also prioritize cost-benefit analyses of ratio improvements to support sustainable, high-quality ECEC practices.

1. Introduction

1.1. Introduction to Early Childhood Education and Care (ECEC)

The importance of Early Childhood Education and Care (ECEC) is widely acknowledged for its developmental, economic, and social benefits, particularly in addressing disparities arising from socio-economic differences and laying the foundation for both cognitive and non-cognitive outcomes (Bauchmüller et al., 2014; Christoffersen et al., 2014; Cornelissen et al., 2018; Dale et al., 2023; Heckman, 2013; Larsen & De La Porte, 2022; Van Huizen & Plantenga, 2018; Vandenbroeck et al., 2014). Rooted in human capital theory, early investments in children foster compounding benefits and skill development across cognitive, socio-emotional and academic domains, benefitting not only the individuals involved but also society at large (Baker et al., 2019; Cunha & Heckman, 2009; Heckman, 2013; Heckman & Karapakula, 2019; Vandenbroeck et al., 2014).

Research consistently underscores the pronounced impact of early interventions, especially for children from disadvantaged backgrounds (Christoffersen et al., 2014; Cornelissen et al., 2018; García et al., 2021; Vandenbroeck et al., 2014) providing long-term social returns such as improved workforce participation and reduced reliance on social support systems (García et al., 2021; Heckman, 2013; Sander et al., 2024; Schweinhart et al., 2005; Vandenbroeck et al., 2014). This perspective aligns with economic and human capital theories advanced by Heckman and colleagues, which consistently demonstrate that early investments in children can yield higher returns than later interventions (Heckman, 2013). Early skill development fosters cumulative advantages, whereas remediating skill deficits at a later stage is often more complex and costly (Cunha et al., 2006; Heckman, 2006, 2013; Knudsen et al., 2006).

However, later interventions can still be effective. Researchers, including Heckman, stress that early interventions are not inherently superior to later ones and emphasize the importance of carefully evaluating costs and effects on a case-by-case basis (Rea & Burton, 2020, 2021; Rosholm et al., 2021). Nonetheless, if high-quality ECEC programs with substantial returns on investment are implemented early and sustained throughout childhood, the need for later remedial interventions may be significantly reduced (Cunha et al., 2006; Cunha & Heckman, 2009; García et al., 2021; Heckman, 2008; Heckman & Karapakula, 2019).

1.2. Denmark's Leading Role in ECEC

For decades, Denmark has been taking the lead in expanding national childcare opportunities, boasting high enrollment rates and substantial ECEC funding compared to other Western and Scandinavian countries (Broström et al., 2018; Larsen & De La Porte, 2022; OECD, 2024, 2023). The high enrollment rate is especially significant among younger children, particularly within the nursery-age population (Hansen, 2024; Jensen et al., 2010; Larsen & De La Porte, 2022). Additionally, Denmark continues to rank highly in ECEC

funding, with a significant portion directed toward staffing (C. Dalsgaard et al., 2014; C. T. Dalsgaard et al., 2016; Larsen & De La Porte, 2022; OECD, 2024). Originally designed to support workforce participation and women's liberation, Denmark's modern ECEC sector has evolved into a comprehensive government-funded model that emphasizes developmental progress in various domains, complementing children's upbringing within the family settings (De Økonomiske Råd, 2021a, 2021b; Hansen, 2024; Larsen & De La Porte, 2022; Sander et al., 2024; Sommer, 2019).

Denmark's investment in ECEC has been central to the nation's commitment to social equity and welfare opportunities for families, reflected in the high enrollment rates and significant government funding (De La Porte et al., 2023; Larsen & De La Porte, 2022; OECD, 2024). This investment aligns with Denmark's broader goals of addressing inequalities and fostering a robust childcare culture that emphasizes the child's holistic development, as the Danish ECEC model prioritizes professional care and high-quality environments to support cognitive, socio-emotional and academic growth (Jensen et al., 2010; Koch & Jørgensen, 2023; Ministry of Children and Education, 2020; Sommer, 2019). These factors play a pivotal role in influencing long-term outcomes and fostering child development and learning (Bornstein et al., 2013; Cunha & Heckman, 2009; Dale et al., 2023; Deding & Minnaert, 2024; Melhuish et al., 2015; Schaffer, 2006).

In recent years, Danish ECEC has implemented a national guiding curriculum, accompanied by legislative changes aimed at enhancing quality and child outcomes (Koch & Jørgensen, 2023; Ministry of Children and Education, 2020). The curriculum focuses on learning, development, well-being, and formation, emphasizing both individual children and peer groups within their natural environments (Koch & Jørgensen, 2023; Ministry of Children and Education, 2020; Næsby, 2021). Additionally, it seeks to establish a 'culture of evaluation' in pedagogical learning environments through goal-setting, documentation, and ongoing reflection and improvement (Ministry of Children and Education, 2020, p. 50).

1.3. Trends in ECEC Policy and Practices

Denmark's ECEC landscape, like that of other Western nations, has evolved over time, marked by changes in legislation, professional training and education, and the introduction of standardized curricula in recent decades (Bøje et al., 2024; De La Porte et al., 2023; Koch & Jørgensen, 2023; Larsen & De La Porte, 2022; Ministry of Children and Education, 2020; OECD, 2006, 2024). In those decades, Denmark has expanded parental leave, guaranteed childcare for all children, and begun making childcare compulsory for some at-risk children (Larsen & De La Porte, 2022). Among the most significant recent changes in Danish ECEC is the implementation of standardized staff-to-child ratios, also called the minimum norms in Denmark, mandating 1 adult per 3 children in nurseries and 1 adult per 6 children in kindergartens (Koch & Jørgensen, 2023; Larsen & De La Porte, 2022). This change was driven by campaigns from various stakeholders concerned with the quality of ECEC provision (De La Porte et al., 2023; Koch & Jørgensen, 2023; Larsen & De La Porte, 2022; Næsby, 2021).

Reforms establishing staff-to-child ratio standards in ECEC have been implemented across many Western nations in recent decades, with Denmark being one of the last to introduce minimum ratio standards, possibly reflecting already high standards in this area (Eurydice, 2023, 2019; Koch & Jørgensen, 2023; Munton, 2002; OECD, 2017, 2024). These reforms reflect broader trends focused on ensuring quality care and equitable access for all children, with an emphasis on integrating developmental psychology with economic theory to address both immediate and long-term societal needs through ECEC investment (Christoffersen et al., 2014; De La Porte et al., 2023; Gray et al., 2020; Larsen & De La Porte, 2022; NICHD Early Child Care Research Network, 2006). The investment in children is reflected in the new mandate for minimum staff-to-child ratios, which, although accompanied by some investment in staff education and development, primarily focuses on the ratios based on the theory that improving them will enhance ECEC quality, benefiting children (Børne- og Undervisningsministeriet, 2020; Regeringen, 2019).

1.4. Impacts and Limitations of ECEC Research

While there is consistent evidence of the positive effects of ECEC, effects and outcomes often depend on factors such as the comparison group, timing of measurement, and the nature of alternative care arrangements. For example, studies indicate that benefits of ECEC, and effects from interventions, may diminish over time after participation (Anders et al., 2012; NICHD, 2006; Ogden, 2013; Vandell et al., 2010). Moreover, studies reporting strong effects often compare children in high-quality programs to those in inadequate or no care (De Økonomiske Råd, 2021; Taggart et al., 2015), underscoring the importance of contextual factors.

Breaking down ECEC quality into specific subcategories reveals that different aspects and levels of quality interact dynamically, influencing research outcomes (P. Slot et al., 2015; P. L. Slot et al., 2018; Von Suchodoletz et al., 2023). Additionally, the characteristics of target and control groups vary across local traditions and cultural practices (Broström et al., 2015, 2018; Garvis et al., 2018; Garvis & Taguchi, 2021; Sommer, 2019; Svinth & Henningsen, 2021), complicating cross-context comparisons and the applicability of findings to specific settings, such as Danish ECEC.

Ultimately, assessing ECEC quality requires analyzing its structural, processual, and systemic dimensions alongside their impact on intended child outcomes and types of quality. Therefore, evaluating staff-to-child ratio changes necessitates a nuanced understanding of ECEC quality domains and their measurement.

1.5. Quality in ECEC: Defining Structural and Process Quality

The concept of quality in ECEC is widely discussed in the literature, with quality indicators varying across studies and research cultures (Dalgaard et al., 2023; Svinth & Henningsen, 2021). However, it is generally accepted that quality can be categorized into two primary domains: structural quality and process quality (Deding & Minnaert, 2024; Eadie et al., 2022; OECD, 2018; Slot, 2018; Von Suchodoletz et al., 2023). Structural quality encompasses factors such as staffing ratios, group sizes, staff qualifications, facilities, and materials, while process quality pertains to the nature of staff-child interactions, including

instructional- and development strategies, relational work, activities, and play (Deding & Minnaert, 2024; EVA, 2017; P. L. Slot, 2018; Togsverd, 2023). Staff-to-child ratios and group sizes are closely linked in the literature and are often examined together. Ratio recommendations frequently depend on group size, and vice versa (Bowne et al., 2017; Munton, 2002; Perlman et al., 2017). While both serve as structural indicators of ECEC quality, ratios indicate the number of children per adult, whereas group size refers to the number of children in a classroom or care group.

Additionally, the literature distinguishes between systemic quality, which refers to policy-level factors such as educator salaries, curriculum frameworks, regulatory reforms, and supervisory standards, and quality of results, which focuses on improvements in child development and learning outcomes (Eadie et al., 2022; EVA, 2017). Nevertheless, structural and process quality remain the dominant analytical categories within ECEC research (Næsby & Sperling, 2023; P. L. Slot, 2018; Von Suchodoletz et al., 2023), with scholars examining the extent to which variations in key structural elements—such as staff-to-child ratios, group sizes, and educator qualifications—impact process quality and, ultimately, child outcomes (Dalgaard et al., 2022; Eadie et al., 2022; EVA, 2017; Phillipsen et al., 1997; P. L. Slot, 2018; Von Suchodoletz et al., 2023).

Research suggests that structural quality plays a crucial role in shaping process quality, particularly in fostering high-quality staff-child relationships and interactions (Christoffersen et al., 2014; Hu et al., 2017; Melhuish et al., 2015; P. Slot et al., 2015; Smidt & Embacher, 2023), however, structural quality levels alone does not fully predict process quality (Næsby, 2021; P. L. Slot, 2018; P. L. Slot et al., 2018). A central theoretical assumption is that improving staff-to-child ratios, for example, increases the amount of individualized attention each child receives, thereby enhancing higher levels of process quality in ECEC settings, with potential cascading effects on child development outcomes (Dalgaard et al., 2023; De Schipper et al., 2006; Munton, 2002; P. L. Slot, 2018). This notion also seemed to underpin the argument for improving staff-to-child ratios in the stakeholder campaign and the subsequent law changes on minimum standards in Denmark (Børne- og Undervisningsministeriet, 2020; Koch & Jørgensen, 2023; Larsen & De La Porte, 2022).

As exemplified in our variation of Pauline Slot's theoretical model of ECEC quality from her OECD report, changes in staff-to-child ratios may directly enhance child learning and developmental outcomes (see Figure 1).

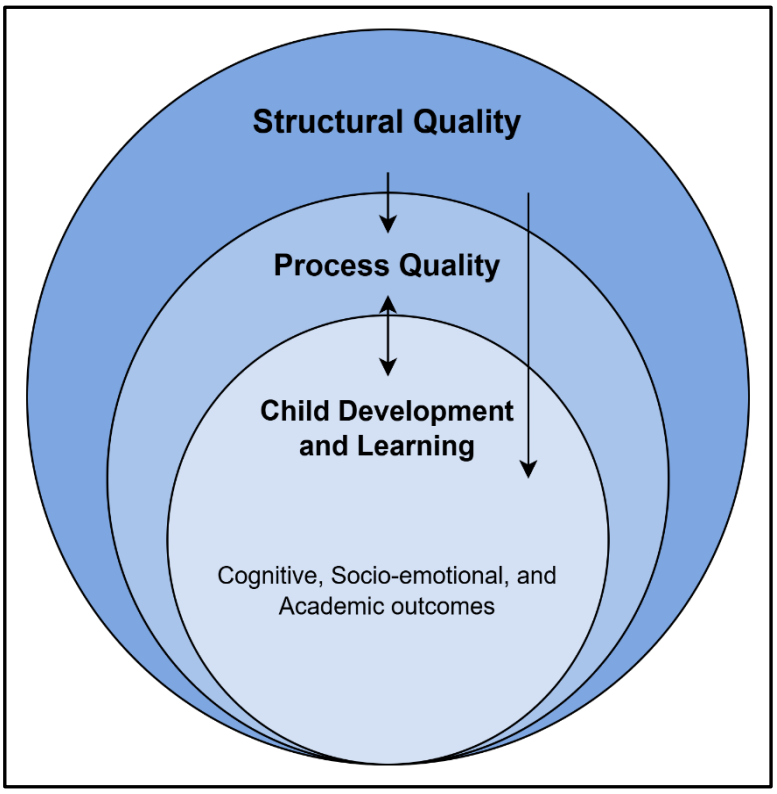

Figure 1 - Theoretical model of ECEC made by author, based on Pauline Slot's model (OECD, 2018)

Additionally, such changes can indirectly enhance process quality in practice, which may, in turn, foster child development and learning, yielding measurable improvements across various child outcome indicators identified in the scientific ECEC literature.

Structural quality in ECEC is typically assessed through objective data points and registry data, providing a broad, quantitative overview (P. Slot et al., 2015; P. L. Slot et al., 2018; Vermeer et al., 2016). In contrast, process quality is often measured using observational data from experts, using controlled preset rating scales. Most common is the so-called Environment Rating Scales (ERS), such as ECERS (Early Childhood Environment Rating Scale), ITERS (Infant/Toddler Environment Rating Scale) and CLASS (Classroom Assessment Scoring System), where trained observers evaluate the quality of learning environments at both institutional, municipal and national levels (Bjørnestad & Os, 2018; EVA, 2020; La Paro et al., 2012; Pianta & Hofkens, 2023; Svinth & Henningsen, 2021). While ERS methodologies were initially developed and refined in the United States, they have been widely adopted in both Western and non-Western contexts (Svinth & Henningsen, 2021; Vermeer et al., 2016). Denmark, for instance, has developed its own ERSs, e.g. KIDS and KVAlid, for nationwide quality assessments of ECEC settings (Lindeberg et al., 2023; Næsby & Holm, 2024; Ringsmose & Kragh-Müller, 2020).

1.6. Recent Research Findings

Findings from ERS-based sample surveys in Danish nurseries and kindergartens have indicated generally medium-to-low overall quality in Danish ECEC institutions, as measured by both ECERS-3 and KIDS (EVA, 2020, 2022; VIVE & EVA, 2023, 2025). This result diverged from earlier results showing high levels of process quality, though comparisons are difficult to make across highly varied types of studies (P. L. Slot et al., 2018). Moreover, while certain structural quality indicators—such as staff education levels and leadership—correlate with process quality, staff-to-child ratios do not exhibit the expected association, and in one case was negatively and significantly associated with ECEC quality in the national ERS-results (EVA, 2020, 2022; Lindeberg et al., 2023). Additionally, the Danish Economic Council conducted research on the relationship between improved staff-to-child ratios and academic child outcomes, finding no associations between the two (De Økonomiske Råd, 2021a, 2021b).

The Danish findings diverge from theoretical expectations and prior research on staff-to-child ratios (Christoffersen et al., 2014; Munton, 2002; Næsby, 2021; Næsby & Sperling, 2023; P. L. Slot et al., 2018). However, this is not entirely unexpected. While some studies report positive associations between improved ratios and specific quality indicators (Gørtz & Andersson, 2014; P. Slot et al., 2015; P. L. Slot, 2018; Smidt & Embacher, 2023), these effects are not consistently observed across all quality measures and child outcomes. Other research finds null or even negative effects on certain outcomes, underscoring the complexity of the relationship between staff-to-child ratios and child outcomes and ECEC quality (Dalgaard et al., 2022; De Økonomiske Råd, 2021a, 2021b; OECD, 2018; Perlman et al., 2017).

Emerging evidence from other structural and process quality dimensions suggests alternative or complementary pathways for improving ECEC quality (Bauchmüller et al., 2014; Deding & Minnaert, 2024; Eadie et al., 2022). This underscores the need for a rigorous, evidence-based assessment of the impact of staff-to-child ratio policies, particularly considering recent standardization efforts across nations and specific legislative reforms, such as those implemented in Denmark (Eurydice, 2019; Koch & Jørgensen, 2023).

To address these complexities, we conduct a review of the existing evidence on staff-to-child ratios in ECEC, with a particular focus on recent Scandinavian and international research. Specifically, we examine its implications for process quality and child outcomes, as well as the potential impact of Denmark's mandated staff-to-child ratio reforms in Danish ECEC.

2. Research scope- and question

The overarching aim of this study is to explore the effects of ECEC staff-ratio policy changes—specifically, the implementation of staff-to-child ratio standards—on both child outcomes and process quality. These policy shifts present a unique opportunity to examine how structural adjustments may influence child development and the overall quality of ECEC provision. While numerous studies have demonstrated that structural features, such as staff-to-child ratios, can shape both ECEC quality and child outcomes, there remains a need for research that scrutinizes the empirical robustness of these claims and investigates how such effects unfold within a clearly defined policy context.

The introduction of staff-to-child ratio mandates has been a central policy reform aimed at enhancing ECEC quality and child outcomes. However, the relationship between these structural changes and the resulting empirical effects remains under-explored. As such, this study seeks to bridge the gap in existing literature by providing a more differentiated understanding of how structural reforms in ECEC affect both the quality of care and child developmental outcomes. The findings will ultimately be used to assess the expected impact of recent policy changes within the Danish ECEC context.

The primary research questions guiding this study are as follows:

1. To what extent does empirical evidence support improvements in ECEC quality and/or child outcomes through enhanced child-to-staff ratios?

    1.1 To what extent is empirical evidence supporting improvements in ECEC quality and/or child outcomes through improved staff-to-child ratios contingent on other interdependent subdomains or contextual variables of ECEC quality?

    1.2 To what extent does empirical evidence support the necessity of minimum staff-to-child ratios, such as 1:3 for infants and 1:6 for preschool-aged children, in ensuring ECEC quality and/or improved child outcomes?

3. Methods

3.1. Data collection process

This study employs a systematic literature review of relevant international research on the impact of staff-to-child ratios on ECEC quality. The objective is to evaluate whether ratio improvements improve quality and/or child outcomes by synthesizing the strength of evidence reported in the scientific literature (Knopf, 2006).

Systematic reviews and meta-analyses were prioritized for their ability to quantify effect sizes and integrate empirical findings across multiple studies (Borenstein et al., 2021; Davies, 2000; Gough, 2007; Petticrew & Roberts, 2006). Given that much of the existing Danish literature on ECEC quality and staff-to-child ratios relies on qualitative or descriptive methodologies (Bondebjerg et al., 2019; Dalgaard et al., 2023; Guldbrandsen et al., 2024b; Yilmaz, 2013), a focus on more statistical, evidence-based studies provides valuable insights to advance the field and address gaps in knowledge, particularly from a Danish perspective.

Additionally, scoping reviews were included to map the breadth of research in this field, clarify key concepts, and identify gaps or methodological limitations in the literature (Arksey & O'Malley, 2005; Munn et al., 2018; Paré & Kitsiou, 2017). By drawing on meta-analyses, systematic reviews, and scoping reviews, this study adopts a meta-perspective, leveraging synthesized evidence from studies that have already addressed methodological biases and limitations in primary research (Borenstein et al., 2021; Gough, 2007; Hart, 2018; Knopf, 2006; Munn et al., 2018).

3.2. Selection criteria for included studies

Beyond the predefined inclusion criteria for study types in this meta-systematic literature review, additional selection parameters were established to ensure relevance to the research question and its contextual foundation. The review was restricted to studies examining the typical ECEC age range (0–6 years), thereby excluding research on specialized ECEC target groups that are not directly comparable to those covered by Danish staff-to-child ratio regulations.

To align with contemporary ECEC practices and provide meaningful insights for current policy and practice, only studies published between 2014 and December 2023 (the date of the search) were included. Additionally, only peer-reviewed studies published in scientific journals or indexed in the peer-reviewed Scandinavian ECEC research database, NB-ECEC.org, were considered.

3.3. Database searches

A systematic electronic search was conducted to identify the relevant scientific publications, examining the relationship between child-staff ratios and ECEC quality. The search was performed across multiple specialized databases at the end of 2023.
To ensure a thorough and targeted search, a preliminary review of the literature on child-

staff ratios and structural quality was undertaken to identify key search terms related to "staff-to-child ratios" and "ECEC." These terms guided the database search, which was executed via EBSCOhost. The applied keywords and search parameters (outlined in Table 1) yielded hundreds of hits, with 32 relevant results after abstract screening.

Search Terms Used in Database Searches*		
Denifitions of staff-to-child ratio in ECEC	*Type of Study*	*Target Population*
** Staff-to-child ratio or adult-to-child ratio caregiver-to-child ratio, teacher-to-child ratio teacher-to-student ratio, or staff?ratio, or teacher?ratio, or personnel?ratio, or group sizes, or class sizes	Systematic review or Meta*analysis (meta analysis or meta-analysis) or Scoping review	ECEC or early childhood education and care or Early childhood education or ECE or early years or early years education or EYE or creche or nursery or child care or preschool or kindergarten or pre-K or Pre-kindergarten or childcare

Table 1. Search terms used in database searches

** Based on terminology and search terms from introductory literature, and expert consultations.*
*** To ensure comprehensive coverage, variations of each term were included in the literature search. For example, 'child-to-staff ratio' encompassed searches for 'staff-to-child ratio,' 'staff-child ratio,' 'staff:child ratio,' and 'child:staff ratio.' For consistency, only one version is listed in the table as a representative term.*

In the ERIC database, a different search strategy was employed, utilizing Thesaurus Descriptors to retrieve publications containing the terms "Teacher-Student Ratio" and "Early Childhood Education," with an additional filter for journal articles published since 2014 (the last ten years). This approach resulted in 31 relevant studies. Lastly, the NB-ECEC database, which specializes in Scandinavian ECEC research, was searched using similar descriptors as in the ERIC search but with broader criteria, yielding 27 relevant results. After removing duplicates, the remaining studies were screened based on the predefined inclusion criteria (see Figure 2 & Table 3).

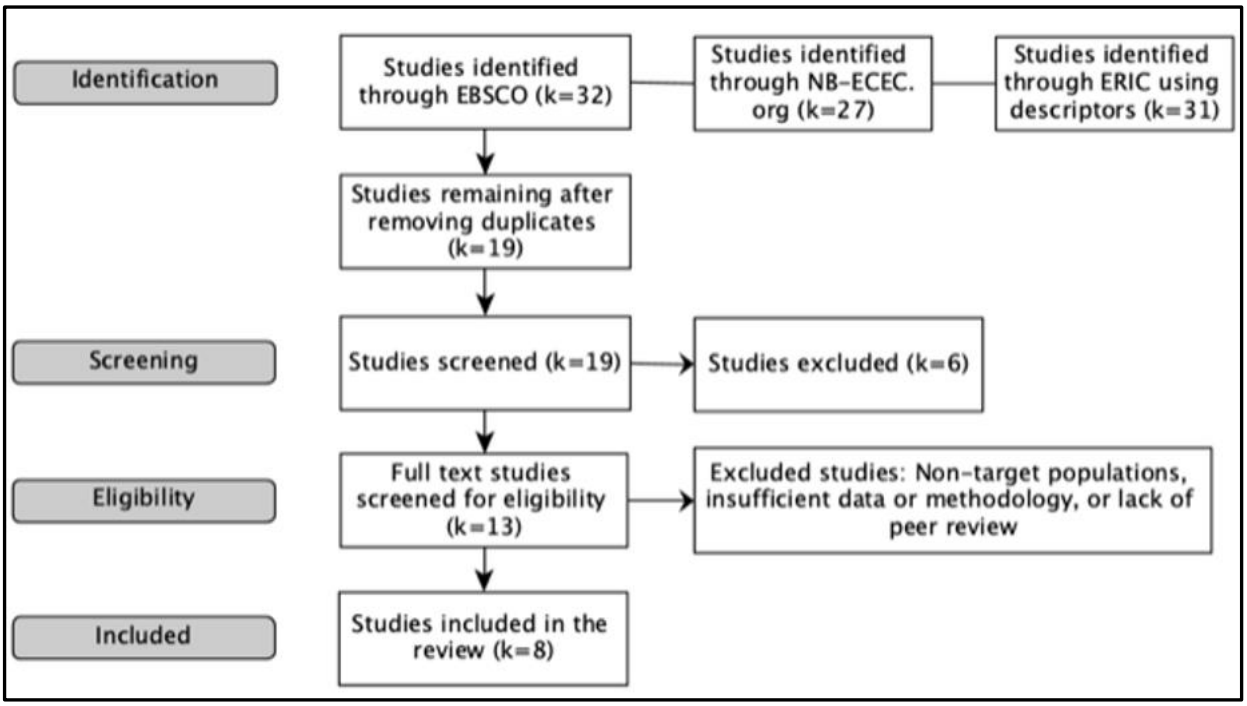

Figure 2. Flow chart of review process, based on Prisma standards (Page et al., 2021).

Eight unique articles were ultimately retained for inclusion in this systematic literature review (see Table 2). Studies were excluded if they focused on irrelevant or overly broad target groups or if they incorporated multiple structural factors that complicated their applicability to the research question and context. The eight selected studies met the established criteria, enabling a comprehensive synthesis of evidence to assess the impact of child-staff ratios on ECEC quality and/or child outcomes.

Included Studies for Meta-Systematic Literature Review	
A Meta-Analysis of Class Sizes and Ratios in Early Childhood Education Programs: Are Thresholds of Quality Associated With Greater Impacts on Cognitive, Achievement, and Socioemotional Outcomes? *Bowne et al., 2017*	Daginstitutionens betydning for børns udvikling – en forskningsoversigt ('*The Significance of Early Childhood Institutions for Children's Development – A Research Overview*' - Authors translation) *Christoffersen et al., 2014*
Adult/child ratio and group size in early childhood education or care to promote the development of children aged 0–5 years: A systematic review *Dalgaard et al., 2022*	Caregiver/child ratio and group size in Scandinavian Early Childhood Education and Care (ECEC): a systematic review of qualitative research *Dalgaard et al., 2023*
Domains of quality in early childhood education and care: A scoping review of the extent and consistency of the literature *Eadie et al., 2022*	Child-Staff Ratios in Early Childhood Education and Care Settings and Child Outcomes: A Systematic Review and Meta-Analysis *Perlman et al., 2017*
Early childhood education and care quality and associations with child outcomes: A meta-analysis *von Suchodoletz et al., 2023*	Quality of Child Care Using the Environment Rating Scales: A Meta-analyses of International Studies *Vermeer et al., 2016*

Table 2. Included Studies for Meta-systematic Literature Review

A data extraction protocol was developed prior to reviewing and analyzing the selected publications (see Table 3) to ensure consistency in the synthesis and comparison of findings. This protocol facilitated a systematic assessment of key aspects across all included studies, supporting a structured analysis and synthesis of the literature (Hart, 2018; Knopf,

2006; Petticrew & Roberts, 2006). The approach enabled the integration of content from the publications into a unified description of each study's contributions, providing a clear foundation for the overall synthesis of the literature. For an overview of the data from the included studies, see Table 4.

1	Study Type and year of publication
2	Origin and Funding
3	Number of secondary studies, number of samples, sample sizes, and effect sizes included in primary studies
3a	*Data on secondary studies publication year, samples, sample- and effect sizes*
3b	*Data on staff-to-child ratios, including the mean and range of ratios reported*
4	Research questions- or purpose
5	Theoretical assumptions (in regards to staff-to-child ratio)
6	Results
7	Conclusions
8	Limitations and Discussion points
9	Recommendations for future research and ECEC

Table 3. Data Extraction Protocol

The subsequent sections will describe the conclusions and contributions of each publication to the research question, followed by a comprehensive summary of the data, results, and conclusions from the eight studies. Finally, cross-sectional analyses will be conducted to explore whether different research types yield varying results. By differentiating publications based on origin, funding, and research type, we aim to identify how specific characteristics and research traditions influence outcomes in the field (Hart, 2018; Knopf, 2006; Okoli, 2015).

Citation	*Type of Study*	*Type of studies assesed*	*Quality domain or Outcome measured*	*Target population*	*Country of origin; 1) main study 2) included studies*	*Publication date of included studies*	*Number of included studies and samples*
Bowne et al., 2018	MA	Center-based ECE program evaluations (at least a dosage of 10 hours a week of ECE programs for 4 or more months)	Child Outcomes: Cognitive, Achievement, and Socioemotional Outcomes	3-5 years of age	1) US, 2) US	1960 - 2007	38 studies, 53 contrasts, and 328 effect sizes
Christoffersen et al., 2014	SR	Experimental and quasi-experimental research	Process Quality & Child Outcomes	All ages pre school-entry	1) Denmark, 2) 2 US, 1 Sweden, Australia, United Kingdom, the Netherlands, New Zealand	1978 - 2006	7 studies, 259 ECEC instituions & 135 child groups
Dalgaard et al., 2022	SR & MA	Quantitative studies with well-defined control group	Process Quality & Child Outcomes	All ages pre school-entry	1) Denmark, 2) SR: 20 US, 2 New Zealand & Sweden, 1 Australia, Denmark, England, Portugal, Korea, The Netherlands, Italy - MA: 4 US, 1 Australia, Denmark, New Zealand & the Netherlands	1968-2019 / 1980-2019	26 studies for SR & 12 studies, with 8 populations (n = 4200) for MA
Dalgaard et al., 2023	SR	Qualitative studies from Scandinavia	Structural- and Process Quality & Child Outcomes	0-5 years of age	1) Denmark, 2) 7 Sweden, 3 Norway, 1 Iceland/Sweden/Norway	2007-2019	11 studies
Eadie et al., 2022	SCR	Systematic Reviews and Meta-analysis'	Consistency of evidence in ECEC literature	0-6 years of age	1) Australia, 2) NA	2015 - 2021	85 studies compared (4 studies on ratios)
Perlman et al., 2017	SR & MA	Studies reporting associations in cohort, cross-sectional or longitudinal analyses	Child outcomes: Cognitive, Language, Math, and Socio-emotional	30 to 72 months	1) Canada, 2) 25 US, 2 Bermuda, 1 Korea, Germany	1980 - 2013 / 2002 - 2012	SR, 29 studies & 31 samples - MA, 3 studies & 3 samples
von Suchodoletz, 2023	MA	Studies assessing indicators of quality in center-based ECEC programs	Process Quality & Child Outcomes	0-6 years of age	1) US / UAE 2) 123 US, 62 Others (39 Western Europe, 12 Asia and the Pacific, 8 Latin America and Caribbean, 3 Africa)	2010-2020	185 studies, (10-18 included studies in MA's on ratios)
Vermeer et al., 2016	MA	Studies using ERS' assessing Structural- and Process Quality	Process Quality	0-5 years of age	1) the Netherlands, 2) 6 Europe, 3 North America, 1 South America	1989 - 2013 (range for all studies - only ratio-MA studies, NA)	10 studies, N = 963

Table 4. Characteristics of Included Studies
Type of study: Meta-analysis (MA); Systematic Review (SR); Scoping Review (SCR)

4. Results

Bowne et al. (2017) present a U.S-based meta-analysis, aiming to examine the relationship between child-staff ratios, group sizes, and children's cognitive, socio-emotional, and academic outcomes in ECEC. A key aspect of the study was the search for 'thresholds', or specific values that could indicate minimum and maximum limits for a given quality state or effect. The study found no significant relationship between children's outcomes and ratios, except at the lower end of the distribution, where reducing one child per adult (from 7 to 6 children per staff) led to a small but significant improvement ($p<.05$; $d = 0.22$) in cognitive and academic outcomes, with little effect on socio-emotional development.

These results provide preliminary support for the hypothesis that lower ratios may improve outcomes, but the researchers caution against applying the findings to broader ECEC settings. The small effect was mainly observed in demonstration programs including 'high-risk children,' and practices not applicable to typical ECEC settings [1]. The authors also advise against increasing ratios to improve learning outcomes due to high costs, recruitment challenges, and potential resource diversion from other quality aspects, such as staff training.

The authors highlight several limitations, including the study's inability to produce causal estimates due to the correlational nature of the data and the lack of objective comparability across studies. They also note the absence of basic data on ratios and group sizes in several evaluations. As a recommendation, they call for further research, including qualitative and observational studies, to explore the causes of the significant results found at the lower end of the ratio distribution.

Christoffersen et al. (2014) present a Danish based systematic review, primarily based on international research, of the impact of ECEC on children's emotional, cognitive, and social development, with a focus on quality aspects such as ratios and group sizes. Findings indicate that *better* child-staff ratios are associated with a myriad of positive outcomes such as improved attachment, sensitive caregiving, cognitive development, and fewer behavioral issues. Notably, the review found exclusively positive associations and notable improvements, with few exceptions where conditional settings showed the opposite effect.

Lower staff-to-child ratios are associated with improvements in child-caregiver attachment, interaction quality, and cognitive and linguistic development, while potentially reducing stress, behavioral issues, and conflicts, particularly for vulnerable children. They

[1] Bowne et al.'s study appears to combine various target groups, including typical children, at-risk demonstration programs, and mixed groups such as those in the Perry Preschool Project and Head Start, which focus on socioeconomically disadvantaged families (J. Heckman & Karapakula, 2019; Schweinhart et al., 2005). These programs are only comparable to Danish ECEC settings that provide extra staffing for at-risk children—staffing that is excluded from the official municipal data used to assess Denmark's minimum standards (Børne- og Undervisningsministeriet, 2024a, 2024b). As such, the additional resources in these programs are not reflected in Danish ratio calculations, limiting the relevance of Bowne et al. (2017) to Danish ECEC policy.

also foster warmer caregiving, fewer negative discipline techniques, and greater staff stability.

Christoffersen and colleagues caution that the research offers limited insight into optimal ratios and that causal conclusions are challenging due to the broader structural context of ECEC. They highlight difficulties in assessing Danish ECEC quality due to data limitations and emphasize the challenge of quantifying the benefits of quality improvements, such as higher ratios. While the review finds overall positive associations between ratios, ECEC quality, and child outcomes, methodological issues—including bias, clarity, and effect size variations—complicate the analysis of structural parameters. Ultimately, the authors stress that while ratios reflect resource allocation, their effective use is crucial for achieving desired quality outcomes in ECEC.

Dalgaard et al. (2022) present a Danish based systematic review and random-effects meta-analysis, primarily with data from US based studies, to investigate the relationship between ratios, group sizes, and process quality in ECEC, along with their impact on children's well-being and developmental outcomes. Results from the meta-analysis showed a small, positive but not statistically significant effect on process quality from improved staffing ratios (ES = 0.10, 95% CI = [−0.07, 0.27]), largely positively influenced by a Dutch study (De Schipper et al, 2006), "which received a weight of 84.4% in the analysis." (Dalgaard et al., 2022, p. 17). Further analysis indicated a significant effect (ES = 0.10, 95% CI = [0.004, 0.20]) using alternative models, suggesting that improved ratios may positively impact process quality in structured situations. Five studies were included in the meta-analysis.

For language and literacy outcomes, the meta-analysis found a negative but non-significant effect (ES = −0.04, 95% CI [−0.61, 0.53]). However, this analysis was based on only three studies, which exhibited substantial variability in findings, wide confidence intervals, and methodological and contextual differences.

Dalgaard et al. (2022) identified considerable methodological challenges, including inconsistent data on ratios and child outcomes, as well as risks of bias in the included studies. They concluded that there is a notable lack of high-quality studies on the effects of ratio changes, particularly regarding socio-emotional development in children. The authors caution against concluding that ratios and group sizes are inconsequential and argue that they "tentatively support" the hypothesis that "lowering" ratios improves process quality (Dalgaard et al., 2022, p. 24). Moreover, the authors emphasize the need for more robust, methodologically sound research and randomized controlled trials, especially for the 0 to 2 year olds, as also noted by other Scandinavian research reviewers (Guldbrandsen et al., 2024a).

Dalgaard et al. (2023) present a systematic review of qualitative research from Scandinavian ECEC settings, aiming to identify and present all available qualitative studies on ratios and group sizes. The review sought to assess how structural factors, such as ratios and group sizes, affect children's development, well-being, and experiences in ECEC settings, focusing on studies that explored ratios and group sizes from the perspectives of

children, parents, staff, or observers, and included empirical data, methodologies, and data collection methods.

The review found that most staff perceived poorer ratios as detrimental to ECEC quality, leading to fewer stimulating interactions and more disengaged children in larger groups. All but one study supported the positive effects of improved ratios, with none identifying negative effects.

Through inductive analysis, nine themes were identified. Poor ratios led staff to adopt more observational, conflict-reducing, and practical roles, while inadequate ratios hindered consistent learning opportunities and recognition of children's potential. Perceptions of ratios were influenced by familiarity and self-perceived competence. Across studies, smaller group sizes and lower staff-to-child ratios were consistently viewed as beneficial, although varying definitions of *adequate* ratios complicated cross-study comparisons.

Dalgaard et al. (2023) noted a lack of experimental studies and research on optimal ratios, as well as limited exploration of educators' perspectives on ratios in relation to working conditions and health. They also highlighted the absence of studies directly addressing children's or parents' perspectives.

Eadie et al. (2022) present a scoping review to examine the scope and consistency of research on three dimensions of ECEC quality: process, structural, and system quality, with a particular focus on ratios and group sizes as a subdomain of structural quality. The review included only four studies on ratios, representing only 3.4% of the included research. The analysis revealed inconsistent findings, with studies showing no, minimal, or context-specific effects of improved child-staff ratios on quality. The studies included in their review, are the same as the international studies included in this review, excluding the Eadie et al.'s (2022) scoping review and the Danish studies.

A notable finding was that ratios and group sizes were among the least studied and least consistent subdomains of ECEC quality, with only few studies showing "limited and inconsistent evidence about the impact of educator-child *ratios or group* size on quality" (Eadie et al., 2022, p. 16), yielding insufficient and uncertain evidence compared to other quality domains (see Figure 3). Similarly, pre-service qualifications and training also demonstrated low evidence consistency, despite being, along with ratios and group size, widely regarded as critical components of ECEC quality (Deding & Minnaert, 2024; Manning et al., 2017; Næsby & Sperling, 2023). The findings highlight major gaps in the research literature and underscore the need for more rigorous and focused investigations into effects of child-staff ratios. In contrast, other quality domains are supported by stronger and more consistent evidence, derived from a substantially larger body of research, e.g. ECEC programs and interventions, and professional development.

Eadie and colleagues noted that the absence of reviews and meta-analyses may suggest a general lack of research but could also indicate that no comprehensive studies have been conducted on specific topics, such as staffing ratios. Additionally, it may overlook a substantial body of grey literature and qualitative research.

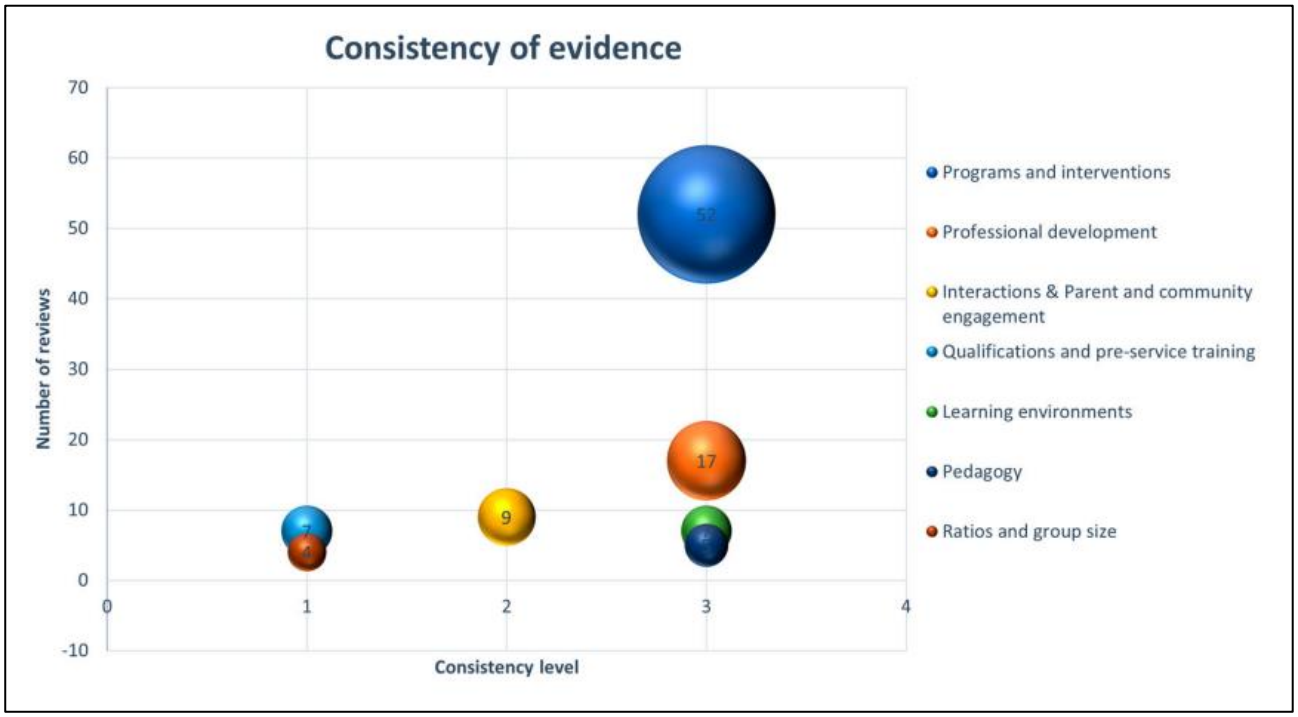

Figure 3. Matrix on the 'Consistency of evidence' measured by number of studies, as well as consistency of the results in the analyzed studies in each categorical subdomain of ECEC quality – (Eadie et al., 2022, p. 17)

Perlman et al. (2017) present a systematic review and meta-analysis, funded by the Canadian Institute of Health, to evaluate the effects of child-staff ratios on child outcomes—focusing on pre-school aged children. The study aimed to synthesize existing literature to identify "appropriate" or "ideal" ratios that yield positive long-term impacts, noting that no prior synthesis had explicitly addressed this topic (Perlman et al., 2017, p. 2). The introduction highlights prior research showing mixed results regarding the long-term effects of ratios on child outcomes.

The findings predominantly indicate minimal or no associations between child-staff ratios and children's cognitive, linguistic, or socioemotional development, with studies reporting mixed results, including both positive and negative significant effects. Perlman et al. (2017) conclude that these results "suggest small or no associations between child-staff ratios and children's cognitive, language, and social-emotional outcomes." (Perlman et al., 2017, p. 17). This inconsistency is not attributed to substantial heterogeneity across studies but rather to a lack of reliable data on alternative factors, moderators, and consistent quality measures.

The meta-analysis included three studies examining the effects of staff-to-child ratios on children's language comprehension, revealing no statistically significant effect (pooled correlation coefficient = 0.03; 95% CI: 0.00 to 0.05). Perlman et al. (2017) caution against interpreting these results as support for reducing ratio standards, but emphasize that improved ratios, similar to class-size findings in school research (Hattie, 2008, 2023), are not

necessarily linked to improved child outcomes. Instead, they advocate focusing on other quality factors, such as staff development and incentives for improved practice.

The authors identify several limitations undermining the robustness of the evidence. These include the age and potential irrelevance of included studies, inconsistencies in how ratios and outcomes were measured, and the predominantly observational nature of the studies, which limits causal conclusions. Perlman et al. underscore the need for methodologically rigorous research to more accurately assess the impact of child-staff ratios on long-term outcomes and overall ECEC quality.

Von Suchodoletz et al. (2023) present a systematic review and meta-analysis on the relationship between ECEC quality and children's outcomes, focusing on moderating effects across quality domains, and short-term effects rather than longitudinal outcomes. Results showed small effect sizes, with structural quality indicators (e.g., teacher qualifications, group size, staff-to-child ratio) having no significant impact on child outcomes. However, process quality indicators, particularly in behavior and math, were significantly related to child outcomes, albeit with small effect sizes.

The study found that staff-to-child ratio “moderated the association between process quality and behavioral problems” (Von Suchodoletz et al., 2023, p. 15), suggesting an improved ratio contributes to behavior management. No other statistically significant or positive associations were found between staffing ratios and process quality or child outcomes. The authors noted, however, the lack of simultaneous measurements of both structural and process quality in many studies, complicating the analysis.

Von Suchodoletz et al. discussed the limited availability of effect sizes for structural quality, suggesting this may be due to prior research focusing on common ECEC quality indicators, which have likely improved structural quality indicators substantially over time, making the predictive power of e.g. ratios limited. The predominance of studies from the U.S. limited the generalizability of the findings to international ECEC practices and policies. They call for more research outside the U.S. and a shift towards studying staff development and working conditions as key quality factors, which could provide more cost-effective improvements.

Vermeer et al. (2016) present a meta-analysis of international quality indicators in ECEC settings, focusing on both structural and process quality as assessed by Environment Rating Scales (ERS). The study explored the relationship between structural features—specifically child-staff ratios—and process quality, while also evaluating the reliability of various ERS tools in measuring overall quality.

Ratios ranged from 1:3 to 1:25, in the 10 studies included in the final meta-analysis, which the authors found to be a relatively small and limiting number of studies for their hypothesis testing. Ratios were chosen over other structural quality indicators, such as staff qualifications and experience, due to the perceived consistency in measuring this parameter across countries.

The findings in their analysis indicate a negative correlation between child-staff ratios and overall quality (r =-.17; p < .01; CI-.27 to-.07), suggesting that poorer ratios are associated with lower quality. Additionally, their analysis found that 'caregiver sensitivity', an element of process quality, exhibits a stronger positive correlation with overall quality (r = .62, p < .01, CI .56-.67). No significant relationship was found between the type of ERS tool used and overall measured quality.

The study acknowledged limitations, including the small number of studies examining direct causal relationships between ratios and quality and significant cross-country differences in structural quality and ECEC policies. The authors concluded that global efforts to improve ECEC quality are necessary, with North America and Oceania generally showing higher quality than other regions. They also highlighted the need for further research on cross-cultural comparability of ERS tools.

4.1. Summary of the included studies

A review of eight studies on the impact of staff-to-child ratios on ECEC quality and/or child outcomes reveals mixed findings, with inconclusive evidence in certain domains. While some research indicates a relationship between ratios and ECEC quality, positive associations are generally small, context-dependent, and constrained by methodological challenges. These limitations impede definitive overall conclusions about the impact of staffing ratios on both ECEC quality and/or child outcomes.

Across studies by Bowne et al. (2017), Christoffersen et al. (2014), Dalgaard et al. (2022, 2023), and Vermeer et al. (2016), improved child-staff ratios are associated with small but positive effects on children's cognitive, social, and emotional development, as well as enhanced process quality and classroom interactions. However, these effects vary depending on methodological approaches, with some findings relying on qualitative perspectives or studies with limited statistical power. In contrast, Perlman et al. (2017) found no long-term effects of staff-to-child ratios on children's outcomes. Their systematic review presents mixed findings, while the meta-analysis reports null effects, ultimately concluding that ratios have no consistent impact. This highlights the need for further analysis, and more robust research to establish generalizability and applicability to specific ECEC settings.

Methodological limitations in the included studies further complicate these conclusions. Similarly, Eadie et al. (2022), Von Suchodoletz et al. (2023), and Perlman et al. (2017) emphasize the lack of consistent evidence on ratios and call for a deeper understanding of how structural factors interact with process quality in ECEC. Their research suggests that other factors—such as staff qualifications, pedagogical approaches, and institutional support—may play a more significant role in improving ECEC quality than ratios alone.

Dalgaard et al. (2023) and Von Suchodoletz et al. (2023) underscore the importance of incorporating diverse national and stakeholder perspectives and expanding the focus beyond structural features like ratios. This gap is also noted in Scandinavian research reviews (Guldbrandsen et al., 2024a; Klippen et al., 2024). While qualitative and descriptive research highlights that ECEC staff consider ratios critical for resources, professional focus,

and attention to children, meta-analyses and systematic reviews find limited or no significant effects. These effects often stem from small sample sizes (Dalgaard et al., 2022), under specific conditions (Bowne et al., 2017; Von Suchodoletz et al., 2023), or from comparisons of widely different ratio conditions (Christoffersen et al., 2014; Vermeer et al., 2016). Both qualitative and quantitative studies face methodological constraints, including potential biases and insufficiently detailed descriptions of methods and data. Ultimately, the limited number of studies on staff-to-child ratios included in the systematic reviews, meta-analyses, and scoping review reduces the overall weight and robustness of evidence.

Caution is therefore warranted when making specific recommendations on optimal ratios, as conclusions vary across studies. Support for improved ratios remains tentative, reflecting the complexity of the research field and its dependence on contextual factors. In summary, while some evidence links improved ratios to higher ECEC quality, this relationship remains complex and highly context dependent. The limited and sometimes contradictory findings highlight the need for more rigorous, comparative research across diverse settings.

4.2. Staffing ratios recommendations in the included literature

Few studies provide concrete recommendations, with Bowne et al. (2017) suggesting a maximum ratio of 1:10 for preschool-aged children, while Perlman et al. (2017) advise against relaxing existing standards. Moreover, Perlman cites staff-to-child ratio recommendations that vary based on child group size, often exceeding the recommended 1:3 ratio in nurseries and 1:6 in kindergartens as mandated in Danish ECEC. The lack of universal guidance could stem from the difficulty of extracting broadly applicable recommendations from the literature (Christoffersen et al., 2014; Dalgaard et al., 2022), as optimal ratios depend on contextual and structural preconditions.

5. Cross-Sectional Analysis

In our research, we conducted a cross-sectional analysis across pre-defined domains, such as study type, methodology, research origin, and funding. This paper examines key divergences in the literature, particularly how study design, inclusion criteria, and researchers' geographical and institutional backgrounds might influence findings. The analysis focuses on three dimensions: study origin, methodological approaches, and study type. These factors could reveal notable distinctions in the research on staffing ratios in ECEC, helping to better understand the complexities and nuances within the existing evidence base (Hart, 2018; Knopf, 2006).

5.1. Origin

Studies from Denmark, including Christoffersen et al. (2014) and Dalgaard et al. (2022, 2023), support the hypothesis that lower staffing ratios lead to higher quality- an assumption widely held among other Danish ECEC researchers (Larsen & De La Porte, 2022; Næsby & Sperling, 2023; Sommer, 2019). However, the broader international literature presents a more varied picture. While some studies find an association between staffing ratios and quality under specific conditions (Bowne et al., 2017; Vermeer et al., 2016), others emphasize more effective factors, such as staff training, qualifications, organizational structures, leadership, and curriculum quality (Bowne et al., 2017; Eadie et al., 2022; Von Suchodoletz et al., 2023).

Notably, all three Danish studies originate from the same organization, *Vive* [2], while the international studies represent five different universities and countries. However, except for Dalgaard et al. (2023), all studies relied heavily on firsthand U.S.-based data. This distinction is particularly interesting given that Dalgaard et al. (2022) tentatively supported their quantitative findings, based mostly on U.S. data, by incorporating results from their qualitative study (Dalgaard et al., 2023), which was based primarily on non-Danish Scandinavian data. Besides apparently deviating from their research protocol by integrating external findings, the methodological and contextual disparities between the two studies may explain the tentative nature of their support.

Although the Danish studies tentatively support the notion that lower ratios improve quality, international research provides little consistent evidence for this claim. Some studies suggest that staffing ratios may already be sufficiently high in certain contexts, making other quality domains more relevant for improvement (Bowne et al., 2017; Perlman et al., 2017; Von Suchodoletz et al., 2023). Others compare ECEC systems across countries, proposing that better ratios correlate with higher quality but offering limited insight into national or regional variations, where ratio differences are less pronounced

[2] The Danish Center for Social Science Research - VIVE is an independent government research center funded by the state, municipalities and external grants and actors. E.g., Christoffersen et al. (2014) was funded by the state, Local Government Denmark, and the workers union for ECEC pedagogues, BUPL.

(Vermeer et al., 2016). Surprisingly, the Danish systematic review by Christoffersen et al. (2014) found consistently positive studies on the effect from improved ratios, while the Perlman et al. (2017)-study found very mixed results in their systematic review. This variance is also reflected in the varied consistency of evidence behind ratios in ECEC in the Eadie et al. (2022) scoping review.

5.2. Qualitative versus Quantitative evidence

Dalgaard et al. (2023) was the only strictly qualitative study included in our meta-review. Their systematic review synthesized qualitative evidence from Scandinavian ECEC research (with no Danish studies included) on staffing ratios in relation to children's development, well-being, and experiences.

Findings indicated a broad consensus that insufficient ratios negatively impact adult-child interactions and children's engagement. Staff behavior became more observational, conflict-mitigating, and task-oriented. Similar results were reported in several studies referenced by Christoffersen et al. (2014).

Dalgaard et al. (2023) highlighted several limitations, including a lack of data on key aspects and the limited number of studies examining ratio changes. Additionally, inconsistent definitions of 'good' and 'bad' ratios complicated quantification and generalization. A similar issue was observed in Christoffersen et al. (2014), which adopted an almost descriptive approach to the research literature. Instead of presenting quantified results in terms of effect sizes or statistical significance, the study primarily relied on qualitative descriptors such as 'better', 'improved', and 'associated' to convey findings derived from otherwise quantifiable evidence.

While Dalgaard et al. (2023) offer valuable insights into the effects of staff-to-child ratios, particularly regarding ECEC workforce conditions and professional discretion in assessing effects on process quality and child outcomes, they also acknowledge limitations inherent in their qualitative approach. They call for further research involving diverse stakeholders to better understand staffing ratios, emphasizing the need for more data on optimal ratios and the perspectives of children and parents. This need for further investigation is similarly highlighted in studies by other leading ECEC researchers examining research quality in Scandinavia (Guldbrandsen et al., 2024a).

It is evident that ECEC research in Denmark and Scandinavia is predominantly qualitative, with relatively few studies employing quantifiable measures or focusing on 'what works' in ECEC practice. As a result, it is not surprising that the literature on staffing ratios in ECEC for this meta-review includes a substantial number of Scandinavian qualitative studies, alongside a larger proportion of U.S.-based quantitative studies. Notably, the methodological approaches employed in these studies result in highly varied findings. When evaluating the quantitative evidence in this meta-review, we observe mixed results and a lack of high-quality studies across the board. In several meta-analyses, only a limited number of studies meet the criteria for inclusion in the final analysis (Dalgaard et al., 2022; Perlman et al., 2017).

Variation in the cross-sectional analysis suggests that regional policies and ECEC contexts influence how findings are interpreted. Thus, conclusions about staffing ratios must consider local contexts, as research on ratios cannot stand alone. Cultural and traditional perspectives likely shape both policy decisions and the interpretation of findings. This pattern also emerges when accounting for differences in study methodologies.

5.3. Study type

The differences in evidence across study types also warrant careful consideration. Specifically, meta-analyses, scoping reviews, and systematic reviews provide varying perspectives on the impact of staffing ratios on ECEC quality, highlighting the complexities involved in interpreting these findings.

5.3.1. Meta-Analyses

Meta-analyses on the relationship between staffing ratios and ECEC quality and/or child outcomes have yielded inconsistent results. While some studies indicate a link between lower ratios and improved quality (Bowne et al., 2017; Vermeer et al., 2016) others do not establish this connection. These discrepancies often stem from methodological differences, emphasizing the need to account for additional factors, such as staff expertise and working conditions (Perlman et al., 2017). Dalgaard et al. (2022) similarly found weak evidence supporting a direct link between staffing ratios ECEC quality – and no link to child outcomes – suggesting that while ratios are important, they cannot be the sole determinant of quality in ECEC. The limited number of studies included in most meta-analyses further undermines the certainty of these findings, highlighting a significant gap in high-quality research on this topic. A similar finding is also shared by other meta-reviewers in the field of Scandinavian ECEC research (Guldbrandsen et al., 2024a; Klippen et al., 2024).

5.3.2. Scoping Review

Eadie et al. (2022) conducted the only scoping review included in this meta-review, which, not surprisingly, revealed inconsistent findings regarding the impact of staffing ratios on quality. While some studies suggest lower ratios improve quality, others report no significant effects.

A key finding of this review is the comparison between staffing ratios and other quality subdomains. Eadie et al. (2022) conclude that staffing ratios remain an under-researched aspect of ECEC quality, with limited supporting evidence, compared to other subdomains of ECEC quality, and call for more rigorous studies to explore the relationship between ratios and ECEC quality and for clearer methodologies to guide future policy decisions on the matter.

5.3.3. Systematic Reviews

Systematic reviews, such as those by Dalgaard et al. (2023) and Christoffersen et al. (2014), provide broad overviews of the research on staffing ratios. Dalgaard et al. (2023) emphasize staff perceptions that lower ratios negatively affect interaction quality and practice engagement, while Christoffersen et al. (2014) report a positive association between higher ratios and better developmental outcomes. However, both reviews

acknowledge the challenge of defining "optimal" ratios and establishing direct causal relationships. Another systematic review shows more varied results, with both positive and negative significant effects from improved ratios (Perlman et al., 2017). These findings highlight that staffing ratios should be considered alongside other factors, such as staff qualifications, pedagogical practices, and baseline conditions in the research. This may explain why some studies show positive and significant results while others do not. For instance, the effects of ratio adjustments may depend on whether they improve conditions from very poor levels or are implemented in settings with already qualified staff. Further research is needed to clarify the specific contexts in which ratios matter most and their precise impact on ECEC quality.

5.4. Summary

The cross-sectional analysis reveals several factors shaping the research on ratios in ECEC. Studies, based on origin, reveal differing support for the notion of improving ratios and also varies in the overall findings of positive studies. There is also a seemingly methodological divide, with qualitative results appearing more consistent and directionally aligned, while quantitative findings vary and point in multiple directions. Finally, studies included in the systematic reviews show a slightly more positive effect than what can be found in the meta-analyses, with the latter often drawing on very few studies. Together, these factors underscore the importance of accounting for cross-sectional differences in research literature when assessing the evidence. Moreover, it highlights significant gaps between theoretical and qualitative assumptions, the statistical potential of the current research, and the practical limitations of what can be effectively measured in real-world ECEC settings.

6. Discussion

The relationship between child-staff ratios and the quality of ECEC is a central issue in both academic and policy circles. While many studies assume that improving child-staff ratios will automatically lead to better outcomes for children, the evidence is not entirely consistent. Several studies highlight concerns that reducing ratios without addressing other ECEC quality domains may have very limited impact on process quality and child outcomes (Bowne et al., 2017; Eadie et al., 2022; Perlman et al., 2017; Von Suchodoletz et al., 2023). Thus, our research highlights several factors that challenge existing narratives and assumptions about ECEC staff-to-child ratios.

6.1. The Danish Context: Scaling and Defining Optimal Ratios

Like many other Western nations, Denmark recently introduced nationwide minimum standards for child-staff ratios. The country has long maintained relatively low ratios, both before and after these legal changes (Eurydice, 2019; Larsen & De La Porte, 2022; OECD, 2024). However, despite Denmark's already low ratios compared to international standards, research remains inconclusive on what constitutes an optimal staff-to-child ratio – a point also noted by several Danish researchers (Bayer et al., 2021; Christoffersen et al., 2014; Dalgaard et al., 2023; Svinth & Henningsen, 2021).

A key challenge in interpreting existing research is that many studies rely on settings with low ecological validity for typical ECEC environments or employ methodologies that do not align with Danish ECEC practices (Bowne et al., 2017; Christoffersen et al., 2014; Vermeer et al., 2016). For instance, many studies improve ratios by removing children from target groups in control comparisons, whereas Danish institutions primarily improve ratios by hiring untrained assistants rather than reducing group sizes or employing additional trained or experienced personnel (see Figure 4) (Danmarks Statistik, 2023). Additionally, effects measured in samples of at-risk children limit generalizability to typical ECEC settings and significantly reduce the applicability of findings at broader, national levels (Bowne et al., 2017; P. L. Slot et al., 2018).

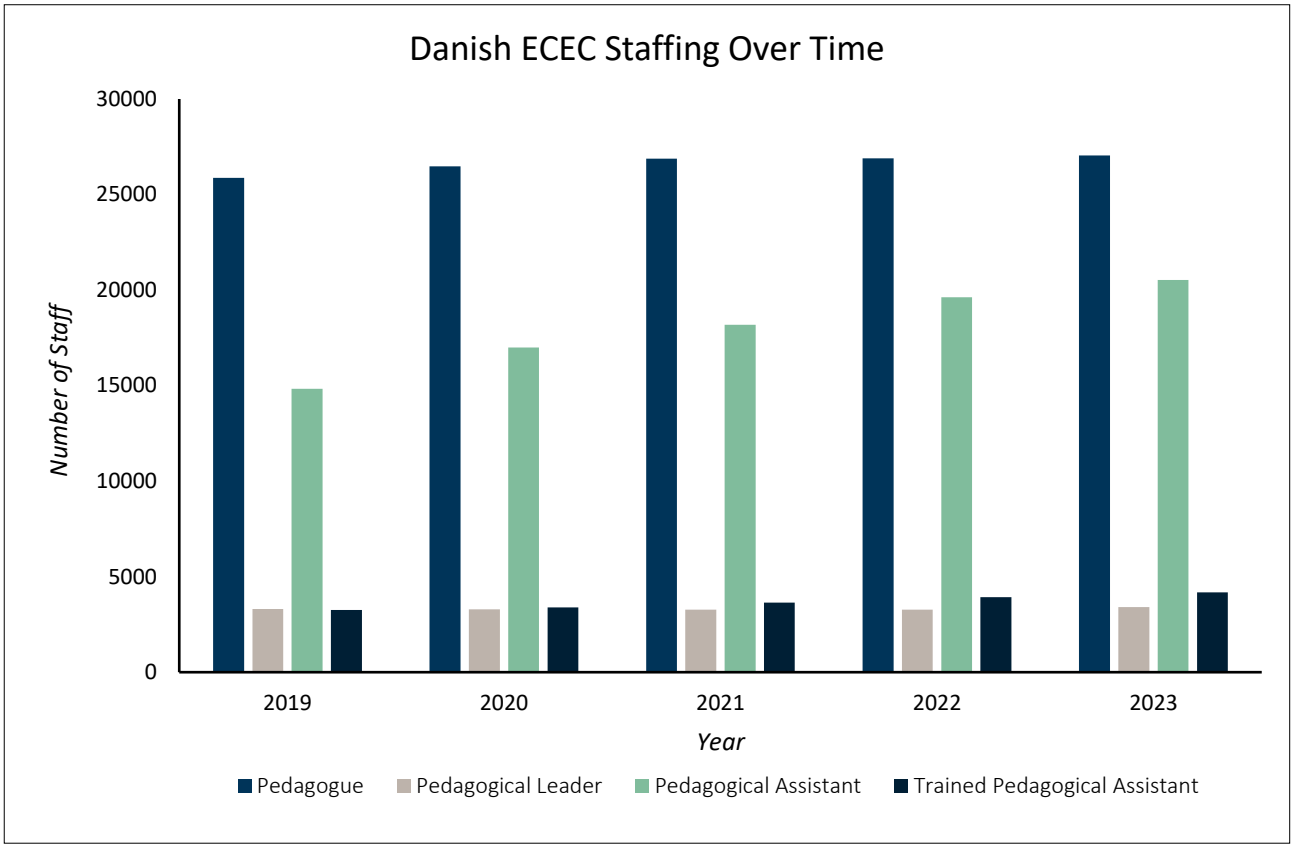

Figure 4. Danish ECEC staffing over time, made by author using national statistics (Danmarks Statistik, 2023)

Despite common assumptions, research suggests that improvements in ratios yield only marginal benefits and require significant financial investment (Bowne et al., 2017; Eadie et al., 2022; Perlman et al., 2017; Von Suchodoletz et al., 2023). Moreover, some studies that do report positive effects on process quality often compare target- and control groups that differ significantly in baseline quality or characteristics. In many cases, observed effects are conditional upon very low pre-intervention quality, only affect specific subdomains or age groups, or are not feasible to implement in a typical Danish ECEC setting (Bowne et al., 2017; Dalgaard et al., 2022; Vermeer et al., 2016). This suggests that the effects of ratio improvements are highly conditional and dependent on additional preconditions, quality interventions, regulatory frameworks, and financial resources.

This mixed evidence raises questions about whether further resources should be allocated to reducing ratios, particularly in Denmark, where existing ratios are already low by international standards. Some researchers even argue that an overemphasis on ratios may divert attention from more impactful reforms, such as improving pedagogical practices and the overall structural quality (Bowne et al., 2017; Perlman et al., 2017; Von Suchodoletz et al., 2023).

Theoretical benefits observed in small-scale ECEC studies have often failed to materialize or remain sustainable when scaled to national or state levels (Bowne et al., 2017; Christoffersen et al., 2014; Heckman, 2013; Ogden, 2013). Several ECEC researchers have also

pointed to the high costs and limited quantifiable effects of ratio improvement (Bowne et al., 2017; De Økonomiske Råd, 2021a; Muenchow & Marsland, 2007; Perlman et al., 2017; Ruopp et al., 1980; Von Suchodoletz et al., 2023). As Bowne et al. (2017) warned, Danish municipalities could face financial constraints when implementing structural reforms to reduce ratios, often resulting in budget cuts in other areas of ECEC or welfare (Aarhus Kommune, 2024). Additionally, the Economic Councils of Denmark conducted a review and meta-analysis of international evidence on the effects of staffing ratios on children's academic outcomes following the ECEC ratio reforms. They concluded that the research provided little support for the assumed benefits of lower ratios and that a cost-benefit analysis barely justified Denmark's costly minimum standards, instead recommending other initiatives to improve ECEC quality (De Økonomiske Råd, 2021a, 2021b).

The assumption that smaller ratios inherently improve quality is further complicated by the role of other domains or subdomains of ECEC quality. Eadie et al. (2022) highlighted that the evidence linking improved ratios to better quality remains limited, inconsistent, and contested in international literature—a pattern which, according to the author of this review, also holds true in a Danish context, particularly given the negative, null, or weak correlations in Danish research. While some qualitative studies, particularly those from Scandinavian ECEC staff (Dalgaard et al., 2023), report positive effects of improved ratios, Danish research presents a more complex picture. Large-scale quantitative analyses often find null, negative, or marginally significant effects, with few clear positive outcomes (Bauchmüller et al., 2014; EVA, 2020, 2022, 2025; Lindeberg et al., 2023; P. L. Slot et al., 2018). This challenges the assumption that reducing ratios alone will lead to significant improvements in Danish ECEC quality. Meanwhile, broader academic literature suggests that factors such as staff development and focus on the pedagogical practices may have a more substantial impact on ECEC quality than ratios alone (Deding & Minnaert, 2024; Eadie et al., 2022).

6.2. Methodological Challenges in Ratio Studies

The methodological challenges of studying the effects of child-staff ratios make it difficult to draw definitive conclusions. Most research in this area is observational, with few studies employing randomized controlled trials (RCTs) or other rigorous experimental designs that could yield more conclusive evidence (Eadie et al., 2022; Guldbrandsen et al., 2024a; Klippen et al., 2024). Danish researchers from VIVE and the Campbell Collaboration initially highlighted the limited number of studies included in previous meta-analyses but later encountered the same challenges when conducting their own systematic reviews of both qualitative and quantitative evidence (Dalgaard et al., 2022, 2023). Similar challenges were noted by researchers from the Danish Economic Councils (De Økonomiske Råd, 2021a, 2021b). Furthermore, inconsistencies in how studies define, and measure staff-to-child ratios complicate comparisons and generalizations, potentially contributing to challenges in large-scale analyses (Dalgaard et al., 2022; P. L. Slot et al., 2018; Svinth & Henningsen, 2021).

For example, the widely cited study by de Schipper et al. (2006), which accounted for 84.4% of the weighted effect in Dalgaard et al.'s (2022) meta-analysis on process quality,

reported small but statistically significant positive effects from improved ratios in structured settings. However, it also exemplifies common limitations in ratio studies. Beyond ambiguous result data and concerns about its low ecological validity for typical ECEC settings (Dalgaard et al., 2022), the de Schipper et al. (2006) study presented findings seemingly based on mean ages, leading to an interpretation centered on children around almost three years of age in the Dalgaard et al. (2022) study. Yet, graphical data indicated that younger children benefited more from improved ratios (see figure 5), while the effects were negligible for children aged three and above (de Schipper et al., 2006). This ultimately skewed the analysis in the Dalgaard et al. (2022) study, who argued for a lack of included studies regarding 0-2 years of age, while the study carrying the majority of the weight in their analysis made contrasting conclusions:

"Strong conclusions with regard to which ratios produce significant and meaningful differences for older children cannot be drawn on the basis of the present data, however. The data suggest that a child– caregiver ratio of 5:1 may actually be more favorable for older preschoolers in a structured play situation than a child– caregiver ratio of 3:1", (de Schipper et al., 2006, p. 872).

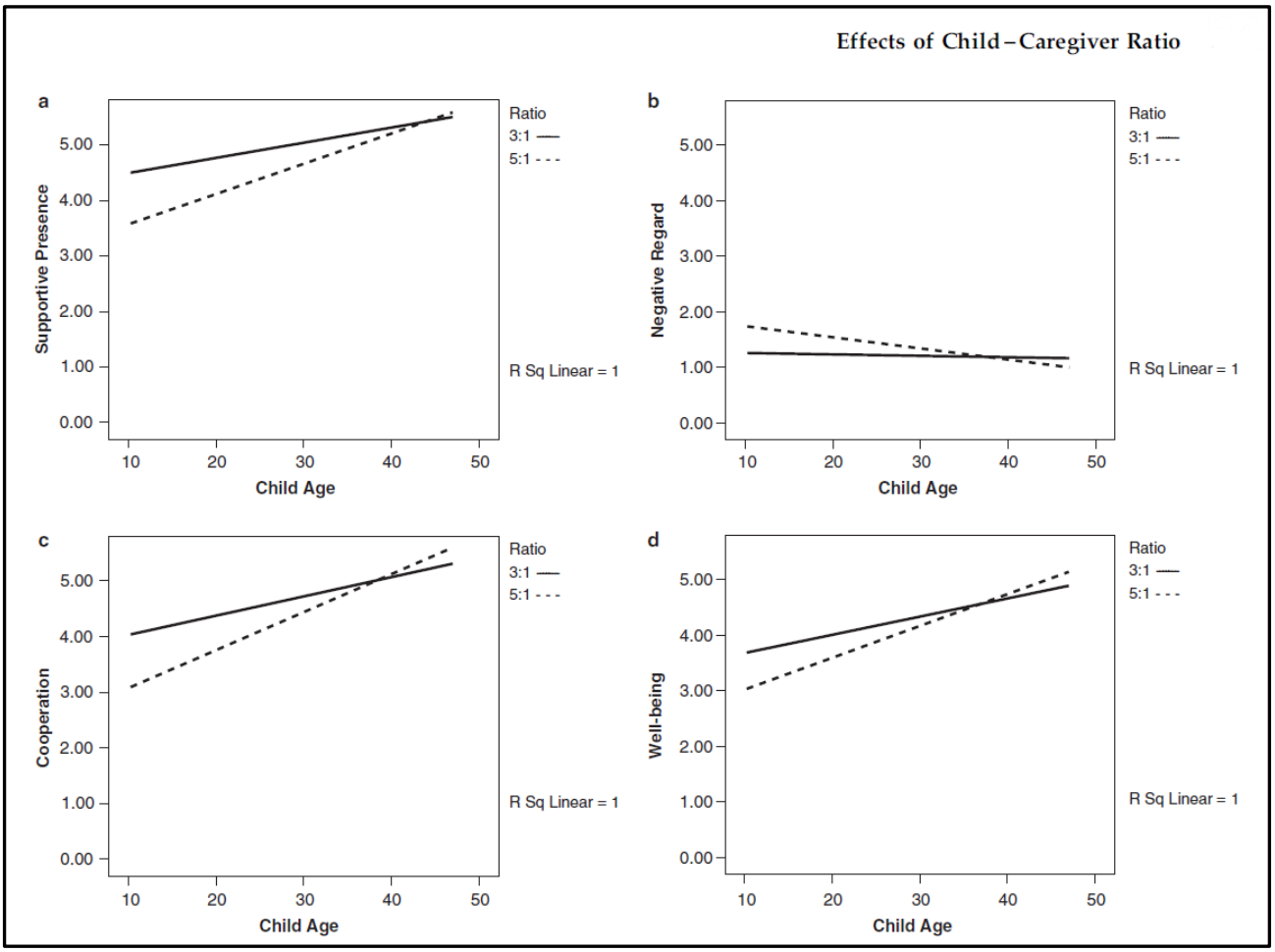

Figure 5. Relations of interaction variable to child age (in months) for different child - caregiver ratios (Figure 1 in: de Schipper et al., 2006, p. 869)

This underscores the importance of how data and effects are calculated when interpreting research on staffing ratios. The evidence on ratio improvements is more complex than often assumed and does not follow a simple linear pattern across settings and age groups. Furthermore, staff-to-child ratios can be calculated using registry and employment data or through direct observations, where only staff directly engaged in child interactions are included—leading to variations in reported ratios depending on the measurement approach (Bayer et al., 2021; Danmarks Statistik, 2023; Eurydice, 2019; Glavind, 2021; Munton, 2002; P. Slot et al., 2015; P. L. Slot et al., 2018; Svinth & Henningsen, 2021).

Ultimately, staff-to-child ratios are shaped by the chosen measurement method. This also applies to assessing whether minimum ratio standards are met, which in Denmark is determined at the municipal rather than the individual ECEC center level. This approach is highly contested among stakeholders, as it differs significantly from the ratios typically analyzed in research, further complicating the application of empirical findings to the Danish context.

Given these limitations, further research- particularly RCTs and longitudinal studies- is needed to provide stronger evidence for policymakers. Standardizing ratio research, along with definitions and measurement methods across studies, would enhance the reliability and applicability of future findings, strengthening the evidence base for costly national policy decisions.

While previous research demonstrates that early investments in ECEC can yield high returns on investment (Cunha & Heckman, 2009; Heckman, 2013; Heckman & Mosso, 2014), not all ECEC initiatives produce the same positive outcomes (Rea & Burton, 2020, 2021; Rosholm et al., 2021). As highlighted by various studies, it is crucial to focus on sustained and consistent effects, enabling decision-makers to optimize resources and prioritize interventions that provide the greatest benefits for children, families, and communities (Caronongan et al., 2016; Center on the Developing Child, 2007; De Økonomiske Råd, 2021a, 2021b; Karoly, 2012).

Denmark had a unique opportunity to conduct RCT's or natural experiments following legislative changes, assessing the impact of improved staff-to-child ratios in ECEC (Dyssegaard, 2015). This approach could have been a cost-effective way to determine whether the reforms enhanced quality and warranted long-term, or additional, implementations. Ratios were gradually improved nationwide, with some municipalities implementing early trials before the legal mandate (Børne- og Undervisningsministeriet, 2020). However, no comprehensive evaluation was conducted despite the reform's high cost of 7 billion DKK over a six-year implementation period (Børne- og Undervisningsministeriet, 2020) with an annual cost of 1.8 billion DKK once fully implemented (Næsby & Sperling, 2023). This reflects a prominent trend in the Scandinavian ECEC research tradition, where economics is the least explored topic in modern ECEC research papers (Klippen et al., 2024).

6.3. The Need for Further Research

While existing studies offer valuable insights, significant gaps remain in understanding how child-staff ratios impact ECEC quality. More detailed research is needed to

differentiate the effects of ratios across age groups, stakeholder perceptions, moderating factors, and dynamic influences, as well as to refine evidence on optimal ratios (Bowne et al., 2017; Dalgaard et al., 2022, 2023; Perlman et al., 2017; Von Suchodoletz et al., 2023). Such studies could support policymakers in developing more targeted strategies for improving ECEC quality and child outcomes.

Von Suchodoletz et al. (2023) highlights the need to examine how professional development, staff quality, and pedagogical practices interact with structural factors such as ratios to influence child outcomes. Longitudinal studies and RCTs are particularly important for isolating the effects of ratio changes and assessing whether observed impacts persist over time, though researchers must carefully consider their methodological options. While randomized controlled trials (RCTs) remain the gold standard for establishing causal evidence—and should be pursued when feasible—their use in ECEC research is often constrained by ethical concerns, particularly when high-quality care must be withheld from a control group. Controlled quasi-experimental designs offer a more practical and ethically sound alternative. For example, the staggered implementation of Denmark's minimum standards across municipalities presents a valuable opportunity to examine the effects of ratio improvements within real-world settings. Such designs can yield robust, ecologically valid insights while accounting for the complexities of policy rollout and can complement qualitative findings by contributing empirical evidence within a mixed-methods framework.

This is especially relevant given the scarcity of such studies in Scandinavian ECEC research (Guldbrandsen et al., 2024a), with few specifically addressing ratios' impact on quality and outcomes (Klippen et al., 2024). Although recent Scandinavian studies both support and challenge earlier findings on ratios (Bjørnestad & Os, 2018; Lehto et al., 2024), the overall research base remains limited, making it difficult to draw definitive conclusions about expected effects in these contexts. Danish research further reflects this uncertainty, reporting both negative and only marginally positive effects of improved ratios on specific quality subdomains (EVA, 2020, 2022; Lindeberg et al., 2023; Møller & Sperling, 2023; P. L. Slot et al., 2018; Sperling, 2023). Furthermore, not one Danish study was included in the exclusively Scandinavian systematic review of qualitative research on staff-to-child ratios, showing a key gap in the scientific literature, when applying the research findings and synthesis to a Danish ECEC context.

7. Limitations

Meta-analyses based on a limited number of studies inherently provide weaker evidence, reducing the reliability of their findings (Borenstein et al., 2021). Moreover, some studies supporting improvements in staff-to-child ratios rely on broad regression analyses encompassing diverse research domains, where stronger effects in unrelated areas are excluded. This raises concerns about the validity of the reported effects and suggests that other dimensions of ECEC quality may be more comprehensively examined and supported by more robust empirical evidence, as also stated by Eadie et al. (2022).

Additionally, differing effects are observed to some extent in studies based on more scholastic, US-based ECEC research compared to Scandinavian ECEC models, as well as in research from low-income and Global South contexts. Variations in ECEC traditions, structural conditions, and educational priorities, as evidenced from the ECEC literature, may contribute to these differences across targeted populations (CoRe, 2011; Dietrichson et al., 2018; Eurydice, 2023; Garvis et al., 2018; Koch & Jørgensen, 2023; Munton, 2002).

Following established review protocols (Knopf, 2006; Page et al., 2021), this meta-systematic literature review excluded grey literature, such as the systematic review and meta-analysis by the OECD (2018). While these sources may offer valuable insights, they do not meet the methodological rigor required to be included. For example, an OECD (2018) report, including a meta-analysis on structural- and process ECEC quality, is categorized as a literature review, and lacks clear quantifiable evidence regarding staff-to-child ratios (P. L. Slot, 2018). Notably, the primary author of this OECD report, Von Suchodoletz, also conducted one of the meta-analyses included for this review, using similar data (Von Suchodoletz et al., 2023). Given this overlap, excluding the earlier OECD report does not significantly weaken the scope of this study, as similar evidence is reassessed within the meta-review framework.

The study by Christoffersen et al. (2014) was included based on an external assessment by NB-ECEC, which classified it as a systematic review in their database. However, it differs from other systematic reviews due to its more qualitative and descriptive nature. Only the findings from experimental and quasi-experimental research within Christoffersen et al. (2014)'s review were included for review, even though the report cites a broader range of scientific papers, using different scientific methods. Under other circumstances, this type of research report would have been excluded. However, since the NB-ECEC database had been selected for inclusion in this meta-review prior to its initiation, and given the external expert classification, it was retained for further analysis and integration into both the meta-review synthesis and the subsequent cross-sectional analysis.

Given the broad scope of this meta-systematic review, which includes evidence from diverse international samples—predominantly from Western contexts—it does not provide direct guidance for local decision-making. Instead, it offers a synthesis of the literature on staff-to-child ratios and their effects on ECEC quality and child outcomes, serving as a

foundation for understanding broader trends. While the findings should be interpreted with caution in local contexts, they may inform policy discussions at national and international levels, particularly in setting standards and guiding further research on staffing ratios in ECEC.

8. Conclusion and recommendation

The cautious approach researchers take regarding recommendations for optimal staff-to-child ratios is striking. The evidence supporting improved ratios remains preliminary and highly context dependent. Positive effects are most evident in studies where significant ratio changes were implemented, such as removing children or adding trained educators to enhance conditions. These interventions contrast with recent trends in Denmark, where staffing adjustments have often involved adding untrained personnel or increasing the number of children per adult. Consequently, assuming that improved ratios will consistently enhance quality—particularly in a country like Denmark with some of the world's most favorable ratios—requires careful consideration of conditions and context.

There is some evidence that improving ratios positively influences process quality, particularly in settings with initially low-quality indicators, with substantial improvements in ratios, or where special care and behavioral support are needed. However, the clearest benefits appear in qualitative staff assessments, where improved ratios are associated with a greater sense of professional efficacy. This suggests that future research should explore the effects of ratios on work environments, particularly in relation to staff well-being and professional development within ECEC practices. Notably, the existing literature provides little evidence that improved ratios directly enhance child outcomes.

A key finding of this review is the discrepancy between Danish and international research regarding the conclusions drawn from the effects of staff-to-child ratios. The weight of evidence and overall assumptions vary, suggesting that traditions, cultural expectations, and regional factors may influence both the analysis and conclusions of these studies. These differences highlight the need for further research that explicitly accounts for contextual variations within ECEC systems.

Given the high financial cost of ratio improvements, policymakers should carefully weigh alternative, cost-effective strategies for enhancing ECEC quality. If a setting already maintains high levels of process quality, job satisfaction, and low staff stress, other interventions may offer more efficient means of fostering child development and quality ECEC. Future research should include cost-benefit analyses to identify the most effective quality improvements, assessing whether ratio adjustments yield meaningful benefits compared to other potential lower-cost investments and whether such policies are best implemented at the national or municipal level.

While some evidence links staff-to-child ratios with ECEC quality, this relationship remains complex and influenced by numerous contextual factors. A narrow focus on ratios overlooks the interplay of other quality indicators, and in some cases, the impact of ratio changes may be minimal. Given the scarcity of consistent findings, a broader evidence base is needed to clarify the dynamic and moderating effects of ratios. Future studies

should aim to establish more definitive conclusions regarding when and how ratio improvements meaningfully contribute to ECEC quality and child outcomes. We recommend starting with evidence-based empirical research on the effects of costly initiatives, integrated into the implementation of ECEC policies such as the Danish minimum standards, and evaluating their impact, with a particular focus on the cost-benefit analysis of these reforms.

The synthesis of research on staff-to-child ratios in ECEC does not provide strong empirical support for specific minimum thresholds. While some studies indicate positive effects from ratio improvements, the commonly cited standards of 1:3 in nurseries and 1:6 in kindergartens appear to be based more on policy-driven targets and professional consensus than on robust empirical evidence. These ratios represent aspirational benchmarks rather than definitive research-based thresholds for quality improvements.

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