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<https://doi.org/10.1057/s41599-025-05008-2>

OPEN

Children supervising children across low- and middle-income countries: the role of mothers' education

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Around the world, many young children spend time supervising or being supervised by other children without adults. This can have both positive (e.g., strengthening sibling ties) and negative (e.g., hinder supervisor's schooling) consequences for children, families, and communities. Population-based information from low- and middle-income countries (LMIC) is scarce on this phenomenon. Poisson random effect regression models using the most recent Multiple Indicator Cluster Surveys (MICS) and Demographic and Health Surveys (DHS) from 81 LMIC were built to estimate the prevalence of leaving children under five years-old under the supervision of another child younger than 10 years of age and the role of maternal education in this childcare arrangement. Prevalence of child-to-child supervision ranged from no supervision at all to 55.7% globally, with large variations across countries and regions. The highest prevalence was found in West and Central Africa. In 90% of the countries across all regions, higher maternal education was associated with lower prevalence rates of children supervised by another child. No clear pattern was found among the eight countries across four continents displaying the opposite trend. These findings call for context-based studies to identify determinants and consequences of this care arrangement and for continued support to mothers' education to bolster the supervision and healthy development of child supervisors and supervisees.

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Introduction

In recent years, there has been a growing interest in studying the well-being of children without adult supervision, defined as either alone or with another child. A nurturing environment characterized by responsive caregiving and adequate supervision is pivotal to fostering early childhood development (Jeong et al. 2022). The experience can vary, however, as some children are left alone without an adult caregiver nearby while others receive partial supervision from an adult who may be a friend, a relative or a neighbor (Ekot, 2012; Ruiz-Casares and Heymann, 2009). Some children are cared for by older siblings, friends, or domestic workers who themselves are children (Gamlin et al. 2015). Indeed, children's contribution to childcare is a common and normative practice in multiple contexts (Ruiz-Casares et al. 2018; Weisner, 2017). Though adults are usually physically present—within earshot & eyesight, child-to-child supervision also happens in their absence (Kline and Killoren, 2022; Ruiz-Casares et al. 2018a). This is clearly the case of unaccompanied child-headed households (i.e., those with no member aged 18 years or older), particularly in Sub-Saharan Africa (Chademaana and van Wyk, 2021; Goronga and Mampane, 2021) and also in the context of teenage parenthood in high-income countries such as the USA, where many adolescents every year become parents to their children (Mollborn, 2017; Powers et al. 2021). The public health and social consequences of these arrangements (e.g., childhood injuries and decrease in school attendance) may affect both the children who receive care and the children providing care (Bliznashka et al. 2023; Hendricks et al. 2021; Sadeghi-Bazargani et al. 2017; Swanson et al. 2018). Variations in childcare practices in line with the changing employment status of women have also been suggested to contribute (Doi et al. 2018; Khan and Meher, 2021), yet poorly explore this phenomenon as it pertains to child supervision in low- and middle-income countries (LMIC). This study provides up-to-date prevalence of child-to-child supervision in LMIC and investigates whether mother's education plays a protective role in this arrangement.

Child-to-child supervision (which can include sibling as well as care by a non-relative child) is a double-edged phenomenon. On the one hand, there are several advantages associated with children's involvement in caring for younger children and siblings. It can promote personal growth and foster closeness and affection between family members (Kline and Killoren, 2022). It can also contribute to a sense of generosity and purpose in life among children who provide care (Dellazzana-Zanon et al. 2021). There is evidence that taking care of younger children can also help the supervising children develop problem-focused coping skills (Kelada et al. 2022), as well as self-confidence, autonomy, and positive relationships with siblings (Park, 2019). Promoting cultural values as part of age-appropriate caretaking can boost resilience and strengthen healthy family dynamics (Hendricks et al. 2021; Wei et al. 2021). Despite the advantages, child-to-child supervision can pose challenges and result in negative outcomes for supervisors and supervisees. For instance, there is evidence showing that it can increase the risk of unintentional childhood injuries as older children may not yet be fully aware of situations causing serious injuries to children under their care (Swanson et al. 2018). Additionally, it can prevent the supervising child from participating in activities that are essential for their well-being and personal growth, such as age-appropriate activities including peer socialization (Borchet et al. 2020). This can negatively impact social and educational development as caregiving responsibilities may interfere with children's ability to complete school assignments or spend time with their friends (Stamatopoulos, 2018). In a study done in Türkiye, Akkan (2019) found that 12–14-year-old children who cared for their

0–4-year-old siblings faced a range of physical and emotional burdens as they had to prioritize the needs of their younger siblings at the expense of their own. Non-adult supervision can also lead to quarreling, anger, and violence between siblings (Järkestig-Berggren et al. 2019; Khan and Meher, 2021).

Outside the literature on home injuries, most studies examining non-adult supervision were conducted with adolescents (12–18 years old) as the supervisee. Indeed, very few studies have been done on supervision of grade-schoolers or very young children (i.e., infants, toddlers, and preschoolers). The existing gaps are even more pronounced in LMIC. When studying child supervision, attention to women—and most often mothers—is paramount as they are usually the primary caregivers of young children and tend to spend more time with them. Sociocultural beliefs often expect that women fulfill both caregiving and employment roles, posing challenges for women in maintaining a work-life balance (Okelo et al. 2022). The current literature, however, does not provide adequate evidence as to how mothers' education may influence the likelihood of child-to-child supervision. The assumption may be that mothers with higher levels of education are more aware of potential harms caused by non-adult supervision. Higher levels of education may also lead to better job prospects and higher income for mothers, thus making daycare more affordable when available. In this way, maternal education can contribute to children's health by increasing mothers' knowledge and financial resources (Le and Nguyen, 2020). As a result, mothers may end up spending less time with their children to meet their financial needs. Additionally, children's role in caring is often studied in a context of providing care to different groups of people including parents, grandparents, and siblings. Focusing primarily on the care and supervision provided by, and to children is imperative to better understand the phenomenon of child-to-child supervision in the context of the changing landscape of maternal education, and the impact of this care arrangement on children's well-being. This study investigates the extent to which nationally representative samples of children aged under 5 years old are supervised by another child younger than 10 years old without the presence of an adult in a range of LMIC. Child supervision was investigated in the context of maternal education.

Materials and methods

Data sources and sample size. Data sources used for the present study consisted of 81 standardized, nationally representative, and population-based household surveys, including 67 Multiple Indicator Cluster Surveys (MICS) and 14 Demographic and Health Surveys (DHS). Both surveys were implemented in LMIC to monitor children's well-being and use comparable multistage random sampling to generate a nationally representative sample. To study supervision practices for children under the age of five, we focused on specific items on child supervision introduced in MICS4 (see Section "Measures"). Since these items were optional, only countries that chose to include them were retained for our study. To obtain the most updated information, we included the latest wave of data collection for each country that were publicly available in July 2021. Survey dates in our sample ranged from 2010 to 2020. All survey data and questionnaires were obtained online from UNICEF (<https://mics.unicef.org/>) and DHS (<https://dhsprogram.com/>).

The total number of children available for analyses was 578,286 in 81 countries and depending on the type of analysis carried out these numbers were reduced (Fig. 1).

Measures. Several measures of interest were included in our analyses. Interviewers received training to avoid bias in questioning.

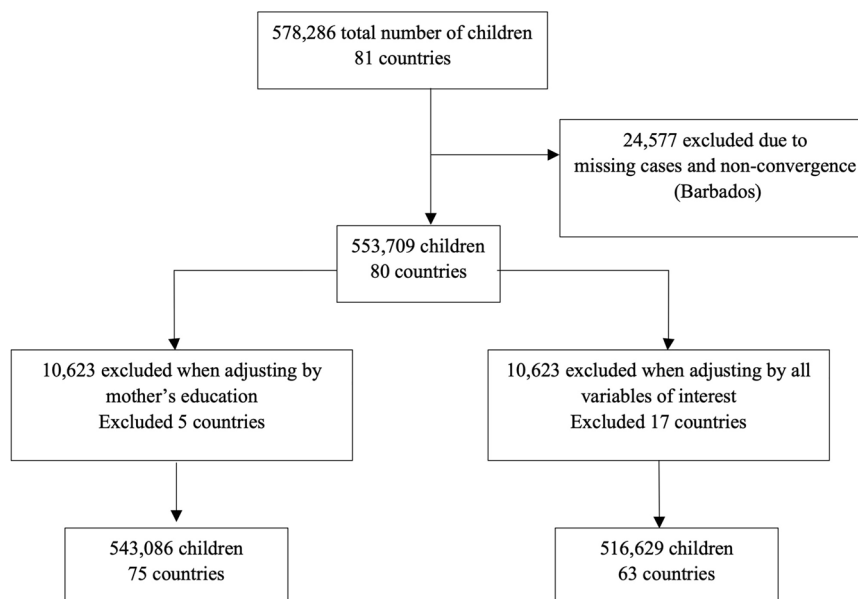


Fig. 1 Sample size flow chart.

Child supervised by another child. We assessed the extent to which a child aged under five years was supervised by another child younger than ten years through a question included in the MICS and DHS. Specifically, this question was as follows: “Sometimes adults taking care of children have to leave the house to go shopping, wash clothes, or for other reasons and have to leave young children. On how many days in the past week was (name) left in the care of another child, that is, someone less than 10 years old, for more than an hour?” Responses ranged from zero to seven days. For the purposes of the current analyses, we combined responses from one to seven days to convert this measure into a dichotomous outcome (0 = zero days, 1 = one day or more), as we focus on breadth with a cross-country comparison, following earlier work (Ruiz-Casares et al. 2018b).

Mother’s education. Given the heterogeneity of each country’s education system and the varied distribution of mothers’ education level, we combined groups to dichotomize this variable of interest. For example, some countries had more than one post-secondary education levels, whereas others only had one. Moreover, some education levels of certain countries had a low case count, which might have led to convergence issues during statistical analysis. Therefore, to maximize the comparability of datasets across countries, we classified mother’s education in most countries into “Primary or below” or “Secondary and above”. The only exceptions were Belarus and Turks and Caicos, where all mothers had an education level of secondary or above. Therefore, in these two countries we regrouped the education categories as “Secondary” and “Above secondary”.

Control variables. Following the literature on child supervised by another child (Ruiz-Casares et al. 2018b), we included seven control variables. We considered demographic characteristics of the child, including sex (0 = male, 1 = female) and age (in months). We also considered demographic characteristics of the mother—marital status (3 categories: Yes, currently married; Yes, living with a partner; No, not in union) and age (in years). Household characteristics included: residence (0 = rural, 1 = urban) and household size (the total number of individuals living in the household). Lastly, we considered socioeconomic status using the Wealth Index Score (WIS) (Rutstein and

Johnson, 2004), which is calculated using household characteristics (e.g., electricity, water, number of rooms), presence of material goods (e.g., television, telephone), and ownership of various goods (e.g., computer, camera). The WIS was divided into five quintiles within each country, where the lowest represented the poorest group and the highest represented the richest.

Statistical analysis and model selection. We conducted random-effect Poisson regression analyses with sampling weights to account for variation in selection probability. We ran three separate models in each country dataset for the risk of being supervised by another child: (1) base model without predictors or controls, (2) model adjusted by mother’s education, and (3) a fully adjusted model by mother’s education and seven control variables (i.e., child sex, child age in months, household size, mother’s marital status, mother’s age in years, wealth index, residence). For each of these models, we ran them once with missing cases included and once without missing cases, which affected only two variables (i.e., mother’s education and marital status). All analyses were performed using Stata 17 (StataCorp, 2021).

Certain variables were excluded from some countries’ fully adjusted models for various reasons. For Algeria, the household size, mother’s marital status, and mother’s age were not available. Next, for Argentina, we excluded residence because all participants reported living in an urban residence. Furthermore, we excluded mother’s education for Georgia, Jamaica, Kazakhstan, and Tonga because all mothers reported having secondary education. Lastly, for Qatar, wealth index was not available, and residence was also excluded because all participants reported living in urban residence.

Results

Unadjusted prevalence of child supervised by another child. Figure 2 and Table 1 show the raw prevalence values of children supervised by another child across 80 countries, without missing cases ($N = 553,709$). Barbados was excluded because convergence was not reached. See Supplementary Materials for the unadjusted prevalence across 81 countries with missing cases included (Table S1).

In the East Asia and Pacific (EAP) region, results showed that between 3.1% (Thailand) to 14.9% (Timor-Leste) of children under

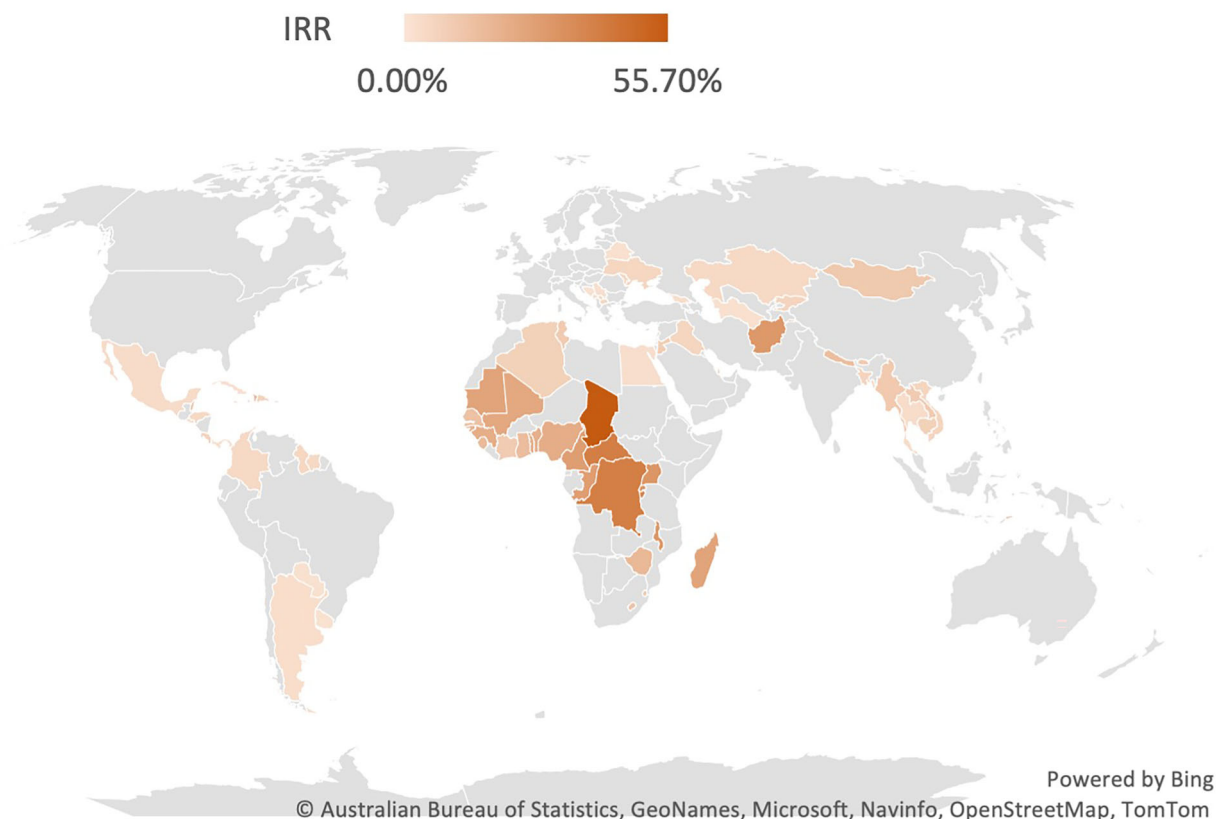


Fig. 2 Unadjusted prevalence of children supervised by another child ($N = 553,709$).

five were supervised by another child under ten. Mongolia, Myanmar, Kiribati, Samoa, and Laos reported higher prevalence of around 10%.

In Europe and Central Asia (ECA), results showed that countries in this region generally had a lower prevalence of children supervised by another child of the ages in focus compared to other regions, such that the lowest was 1.1% (Bosnia and Herzegovina) and the highest was 6.5% (Kyrgyzstan).

In the Eastern and Southern Africa (ESA) region, results revealed higher prevalence rates ranging from 10.2% (Eswatini) to 37.3% (Burundi). Other countries with high rates of children supervised by another child in this region were Uganda, Rwanda, and Malawi, which were around 30%.

In Latin America and the Caribbean (LAC), we observed similar results to prevalence rates found in EAP, with the lowest being 0.4% (Trinidad and Tobago) and the highest being 16.8% (Haiti). Belize also had a higher prevalence rate in this region, with 12.1% of children supervised by another child.

In the Middle East and North Africa region (MENA), results showed similar prevalence rates to EAP and LAC, ranging from 2.7% (Egypt) to 11.2% (Palestine). Tunisia also had a higher prevalence rate in this region (10.3%).

In South Asia (SA), like ESA, results showed relatively higher rates of children supervised by another child ranging from 6.4% (Bangladesh) to Afghanistan (30.4%). Among these countries, Nepal also had higher rates around of 15%.

Lastly, the highest prevalence of children supervised by another child was found in the West and Central Africa (WCA) region. Results showed that the lowest prevalence rate in the region was 9.6% (The Gambia) and the highest both in this region and across all countries was 55.7% (Chad). We also observed high prevalence rates in Central African Republic and Congo, which were around 40%.

Adjusted prevalence of child supervised by another child.

Figure 3 and Table 2 show the prevalence of children supervised by another child across 63 countries ($N = 516,629$), adjusted by mother's education and control variables (see "Measures" section). The following countries were excluded as they presented problems of convergence due to small number in the outcomes, which made multivariable analyses unstable: Belarus, Belize, Bosnia-Herzegovina, Costa Rica, Cuba, Georgia, Jamaica, Moldova, Montenegro, Serbia, Saint Lucia, Trinidad and Tobago, Turkmenistan, Turks and Caicos, Tuvalu, Ukraine, and Uruguay.

In EAP, after adjusting for the seven control demographic variables, results showed that between 1.1% (Samoa) to 6.3% (Kiribati) of children were supervised by another child. In general, we observed lower prevalence of children supervised by another child. For example, while Timor-Leste had the highest unadjusted prevalence (14.9%), the risk of being supervised by another child was reduced to 6.2% after accounting for other variables. However, results showed higher prevalence in the unadjusted versus the adjusted models for Thailand and Tonga.

In ECA, results demonstrated lower prevalence of children supervised by another child for most countries in the region after adjusting for demographic variables, such that values were close to zero. As a result, after excluding countries with very low prevalence rates, the lowest rate was 0.2% (Kazakhstan) and the highest was 5.6% (Macedonia). For Macedonia, results showed higher prevalence in the unadjusted versus the adjusted model.

In ESA, adjusted results also demonstrated lower prevalence of children supervised by another child after adjusting for demographic variables for all countries. Rates ranged between 8.5% (Lesotho) to 26.8% (Uganda).

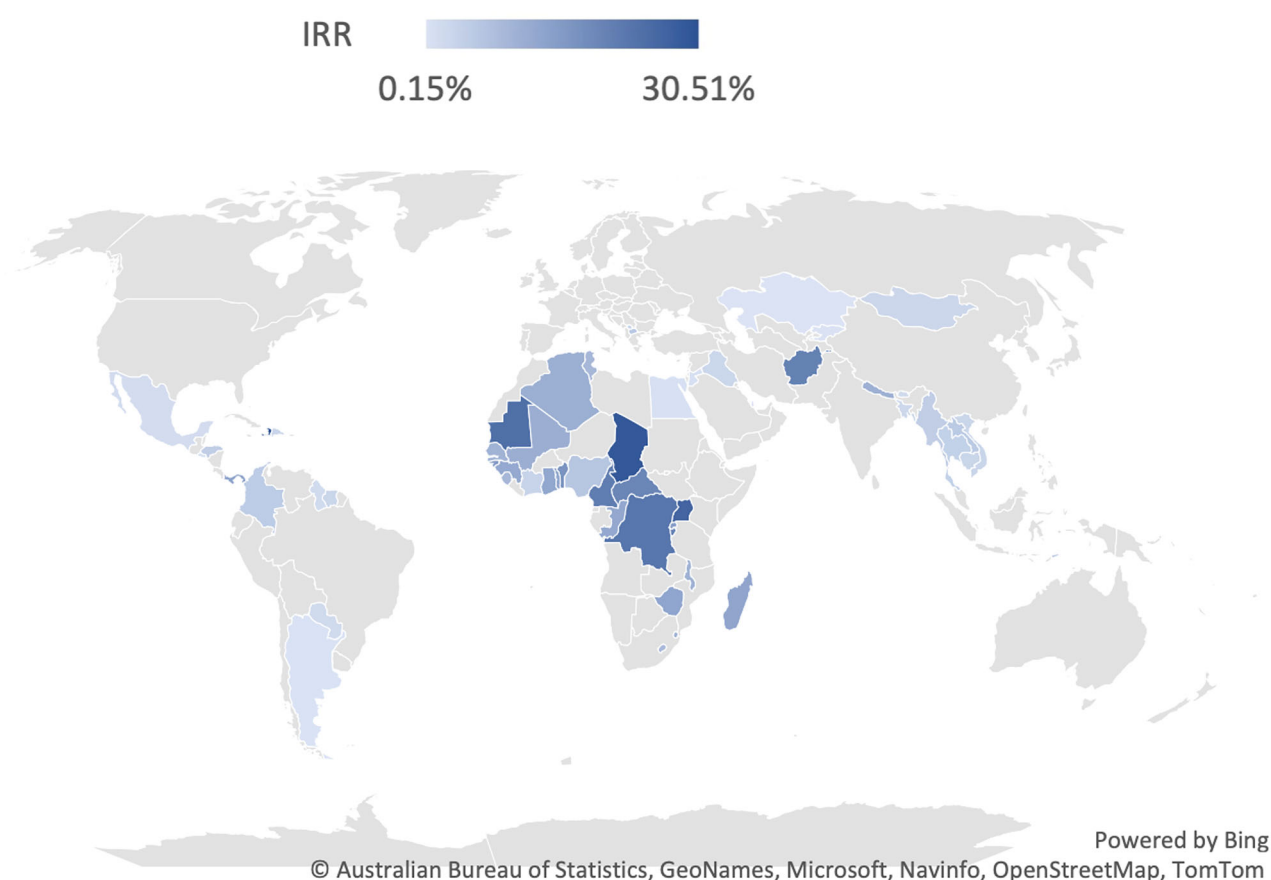
In LAC, like previous regions, we observed lower prevalence of children supervised by another child after adjusting for

Table 1 Unadjusted prevalence of children aged <5 years at home supervised by another child <10 years grouped by region.

Region	Country	Survey	Child-to-child supervision (%)	N
East Asia and Pacific (EAP)	Cambodia	DHS7 - 2014	7.80	6872
	Kiribati	MICS6 - 2018-19	10.24	2050
	Laos	MICS6 - 2017	9.90	11,002
	Mongolia	MICS6 - 2018	11.00	5789
	Myanmar	DHS7 - 2015-16	10.63	4537
	Samoa	MICS6 - 2019-20	10.00	2471
	Thailand	MICS6 - 2019	3.10	10,732
	Timor-Leste	DHS7 - 2016	14.90	4115
	Tonga	MICS6 - 2019	5.63	1223
	Tuvalu	MICS6 - 2019-20	6.90	433
	Vietnam	MICS5 - 2014	5.90	3186
Europe and Central Asia (ECA)	Belarus	MICS6 - 2019	2.10	3476
	Bosnia and Herzegovina	MICS4 - 2011-12	1.10	2266
	Georgia	MICS6 - 2018	3.00	2482
	Kazakhstan	MICS5 - 2015	4.55	5405
	Kosovo	MICS6 - 2019-20	5.90	1522
	Kyrgyzstan	MICS6 - 2018	6.50	3366
	Republic of North Macedonia	MICS6 - 2018-19	4.56	1497
	Moldova	MICS4 - 2012	4.70	1756
	Montenegro	MICS6 - 2018	2.96	1124
	Serbia	MICS6 - 2019	2.30	1804
	Turkmenistan	MICS6 - 2019	1.90	3647
Eastern and Southern Africa (ESA)	Ukraine	MICS4 - 2012	5.60	4280
	Burundi	DHS7 - 2016-17	37.30	12,395
	Lesotho	MICS6 - 2018	12.80	2559
	Madagascar	MICS6 - 2018	25.70	11,958
	Malawi	MICS5 - 2013-14	30.60	17,998
	Rwanda	DHS7 - 2017	30.67	7403
	Eswatini	MICS5 - 2014	10.20	2225
	Uganda	DHS7 - 2016	31.29	13,850
	Zimbabwe	MICS6 - 2019	17.80	5506
Latin America and Caribbean (LAC)	Argentina	MICS6 - 2019-20	3.00	5900
	Barbados	MICS4 - 2012	-	-
	Belize	MICS5 - 2015-16	12.10	2442
	Colombia	DHS6 - 2010	4.50	16,930
	Costa Rica	MICS6 - 2018	6.52	3524
	Cuba	MICS6 - 2019	1.81	5109
	Dominican Republic	MICS6 - 2019	6.62	7934
	El Salvador	MICS5 - 2014	1.56	7100
	Guyana	MICS6 - 2019-20	5.24	2611
	Haiti	DHS7 - 2016-17	16.84	3881
	Honduras	MICS6 - 2019	4.45	8071
	Jamaica	MICS4 - 2011	0.54	1540
	Mexico	MICS5 - 2015	3.50	7894
	Panama	MICS5 - 2013	1.69	5472
	Paraguay	MICS5 - 2016	1.80	4394
	Saint Lucia	MICS4 - 2012	2.90	274
	Suriname	MICS6 - 2018	4.50	3733
	Trinidad and Tobago	MICS4 - 2011	0.40	1124
	Turks and Caicos Islands	MICS6 - 2019-20	0.70	274
Middle East and North Africa (MENA)	Uruguay	MICS4 - 2012-13	1.40	1525
	Algeria	MICS6 - 2018-19	7.80	14,728
	Egypt	DHS6 - 2014	2.66	15,349
	Iraq	MICS6 - 2018	6.10	16,497
	Jordan	DHS7 - 2017-18	9.20	5265
	Palestinian National Authority	MICS6 - 2019-20	11.20	6302
	Qatar	MICS4 - 2012	4.86	1961
	Tunisia	MICS6 - 2017	10.30	3376
South Asia (SA)	Afghanistan	MICS4 - 2010-11	30.40	13,967
	Bangladesh	MICS6 - 2019	6.40	22,789
	Bhutan	MICS4 - 2010	9.50	5939
	Maldives	DHS7 - 2016-17	9.80	2997
	Nepal	MICS6 - 2019	15.40	6509
West and Central Africa (WCA)	Benin	MICS5 - 2014	20.80	11,612
	Cameroon	DHS6 - 2011	27.90	5327
	Central African Republic	MICS6 - 2018-19	40.80	8105

Table 1 (continued)

Region	Country	Survey	Child-to-child supervision (%)	N
	Chad	MICS6 - 2019	55.70	19,898
	Congo	DHS6 - 2011-12	28.30	8495
	Democratic Republic of the Congo	MICS6 - 2017-18	40.70	19,925
	Ivory Coast	MICS5 - 2016	10.30	8416
	Gambia	MICS6 - 2018	9.60	9386
	Ghana	MICS6 - 2017-18	15.53	8119
	Guinea	MICS5 - 2016	21.60	6813
	Guinea-Bissau	MICS6 - 2018-19	19.10	4008
	Mali	MICS5 - 2015	24.00	15,139
	Mauritania	MICS5 - 2015	26.00	9626
	Nigeria	MICS5 - 2016-17	22.10	26,273
	São Tomé and Príncipe	MICS6 - 2019	13.54	1727
	Senegal	DHS7 - 2017	13.97	11,329
	Sierra Leone	MICS6 - 2019	16.60	10,516
	Togo	MICS6 - 2017	20.70	4655

**Fig. 3** Adjusted prevalence of children supervised by another child ($N = 516,629$).

demographic variables, with values ranging from 0.5% (El Salvador) to 30.5% (Haiti). However, there was higher prevalence in the adjusted compared to the unadjusted prevalence rates for Colombia, Haiti, Honduras, and Panama. Moreover, Haiti was the country with the highest percentage of children supervised by another child both in the unadjusted and the adjusted models.

In MENA, the prevalence rates were consistently lower in the unadjusted models compared to the adjusted models. After adjusting for demographic variables, the percentage of children supervised by another child were between 0.6% (Qatar) and

10.8% (Algeria). The only country with higher prevalence in the unadjusted versus adjusted results was Algeria.

In SA, for all countries in the region, we observed lower prevalence rates when accounting for demographic variables. The percentage of children supervised by another child ranged between 2.7% (Bangladesh) to 20.5% (Afghanistan).

Finally, in WCA, consistent with the pattern observed in other regions, results showed lower prevalence of children supervised by another child after adjusting for demographic variables, except for Gambia and Sao Tome and Principe. The lowest prevalence

Table 2 Adjusted prevalence of children aged <5 years at home supervised by another child <10 years grouped by region.

Region	Country	Survey	Child-to-child supervision (%)	N
East Asia and Pacific (EAP)	Cambodia	DHS7 - 2014	3.21	6872
	Kiribati	MICS6 - 2018-19	6.33	2050
	Laos	MICS6 - 2017	5.43	11,002
	Mongolia	MICS6 - 2018	2.93	5789
	Myanmar	DHS7 - 2015-16	4.77	4537
	Samoa	MICS6 - 2019-20	1.13	2471
	Thailand	MICS6 - 2019	4.05	10,732
	Timor-Leste	DHS7 - 2016	6.22	4115
	Tonga	MICS6 - 2019	6.03	1223
	Vietnam	MICS5 - 2014	3.23	3186
Europe and Central Asia (ECA)	Kazakhstan	MICS5 - 2015	0.15	5405
	Kosovo	MICS6 - 2019-20	3.37	1522
	Kyrgyzstan	MICS6 - 2018	0.34	3366
	Republic of North Macedonia	MICS6 - 2018-19	5.56	1497
Eastern and Southern Africa (ESA)	Burundi	DHS7 - 2016-17	19.97	12,395
	Lesotho	MICS6 - 2018	8.51	2559
	Madagascar	MICS6 - 2018	12.78	11,958
	Malawi	MICS5 - 2013-14	10.14	17,998
	Rwanda	DHS7 - 2017	14.49	7403
	Eswatini	MICS5 - 2014	9.97	2225
	Uganda	DHS7 - 2016	26.75	13,850
	Zimbabwe	MICS6 - 2019	12.97	5506
Latin America and Caribbean (LAC)	Argentina	MICS6 - 2019-20	0.50	5900
	Colombia	DHS6 - 2010	5.02	16,930
	Dominican Republic	MICS6 - 2019	3.12	7934
	El Salvador	MICS5 - 2014	0.48	7100
	Guyana	MICS6 - 2019-20	1.84	2611
	Haiti	DHS7 - 2016-17	30.51	3881
	Honduras	MICS6 - 2019	4.77	8071
	Mexico	MICS5 - 2015	1.58	7894
	Panama	MICS5 - 2013	13.36	5472
	Paraguay	MICS5 - 2016	1.99	4394
Middle East and North Africa (MENA)	Suriname	MICS6 - 2018	3.19	3733
	Algeria	MICS6 - 2018-19	10.78	14,728
	Egypt	DHS6 - 2014	0.83	15,349
	Iraq	MICS6 - 2018	2.94	16,497
	Jordan	DHS7 - 2017-18	0.90	5265
	Palestinian National Authority	MICS6 - 2019-20	1.29	6302
	Qatar	MICS4 - 2012	0.56	1961
	Tunisia	MICS6 - 2017	8.96	3376
South Asia (SA)	Afghanistan	MICS4 - 2010-11	20.48	13,967
	Bangladesh	MICS6 - 2019	2.69	22,789
	Bhutan	MICS4 - 2010	1.96	5939
	Maldives	DHS7 - 2016-17	3.62	2997
	Nepal	MICS6 - 2019	10.52	6509
West and Central Africa (WCA)	Benin	MICS5 - 2014	16.61	11,612
	Cameroon	DHS6 - 2011	21.25	5327
	Central African Republic	MICS6 - 2018-19	19.44	8105
	Chad	MICS6 - 2019	29.31	19,898
	Congo	DHS6 - 2011-12	12.41	8495
	Democratic Republic of the Congo	MICS6 - 2017-18	22.78	19,925
	Ivory Coast	MICS5 - 2016	3.57	8416
	Gambia	MICS6 - 2018	10.16	9386
	Ghana	MICS6 - 2017-18	12.55	8119
	Guinea	MICS5 - 2016	12.18	6813
	Guinea-Bissau	MICS6 - 2018-19	14.73	4008
	Mali	MICS5 - 2015	10.90	15,139
	Mauritania	MICS5 - 2015	24.22	9626
	Nigeria	MICS5 - 2016-17	6.26	26,273
	São Tomé and Príncipe	MICS6 - 2019	17.77	1727
	Senegal	DHS7 - 2017	9.87	11,329
	Sierra Leone	MICS6 - 2019	8.95	10,516
	Togo	MICS6 - 2017	12.19	4655

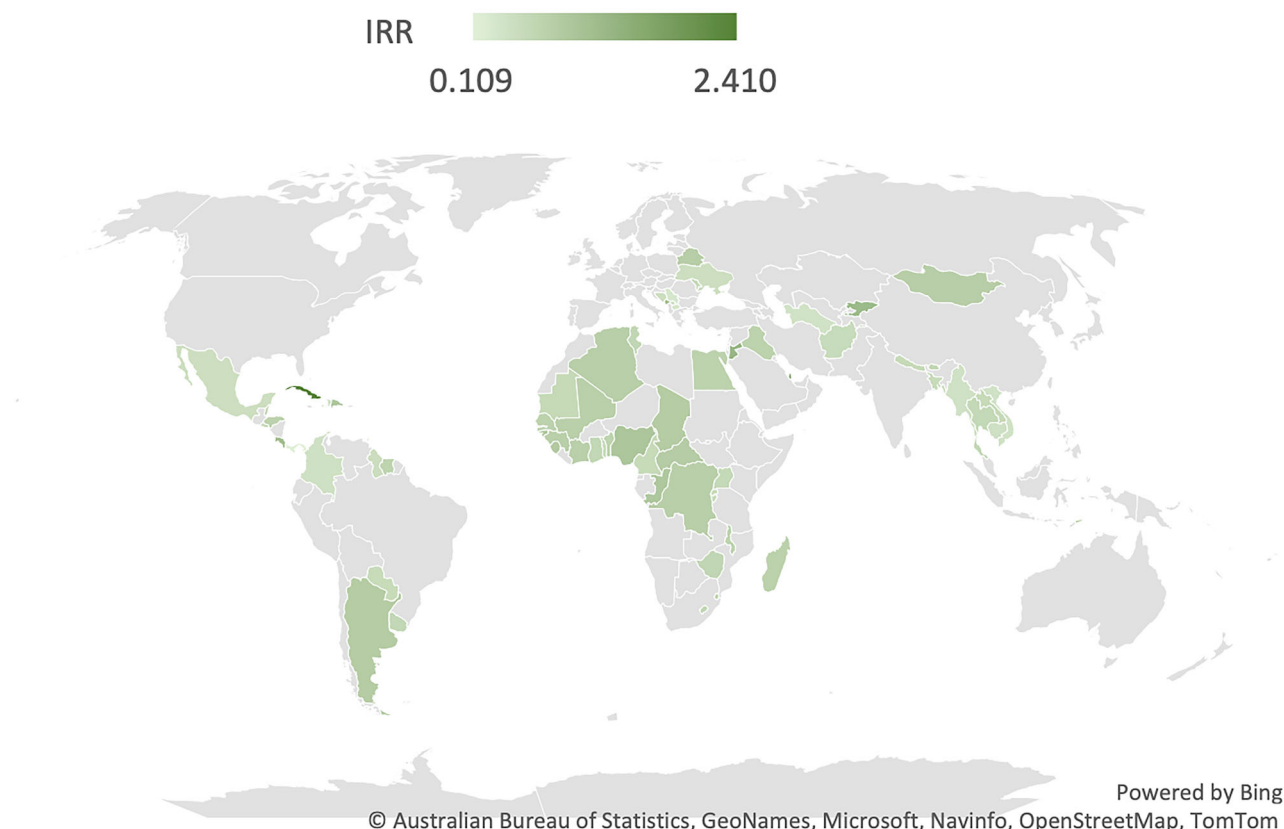


Fig. 4 Prevalence of children supervised by another child adjusted for maternal education ($N = 543,086$).

rate for this region was 3.6% (Ivory Coast) and the highest was 29.3% (Chad).

Mother's education. Figure 4 and Table 3 show the IRR and the confidence intervals of the association between a child supervised by another child and maternal education across 75 countries, without missing cases ($N = 543,086$). Barbados, Georgia, Jamaica, Kazakhstan, Tonga, and Turks and Caicos were excluded because they did not produce valid estimates. See Supplementary Materials for results with missing cases included ($N = 566,442$) (Table S1).

Overall, results revealed that higher maternal education (Secondary and above) was associated with lower prevalence rates of children supervised by another child. This pattern was observed across most countries in all regions. Interestingly, we observed that this was the opposite for a few countries (i.e., Cuba, Qatar, Samoa, Maldives, Jordan, Kyrgyzstan, Costa Rica, Montenegro), where lower maternal education (Primary and below) was associated with lower prevalence rates of children supervised by another child. The analyses per region should be replicated here.

Discussion

Prevalence of children caring for other children. Results from this study provide evidence that many children under 5 years spend time supervised by another child younger than 10 years without an adult around. While in some countries this phenomenon was uncommon (e.g., under 1% in Trinidad and Tobago, Jamaica, and Turks and Caicos Islands), in others, such as Burundi, Central African Republic, and the Democratic Republic of the Congo, more than one-third of children under 5 years of age are reported to spend time home alone supervised by

a child under 10 years of age. In Chad, that proportion reaches 55%.

Several factors may contribute to this care arrangement. Many countries—though not all, with high prevalence of child-to-child supervision are facing or have faced structural situations of instability following conflict or natural disaster (e.g., Afghanistan, Burundi, Chad, Nepal, Palestine, Rwanda, and Timor-Leste). Indeed, the breakdown of family-support services may compound customary practices of shared care involving young people as caregivers. Social and cultural norms as well as parents' experiences and circumstances influence their attitudes about the appropriate age at which a child can be left under the supervision of another child or in charge of a younger sibling (Park, 2019). According to a study done by Wei et al. (2021) in Taiwan, non-adult supervision can be conceptualized in terms of taking on adult-like roles; a practice that aligns with cultural expectations surrounding children's contributions to supporting their parents and younger siblings. Cultural norms and values can also explain different views on child-to-child supervision (van der Hoek, 2021). Archard (1993) for example argues that societies that have followed a different historical trajectory to Western Europe and North America do not make such clear-cut distinctions between children and adults. In West Africa for example research has shown that the distinction made between the phase of adulthood and that of childhood in much of Western Europe and North America is not as clearcut (Nsamenang, 1992, 2004). This has implications for conceptualizations of both adulthood and childhood and the roles each are supposed to play in their society (Twum-Danso, 2009; Twum-Danso Imoh, 2022; Twum-Danso Imoh and Okyere, 2020). Moreover, in many societies today, including those in Sub-Saharan Africa, transitions from childhood and adulthood are not based on chronological age, but instead on key markers that have been passed down from

Table 3 Predictors of child supervised by another child (incidence rate ratio) by mother's level of education (lowest vs. highest), unadjusted and adjusted.

Region	Country	Education (baseline model without missing) 95% CI ^a			N	Education (full adjusted model without missing) 95% CI ^a			N
		IRR ^a	LCI ^a	UCI ^a		IRR ^a	LCI ^a	UCI ^a	
East Asia and Pacific (EAP)	Cambodia	0.416	0.292	0.594	6872	0.677	0.467	0.982	6872
	Kiribati	0.540	0.343	0.849	2050	0.687	0.434	1.088	2050
	Laos	0.541	0.462	0.634	11,002	0.863	0.721	1.033	11,002
	Mongolia	0.807	0.489	1.334	5789	0.916	0.591	1.420	5789
	Myanmar	0.404	0.300	0.544	4537	0.701	0.508	0.968	4537
	Samoa	1.442	0.637	3.265	2471	1.537	0.619	3.819	2471
	Thailand	0.591	0.359	0.972	10,732	0.646	0.379	1.103	10,732
	Timor-Leste	0.759	0.617	0.933	4115	0.949	0.726	1.240	4115
	Tuvalu	0.577	0.222	1.504	433	0.810	0.274	2.394	433
	Vietnam	0.380	0.270	0.535	3186	0.759	0.527	1.093	3186
Europe and Central Asia (ECA)	Belarus	0.817	0.465	1.436	3476	0.984	0.554	1.750	3476
	Bosnia and Herzegovina	0.454	0.237	0.867	2266	0.699	0.289	1.689	2266
	Kosovo	0.421	0.185	0.958	1522	0.558	0.285	1.095	1522
	Kyrgyzstan	1.195	0.149	9.601	3366	1.411	0.173	11.521	3366
	Republic of North Macedonia	0.309	0.109	0.874	1497	0.312	0.110	0.884	1497
	Moldova	0.548	0.125	2.400	1756	1.401	0.198	9.924	1756
	Montenegro	1.113	0.205	6.060	1124	1.422	0.199	10.169	1124
	Serbia	0.292	0.111	0.767	1804	0.296	0.080	1.094	1804
	Turkmenistan	0.375	0.052	2.722	3647	0.549	0.067	4.493	3647
	Ukraine	0.463	0.048	4.447	4280	2.065	0.205	20.759	4280
Eastern and Southern Africa (ESA)	Burundi	0.499	0.432	0.578	12,395	0.653	0.554	0.768	12,395
	Lesotho	0.607	0.474	0.776	2559	0.948	0.716	1.255	2559
	Madagascar	0.738	0.659	0.826	11,958	0.978	0.874	1.094	11,958
	Malawi	0.681	0.612	0.758	17,998	0.856	0.771	0.949	17,998
	Rwanda	0.514	0.431	0.614	7403	0.713	0.583	0.873	7403
	Eswatini	0.651	0.481	0.882	2225	0.931	0.671	1.291	2225
	Uganda	0.574	0.506	0.653	13,850	0.858	0.759	0.970	13,850
	Zimbabwe	0.649	0.569	0.741	5506	0.874	0.759	1.007	5506
Latin America and Caribbean (LAC)	Argentina	0.839	0.395	1.781	5900	0.988	0.448	2.182	5900
	Belize	0.652	0.477	0.891	2442	0.623	0.446	0.871	2442
	Colombia	0.417	0.341	0.510	16,930	0.562	0.444	0.711	16,930
	Costa Rica	1.134	0.640	2.010	3524	1.035	0.623	1.719	3524
	Cuba	2.410	0.302	19.220	5109	2.486	0.281	21.471	5109
	Dominican Republic	0.960	0.718	1.284	7934	1.112	0.806	1.533	7934
	El Salvador	0.503	0.296	0.853	7100	0.769	0.356	1.659	7100
	Guyana	0.474	0.273	0.821	2611	0.845	0.518	1.377	2611
	Haiti	0.448	0.347	0.580	3881	0.570	0.435	0.747	3881
	Honduras	0.711	0.554	0.911	8071	0.820	0.616	1.092	8071
	Mexico	0.459	0.312	0.676	7894	0.758	0.476	1.206	7894
	Panama	0.109	0.055	0.217	5472	0.143	0.035	0.577	5472
	Paraguay	0.533	0.286	0.994	4394	0.759	0.459	1.254	4394
	Saint Lucia	0.172	0.032	0.930	274	0.197	0.012	3.166	274
	Suriname	0.673	0.438	1.033	3733	0.910	0.512	1.617	3733
	Trinidad and Tobago	0.446	0.045	4.418	1124	0.761	0.047	12.254	1124
	Turks and Caicos Islands	4.668	0.358	60.894	274	0.586	^b		274
	Uruguay	0.606	0.214	1.713	1525	0.462	0.176	1.216	1525
Middle East and North Africa (MENA)	Algeria	0.785	0.666	0.926	14,728	0.813	0.691	0.958	14,728
	Egypt	0.708	0.520	0.963	15,349	0.973	0.718	1.318	15,349
	Iraq	0.714	0.565	0.903	16,497	0.817	0.625	1.068	16,497
	Jordan	1.279	0.753	2.172	5265	1.497	0.864	2.593	5265
	Palestinian National Authority	0.727	0.573	0.921	6302	0.968	0.747	1.255	6302
	Qatar	1.769	0.661	4.731	1961	1.693	0.640	4.475	1961
	Tunisia	0.636	0.508	0.796	3376	0.853	0.643	1.130	3376
South Asia (SA)	Afghanistan	0.537	0.426	0.678	13,967	0.794	0.635	0.992	13,967
	Bangladesh	0.533	0.473	0.600	22,789	0.827	0.727	0.940	22,789
	Bhutan	0.618	0.450	0.849	5939	1.247	0.914	1.701	5939
	Maldives	1.415	0.855	2.343	2997	1.122	0.645	1.951	2997
	Nepal	0.547	0.475	0.630	6509	0.801	0.686	0.936	6509
West and Central Africa (WCA)	Benin	0.685	0.581	0.808	11,612	0.910	0.757	1.096	11,612
	Cameroon	0.540	0.443	0.657	5327	0.765	0.637	0.920	5327
	Central African Republic	0.848	0.758	0.948	8105	0.943	0.833	1.066	8105

Table 3 (continued)

Region	Country	Education (baseline model without missing) 95% CI ^a			N	Education (full adjusted model without missing) 95% CI ^a			N
		IRR ^a	LCI ^a	UCI ^a		IRR ^a	LCI ^a	UCI ^a	
	Chad	0.840	0.780	0.906	19,898	0.901	0.834	0.973	19,898
	Congo	0.938	0.801	1.099	8495	1.009	0.851	1.197	8495
	Democratic Republic of the Congo	0.789	0.724	0.860	19,925	1.000	0.927	1.080	19,925
	Ivory Coast	0.764	0.562	1.040	8416	0.892	0.646	1.231	8416
	Gambia	0.711	0.577	0.875	9386	0.786	0.630	0.982	9386
	Ghana	0.606	0.508	0.722	8119	0.832	0.699	0.989	8119
	Guinea	0.766	0.640	0.915	6813	0.921	0.753	1.125	6813
	Guinea-Bissau	0.880	0.669	1.158	4008	0.838	0.637	1.102	4008
	Mali	0.784	0.649	0.947	15,139	1.012	0.831	1.233	15,139
	Mauritania	0.564	0.476	0.668	9626	0.706	0.587	0.850	9626
	Nigeria	0.970	0.900	1.046	26,273	1.150	1.052	1.258	26,273
	São Tomé and Príncipe	0.535	0.406	0.705	1727	0.640	0.476	0.861	1727
	Senegal	0.706	0.566	0.881	11,329	1.076	0.869	1.333	11,329
	Sierra Leone	0.870	0.743	1.019	10,516	0.991	0.836	1.174	10,516
	Togo	0.498	0.387	0.639	4655	0.761	0.589	0.982	4655

^aCI confidence interval, IRR incidence rate ratio, LCI lower confidence interval, UCI upper confidence interval.

^bVariance matrix non-symmetric or highly singular, CIs not generated.

one generation to the next for hundreds of years, such as motherhood (in the specific case of girls) or economic independence (for boys in particular) (Nsamenang, 2004; Tafere and Chuta, 2020; Twum-Danso Imoh, 2019). Nonetheless, whereas some studies have shown that non-adult supervision practices vary due to the distinct gender roles (e.g., girls provided more child care and domestic work compared to boys (Becker and Sempik, 2019; Joseph et al. 2019; Wikle et al. 2018), others have found that there is no significant difference between boys and girls in terms of caring activities (Järkestig-Berggren et al. 2019).

Children of immigrant parents, as well as children of working or single parents may be more likely to experience home alone and non-adult supervision (Klassen et al. 2022; Londoño et al. 2022; Wikle et al. 2018). Sometimes, children may experience parentification, which occurs when children are expected to provide care in a manner that exceeds their capacities and abilities (Masiran et al. 2023). However, it is also important to note that the allocation of chores to children may follow a stepwise, non-random process in many communities. Studies by Nsamenang (1992, 2004), Serpell (1993), Lancy et al. (2010), and Punch (2001) illustrate that families communities put in place mechanisms to assess a child's maturity and capability by assessing the tasks that they can complete, giving a more complex one only when they master simple ones. This continues until they can undertake the same level of tasks as adults do. A child's caring experience is shaped by the roles and responsibilities assigned to them, which may include basic care, household chores, helping a younger sibling with homework assignments, and assisting with other tasks when parents are unavailable or busy (Kline and Killoren, 2022; Ruiz-Casares and Rousseau, 2010). Moreover, in some places a key tenet in the construction of childhood is that children are expected to provide care and to have responsibilities. It is not just part of socialization processes, but it is embedded in conceptualizations of childhood due to notions of mutual duty, reciprocal obligations that underpin both intergenerational and intra generational relations (Kassa, 2017; Twum-Danso Imoh, 2022). As a result, there is evidence that children can develop a positive perception of caretaking if they are supported and validated by their parents (Masiran et al. 2023) or communities (Lancy et al. 2010; Nsamenang, 1992, 2004; Serpell, 1993).

Finally, other factors contributing to child-to-child supervision include sudden changes in the family such as illness, the separation of parents, or the death of the main carer (e.g., due to HIV/AIDS or conflict). These circumstances have led to the emergence of child-headed households in LMIC, particularly in Sub-Saharan Africa (Chademana and van Wyk, 2021; Goronga and Mampane, 2021; Leu et al. 2018), either as a result of caregivers' disposition or children's own decisions (Ruiz-Casares, 2009; Ruiz-Casares et al. 2018b). Sibling care may be a necessity, as extended families are not always able to fill in the absence of parents since they may have also lost adults (Ndlovu, 2020). The decline and stagnation of care by extended families within contexts characterized by HIV/AIDs has been documented widely (Chademana and van Wyk, 2021; Inbaraj et al. 2020). All in all, the importance of studying child supervision in context cannot be understated. Even more so considering likely variations in people's understanding of what being "home alone" means (e.g., with no adult? or child? in the same room? or housing unit?). Policies and programs to support child supervision also need to be responsive to needs and circumstances in each setting.

Maternal education and children caring for other children.

Studies examining caregivers' attitudes toward non-adult supervision and its impact on children's well-being typically involve mothers. Our findings show that in most LMIC, more maternal formal education is associated with lower prevalence of children supervising other children without the presence of an adult. The protective nature of formal education may be at least partly explained by raising awareness of risks of inadequate supervision and of alternative childcare options. Education may influence parents' perception of children's skills and maturity to undertake child supervision. For instance, findings from a study in India showed that caregivers with more years of formal education and higher socioeconomic status reported better knowledge about unintentional childhood injuries and were more likely to engage in preventive measures; 93% of participants in the study were mothers (Inbaraj et al. 2020). Additionally, more educated caregivers may know of and be able to access good-quality day-care centers due to having higher salaries or employment benefits. More educated mothers may also be more likely to be working in

the formal sector and therefore be away from home for more than one hour at a time. They may also have a larger support network through their spouse or their employment or professional circles, able to provide more supervision to children in their absence (Du et al. 2019).

Eight countries across all regions outside the African continent display the opposite trend, namely higher maternal education is associated with more young children being supervised by other children when adults are not around. This is the case of Kyrgyzstan and Montenegro in ECA, Costa Rica and Cuba in LAC, Jordan and Qatar in MENA, Samoa in EAP, and Maldives in SA. An earlier study conducted by Ruiz-Casares et al (2018b) found lower incidence rate ratios of number of days children were supervised by another child in relation to mother's education in Costa Rica, Jordan, and Montenegro but not in Cuba; the other countries were not part of their study sample. It is difficult to explain this pattern of association because these countries do not all share the same traits impinging on child-to-child supervision. Human development index scores in these countries range from medium to very high (0.69–0.85), with Kyrgyzstan having the lowest score and Qatar having the highest (UNDP, 2021). Migration, economic factors, and employment opportunities may contribute to child-to-child supervision in some of these countries. For instance, in Kyrgyzstan, economic challenges such as unemployment and insufficient income have led many highly educated and qualified individuals to engage in labor migration to provide for their families (Critelli et al. 2021). While adult members of the extended family often take on caring responsibilities, children—particularly adolescent girls, frequently bear the burden of assisting with household chores and taking care of their younger siblings. This raises concerns about the quality of supervision these children receive and should be considered in future studies of maternal education and child care in this context.

Studies conducted with mothers of infants in Jordan (Alzoubi et al. 2018) and Qatar (Mraweh et al. 2022) revealed higher awareness of child abuse, home injury, and safety measures among mothers with higher levels of education. Nonetheless, these studies also documented widespread lack of awareness of relevant national laws and social services (the former); and first aid, injury prevention, safety measures and materials, and the proper age at which children can do certain activities on their own (the latter). Moreover, in a study in Türkiye, mothers occasionally left them unsupervised despite believing that their 0–3-year-old children were at moderate or higher risk of injury (Aslan and Parlatan, 2021), and two-thirds of parents in the study in Qatar believed that supervision by siblings was a safe practice (Mraweh et al. 2022). Besides highlighting the importance of raising awareness of proper safety measures and adequate supervision (Aslan and Parlatan, 2021), these findings surface the need to better understand the social and cultural context in which formally educated parents make childcare arrangements as women with higher levels of formal education may prefer child-to-child supervision over other childcare arrangements wherever children are commonly requested to supervise for learning purposes and as a way to balance family relations and value everyone's contribution to the family.

Women across education levels can face difficulty balancing work and caring responsibilities. The existence of social interventions such as family policies to facilitate access to daycare can provide crucial alternatives to children staying home alone or with young siblings. Arranging for alternative childcare can be challenging for working mothers, including growing numbers in female- and single mother-headed households in countries such as Costa Rica (Gindling and Oviedo, 2008) and Cuba (Stavropoulou et al. 2020). Even for stay-at-home mothers, if women are

heavily occupied (e.g., with household chores) their lack of availability for childcare may result in inadequate child supervision (Siu et al. 2019). Of course, attention needs to be paid to the implementation of these policies as current social assistance programs and free daycare and preschool services have been described to fall short of the needs of the population, for example in Cuba (Stavropoulou et al. 2020) and Montenegro (Bošković et al. 2021) (e.g., overcrowded or not accept children under 2 years- old). In consequence, many mothers have no choice but to leave their child with a family member—including children, search for private daycare, or even take the child to work. In Samoa, Brinkman et al. (2017) identified higher level of mother's education as a major contributor to enhancing child development and the presence of someone at home who can take care of the child, as one of the reasons not to send children aged 2–5 years to early childhood education centers. Whether these alternative caregivers must be adults or not is unclear. Moreover, in their study of family policies in Montenegro, Bošković et al. (2021) posit that policies such as long and well-paid maternity leave may not result in better child care and supervision as they may negatively affect career prospects for mothers. Whether and how this applies to women across the formal education continuum needs to be further studied.

Effective programs to support child supervision. Social protection programs aimed at removing structural barriers to childcare and enhancing capacity to supervise can enhance child care and wellbeing. Interventions addressing structural barriers to adequate supervision include, for instance, policies to increase minimum wage or to facilitate flexible working schedule, access to early childhood education and paid parental leave (Li and Zhang, 2023). There is accumulating evidence of the positive effects of such interventions on child health and development (Heymann et al. 2017; Nandi et al. 2016; Ponce et al. 2018), even if the extent to which those extend to the informal economy and any effects on child-to-child supervision require more research. Equally necessary is the evaluation of specific interventions—both programs and policies, aimed at addressing those barriers over-time and in a range of different contexts in LMIC.

Several interventions showed promise on increasing maternal awareness of risks and adequate supervision practices. The extent to which those curve supervision of children by other children, however, is not studied. During a study conducted in Egypt, Aly (2020) offered training sessions to both first-time and experienced mothers about how to prevent and respond to common home injuries. As a result of this intervention, both groups of mothers showed notable improvements in various domains such as active supervision and knowledge of emergency interventions. The education level of most participants, however, was very high (84% of first-time mothers and 63% of experienced mothers had a university education). Some studies and programs targeted mothers with lower levels of formal education in other contexts. For instance, studies in Egypt (Ayed et al. 2021), Iran (Cheraghi et al. 2014), and Guatemala (Domek et al. 2019) reported increases in mothers' knowledge of safety behaviors for young children. None of these studies explored whether these interventions have any impact on the occurrence and frequency of child-to-child supervision. Moreover, oftentimes, studies only use self-report measures and do not explore the effects of the training on supervision practices or outcomes. Notably, a study conducted in Canada, authors examined the effectiveness of a program called Supervising for Home Safety on mothers' supervision behaviors (Morrongiello et al. 2013). As part of this program, mothers were taught about children's physical and cognitive development stages, risk factors for home injuries, and ways to improve safety

behaviors by addressing barriers to adequate child supervision. Findings demonstrated that this program led to an increase in supervision among mothers of children aged 2–5.5 years and a reduction in the amount of time children were left unattended. More research like this is needed, particularly in LMIC contexts. Educating mothers about the importance of adequate supervision may ultimately reduce inadequate supervision, but more research is needed to examine this relationship.

Few studies exist on interventions aimed at preparing children for safe caregiving behaviors. Some programs exist in high-income countries, yet most have not been evaluated and they generally target children older than 10 years (Ruiz Casares and Kilinc, 2021). A rare offering for younger children, Safe Sibs is an online program offered to children aged 7–11 years and their younger siblings (2–5 years) in Canada to enhance the supervision knowledge and practices of child supervisors (Schell et al. 2015). Along with improved supervision knowledge, child supervisors who participated in the program demonstrated improved proactive safety behaviors when caring for younger siblings. In societies where child-to-child care are normative practices, learning to provide childcare often happens gradually and informally as children take increasingly complex tasks and responsibilities. Nonetheless, interventions to enhance the knowledge and skills of child supervisors and supervisees can contribute to preventing injuries and promoting healthy child development. This is the case, for instance, of Careful Cubs, a program in Uganda that helps grade one students recognize hazards and engage in personal safety behaviors (Swanson, 2022). This is an area that deserves attention by program designers and researchers alike, particularly in LMIC. As mentioned earlier, though, a priority in research and intervention must go beyond enhancing individual knowledge and rather establish the environmental conditions and supports that children need to thrive such as access to early childhood education programs.

Strengths and limitations. This study used rigorous methods to analyze nationally representative information from many LMIC. It is further unique by addressing the supervision of very young children. An interdisciplinary team with expertise in sociology, child development, and child rearing in a range of cultural contexts contributed diverse perspectives needed towards the interpretation of the complex phenomenon under study.

Several limitations must be noted. First, regarding the dataset, analyses were performed separately by country rather than pooled due to variations in sampling and weights. Only countries with publicly available datasets in July 2021 were included in our study. The datasets excluded children supervising other children without adults in non-household settings such as in orphanages or in the streets. Second, regarding survey respondents, in MICS, information was provided by mothers or caregivers of children under 5 years, while information was provided by biological mothers in DHS. This may have influenced the provision of information about orphans and foster children as well as respondent's perceptions of the child ability to supervise/be supervised by another child. The use of dialects and local childcare norms may have influenced respondents' answers too, particularly in contexts where children supervising other young children is not considered adequate care. This is despite standardization and translation of tools and training of enumerators on non-biased questioning. Third, low prevalence of children supervised by other children in some countries resulted in their exclusion in some analyses and wide confidence intervals. Fourth, pertaining comparable variables, disparate education systems across countries forced us to group different levels of education yet may hide differences within those groups

as well as countries. Similarly, lack of indicators across all countries to measure relevant variables such as maternal employment, immigration status, and childhood injuries limit our ability to perform global analyses. Particularly relevant will be to incorporate immigration and employment besides marital status in future models to explain the risk of child-to-child supervision. For instance, to explore whether higher maternal education provides single mothers with better employment opportunities while also forcing them to prioritize work over caring for their children since earning a better income ensures financial stability, and how this may be linked to changes in child-to-child supervision. Future analyses should look at this information within countries and regions, as natural disasters, political violence, and presence/absence of family-support policies may help explain child-to-child supervision patterns. Also needed are targeted qualitative studies to understand how these associations unfold in specific contexts and not in others. At the individual level, since the child supervisor is unknown, it is not possible to assess whether gender, age, or ability influence this childcare arrangement or the impact that it may have on their wellbeing or education. Finally, seasonal variations in child supervision as well as data collection are not considered in our analyses yet may contribute to the interpretation of findings.

Conclusions

Population-based estimates from this study confirm that child-to-child supervision in the absence of adults occurs in most LMIC. We hope these results will provide the basis for future studies on this phenomenon as the link between the risk of child-to-child supervision and further learning and health outcomes, beyond the risk of injuries, is grossly understudied. Whereas maternal education seems to be protective in most countries, there are notable exceptions. We need to determine what socioeconomic and other factors may influence caregivers' decision to leave their children under the supervision of another child when adults are not around. Maternal education alone cannot provide the full picture. To assist with the interpretation of these findings, research focused on context (e.g., policies and practices surrounding parental employment) and socio-cultural norms (e.g., status of children and expectation regarding caretaking across age and sex groups) are needed in these settings. The overwhelming majority of studies that focus on interventions intended to improve mothers' knowledge about appropriate supervision focus primarily on home injuries without adequately exploring how these interventions may impact the frequency and incidence of child-to-child supervision. There is also an urgent need to develop and evaluate interventions aimed at educating children on proper and safe supervision practices in LMIC.

Data availability

The datasets generated during and/or analyzed during the current study were obtained online and are available in UNICEF (<https://mics.unicef.org/>) and DHS (<https://dhsprogram.com/>) websites.

Received: 14 March 2024; Accepted: 8 May 2025;

Published online: 21 May 2025

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Acknowledgements

Thank you to Emmanuelle L. Bolduc, Sol Park, Emilia Gonzalez, and Yinan Yu for assistance with the MICS and DHS databases. This study was funded by Insight Grant 435-2020-0685 by the Social Sciences and Humanities Research Council of Canada (SSHRC - CRSH).

Author contributions

Conceptualization: MR-C, JIN-M; Methodology: JIN-M, MR-C, MJ; Formal analysis and investigation: RYF, RI; Writing—original draft preparation: MR-C, RYF, NZ; Writing—review and editing: MR-C, RYF, NZ, RI, MJ, AT-DI, JIN-M; Validation: RYF, JIN-M; Resources: MR-C, MJ, AT-DI, JIN-M; Supervision: MR-C, JIN-M. All authors have revised the paper for important intellectual content and have read and agreed to the present version of the paper.

Competing interests

The authors declare no competing interests.

Ethical approval

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of the McGill University Faculty of Medicine and Health Sciences (protocol code A09-E84-09B) on September 28, 2009 and the Ethics Board of Toronto Metropolitan University (protocol code 2022-421) on November 7, 2022.

Informed consent

Participants' consent was not obtained since this study consisted on secondary analysis of MICS and DHS survey datasets that are publicly available and fully anonymized.

Additional information

Supplementary information The online version contains supplementary material available at <https://doi.org/10.1057/s41599-025-05008-2>.

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