Teacher-to-Child ratio and Teacher Sickness Absenteeism in Child Care Centers

Nina Drange*, Trude Gunnes† and Kjetil Telle‡

Abstract

A large strand of literature has explored whether increasing the teacher-to-child ratio enhances learning in school. But while teachers seem paramount to learning, it has been hard to document beneficial causal effects on student achievements of more teachers per child, at least in a range that seems economically relevant. However, even though smaller classes may fail to raise student performance, there might still be other relevant effects from an increase in the teacher-to-child ratio. We consider the teacher-to-child ratio to be an indication of work pressure, and explore whether increasing the ratio could benefit teachers’ work environment and lead to a lower sickness absence. In line with Gørtz and Andersson [2014], we find that a higher teacher-to-child ratio is associated with a lower sick leave rate among the teachers. We find clear indication of substantial selection. Relying on plausibly exogenous variation in teacher-to-child ratios, we find that the negative effect on sick leave remains in instrumental variable analyses. Still, even though a higher ratio does reduces sick leave, the mechanism could be substitution of low/non-educated teacher assistants who have inherently high sick leave with teachers who have inherently low sick leave. In any case, the results suggest that increasing the teacher-to-child ratio reduces sick leave and could thus be less costly than suggested by the higher wage of teachers over teacher assistants.

KEYWORDS: Child care, Teacher-to-child ratio, Teacher Sickness Absenteeism

JEL-CODES: I1, I2

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1 Introduction

A large strand of literature has explored whether increasing the teacher-to-child ratio is a cost-effective way of enhancing learning in school. But while teachers seem paramount to learning, it has been hard to document beneficial causal effects on student achievements of more teachers per child, at least in a range that seems economically relevant [Hoekstra 2000, Angrist and Levy 1999, Leuven et al. 2008]. However, even though student performance in smaller classes does not necessarily increase enough to be defended in a cost-benefit analysis, there might still be other relevant effects from an increase in the teacher-to-child ratio. If, for example, the teacher-to-child ratio is an indication of work pressure, increasing the ratio could benefit teachers’ work environment. As work place conditions have been showed to be important to explain sickness absence [Labriola et al. 2006], it seems relevant to explore if the teacher-to-child ratio may have any impact on sickness absence among teachers.¹

Sick leave is a substantial cost to society. On a typical working day, around 7% of Norwegian employees are absent from work due to sickness [Markussen et al. 2011]. The insurance coverage is 100% of regular earnings from the first day of absence, and according to Markussen et al. [2011], insurance payments amount to approximately 2.4% of the Norwegian GDP. The level of sickness absence is higher among women, 60 percent above the level of men [Kostøl 2011]. Norwegian child care centers are mainly staffed by women. Thus, the child care sector should provide for an interesting setting in which to investigate the relationship between the teacher-to-child ratio and sick leave among teachers and teacher assistants. Indeed, several studies suggest that social interaction effects are important in health related welfare programs [Rege et al. 2012, Lindbeck et al. 2016], and spillover-effects between educational groups (teachers and teacher assistants) within the same work place can substantially affect utilization of such programs.

Given similar composition of children, the work load would fall with more adults per child. It is therefore hard to see how a causal effect of higher teacher-to-child ratio will not (weakly) reduce sick leave. When trying to estimate the causal effect of teacher-to-child ratio on sick leave, however, at least two fundamental complications arise. First, the pressure on the staff may depend more on the characteristics and needs of the children, than on their number. This is of course well-known, and the teacher-to-child ratio may thus

¹We will focus on the teacher-to-child ratio in the child care center. Albeit this setting may be somewhat different from the classroom, findings from studies of group size in the child care center are similar to those from the classroom [Blau 1999].
depend on the particular needs of the children, implying that centers or cohorts with more demanding child compositions are compensated with more teachers per child. Such increases in employment would contribute to centers with high teacher-to-child ratios having more demanding children, and - unless fully compensated for the more needs of the children - consequently higher work pressure with associated higher sick leave. This contributes to sick leave being higher in centers with higher teacher-to-child ratios, biasing estimates of causal effects down. Second, and similarly, the qualitative composition of the teachers may also differ and be more important than the number of teachers per child. Indeed, when the teacher-to-child ratio is changed in reality, it may very well be implemented by substituting a teacher with a non-certified assistant. Using such variation will not provide us with a reliable estimate of the causal effect of higher teacher-to-child ratio on sick leave, but rather of the combined effect on sick leave of higher teacher-to-child ratio and lower assistant-to-child ratio. Since sick leave is much lower among teachers than teacher assistants, this change in composition reduces sick leave. Moreover, centers with a higher (effective) teacher-child-ratio could be more attractive for healthier teachers. This contributes to sick leave being lower in centers with higher teacher-to-child ratios, biasing estimates of causal effects upwards. We note that both these sources of selection bias are not time-invariant, implying that controlling for time-invariant center characteristics (fixed effects) would not be sufficient for reliable causal estimates.

Gørtz and Andersson [2014] study how child-to-teacher ratio (measured at the municipality level) influences sickness absenteeism in Danish child care institutions. They find clear evidence of selection, and use generalized method of moment as estimation technique to instrument for the endogenous child-to-teacher ratio. Using 1-year lagged levels of the child-to-teacher ratio as an instrument, and including controls for individual teacher characteristics, workplace characteristics and background characteristics of the children, they find little evidence that a higher teacher-to-child ratio decrease sickness absence. Our analysis bears similarities to this study, but in our approach we will implement two separate instrumental variables that both have an impact on the teacher-to-child ratio. Moreover, we try to investigate how changes in teacher-to-child ratios may spill over to the sick leave of teacher assistants.

We start by looking at a descriptive OLS model, and find, in line with Gørtz and Andersson [2014], that a higher teacher-to-child ratio is associated with a lower sick leave rate among the teachers and the
teacher assistants. We find clear indication of substantial selection. However, in contrast to the Danish study, we find that the negative effect on sick leave remains in instrumental variable analyses relying on plausibly exogenous variation in teacher-to-child ratios. Still, the effect may come from substitution of teaching assistants with teachers — meaning that even though a higher ratio reduces sick leave, the reduction could be due to substituting low/non-educated teacher assistants who have inherently high sick leave with teachers who have inherently low sick leave. In any case, the results suggest that increasing the teacher-to-child ratio could be less costly than suggested by the higher wage of teachers over teacher assistants. The reminder of the paper is organized as follows. In Section 2 we present the Norwegian child care and sick leave system respectively. We proceed to describe the empirical strategy in Section 3 and present the data along with some descriptive statistics in Section 4. In Section 5 we present our results. Section 6 concludes.

2 Institutional setting

Child care centers in Norway

Child care centers are part of the education system in Norway, although enrollment is voluntary [Duncan et al., 2011]. Since September 1st 2009 parents have statutory rights, that is, legal rights to a slot in a child care center in their municipality of residence from August the year the child turns 1. If the child is born in September-December, the child does not have a right to a slot until August the year when the child turns 2, although many children enroll earlier. From 2015 there are further requirement from the government stating that no family should pay more than 6 percent of their income on child care for the first child, and with further reductions for siblings. Child care centers are financed by the municipality from local tax income and from government transfers. This implies that it is the elected local council in each municipality that decides on the allocation of funds to the child care sector. Private centers are entitled to the same transfer as the municipal centers, as long as they meet quality requirements elaborated on below. While the local councils decide on funds allocated to child care (and other sectors finances locally, such as primary schools, care for the elderly, renovation and municipal infrastructure) they still have to fulfill the parents right to a slot. Parental co-payment has been capped at a maximum level since 2003, amounting to around 2,500 NOK per month for a full time slot. The municipality can decide to reduce costs further for low-income families.3

2From 2015 there are further requirement from the government stating that no family should pay more than 6 percent of their income on child care for the first child, and with further reductions for siblings.
Quality is regulated, with provisions on staff qualifications, number of children per teacher, size of play area, and educational orientation. There is a nation-wide regulation stating that the preschool teacher/child ratio should be no smaller than 1/9 for the group of toddlers 1-2, and 1/16 for the group of children aged 3-5. If the child care center is not able to recruit as many teachers as required, it may apply for an exception. If granted, the teacher position may be held by an employee without the formal qualifications. Additional regulations on staffing are decided on the municipality level, but each teacher typically works with two assistant teachers. There is no educational requirements for the assistant teachers. The child care teacher education is a three year college degree, and include supervised practice in a formal child care institution. Child care institutions are typically open from around 7.30 am to 5 pm.

Since 2003 there has been a large expansion of child care slots in Norway due to a political agreement that was settled that year (Barnehageforliket). A majority of the seats in the parliament voted in favor of larger investments to expand the number of child care slots, and to lower parental co-payment. The goal was that all parents who wanted to enroll their child in child care should be able to both get a slot and to afford enrolling their child. While about 85 % of 3-5 year-olds and 44 % of 1-2 year-olds were enrolled in child care in 2003, this had increased to 96.5 and 80 % respectively for the two groups in 2013. The expansion came with an increase in government funding.

Sick leave benefits

The Norwegian National Insurance (NNI) program provides public welfare services such as for example sick leave benefits, disability pension and unemployment benefits. The program covers all residents and participation is mandatory. Paid sick leave is provided from day one up to a maximum of one year. Eligibility is determined by the worker having been employed for more than four weeks. If an employee reports absence due to sickness, the employer must finance the first 16 days. After this, the NNI program covers expenses. Up to an established limit (about NOK 550,000 in 2016), the coverage is 100 per cent, but most public employers will replace foregone earnings entirely. Firing employees due to sick leave is prohibited by law. After three or eight days (depending on the type of firm), the employee needs a certificate from a medical doctor to document illness in order to continue to receive sick leave benefits.
3 Empirical strategy

Descriptive approaches

We start out with a simple OLS equation to explore the relationship between the teacher-to-child and adult-to-child ratio respectively and the sickness absenteeism of employees in child care centers. We estimate the following OLS equation:

\[ y_{ijt} = \alpha_0 + \alpha_1 \log \Pi_{jt-1} + \alpha_2 X_{it} + d_t + \varepsilon_{ijt} \]  

(1)

The dependent variable \( y_{ijt} \) is a dummy variable that takes the value 1 if employee \( i \) in child care center \( j \) receives a sick leave benefit in year \( t \) or zero otherwise. \( \alpha_0 \) is a constant. \( \log \Pi_{jt} \) represents the 1-year lagged level of the log ratio, either the teacher-to-child or adult-to-child ratio. \( X_{it} \) represents individual characteristics of employee \( i \) (age, gender, experience at one particular day care center, and experience squared). \( d_t \) are year dummies. \( \varepsilon_{ijt} \) is a random error term clustered on municipality level to allow the error term to be correlated within municipality. Our parameter of interest is \( \alpha_1 \), which captures the correlation (contingent on \( X \) and \( d \)) between the teacher-to-child ratio and sick leave. The coefficient for the natural log transformed ratios can be interpreted in terms of percent change.

It is well known that both individual characteristics and characteristics of the work place are closely associated with sick leave [Markussen et al. 2011]. As discussed in Section 2, child care centers are funded by the municipality, which also have some discretion on how to set and supervise standards of teachers, buildings and curricula, and on how to organize child care centers and allocate children to them. The choices and characteristics of the municipality may thus be important determinants of the work place of the teachers. To account for time-invariant observable and non-observable municipality characteristics, we will thus include municipality fixed effects in some regressions. Similarly, and since most municipalities have more than one child care center, we will also present regressions accounting for time-invariant characteristics of child care centers. Finally, individual characteristics are important predictors of sick leave. We account for several well-known observable determinants of sick leave in \( X_{it} \), but time-invariant unobservable characteristics may also be important, and we will thus present models with individual fixed effects.
These fixed effects models rely on variation in sick leave within the unit, i.e. the municipality, the child care center or the teacher, over time, disregarding any time-invariant characteristics of the unit. This will handle many forms of selection, e.g. as sick leave will tend to remain higher in centers with low funding or weak leadership, and thus often reduce selection-bias in estimates of the effect of teacher-to-child ratio on sick leave. However, work environments are typically not unchanged over time and sometimes changes may by itself enhance sick leave. For example, new cohorts of children enter and leave the child care centers every year, and especially demanding children come and go. While compensatory measures are typically undertaken, like raising staff for particularly demanding children, the compensations are unlikely to be complete. This may seriously affect the work environment and burden on the staff, which may in turn influence the flow of teachers between centers. The dynamics of such processes can impact working conditions severely, and lead to selection that makes the sick leave fluctuate substantially over time. Such dynamics are not handled well by the fixed-effects model, and to elicit causal effects of the teacher-to-child ratios on sick leave, we need variation in the ratio that is plausibly exogenous to determinants of such dynamics.

**Instrumental variable approaches**

To allow for causal inference, we need an instrument for the endogenous ratio, i.e. we need a variable that is correlated with the ratio and that has no direct impact on sick leave (other than through the ratio). Here we will employ two instruments.

There is a burgeoning literature on how political parties in power at the local level shape political outcomes, and notably public spending [Pettersson-Lidbom 2008, Ferreira and Gyourko 2009, Fiva et al. 2016]. There seem to be a tendency for the non right block to increase spending on child care. We, however, are interested in whether the political block in power influences not only spending on child care, but more precisely impacts the teacher-to-child ratio. That is, we zoom in on a very specific type on spending, namely financing of high-skilled workers in child care centers. We can for each municipality, at every election (every forth year), identify the change in the electoral support of the non right-wing block. We can hence estimate the following first stage specification:
\[ log\Pi_{jt} = \psi_0 + \psi_1 T_{kt} + f(\text{nonright}) + \gamma_2 X_{it} + d_t + \varepsilon_{ijkt} \]  

(2)

where \( T_{kt} \) is a treatment indicator taking the value 1 for non-right governments and zero for right-wing governments. \( f(\text{nonright}) \) is a control function, i.e., some low-order polynomial in non right vote share/seat share. The parameter of interest, \( \psi_1 \), measures how the policy position of the local council affects the ratio. \( \varepsilon_{ijkt} \) is clustered at the municipality level.

The idea is that municipalities on the margin of obtaining a right wing or non-right wing majority are similar, but that the non-right wing wants to spend more money on improving the teaching environment of child care centers and in particular on raising the teacher-to-child ratio. By running Equation 2 with the control function, or without but on a sample of right and non-right wing local governments that are close to the treatment threshold, e.g. namely municipalities where the non-right parties get between 45-55 \% of the votes, we obtain variation in the ratio for otherwise similar municipalities. As we move further away from the 50 \% cutoff, possible confounding relationships between the political bloc in power and the teacher-to-child ratio may appear.\footnote{If we were to go closer to the treatment threshold we would lose a substantial number of observations.} Moreover, we include interactions between the treatment indicator and election years (1-4) to see in which year the effect is strongest.

Correctly measuring the implication of each party block is important because it strengthens the predictive power of the second stage of the 2SLS specification. The better we measure the policy positions of the local party blocks, the better we should be able to predict sickness absenteeism generated across otherwise similar municipalities.

The second stage specification reads:

\[ y_{ijkt} = \gamma_0 + \gamma_1 log\hat{\Pi}_{jt} + \gamma_2 X_{it} + d_t + \eta_k + \varepsilon_{ijkt} \]  

(3)

For our IV strategy to produce results that can plausibly be given a causal interpretation, the instrument must satisfy mainly three conditions: First, the political block in power must generate statistically strong variation in the ratio, conditional on \( X \). Second, whether one or the other block wins must be more or less
random. Third, whether the one or the other block wins must affect sickness absenteeism exclusively through the ratio, conditional on $X$. This exclusion restriction is crucial, and there may be some threats to it. For example, the non-right wing may not only raise the ratio, they may also be more eager to impose means that enforce general rights of employees in the municipality. To the extent that such means affect sick leave, our instrumental variable approach may erroneously attribute impacts of such means (on sick leave) to the effect of higher ratio. This may contribute to an upward bias. But the non-right may also practice more understanding for sick leave, and if this leads to more sick leave, it may contribute to a downward bias. Such threats to the exclusion restriction, which are rarely fully absent for any instrument, makes it interesting to see how results may differ if we employ a quite different instrument.

Hoxbey [2000] exploits random variation in the population of children in the appropriate age range to instrument for class size. We follow Hoxbey [2000], and implement a similar instrument to obtain random variation in the teacher-child-ratio. This identification strategy builds on three steps: obtaining estimates of the random part of enrollment variation, then use the random variation in enrollment to identify random variation in the teacher-to-child-ratio, and finally see how sickness absenteeism is affected by random variation in the teacher-to-child ratio. First we estimate the random part of the enrollment variation based on the number of one-year old in each municipality:

$$E_{kt} = \beta_0 + \beta_1 v + \beta_2 v^2 + \beta_3 v^3 + \beta_4 v^4 + ... + \log u_{kt}$$

(4)

where $E_{kt}$ is the number of one-year olds in municipality $k$ in year $t$ and $v$ is variation in time, i.e., a trend, represented with a specific polynomial in time. Equation (4) is estimated separately of each municipality. The $\log$ of the estimated residual is the instrument we need for the ratio. We first estimate the first stage equation:

$$\log \Pi_{jt} = \varsigma_0 + \log u_{kt} + \varsigma_1 X_{kt} + d_t + \varepsilon_{kt}$$

(5)

Finally, we estimate the second stage equation:
\[ y_{ijkt} = \lambda_0 + \lambda_1 \log \Pi_{jt} + \lambda_2 X_{it} + d_t + \varepsilon_{ijkt} \] (6)

This second IV method may eliminate a potential mechanical effect of a higher teacher-to-child ratio on sickness absenteeism. Teacher educated workers relative to teacher assistants have on average lower sickness absenteeism per se. Hence, an increased teacher-child ratio, induced by a larger share of teachers, may reduce sickness absenteeism directly, and does not necessarily impact the work environment. That is, a higher ratio does not necessarily spill over to the sick leave of the teachers’ untrained assistants. Note that the first IV-method is based on a random increase in the number of teachers (i.e., the numerator) whereas the last IV-method is based on a random variation in the number of children (i.e., the denominator), keeping the number of teachers (in the short run) fixed.

4 Data and Descriptive Statistics

We use register data from Statistic Norway on employees in child care centers during 2007-2014. We have information on employees’ age, gender, education; both level and field, sick leave, and experience at each child care center. In addition, we have the type of ownership of child care centers and the total number of children in each child care center. For each child care center we can hence calculate the teacher-child ratio and the adult-child ratio, where the former includes all employees with an education in teaching and pedagogy and the latter include all employees irrespectively of their type and level of education. Included in the sample are employees that work in child care centers more than 30 hours a week.

Table 1 displays summary statistics. We see that the average age of a child care center employee is about 40 years old, and the average years of experience in a particular day care center is 4.3. Child care centers are primarily staffed by women, with a share above 90%.

Little over a third of the staff has a (child care) teacher degree, and this lines up with the norm in some municipalities (including the capital Oslo) that one teacher should work with two assistant teachers. Note, however, that these are averages, and the mix of teachers and teacher assistants will most likely vary

6 Family-driven child care centers are not included in the sample. These centers are very small, and often do not have independent organization IDs. This makes it hard to link employees to centers.
considerably across child care centers. Most of those working in child care centers have a bachelor degree as their highest educational level (teachers included), followed by those having high school as their highest level of education.

The last row of Table 1 reports that the share on sick leave per year is on average 32% and that the average number of sick days per individual per year is 21.

<table>
<thead>
<tr>
<th>Table 1: Summary Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average age</td>
</tr>
<tr>
<td>Average years of experience in a particular child care center</td>
</tr>
<tr>
<td>Female share</td>
</tr>
<tr>
<td>Share of workers with a child care teacher degree</td>
</tr>
<tr>
<td>Share of workers with compulsory education as the highest education level</td>
</tr>
<tr>
<td>Share of workers with high school as the highest education level</td>
</tr>
<tr>
<td>Share of workers with a Bachelor degree as the highest education level</td>
</tr>
<tr>
<td>Share of workers with a Master degree or more as the highest education level</td>
</tr>
<tr>
<td>Share on sick leave</td>
</tr>
<tr>
<td>Average number of sick days</td>
</tr>
</tbody>
</table>

Sick leave

We construct a variable that captures whether the teacher/teacher assistant has been sick at least once throughout the year. Our data contain information on contracted hours per year and contracted hours per year adjusted for sickness absenteeism certified by a doctor. If higher than zero, the sick leave variable takes the value 1 and zero otherwise. Sickness absenteeism does not include other absences. Note, however, that we only have information regarding the total length of sick leave per year per individual, lacking information on frequencies. In addition, we have no information regarding the causes for sick leaves, i.e., diagnoses.

Figure 1 shows the share of employees in child care centers that benefited from certified sick leave during the years 2007-2014. Two interesting features emerge: First, there is a negative trend in sickness absenteeism during the period studied. Second, sickness absenteeism decreases with the education level.
Figure 1: Development in sickness in general and by educational level among workers in child care centers

Teacher-child and adult-child ratios

For each child care center, we take into account that children under the age of 3 are legally required to have twice as many teachers than children over 3. As some child care centers lack employees with a teacher degree, we use teacher per child and not the opposite ratio. We hence calculate the following adjusted ratios:

- $\text{Teachers/}(\text{children under 3} \times 2 + \text{children over 3})$
- $\text{Adults/}(\text{children under 3} \times 2 + \text{children over 3})$

Figure A.1 shows the share of children below 3 years old, and the share of children above 3 years old in the different years studied in this paper. We see that the share of young children is lower than the share of more older children, and that the share of younger children increases somewhat over time, at least in the beginning of the period studied. This is in line with the expansion mentioned in Section 2, where the enrollment rates increased more among the young children. Figure A.2 shows the average yearly levels of the two ratios.

Additional data for the IV-regressions

For the first IV analysis we will rely on the variation from municipalities where the non-right block is on the margin of getting just above or below 50 % of the votes. We therefore add data on the political environment in all municipalities to exploit the fact that the political block in power might impact spending on child care, and more precisely the number of teachers in child care centers. The data used is the same as in Fiva et al. 2016. Figure 2 shows a small jump in the teacher-child ratio in municipalities that experience a shift to a

7 For more information, see http://www.jon.fiva.no/data.htm.
non-right local government. We will exploit this in a (first stage) regression discontinuity (RD)-design.

![Figure 2: RD](image)

For the second IV analysis, based on [Hoxby 2000], we use population data provided by Statistic Norway on the number of 1-year olds in each year for each municipality to calculate a trend and exploit the random variation in the population of children to causally study how the teacher-child-ratio impacts sick leave.

5 Results

Descriptive findings

We start by considering the relationship between the teacher-to-child ratio and sickness absenteeism among child care employees. From Table 2 below, we see that this relationship is negative and significant. This correlation may represent a positive selection of healthy staff into child care centers with a high teacher-to-child ratio, it could be a causal relationship or a mix of the two. Adding controls decreases the estimate somewhat, in line with that we would expect if observable characteristics correct for some of the likely selection. Results for the adult-to-child ratio reported in the lower panel of Table 2 shows a similar relationship, albeit of a larger magnitude.
Table 2: OLS, Sickness Absenteeism

<table>
<thead>
<tr>
<th></th>
<th>No controls</th>
<th>With controls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coef.</td>
<td>Std. Err</td>
</tr>
<tr>
<td>Teacher/child ratio</td>
<td>-0.033</td>
<td>(0.010)***</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.001</td>
<td>0.013</td>
</tr>
<tr>
<td>Adult/child ratio</td>
<td>-0.057</td>
<td>(0.009)***</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.001</td>
<td>0.013</td>
</tr>
</tbody>
</table>

Notes: Control variables are gender, age, experience, experiences squared, and time dummies. Standard errors are clustered on the municipality level. */**/*** statistically significant at the 10/5/1 percent level. Observations=304 470

Since the impact on sickness absence may be different across the distribution of the teacher-to-child ratio, we also implement a specification where we look at associations between sickness absence and ratios using a categorical variable as the outcome. The construction of categories is based on a visual inspection of Figure A.3. In Table 3 we report OLS estimates on the different categories. We see that estimates are similar across categories, indicating that what matters most is to increase the teacher-to-child ratio from a very low level.

Table 3: OLS, Sickness absenteeism: the teacher child ratio as a categorical variable

<table>
<thead>
<tr>
<th>Teacher/child ratio categories</th>
<th>Coef.</th>
<th>Std. Err</th>
</tr>
</thead>
<tbody>
<tr>
<td>(omitted 0.03)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.06</td>
<td>-0.031</td>
<td>(0.006)***</td>
</tr>
<tr>
<td>0.09</td>
<td>-0.039</td>
<td>(0.010)***</td>
</tr>
<tr>
<td>0.12</td>
<td>-0.043</td>
<td>(0.012)***</td>
</tr>
<tr>
<td>0.15</td>
<td>-0.033</td>
<td>(0.014)**</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.013</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Time dummies are included, so are controls for gender, age, experience, and experiences squared. Standard errors are clustered on the municipality level. */**/*** statistically significant at the 10/5/1 percent level. Observations=304 470

As choices and characteristics of the municipality may be important determinants of the work place of the teachers and the teacher assistants, we now turn to fixed effects results. In Table 4 we report estimates that account for time-invariant observable and non-observable municipality characteristics. The first row displays the overall fixed effect estimate of the teacher-to-child ratio on sickness absence. The estimate is smaller than the OLS estimate, in line with that we would expect if the fixed effect model accounts for time-invariant endogeneity within the municipality. We also estimate the fixed effect model using the categorical teacher-child ratio as the outcome. Results are reported in the middle part of Table 4. We see that increasing the teacher-to-child ratio from a low level seems to decrease sickness absence up until a certain point, and after that it matters less. The last row of Table 4 displays fixed effects estimates of adults-per-child on sickness
Table 5: Individual fixed effects

<table>
<thead>
<tr>
<th>Coef</th>
<th>Std. Err</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher/child ratio</td>
<td>0.006 (0.003)</td>
</tr>
<tr>
<td>0.06</td>
<td>-0.008 (0.005)</td>
</tr>
<tr>
<td>0.09</td>
<td>-0.004 (0.005)</td>
</tr>
<tr>
<td>0.12</td>
<td>0.004 (0.006)</td>
</tr>
<tr>
<td>0.15</td>
<td>0.007 (0.009)</td>
</tr>
</tbody>
</table>

Notes: Time dummies are included in all regressions, so are controls for gender, age, experience, and experiences squared. Standard errors are clustered on the organizational level and municipality level. */**/*** statistically significant at the 10/5/1 percent level. Observations=304 470

absence. In the fixed effects model, the association between the ratio and sickness absence is close to zero, indicating that when time-invariant observable and non-observable municipality characteristics are accounted for,

Table 4: Sickness absenteeism, municipality fixed effects

<table>
<thead>
<tr>
<th>Coef</th>
<th>Std. Err</th>
</tr>
</thead>
</table>
| Teacher/child ratio | -0.013 (0.005)***
| 0.06  | -0.026 (0.006)***
| 0.09  | -0.029 (0.006)***
| 0.12  | -0.031 (0.006)***
| 0.15  | -0.019 (0.011)*

Notes: Time dummies are included in all regressions, so are controls for gender, age, experience, and experiences squared. Standard errors are clustered on the municipality level. */**/*** statistically significant at the 10/5/1 percent level. Observations=304 470

In Table 5 below, we report estimates from a model that account for time-invariant observable and non-observable individual characteristics. We can think of this model as picking up variation that is related to the working environment, and not to the individual’s own characteristics. We see from the table that the teacher-to-child ratio does not matter much when individual fixed effects are accounted for. This is unsurprisingly also true when considering the categorical teacher-child ratio.
IV findings

The descriptive evidence suggests a correlation between the teacher-to-child ratio and sickness absence among the staff. However, and as discussed in Section 3, we need plausible exogenous variation in the teacher-to-child ratio in order to conclude whether this is a causal relationship. We now turn to IV results in Table 6, where we start by looking at a sample of municipalities where the non-right is on the margin of getting above 50% of the votes. The first stage suggests that in this sample, getting above 50% of the votes increases the teacher-to-child ratio. This is in line with what we would expect if non-right parties are more likely to allocate funds to the child care sector. Moving now to the second stage and results, we see that a higher teacher-child ratio indeed reduces sickness absenteeism. Note that this estimate is a local average treatment effect (LATE).

A LATE estimate is always larger than an intention-to-treat (ITT) estimate.

| Table 6: 2SLS, political block in power |
|---|---|---|
| **First stage:** | | |
| Above 50% non right | 0.128 (0.032)*** | 16.4 |
| **Second stage:** | | |
| Teacher-child-ratio | -0.137 (0.080)* | |

Notes: Included in all regressions are time dummies, controls for gender, age, experience, and experiences squared as well as additional controls for female mayor and female council members. Standard errors are clustered on the municipality level. */**/*** statistically significant at the 10/5/1 percent level. Observations=75729

This political block IV-sample is smaller than the sample on which we run the OLS and the municipality fixed effect estimations. Running the OLS and fixed effects model on this smaller sample yields negative estimates as well, see Table 7.

| Table 7: Fixed effects, the political block in power IV sample, Sickness Absenteeism |
|---|---|---|---|
| | No fixed effect | Municipality fixed effects |
| | Coef. | Std. Err | Coef. | Std. Err |
| Teacher/child ratio | -0.039 (0.005)*** | -0.018 (0.004)*** |

Notes: Included in all regressions are time dummies. Control variables are gender, age, experience, and experiences squared. Standard errors are clustered on the municipality level, organizational level, and individual level respectively. */**/*** statistically significant at the 10/5/1 percent level. Observations=75729

A negative impact is no longer found in Table 8 where we exploit random variation in the population of children to identify a causal relationship, following Hoxby [2000]. This might suggest that there is a mechanical effect of the ratio on sickness absenteeism. That is, a higher teacher-to-child ratio will only negatively impact
sick leave when there is an increase in the number of teachers, but not when there is a decrease in the number of children as teachers per se have a lower sickness absenteeism, indicating that an increased teacher-to-child ratio has no direct effect on the work environment in day care centers, i.e., a higher ratio does not spill over to the sick leave of the teachers’ untrained assistants. This result is in line with what we saw in Table 5, where the teacher-to-child ratio did not seem to matter when individual fixed effects were accounted for.

Table 8: 2SLS, population variation

<table>
<thead>
<tr>
<th></th>
<th>Coef.</th>
<th>Std. Err</th>
<th>F-statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First stage:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual</td>
<td>-0.068</td>
<td>(0.022)***</td>
<td>10.05</td>
</tr>
<tr>
<td><strong>Second stage:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher/child-ratio</td>
<td>0.215</td>
<td>(0.200)</td>
<td></td>
</tr>
</tbody>
</table>

Notes: The outcome variable in the first stage is the teacher/child ratio, whereas the outcome variable in the second stage is sick leave. Included are time dummies and controls for gender, age, experience, and experiences squared. Standard Errors are clustered on municipality level. */**/*** statistically significant at the 10/5/1 percent level. Observations=304 470

6 Conclusion

Given the substantial cost sickness absence imposes on society, implementing measures to reduce it seems to be of great importance. We explore the potential of the teacher-to-child ratio to impact sickness absence among teachers and teacher assistants in the child care sector in Norway. Implementing OLS and municipality fixed effects models, we find in line with Gørtz and Andersson [2014] that a higher teacher-to-child ratio is associated with a lower sick leave rate among the teachers and the teacher assistants. We find clear indication of substantial selection. We proceed to take advantage of an instrumental variable approach where we focus our analysis on municipalities where the non-right parties obtain from 45 to 55% of the votes. We go on to instrument the teacher-to-child ratio on this sample with whether or not the non-right obtained above 50% of votes. In contrast to Gørtz and Andersson [2014], we find that the negative effect on sick leave remains when relying on this plausibly exogenous variation in teacher-to-child ratios. Following Hoxby [2000], we implement another instrument to obtain random variation in the teacher-child-ratio. This identification strategy builds on three steps: obtaining estimates of the random part of enrollment variation (i.e., random change in the number of children, that is the denominator of the ratio), then use the random variation in enrollment to identify random variation in the teacher-to-child-ratio, and finally see how sickness absenteeism is affected by
random variation in the teacher-to-child ratio. The results from this approach indicate that there might be a mechanical negative effect of the teacher-to-child ratio on sickness absenteeism. In fact, we do no longer find a negative and significant effect of the teacher-to-child ratio on sickness absenteeism, suggesting that it is only when there is a real increase in the number of teachers, which have a lower sickness absenteeism per se, that we are able to detect a negative impact. This questions the “improved work environment” hypothesis and the idea that a higher ratio spills over to the sick leave of the teachers’ untrained assistants. In any case, the results suggest that increasing the number of teachers in child care centers could be less costly than suggested by the higher wage of teachers over teacher assistants.

References


Appendix

Figure A.1: Share of children below and above three years old

![Figure A.1](image1.png)

Figure A.2: The yearly average development of the teacher-child ratio and the adult-child ratio

![Figure A.2](image2.png)

Figure A.3: Density of the teacher-child ratio and the adult-child ratio respectively

![Figure A.3](image3.png)