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Original research paper

JELENA ČVOROVIĆ
Institute of Ethnography SASA, Belgrade
jelena.cvorovic@ei.sanu.ac.rs

Stunting, Maternal Investment, and Early Child Development in Serbian Roma Children Aged 36–59 Months*

Stunting has shown negative associations with poor child developmental indicators. However, in poor ethnic minority populations the evidence for associations of anthropometric growth indicators and child development is limited. This study examined associations between stunting, height for age z scores (HAZ) and other determinants, with Early Child Development (ECD) among children in poor Roma communities. Publicly available data from Multiple Indicator Cluster Surveys for Serbian Roma settlements were used to assess a cohort of 1075 Roma children aged 36–59 months. Indicators of child growth and nutrition included children's HAZ scores and stunting. ECD assessed physical, learning/cognition, literacy/numeracy and socio-emotional developmental domains. Multiple regressions were used to assess the association between HAZ and stunting with ECD, controlling for maternal and child confounders. Sum score for ECD in Roma children was low, and 18% of children were stunted. After adjusting for potential confounders, HAZ and stunting revealed no significant associations with developmental outcomes. Instead, increasing maternal investment was positively associated with overall ECD score and higher scores in each of the individual developmental domains, except socio-emotional. In a low-resource setting, maternal investment appeared a good predictor of child development: it may buffer against the effects of poverty and stimulate child development.

* Ethical approval: This study used the existing collections of data from UNICEF's fifth and sixth MICS (2014 and 2019) for Serbian Roma settlements that contain only non-identifiable data about people (e.g. publicly accessible records, available at http://mics.unicef.org/surveys).

Key words: stunting, maternal investment, early child development, Roma

Заостајање у развоју, улагање мајки и рани развој ромске деце узраста 36–59 месеци

Заостајање у расту је негативно повезано са показатељима раног развоја детета. У сиромашним популацијама етничких мањина докази о повезаности показатеља антропометријског раста и развоја детета су ограничени и недовољно испитани. Ово истраживање се бави повезаношћу између заостајања у расту, телесне висине за дати узраст (HAZ) и других показатеља, и раног развоја детета (ECD) међу децом у сиромашним ромским заједницама. Јавно доступни подаци из УНИЦЕФ-а MICS за ромска насеља у Србији коришћени су за процену кохорте од 1075 ромске деце у доби 36–59 месеци. Показатељи раста и стања ухрањености обухватају телесну висину за дати узраст (HAZ) и заостајање у развоју за више од две стандардне девијације у односу на референтну групу. Рана скала развоја (ECD) процењује физичке домене, учење/спознавање, писменост/рачунање и социо-емоционални развој. Вишеструка регресија је коришћена за процену повезаности између HAZ и заостајања у развоју са ECD, контролишући остале варијабле мајки и деце. Збирни резултат за ECD ромске деце је низак, а 18% деце заостаје у развоју. Резултати показују да HAZ и заостајање у развоју нису значајно повезани са развојним исходима. Уместо тога, повећање мајчинског улагања позитивно је повезано са укупним резултатом ECD-а и већим скоровима у сваком од појединачних развојних домена, осим социо-емоционалног. У условима сиромаштва и ограничених ресурса, родитељско улагање мајки показало се као добар предиктор развоја детета, са могућношћу ублажавања последица сиромаштва и стимулације развоја деце.

Кључне речи: заостајање у развоју, мајчино улагање, рани развој детета, Роми

INTRODUCTION

The early childhood years are essential for development of language, cognitive, emotional, social, and physical skills (McCoy et al. 2016; Nguyen et al. 2018). Compromised early child development may occur as a com-

bination of biological and psychosocial risk factors, aggravated by poverty. Numerous studies have shown that stunting (height-for-age z score < −2SD as per the median of WHO reference population), an indicator of chronic malnutrition, is associated with developmental setbacks; consequently stunting has been often used as a proxy indicator of health and development (Jeong et al,, 2019; McGovern et al. 2017; Kang et al. 2018; Sudfeld et al. 2015; Miller et al. 2016; Black et al. 2019). However, the specific causes of poor developmental outcomes remain poorly understood as recent studies found physical growth to be a poor indicator of child development (Tran et al. 2019; Prado et al. 2019).

Exposure to poverty and its associated factors during early life might govern child early nutritional status and development by partly overlapping paths, while both conditions may be influenced by home environment, i.e., caregiving practices (Prado et al. 2019; Berger et al. 2009). Thus, caregiving behaviors, especially maternal investment, can promote early child development and mitigate the effects of risks such as growth failure, through direct and indirect processes (Black et al. 2017). Maternal (parental) investment is taken as any cost (e.g. time) associated with raising offspring that reduces the maternal ability to produce or invest in other offspring (Trivers 1972). Thus, maternal investment reflects readiness and ability to invest the following in a particular child: allocation of resources in terms of energy, money and time, including time spent performing activities with children, e.g. reading and playing (Cobb-Clark et al. 2019). The latter are those investments that enhance child well-being over and above that which is necessary to ensure survival alone, i.e., surplus resources, in contrast to base level resources required for basic survival and adequate health, such as in-utero nutritional transfers, practices such as protection, breastfeeding, food allocation, preventing and health seeking behaviors (Downey 2001; Sear 2011). In order to survive, all children need base resources; however, mothers can choose to allocate surplus resources differentially between children. Maternal investment depends on a number of maternal and child factors, such as age, ethnicity, birth spacing, family size, and resource availability (Lycett & Dunbar 1999). Differential maternal investment can also entail excessive costs for the well-being of children growing up in poverty, as they are exposed to multiple risk factors, including nutritional deprivation, Thus, a high-risk, resource poor environment affects maternal conditions, and may influence overall investment, resulting in reduced maternal effort overall (Quinlan 2007). However, the association between child development and growth, and maternal investment in ethnic minority populations, is still not well understood (Čvorović 2020; Van Mourik, et al. 2017).

Roma are the largest European minority population, with high levels of exclusion and mass poverty. Owing to difficulties in assessing ethnicity, the Roma population is typically represented by a poorly documented health status (Čvorović 2014). Compared to non-Roma, Roma children often lag behind in development and nutritional outcomes, negatively influencing life outcomes and leading to an intergenerational cycle of poverty (UNICEF 2015). Across Europe, poverty, socio-cultural deprivation, but also poor school-performance, often result in the over-representation of Roma children in "special needs" schools (Cashman 2017; Peleg 2018; Čvorović 2014). Despite evidence of a high burden of developmental delays, the health status and development of Roma children are poorly understood, as information at the population level is scarce. Thus, further defining of the underlying causes of child developmental setbacks among the Roma is required to inform future intervention and studies aimed at improving child development and wellbeing. To address this aspect, this study assessed the associations between height-for-age and stunting with overall and multiple domains of early child development among Roma children aged 3 to 5 years, using Multiple Indicator Cluster Surveys (MICS) for Serbian Roma settlements and adjusting for maternal investment and other confounding factors.

METHOD

Study design

This is a secondary analysis of publicly available, aggregated data from UNICEF's fifth and sixth MICS (2014 and 2019) for Serbian Roma settlements (available at http://mics.unicef.org/surveys). The surveys include estimates on child health indicators at the national level, and separately for the Roma communities. Details regarding the surveys methodology can be found elsewhere (UNICEF 2015, 2019). MICSs include both child anthropometric and early child development data, along with elementary information on mothers, caregiving practices and households. Roma mothers reported on their children's age, gender, birth order, care and feeding practices, and parental stimulating caregiving activities.

The sample consisted of 1075 Roma children aged 36 to 59 months. 15% of children had missing data, which were tested with MCAR test (Little's Missing Completely at Random test), indicating missing at random ($\chi 2(27)=174.12$, $p=0.00$). Missing data were then estimated by separate multiple imputation regression models, including all other covariates as predictors. Statistical analyses were conducted in R (version 4.0.2).

Measures

Child development was estimated by the mother-reported Early Child Development (ECD) scale for children aged 36-59 months in the physical (two items), learning/cognition (two items), literacy/numeracy (three items) and socio-emotional developmental domains (three items) (UNICEF 2017). ECD scale included 10 questions (yes/no) on the four developmental domains. A composite score for ECD was made by summing up the number of positive responses across the literacy-numeracy, social-emotional, learning, and physical development domain items, with the total score ranging from 0 (least optimal development) to 10 (most optimal development) (UNICEF 2015). The ECD scale sum score as well as the scores for the four domain/subscales were then normalized to a z score (mean of 0 and standard deviation [SD] of 1). The internal consistency of the Roma child development scale in this sample was $\alpha = 0.41$, which is comparable with other recent studies using the same scale (Urke et al. 2018; Jeong et al. 2016).

Height-for-age z (HAZ) scores, severe and any stunting (z-scores below three and two standard deviations i.e., –3SD and –2SD from median of WHO's reference population), were used as indicators of child growth and nutritional status. Z-scores are indicators for child nutritional status as they measure the number of standard deviations from the median of the reference population by child age. Too small for age, i.e., stunting, reflects the health of the child: it is very likely that a stunted child has experienced malnutrition for a relatively long period (UNICEF 2015). As severely stunted children were likely exposed to malnutrition for an even longer period or in greater severity than other children, the two stunted groups were analysed separately to assess whether the strength of the association is affected by the severity of stunting (Miller et al. 2016).

The quality of mother-child interaction was used as a proxy for maternal investment in surplus resources (Čvorović 2020). Mother-child interaction was mother-reported, and refers to the types and number of activities a mother engaged in with her child over the past three days. A total of six activities, i.e., reading books or looking at picture books; telling stories to the child; counting or drawing with the child; singing songs/lullabies; taking the child outside the home, into a yard or park; and playing with the child, are regarded as the common proxies for quality parental-child interaction and essential to early cognitive development and socio-emotional well-being (Sun et al. 2016). The score of these activities ranged from 0 to 6 points, and similar to its use as a measure of parental

engagement in other studies, maternal investment was divided into three categories: low engagement (0–2 activities), moderate engagement (3–4 activities), and high engagement (5-6 activities) (Jeong et al. 2016; Bornstein & Putnick 2012). In this sample, internal consistency was α=0.67.

One way ANOVA and Chi-square test for independence were used to detect differences among Roma children based on their nutritional status (< -3SD, from -3SD to -2SD and >-2SD), across socio-demographic variables, maternal investment and standardized ECD and individual domains scores.

Multiple hierarchical regressions were conducted to determine associations between HAZ scores, any stunting and severe stunting with ECD, and four individual domain scores, adjusting for maternal investment (continuous) considered to be essential to child development, and other confounding variables, such as: maternal age (continuous);basic literacy skills (0- illiterate, 1-literate) and household access to improved toilet facility (0-unimproved, 1-improved) as proxies for socioeconomic status; marital status (0-not in a union, 1-in a union), parity (continuous); child's age in months (continuous); gender (0-girls, 1-boys); and birth order (continuous). Only pooled results and full models are shown. To assess the effects of severe and any stunting, independent variable height was dichotomized and categorized as 0-< -3SD and 1->-3SD and 0-< -2SD and 1->-2SD, while ECD and four individual domain sum scores were standardized.

Results

Table 1 presents descriptive statistics (original data) of 1075 Roma children aged 36-59 months and their mothers, and differences between children (pooled data) by nutritional status. The average child age was 47 months and there was an excess of boys (52.7%). Children were on average third born, with a mean HAZ score of less than zero (-0.99, SD=1.18, not shown). In the original sample, 18% were stunted (any stunting, -2SD) and 5% were severely stunted (-3SD). ECD score was low, at 1.59 out of 10 (ranges 1-7), while all four individual domains were on average less than one. Roma mothers were young at average of 24 years (age range 12-44), with an average of three children (range 1-10), more than one third were illiterate, and 17% lived in households without access to improved toilet facility.

There was no difference in maternal investment (continuous). Most mothers engaged moderately in activities with their children: the average level of investment was 3.33 (SD=1.61), while 7% (74) of mothers had no investment whatsoever (0 activities with a particular child). Frequencies

Table 1. Descriptive statistics (original data) and differences between children (pooled data) by nutritional status (n=1075)

	HAZ scores pooled data				
	Original data	< -3SD n=50.60	>-3SD to -2SD n=139.25	>-2SD n=885.15	p*
ECD score (standardized), M (SD)	1.59 (1.35)	0.05 (0.98)	-0.15 (1.01)	0.02 (1.00)	0.23
Literacy/numeracy, M (SD)	0.63 (0.84)	-0.08 (1.05)	-0.21 (0.86)	0.04 (1.01)	0.02
Physical, M (SD)	0.33 (0.48)	-0.06 (1.03)	0.01 (1.00)	0.00 (1.00)	0.94
Learning/cognition, M (SD)	0.09 (0.34)	0.05 (0.91)	0.07 (1.24)	-0.01 (0.96)	0.71
Socio-emotional, M (SD)	0.56 (0.76)	0.29 (1.12)	-0.06 (1.00)	-0.01 (0.99)	0.13
Basic literacy, n (%)					
illiterate	35.6	24.90 (49.21)	63.70 (45.75)	288.30 (32.57)	0.00
literate	64.4	25.70 (50.79)	75.55 (54.25)	596.85 (67.43)	
Maternal age, M (SD)	23.56 (5.78)	23.79 (5.30)	24.14 (5.70)	23.46 (5.80)	0.46
Type of toilet facility, n (%)					
Unimproved and open facility	16.8	11.10 (21.94)	27.90 (20.04)	141.55 (15.99)	0.12
Improved facility	83.2	39.50 (78.06)	111.35 (79.96)	743.60 (84.01)	
Maternal investment (continious), M (SD)	3.33 (1.61)	3.12 (1.54)	3.17 (1.53)	3.37 (1.63)	0.25
Maternal investment (categoricala), n (%)					
Low investment	6.9	4.25 (8.40)	10.85 (7.79)	58.90 (6.65)	0.02
Moderate investment	69.0	38.65 (76.38)	102.00 (73.25)	601.35 (67.94)	
High investment	24.1	7.70 (15.22)	26.40 (18.96)	224.90 (25.41)	
Marital status, n (%)					
not in union	9.5	5.50 (10.87)	16.70 (11.99)	79.30 (8.96)	0.25
in union	90.5	45.10 (89.13)	122.55 (88.01)	805.85 (91.04)	
Parity, M (SD)	3.26 (1.58)	3.77 (2.12)	3.45 (1.68)	3.22 (1.52)	0.05
Child gender, n (%)					
Male	52.7	22.75 (44.96)	68.15 (48.94)	417.10 (47.12)	0.55
Female	47.3	27.85 (55.04)	71.10 (51.06)	468.05 (52.88)	
Child;s age, M (SD)	47.56 (7.18)	45.71 (7.84)	46.09 (6.56)	47.89 (7.18)	0.01
Birth order, M (SD)	2.59 (1.59)	3.10 (2.00)	2.79 (1.70)	2.54 (1.54)	0.06

*p=≤ 0.05

for the activities with a child were not available, but only 20% of Roma mothers engaged in book reading, while the majority (58%) engaged in storytelling, song singing (57%), playing with (84%) and taking the child outside (81%), and 32% name counted or drew with the child.

There was a significant difference in maternal basic literacy in that severely stunted children were born to mothers with the highest proportion of illiteracy ($\chi 2(1, 303.61)=11.91$, $p=0.00$). Also, severely stunted children received reduced maternal investment compared to their counterparts ($\chi 2$ $(1, 3569.95)=5.27$, $p=0.02$). Well-nourished Roma children had a higher literacy/numeracy score than undernourished children ($F(2, 5833.55)=3.75$, $p=0.02$, small effect size $\eta 2=0.01$; children taller than -2SD (M=0.04, SD=1.01) and had a higher literacy/numeracy score compared to children who were below -3SD and -2SD,((M=-0.21, SD=0.86), $t(5247.27)=2.66$, $p=0.01$). Furthermore, well-nourished children were older than their counterparts ($F(2, 2026.67)=5.00$, $p=0.01$, small effect size $\eta 2=0.01$; children taller than -2SD (M=47.89, SD=7.18) and older compared to children below -3SD and -2SD(M=46.09, SD=6.58), $t(1278.82)=2.60$, $p=0.01$). There was no difference in ECD and four domain sum scores between the children in regard to nutritional status ($p>0.05$).

Table 2 presents the fully adjusted associations between children's nutritional status and growth (severe stunting, any stunting, individual-level HAZ scores), and ECD and individual domain z scores. In the fully adjusted models that controlled for maternal investment, socioeconomic position, marital status and parity, and child gender, age, and birth order, results revealed no significant associations between measures of nutritional status and growth with either ECD or individual domain z scores ($p>0.05$). Instead, there were statistically significant positive associations between maternal investment and ECD z-scores, and maternal investment and all individual domain z-scores except in the socio-emotional domain.

Thus, in the first model, maternal investment was significantly associated with ECD score ($\beta=0.20$; 95%CI, -3.36, 2.96; $p=0.03$): increased maternal investment was associated with an increase of 0.20 standard deviations in ECD score. Additionally, increase in child age was positively associated with ECD score ($\beta=0.29$; 95%CI, -13.78, 14.35; $p=0.00$): an increase in child's age was associated with an increase of 0.29 standard deviations in ECD score. In the second model, again, both maternal investment ($\beta=0.20$; 95%CI, -3.37, 2.96; $p=0.03$) and child age ($\beta=0.29$; 95%CI, -13.78, 14.35; $p=0.00$) were positively associated with ECD scores: an in-

Table 2. Fully adjusted models on children's severe stunting, any stunting, individual-level HAZ scores, and ECD and individual domain z scores (n=1075)

	HAZ -3SD		HAZ -2SD		HAZ CONTINIOUS									
	ECD				ECD		Literacy/ numeracy		Physical		Learning/ cognition		Socio-emotional	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
HAZ2	-0.12	(-0.54, 0.29)	-0.27	(-1.03, 0.47)	-0.65	(-2.98, 1.67)	-0.72	(-1.47, 0.03)	0.15	(-0.59, 0.90)	0.12	(-0.62, 0.88)	0.22	(-0.53, 0.97)
Basic literacy	-0.05	(-0.99, 0.88)	0.02	(-0.91, 0.96)	0.02	(-0.91, 0.96)	0.04*	(-0.89, 0.98)	0.00	(-0.93, 0.94)	-0.03	(-0.97, 0.90)	-0.00	(-0.94, 0.93)
Maternal age	0.56	(-10.75, 11.88)	0.52	(-10.80, 11.84)	0.43	(-10.88, 11.75)	1.11	(-10.22, 12.45)	0.42	(-10.91, 11.77)	0.16	(-11.17, 11.51)	-0.62*	(-11.96, 10.71)
Type of toilet facility	-0.00	(-0.73, 0.73)	-0.00	(-0.73, 0.73)	-0.00	(-0.73, 0.73)	0.00	(-0.73, 0.74)	-0.00	(-0.73, 0.73)	-0.00	(-0.73, 0.73)	-0.00	(-0.74, 0.73)
Maternal stimulation	0.20*	(-3.36, 2.96)	0.20*	(-3.37, 2.96)	0.21*	(-3.37, 2.95)	0.06*	(-3.23, 3.10)	0.10*	(-3.27, 3.06)	0.12*	(-3.28, 3.04)	0.11	(-3.28, 3.05)
Marital status	0.01	(-0.56, 0.59)	0.01	(-0.56, 0.59)	0.01	(-0.56, 0.59)	0.03	(-0.54, 0.60)	-0.01	(-0.59, 0.56)	-0.01	(-0.59, 0.56)	0.00	(-0.57, 0.57)
Parity	0.05	(-3.04, 3.15)	0.05	(-3.04, 3.15)	0.03	(-3.06, 3.13)	-0.14*	(-2.97, 3.25)	-0.10	(-3.21, 3.01)	0.04	(-3.06, 3.16)	-0.02	(-3.14, 3.08)
Child gender	-0.02	(-1.01, 0.95)	-0.02	(-1.01, 0.95)	-0.02	(-1.00, 0.96)	-0.06	(-1.05, 0.91)	-0.01	(-0.99, 0.97)	-0.00	(-0.98, 0.98)	0.02	(-0.96, 1.00)
Child's age	0.28*	(-13.78, 14.35)	0.28*	(-13.78, 14.35)	0.26*	(-13.80, 14.33)	0.29*	(-14.36, 13.77)	-0.85	(-14.91, 13.22)	0.76	(-13.29, 14.83)	0.87	(-13.19, 14.94)
Birth order	0.02	(-3.09, 3.14)	0.02	(-3.09, 3.14)	0.02	(-3.09, 3.14)	0.04	(-3.08, 3.17)	-0.00	(-3.12, 3.12)	-0.00	(-3.13, 3.12)	-0.00	(-3.13, 3.12)

*p=≤ 0.05

crease in maternal investment and child age were associated with an increase of 0.20 and 0.29 standard deviations in ECD score, respectively. In the third model, maternal investment (β=0.21; 95%CI, -3.37, 2.95; p=0.04) and child age (β=0.27; 95%CI, -13.80, 14.33; p=0.00) were positively associated with ECD score: an increase in maternal investment and child age were associated with an increase of 0.21 and 0.27 standard deviations in ECD score, respectively.

Furthermore, maternal investment was positively associated with child literacy/numeracy (β=0.07; 95%CI, -3.23, 3.10; p=0.00), physical (β=0.10; 95%CI, -3.27, 3.06; p=0.00) and learning/cognition ((β=0.12; 95%CI, -3.28, 3.04; p=0.02) domains: an increase in maternal investment was associated with an increase of 0.07, 0.10, and 0.12 standard deviations in ECD score, respectively.

In addition, child literacy/numeracy was also influenced by maternal education (β=0.04; 95%CI, -0.89, 0.98; p=0.01), parity (β=-0.14; 95%CI, -2.97, 3.25; p=0.00) and child age (β=0.29; 95%CI, -14.36, 13.77; p=0.00). Thus, children born to literate mothers scored higher for 0.04 standard deviations in literacy/numeracy than children with illiterate mothers; an increase in parity was associated with a decrease of 0.14 standard deviations in literacy/numeracy score, while older children scored 0.29 standard deviations higher than younger ones. Maternal age was negatively associated with child socio-emotional domain (β=-0.62; 95%CI, -11.96, 10.71; p=0.02): for this domain, increase in maternal age was associated with a decrease of 0.62 standard deviations.

DISCUSSION

This study examined the associations between child growth and nutritional status, expressed as height for age and stunting, with overall and multiple domains of early child development in a nationally representative sample of Serbian Roma children. While previous studies yielded inconsistent results regarding the relationships between child development, growth and nutrition (Abubakar et al. 2010; Miller et al. 2016; Tran et al. 2019), in this study, after adjusting for potential confounding factors, height for age z-scores and stunting had no significant associations with developmental outcomes. Instead, in fully adjusted models, increasing maternal investment was positively associated with overall ECD score and higher scores in each of the individual developmental domains (0.07 to 0.12 SD), except socio-emotional. These findings corroborate previous research on the positive influence of home environment on child development (Black et al. 2016; Luby 2015; Britto et al. 2017; Prado & Dewey

2014), and highlight the importance of assessing developmental outcomes as such, instead of using HAZ scores as a proxy measure for overall child development (Prado et al. 2019).

Roma children had a mean HAZ of less than 0 (-0.99) and 18% were stunted. In young children, height serves as an indicator of the cumulative effect of nutritional and health loads from conception (Wells et al. 2019). Some studies have shown that even children with HAZ >–2 may still have inadequate linear growth and that nutritional outcome measures may be positively correlated with health and development throughout the HAZ measures' range, without cut off effect at –2 SD or any other cut-point (Perumal et al. 2018). In contrast, for the Roma children in this sample, HAZ score and stunting had no effect on development; instead, and in spite of the potential negative effects of child low HAZ or stunting on development, increasing maternal investment buffered against low child development scores (Rubio-Codina et al. 2016; Obradović et al. 2016).

In turn, the ECD sum score for the Roma children was low, with the lowest in the learning/cognition domain. Many Roma children grow up in poverty, deprived of even basic needs, and the activities with children at home, such as reading of books or teaching them about letters and numbers, require not only actual books but also basic literacy and numeracy skills, which many Roma women lack (Čvorović 2020). Therefore, unsurprisingly, the majority of Roma mothers who invested in their children did so by means of playing, singing, and storytelling, while notably few engaged in book reading or name counting. However, these "non-instrumental" teaching practices were found to be beneficial to children's development and education, especially so in more traditional settings (McKeough et al. 2008; Isbell et al. 2004). Thus, for Roma children and many other disadvantaged children living in poverty, the extent of maternal investment appears to be critical for child well-being, regardless of activity type. Nonetheless, some children were more invested in than others, as mothers tend to differentiate their investment depending on the characteristics of both individual child and mother (Miedel & Reynolds 1999; Kaplan 1996). Poor genotypic and phenotypic quality of a child is regarded as the main factor influencing parental investment, in addition to environmental constraints (Clutton-Brock 1991). In this sample, illiterate Roma mothers had a higher share of severely stunted children, who received, on average, lower investment in comparison to their counterparts. In low-and-middle-income countries, maternal education has been positively associated with child health and development, facilitating maternal investment and practices at the same time (Walker et al. 2011). In this context, Ro-

ma maternal literacy, but not maternal investment, has been found to be positively associated with the socio-emotional domain, and the observed lack of association in this study may be due to the particular measures of socio-emotional development, which appear as untailored to culture and context more so than measures of other developmental domains (Wong et al. 2020; Miller et al. 2016). Additionally, socio-emotional development was negatively influenced by increasing maternal age, while parity lowered children's score in literacy/numeracy. Older Roma mothers tend to have more children, and the lower scores most likely reflect the decline of parental investment with each additional birth (Lawson & Mace 2011).

This is the first study of the associations between child growth, nutrition, parental investment and developmental outcomes in a Roma nationally representative sample, and adds to the literature about early child development in poor ethnic minority populations. The present study found no statistical evidence for association of height for age and stunting, and compromised child development. Instead, the findings point to other factors as underlying determinants of child development: consistent with previous studies, maternal investment appeared as a good predictor of child development, thus confirming the impact of the home environment on child development in a low-resource setting (Black et al. 2019). The findings of this study expand on these results by showing that in a limited parental literacy context, mother-child interactions, regardless of type of activity, may buffer against the detrimental effects of poverty and thus stimulate child development.

A number of common determinants influence both child growth and development, including insufficient nutrition, exposure to pathogens, poor access to resources and lack of parental investment (Tran et al. 2019). Early childhood development influences children's future health, education achievement and socioeconomic position (Nguyen et al. 2018). For many Roma children and their parents, suboptimal early development remains an ongoing challenge and thus investments in children's well-being should be prioritized within the family setting where maternal caregiving behaviors should be targeted for healthy child development.

The present study included several limitations: being a secondary analysis of existing MICS datasets and providing for only a limited range of mostly self-reported variables, it is susceptible to potential biases. This study used height-for-age and stunting as indicators for growth and nutrition, but other indicators, such as weight-for-age, weight-for-height or head circumference, may also be used (Tran et al. 2019). Furthermore, ECD in MICS was not observational but instead mother-reported and,

as such, has been shown to have limited adaptation to local culture and context (McCoy et al. 2017). In addition, the ECD questions for assessing literacy/numeracy were shown to be too advanced for 3- and 4-year-old children (McCoy et al. 2016) - this being particularly pertinent in regard to the Roma and other disadvantaged children, where home and parental literacy is limited.

Other potential confounders, such as mother's height and health status, child's weight at birth and breastfeeding practices were not collected. Also, some indicators of maternal investment and behavior measured may not be entirely appropriate for Roma culture or represent all the possible ways that mothers invest in their children's development. Thus, future research should focus on developing new set of indicators culturally relevant to the Roma that capture not only child early development and learning processes, but also maternal parenting style that may influence expectations for how children should behave and what mothers are supposed to do for their children (Nomaguchi & House 2013; Sincovich et al. 2019).

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