

## ORIGINAL ARTICLE

# Resources for nurturing childcare practices in urban and rural settings: Findings from the Colombia 2010 Demographic and Health Survey

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**Abstract**

**Background:** The health and development potential of young children is dependent on nurturing care (NC) provided by primary caregivers. NC encompasses attention to nutrition; symptom management; early learning, attachment, and socialization; and security and safety. Despite the importance of NC to child health and development, the measurement and study of NC are neglected. This has become a point of major concern in the public health field in low- and middle-income countries (LMICs) such as Colombia where many families are hard pressed for childcare resources. The aims of this study were therefore to (a) create age-specific NC summary indexes (0–5, 6–11, and 12–23 months) suitable for research in LMICs and (2) examine the relationship of NC to maternal resources.

**Methods:** 2010 Colombia Demographic and Health Survey data were obtained from mothers and their children ages 0–5 months ( $n = 1,357$ ); 6–11 months ( $n = 1,623$ ); and 12–23 months ( $n = 3,006$ ). Age-specific NC indexes were created including information on child feeding, immunization, hygiene, response to illness symptoms, and psychosocial care. Independent variables included mother's education level and household assets, and enrolment in a government child development programme. Regression analyses with NC as the outcome variable were conducted with urban and rural subsamples in the 3 age groups.

**Results:** Among rural children, NC was significantly higher with greater household assets, maternal decision latitude, and development programme participation, with variation by child age. Among urban children, higher maternal education and white-collar occupation also predicted higher NC, with some variation by age.

**Conclusion:** It is feasible to measure age-specific NC in survey research, and NC is related to maternal resources. Age and urban–rural differences in how NC is related to social factors are observed. The findings support the importance of subgroup analysis in the study of NC in LMICs such as Colombia.

**KEYWORDS**

childcare, Colombia, education, household wealth, maternal decision latitude, nurturing childcare, urban–rural residence

## 1 | INTRODUCTION

Nurturing care (NC) is a broad concept encompassing the child's fundamental dependency on others for its physical, mental, and social development (Black et al., 2016; Engle, Bentley, & Pelto, 2000; Harris, 1995). The study of NC is of increasing importance as public health attention is widening from "surviving to thriving" (Shonkoff, Radner, & Foote, 2016, p. 1; Black et al., 2016; Britto, Engle, & Super, 2013).

The totality of NC a child receives is potentially more important to its health and development than any particular care practice (Bradley & Caldwell, 1995; Ruel & Arimond, 2003). To illustrate, child malnutrition is affected by several care practices: the amount, quality, and age appropriateness of the food offered to the child (Engle et al., 2000; Nti & Lartey, 2007; Ruel, Levin, Armar-Klemesu, & Maxwell, 1999); the caregiver's feeding style (Engle et al., 2000; Nti & Lartey, 2007); and the ability of caregivers to manage child illness (Engle et al., 2000; Ruel et al., 1999).

Therefore, in addition to compartmentalized research focused on particular care behaviours, there are now calls for NC research using indexes that encompass the full span of essential childcare (Black et al., 2016; Britto et al., 2017; Richter et al., 2016; Woodhead, 2016).

A small literature has explored various ways to approach the development of NC indexes, either through care-domain-specific indexes (Armar-Klemesu, Ruel, Maxwell, Levin, & Morris, 2000; Garg & Chadha, 2009) or more complex indexes combining care domains (Amugsi, Mittelmark, Lartey, Matanda, & Urke, 2014; Nti & Lartey, 2008; Osorio, Bolancé, & Alca iz, 2013; Osorio, Bolancé, & Madise, 2015; Ruel et al., 1999). Armar-Klemesu et al. (2000), Amugsi et al. (2014), Nti and Lartey (2008), and Ruel et al. (1999) all used one or more care indexes in their studies of determinants of childcare (Armar-Klemesu et al., 2000; Peter & Kumar, 2014), or care as a determinant of child nutrition (Amugsi et al., 2014; Moursi et al., 2008; Nti & Lartey, 2008; Ruel et al., 1999). Armar-Klemesu et al. (2000) constructed separate feeding, preventive health seeking, and hygiene practice indexes. Amugsi et al. (2014) and Ruel et al. (1999) combined diet and prevention service use into one childcare index, and Nti and Lartey (2008) included in one index a wide range of care practices, comprising household and personal hygiene, immunization status, dietary diversity, caregiver responsiveness, and hygiene practices during feeding. Engle et al. (2000) further advanced childcare measurement by including the role of socioemotional care as a key component. Osorio et al. (2013, 2015) have constructed several indexes including, but not confined to, care practices; other domains in these indexes include material circumstances and living conditions, child illness, and health services utilization.

However, childcare indexes have only to a limited degree included aspects of psychosocial care, which is a key dimension of care for young children (Engle et al., 2000), or insufficient attention has been given to the age specificity of care requirements (Ministerio de Salud y Protección Social, 2016; WHO, 2008, 2015). To measure NC comprehensively, there is a need for indexes including the widest possible range of care domains, and also taking child age into consideration. The current paper contributes to this gap by creating age-specific NC indexes including psychosocial care aspects, in addition to diet; preventive health seeking; and hygiene practice aspects of care.

### Key messages

- We constructed an index to assess correlates of nurturing care among children aged 0–23 months in Colombia.
- Nurturing care was significantly associated with maternal education, decision latitude, household wealth, and registration in a childcare and development programme, but the associations varied depending on urban–rural residence and child age.
- We conclude that national child health surveys in low- and middle-income countries should consider expanding their measurement of childcare, particularly regarding psychosocial care, to at least the level accomplished by the 2010 Colombia Demographic and Health Survey to better assess care provision to young children.

In the delivery of NC, the role of the mother (and other primary caregivers) is pivotal and highly demanding. Childcare is a constant act of juggling needs and resources, in concert with all the other demands of family and communal life. Caregivers depend on a supportive social network and community infrastructure—and may be hard pressed—in low- and middle-income countries (LMICs) with widespread household and community hardship. The resources available to a mother contribute to the quality of care she is able to provide (Bradley & Caldwell, 1995; Engle et al., 2000; M. Ruel & Arimond, 2003) and include a woman's autonomy, physical and mental health, education, knowledge and beliefs, occupation, household assets, time availability, and social support (Engle et al., 2000). Many of these resources are significantly associated with specific care behaviours: infant feeding (Armar-Klemesu et al., 2000; Guldan et al., 1993; Ickes, Hurst, & Flax, 2015; Jones, 2015; Mallard et al., 2014; Nguyen et al., 2013; Peter & Kumar, 2014); immunization (Pande & Yazbeck, 2003; Thorpe, VanderEnde, Peters, Bardin, & Yount, 2016; Vikram, Vanneman, & Desai, 2012); handwashing practices (Schmidt et al., 2009; Scott, Lawson, & Curtis, 2007); prompt timing of professional treatment seeking (Sreeramareddy et al., 2006; Vikram et al., 2012), compliance with follow-up recommendations for sick children (Paranhos, Pina, & de Mello, 2011); and psychosocial aspects of caregiving (Bradley & Corwyn, 2005; Pande & Yazbeck, 2003; Peter & Kumar, 2014).

Urban compared with rural living is often associated with host of living condition differences that can influence the provision of childcare (Pande & Yazbeck, 2003; Smith, Ruel, & Ndiaye, 2005) and health (Fotso, 2006; Fox & Heaton, 2012; Urke, Bull, & Mittelmark, 2011). Hence, in research on childcare, it is advisable to study urban and rural contexts separately to understand intraurban and intrarural variations in child health and development (Fotso, 2006). Additionally, the presence of health promotion programmes in communities might influence care provision, such as child immunization campaigns, breastfeeding promotion, and broad-based maternal and child health initiatives (Carrillo, Iglesias, & Trujillo, 2014; Padilla & Trujillo, 2015).

Thus, NC is multidimensional, and the factors affecting families' ability to provide NC extend to community conditions and beyond.

This complexity is illustrated in Figure 1, which presents the conceptual model guiding this study. It is a socioecological model that explicitly focuses on NC as a proximal determinant of child health and development and provides guidance about what indicators should be considered in a summary index of NC.

Following from the above considerations, the aims of this study were to (a) create age-specific NC summary indexes (0–5, 6–11, and 12–23 months) suitable for research in LMICs and (b) examine the relationship of NC to maternal resources.

## 2 | METHODS

### 2.1 | Data and sample

The study used secondary data from the 2010 Demographic and Health Survey (DHS) collected in Colombia in 2010. DHS data are generally considered to be of very high quality (Pullum, 2008) and provide nationally representative data. This is obtained through a stratified two-stage

sampling design in which the first stage involved drawing clusters from a national sampling frame. The second stage was systematic selection of households from selected clusters (Ojeda, Ordóñez, & Ochoa, 2011). The present study is based on a subset of data from mothers aged 15–49 years and their youngest child aged 0–23 months. Children in DHS sample ages 24–59 months were excluded from the present analysis because DHS did not collect sufficient care data in this group. The weighted sample size was 5,986 mother–child dyads with the following child age distribution: 1,357 were 0–5 months; 1,623 were 6–11 months; and 3,006 were 12–23 months.

## 3 | MEASURES

### 3.1 | NC indexes

The care practices included in the NC indexes are considered essential to child development (Black et al., 2016; Bradley & Caldwell, 1995; Engle et al., 2000). Three NC indexes were constructed as age-specific

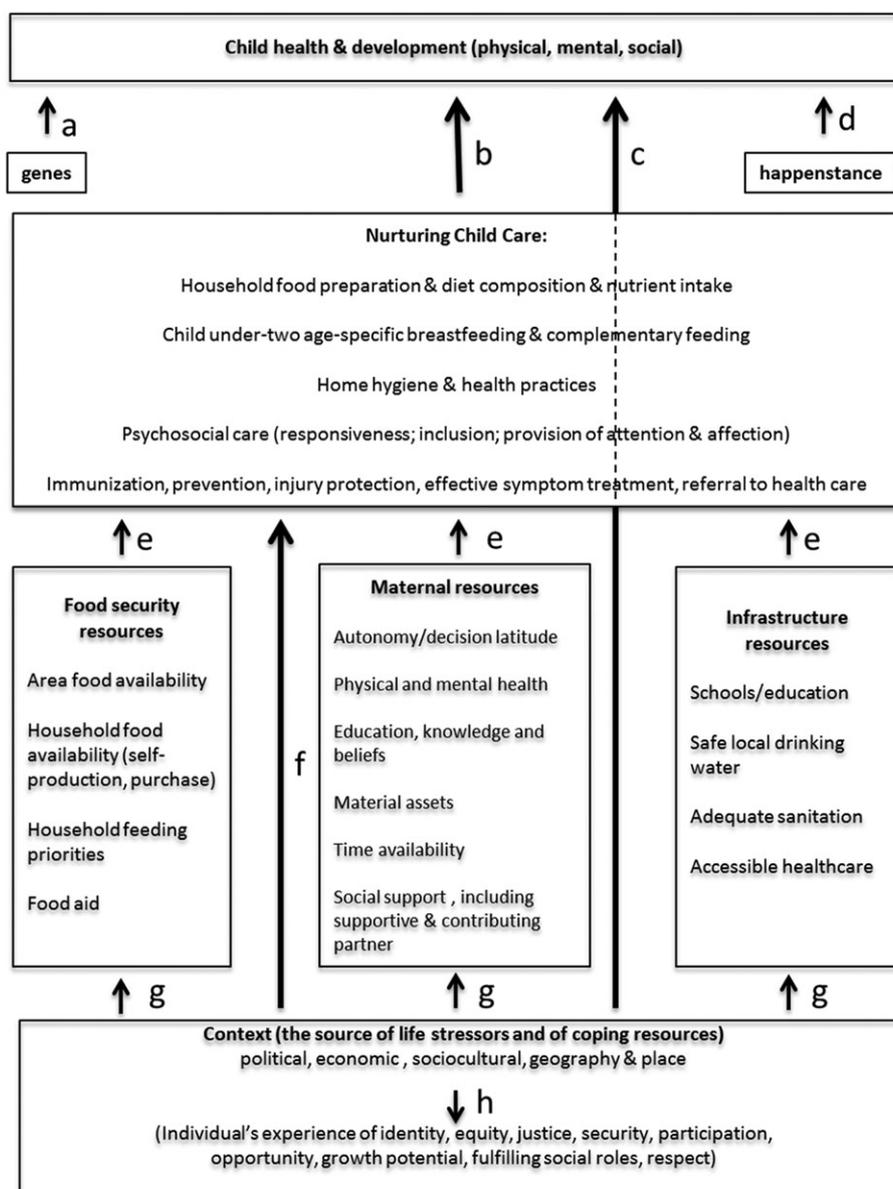


FIGURE 1 Model of childcare

sum scores for children 0–5 ( $M = 8.86$ ;  $SD = 1.81$ ; Cronbach's  $\alpha .41$  [urban sample .41, rural sample .38]); 6–11 ( $M = 10.25$ ;  $SD = 1.95$ ; Cronbach's  $\alpha .45$  [urban sample .45, rural sample .42]); and 12–23 ( $M = 11.10$ ,  $SD = 1.97$ , Cronbach's  $\alpha .47$  [urban sample .43, rural sample .51]) months. Each NC index consisted of 17 (0–5 months) and 18 (6–11 and 12–23 months) specific care practices based on mothers' reports, coded 0 = *care not received* and 1 = *care received*. Each item was equally weighted at 1 (with higher sum score indicating better childcare). See Table 1 for details. The internal consistency of the indexes was examined to see if Cronbach's alpha improved significantly by dropping items. Cronbach's alpha remained stable, and no items were dropped from the final indexes.

*Feeding* variables recorded whether infants 0–5 months were exclusively breastfed, and whether children 6–11 and 12–23 months received minimum acceptable diet based on age-specific dietary diversity and meal frequency recommendations (WHO, 2008).

An *immunization* variable measured whether the child was on track with respect to the WHO recommendations and the Colombian vaccination scheme, including BCG, DPT, polio, and measles (Ojeda

et al., 2011; WHO, 2015); *Hygiene* variables were handwashing after cleaning the baby and safe disposal of child feces (WHO & UNICEF, 2006).

*Treatment seeking* intentions were assessed with the following items: Would you take your child to a health care facility if the child (a) has diarrhoea/fever/vomits; (b) has short rapid breathing; (c) has cough or difficulty breathing; (d) eats or drinks very little; and (e) does not breastfeed or drink.

*Cognitive and socioemotional stimulation* were measured with an adapted version of the *Family Care Indicators* (FCI) instrument. Through five separate items, it assessed whether the past week prior to the survey a person older than 15 years engaged with the child in the following activities: (a) reading, (b) storytelling, (c) singing, (d) playing, and (e) going outside (Kariger et al., 2012). Adequate alternative caregiving in the absence of the mother was ascertained if (a) a child was not left alone or (b) a child was not left with a child younger than 10 years in the past week. The practice of child discipline with or without severe physical punishment was also included in the indexes based on definitions by UNICEF (2010).

**TABLE 1** Overview of variables included in the nurturing care index

Variable	Age group	Recommended practice, and coded 1 if confirmed by mother
Exclusively breastfed	0–6 months	Reported being fed breastmilk only
Minimum dietary diversity	6–11 and 12–23 months	Based on WHO recommendations: 6–11 months and breastfed: $\geq 4$ (out of 7) food groups per day 12–23 months and breastfed: $\geq 4$ (out of 7) food groups per day
Minimum meal frequency	6–8 and 9–23 months (later recoded into 6–11 and 12–23 months)	Based on WHO recommendations: 6–8 months and breastfed: $\geq 2$ meals per day 9–23 months and breastfed: $\geq 3$ meals per day 6–23 months: $\geq 4$ meals per day
Immunization	0–23 months	Based on national and WHO vaccination schemes: If mother reported or health card indicated that child had received all recommended vaccinations for her/his age
Treatment seeking intention	0–23 months	In case of diarrhoea, fever, or vomiting
Treatment seeking intention	0–23 months	In case of short rapid breathing
Treatment seeking intention	0–23 months	In case of cough or difficulty breathing
Treatment seeking intention	0–23 months	In case child eats or drinks very little
Treatment seeking intention	0–23 months	In case child does not breastfeed or drink
Cognitive and socioemotional stimulation	0–23 months	A person older than 15 years engaged in reading with the child the past week
Cognitive and socioemotional stimulation	0–23 months	A person older than 15 years engaged in storytelling with the child the past week
Cognitive and socioemotional stimulation	0–23 months	A person older than 15 years engaged in singing with the child the past week
Cognitive and socioemotional stimulation	0–23 months	A person older than 15 years engaged in playing with the child the past week
Cognitive and socioemotional stimulation	0–23 months	A person older than 15 years took the child outside the past week
Alternative caregiving	0–23 months	Child not left alone the past week
Alternative caregiving	0–23 months	Child not left with child younger than 10 years the past week
Child discipline	0–23 months	Child not punished with severe physical violence such as beating on the head, or beating with an object

### 3.2 | Resources and contextual variables

Maternal education was categorized as *no or primary education*; *incomplete secondary education*; and *complete secondary or higher education*. A scale measuring *maternal decision-latitude* was constructed as a sum score of seven dichotomous items addressing no or partly/full involvement in decision making on household and personal issues (own health care, large household purchases, daily household purchases, visits to family and friends, food to be cooked each day, own studies, and having sex). Cronbach's alpha for the decision-latitude scale was .76 ( $M = 5.31$ ,  $SD = 1.86$ ).

Material assets were measured with the DHS Wealth Index (37). Maternal occupation was coded *not working outside the home*; *agriculture or other manual work*; *sales*; *service work*; and *professional/administrative work*.

The Colombian government conducts the country-wide Child Growth, Development and Care Program. The 2010 Colombia DHS asked whether the child was registered in this programme or not. This variable was coded *no* = 0 and *yes* = 1.

Urban-rural residence was coded *urban* = 0 and *rural* = 1, *child sex* was coded 0 = *male* and 1 = *female*, and *child age* was grouped in the categories 0–5 months, 6–11 months, and 12–23 months.

**TABLE 2** Characteristics of the sample and adjusted F-statistic for difference between urban and rural samples, children 0–23 months. 2010 Colombia DHS

	Urban (N = 4,343) N (%)	Rural (1,643) N (%)	Adjusted F
Child age			.256
0–5 months	993 (22.9)	364 (22.2)	
6–11 months	1,166 (26.8)	457 (27.8)	
12–23 months	2,184 (50.3)	822 (50.0)	
Child sex			.301
Male	2,276 (52.4)	845 (51.4)	
Female	2,067 (47.6)	798 (48.6)	
Maternal age			32.631**
13–19	705 (16.2)	368 (22.4)	
20–29	2,307 (53.1)	836 (50.9)	
30–49	1,331 (30.6)	439 (26.7)	
Number of children born to the mother			81.838**
<3	3,279 (75.5)	1,002 (60.9)	
3+	1,064 (24.5)	642 (39.1)	
Maternal decision latitude			80.006**
0–4 decisions	1,041 (24.0)	560 (34.1)	
5–6 decisions	1,391 (32.0)	538 (32.7)	
7 decisions	1,912 (44.0)	545 (33.2)	
Maternal education			180.124**
No or primary education	712 (16.4)	754 (45.9)	
Incomplete secondary education	1,139 (26.2)	462 (28.1)	
Complete secondary or higher education	2,492 (57.4)	428 (14.7)	
Maternal occupation			70.263**
No work outside the home	563 (13.0)	418 (25.4)	
Work in agriculture or other manual work	283 (6.5)	281 (17.1)	
Sales	1,144 (26.3)	226 (13.7)	
Service	1,637 (37.7)	637 (38.7)	
Professional, thechnical, or administrative	716 (16.5)	82 (5.0)	
Wealth index quintiles			2,996.059**
Poorest	351 (8.1)	1,158 (70.5)	
Poor	926 (21.3)	471 (28.7)	
Middle	1,318 (30.3)	14 (0.9)	
Rich	1,041 (24.0)	0 (0.0)	
Richest	707 (16.3)	0 (0.0)	
Child registered in the Growth, Development and Care Program			4.838*
No	1,255 (28.9)	537 (32.7)	
Yes	3,088 (71.1)	1,106 (67.3)	

\* $p \leq .05$ . \*\* $p \leq .001$ .

Maternal age was treated as a continuous variable, and maternal parity was coded 0 = three or more children and 1 = less than three children.

### 3.2.1 | Missing data

There were no missing data on the maternal resource or sociodemographic variables. Some of the specific childcare practices had missing data: exclusive breastfeeding (4.2%), dietary diversity (1.8%), disposal of child stools (5.3%), and severe physical punishment (1.5%). This resulted in 11%, 9%, and 8% missing for the 0–5, 6–11, and 12–23 months NC indexes, respectively. In handling of missing data, pairwise deletion was used where possible, and list wise deletion was used where required by type of analysis, as was the case for the complex samples general linear modelling procedure in SPSS.

### 3.3 | Statistical Analyses

Descriptive analyses were conducted for all study variables. Independent sample *t* tests and cross-tabulations with adjusted *F*-statistics were carried out to compare the distributions of the NC in sociodemographic subgroups. Categorical principal components analysis was used to explore possible multidimensionality in the sets of variables used in constructing the NC indexes.

Age-stratified linear multiple regression analyses, using general linear modelling, were conducted separately for urban and rural samples. Possible interaction effects on NC were tested between maternal

education and maternal decision-latitude and maternal education and household wealth. Regression analyses were undertaken adjusted for survey design effects (sample weight, strata, and cluster).

Permission to use the Colombia DHS 2010 data was given upon approved application to the DHS programme. The DHS questionnaires and protocols were reviewed and approved by the Macro Institutional Review Board. Informed consent was obtained and anonymity assured before and during data collection (Ojeda et al., 2011).

## 4 | RESULTS

Table 2 presents descriptive statistics with urban–rural comparisons. The rural sample differed significantly from the urban sample by the mother having more children, the mother having lower education level, the mother not working outside the home, and children being less likely to be registered in the national Child Growth, Development and Care Program than their urban counterparts are.

Table 3 presents descriptive statistics for each childcare practice included in NC indexes. Large variation in carrying out the different practices was evident across all age groups. Some practices were more prevalent with age, for example, the prevalence of minimum acceptable dietary diversity was 52% for 6- to 11-month-olds, compared with 70% for 12- to 23-month-olds.

To investigate underlying care dimensions in the NC, categorical principal component analysis was used. The results, presented in

**TABLE 3** Frequency of carrying out care practices in 0- to 5-month, 6- to 11-month, and 12- to 23-month age groups<sup>a</sup>

	0–5 months (N = 1,357)		6–11 months (N = 1,623)		12–23 months (N = 3,006)	
	n (%)	Loadings	n (%)	Loadings	n (%)	Loadings
Exclusive breastfeeding <sup>b</sup>	1,110 (85.2)	-.244				
Minimum acceptable dietary diversity <sup>c</sup>			819 (51.5)	.425	2,081 (70.0)	.432
Minimum acceptable meal frequency <sup>c</sup>			1,162 (71.6)	.285	2,647 (88.0)	.308
On track with child immunization scheme	798 (58.8)	.047	1,071 (66.0)	.271	2,362 (78.6)	.052
Handwash after cleaning the baby	1,229 (90.5)	.179	1,531 (94.4)	.089	2,876 (95.7)	.088
Safe disposal of child stools	49 (3.7)	-.007	116 (7.4)	-.045	681 (23.4)	-.044
Take child to health facility if it has symptoms of						
Cannot breastfeed or drink	60 (4.4)	-.016	44 (2.7)	.083	51 (1.7)	.100
Diarrhoea/fever/vomiting	1,293 (95.3)	.005	1,519 (93.6)	.080	2,856 (95.1)	.097
Short breath	211 (15.6)	.109	277 (17.1)	.174	513 (17.1)	.133
Difficult with breathing	475 (35.0)	.011	594 (36.6)	.134	970 (32.2)	.096
Eats or drinks little	88 (6.5)	.091	89 (5.5)	.100	183 (6.1)	.106
A person older than 15 years in past 7 days engaged with child to						
Read stories or look at picture books	116 (8.6)	.600	374 (23.1)	.632	1,066 (35.5)	.659
Tell stories	159 (11.7)	.618	329 (20.3)	.585	803 (26.7)	.596
Sing songs	842 (62.0)	.702	1,288 (79.3)	.577	2,370 (78.9)	.657
Go for a walk	774 (57.1)	.630	1,287 (79.3)	.495	2,495 (83.1)	.544
Play	830 (61.1)	.717	1,494 (92.0)	.544	2,802 (93.3)	.566
Severe physical aggression (no)	1,200 (89.9)	.110	1,402 (88.3)	.127	2,518 (85.4)	.209
Child left alone the past week (no)	1,343 (99.0)	.063	1,595 (98.3)	-.018	2,954 (98.3)	.136
Child left with child below 10 years the past week (no)	1,327 (97.8)	.061	1,546 (95.3)	.060	2,856 (95.1)	.183

<sup>a</sup>Component loadings of items generated by categorical principal components analysis. 2010 Colombia Demographic and Health Survey.

<sup>b</sup>Only relevant for the 0- to 5-month age group.

<sup>c</sup>Only relevant for the 6- to 11-month and 12- to 23-month age group.

Table 3 under the loadings headings, showed no clear dimensional pattern, except for the items related to cognitive and socioemotional care. Examination of NC item intercorrelations revealed very low correlations, generally below .10. However, the intercorrelations for the cognitive and socioemotional items were larger, ranging between .17 and .50. Due to the lack of clear dimensionality and the low intercorrelations overall, no further analyses examining NC multidimensionality were undertaken. This decision was also in accord with the underlying model of NC, in which the components of the NC are posited to be of equal importance.

Table 4 shows the relationships between NC score and all the other variables in the study, for each age group. There was substantial variation in NC score in the sociodemographic subgroups, with the exception of no NC differences observed in relation to child sex and maternal age. Mean NC scores in the urban samples were significantly higher than in the rural samples, and mean NC scores were higher in each higher age group. Otherwise, mean NC varied significantly for 20 of the 21 comparisons with sociodemographic variables.

Results of multiple regression analyses are presented in Tables 5 and 6 for urban and rural samples, respectively. In the urban 0- to

**TABLE 4** Independent samples *t* tests and one-way independent ANOVA for the distribution difference in childcare (nurturing care) for sociodemographic variables by 0- to 5-month, 6- to 11-month, and 12- to 23-month age groups<sup>a</sup>

	0-5 months			6-11 months			12-23 months		
	<i>n</i>	<i>M</i> ( <i>SD</i> )	<i>F/t</i>	<i>n</i>	<i>M</i> ( <i>SD</i> )	<i>F/t</i>	<i>n</i>	<i>M</i> ( <i>SD</i> )	<i>F/t</i>
Child sex									
Male	659	8.95 (1.82)	1.911	772	10.23 (1.91)	-.481	1474	11.10 (1.97)	.037
Female	583	8.75 (1.80)		733	10.28 (1.99)		1357	11.10 (1.96)	
Maternal age									
13-19	287	9.11 (1.77)	3.783*	290	10.22 (1.84)	.342	416	11.24 (1.81)	1.859
20-29	646	8.80 (1.78)		798	10.29 (1.95)		1491	11.04 (1.99)	
30-49	309	8.73 (1.89)		417	10.20 (2.02)		924	11.13 (2.00)	
Number of children born to the mother									
<3	903	8.99 (1.80)	-4.185**	425	9.59 (1.91)	-8.447**	2034	11.41 (1.82)	-13.124**
3+	339	8.51 (1.79)		1080	10.51 (1.90)		796	10.30 (2.10)	
Place of residence									
Urban	922	8.97 (1.82)	-3.860**	1101	10.36 (1.95)	-3.721**	734	10.46 (2.09)	-9.839**
Rural	320	8.52 (1.74)		404	9.95 (1.91)		2097	11.32 (1.87)	
Maternal education									
No or primary education	276	8.31 (1.71)	29.037**	352	9.47 (1.87)	49.293**	700	10.14 (2.08)	162.891**
Incomplete secondary education	373	8.65 (1.73)		415	10.16 (1.88)		703	10.89 (1.85)	
Complete secondary or higher education	593	9.24 (1.82)		738	10.68 (1.91)		1428	11.67 (1.75)	
Maternal decision latitude									
0-4 decisions	362	8.76 (1.76)	1.709	405	9.89 (1.92)	14.964**	719	10.66 (2.02)	24.694**
5-6 decisions	394	8.79 (1.82)		479	10.17 (1.99)		910	11.26 (1.86)	
7 decisions	485	8.97 (1.84)		621	10.25 (1.95)		1201	11.24 (1.97)	
Maternal occupation									
No work outside the home	219	8.51 (1.76)	13.180**	285	9.87 (1.93)	11.339**	390	10.56 (2.10)	36.490**
Work in agriculture or other manual work	136	8.58 (1.78)		117	10.29 (2.11)		256	10.60 (2.04)	
Sales	249	9.10 (1.81)		343	10.33 (1.88)		695	11.30 (1.82)	
Service	470	8.63 (1.74)		555	10.11 (1.96)		1097	10.96 (1.91)	
Professional, technical, or administrative	169	9.63 (1.85)		205	11.00 (1.76)		393	11.99 (1.85)	
Wealth index quintiles									
Poorest	297	8.38 (1.77)	13.723**	354	9.67 (2.02)	12.500**	665	10.19 (2.08)	75.430**
Poor	285	8.83 (1.73)		386	10.36 (1.76)		658	10.90 (1.82)	
Middle	299	8.76 (1.73)		330	10.34 (2.00)		627	11.35 (1.81)	
Rich	239	9.18 (1.77)		251	10.43 (1.76)		508	11.53 (1.73)	
Richest	122	9.66 (1.98)		183	10.76 (2.11)		371	12.07 (1.84)	
Child registered in the Growth, Development and Care Program									
No	673	8.52 (1.74)	-7.266**	406	9.67 (1.94)	-7.133**	585	10.34 (2.03)	-10.680**
Yes	568	9.25 (1.81)		1099	10.47 (1.91)		2246	11.30 (1.90)	

<sup>a</sup>2010 Colombia Demographic and Health Survey.

\**p* ≤ .05. \*\**p* ≤ .001.

**TABLE 5** Childcare index (nurturing care) regressed on maternal resources and other sociodemographic variables, 0–5, 6–11, and 12–23 months<sup>a</sup>

	0–5 months			6–11 months			12–23 months		
	B	SE	t	B	SE	t	B	SE	t
Child sex ( <i>ref = male</i> )									
Female	.20	.15	1.306	-.06	.14	-.404	-.08	.09	-.900
Maternal age	-.04	.01	-3.314***	-.03	.01	-1.833	-.01	.01	-1.003
Maternal parity ( <i>ref ≤ 3 children</i> )									
3 or more children	-.09	.20	-.474	-.58	.19	-3.063**	-.523	.13	-4.196***
Child registered in the Child Growth, Development and Care Program ( <i>ref = no</i> )									
Yes	.604	.15	4.084***	.31	.16	1.936	.58	.12	4.856***
Household wealth index	2.456E-6	1.193E-6	2.058*	1.195E-6	-6.299E-8	1.910	4.665E-6	7.819E-7	5.966***
Maternal occupation ( <i>ref = not working outside the home</i> )									
Manual or agriculture	.58	.32	1.827	.49	.38	1.288	.17	.22	.826
Sales	.86	.25	3.411***	.04	.24	.184	.38	.17	.697
Services	.60	.24	2.545*	.08	.21	.350	.31	.16	1.893
Professional or administrative	1.32	.30	4.474***	.53	.29	1.864	.66	.20	2.259*
Maternal decision latitude	-.01	.05	-.136	.11	.05	2.401*	.12	.04	.755
Maternal education ( <i>ref = no or primary education</i> )									
Incomplete secondary education	-.08	.22	-.378	.33	.21	1.587	.37	.16	2.295*
Complete secondary or higher education	.22	.23	.946	.63	.22	2.934**	.68	.15	4.496***
R <sup>2</sup> (sampling df)		.11 (722)			.11 (843)			.16 (843)	

<sup>a</sup>Urban sample, 2010 Colombia Demographic and Health Survey.\* $p \leq .05$ . \*\* $p \leq .01$ . \*\*\* $p \leq .001$ .**TABLE 6** Childcare index (nurturing care) regressed on maternal resources and other for sociodemographic variables, 0–5, 6–11, and 12–23 months<sup>a</sup>

	0–5 months			6–11 months			12–23 months		
	B	SE	t	B	SE	t	B	SE	t
Child sex ( <i>ref = male</i> )									
Female	.41	.20	2.021*	.06	.20	.310	-.08	.15	-.537
Maternal age	-.01	.02	-.325	-.02	.02	-1.380	-.01	.02	-.644
Maternal parity ( <i>ref = &lt;3 children</i> )									
3 or more children	-.01	.31	-.037	-.15	.25	-.622	-.74	.23	-3.267***
Child registered in the Growth, Development and Care Program ( <i>ref = no</i> )									
Yes	.573	.23	2.506*	.64	.23	2.791**	1.145	.22	5.121***
Household wealth index	2.521E-6	1.366E-6	1.846	4.052E-6	1.399E-6	2.897**	4.567E-6	1.103E-6	4.141***
Maternal occupation ( <i>ref = not working outside the home</i> )									
Manual or agriculture	-.33	.30	-1.113	.31	.34	.910	.23	.27	.826
Sales	-.40	.35	-1.124	.45	.39	1.143	.18	.26	.697
Services	-.26	.26	-1.034	.44	.25	1.739	.37	.26	1.436
Professional or administrative	-.46	.53	-.876	.26	.43	.590	-.04	.44	-.096
Maternal decision latitude	.13	.06	2.303*	.11	.06	1.965*	.12	.04	2.704**
Maternal education ( <i>ref = no or primary education</i> )									
Incomplete secondary education	.32	.24	1.362	.27	.29	.913	.09	.21	.414
Complete secondary or higher education	.55	.31	1.748	.33	.32	1.056	.40	.23	1.758
R <sup>2</sup> (sampling df)		.13 (328)			.16 (363)			.19 (605)	

<sup>a</sup>Rural sample, 2010 Colombia Demographic and Health Survey.\* $p \leq .05$ . \*\* $p \leq .01$ . \*\*\* $p \leq .001$ .

5-month analysis, child registration compared with no registration in the Child Growth, Development and Care Program ( $t = 4.084$ ,  $p \leq .001$ ) and household wealth ( $t = 2.058$ ,  $p \leq .05$ ) were significantly associated with higher NC level. In addition, maternal occupation in sales ( $t = 3.411$ ,  $p \leq .001$ ), services ( $t = 2.545$ ,  $p \leq .05$ ), and professional or administrative sector ( $t = 4.474$ ,  $p \leq .001$ ) compared with mothers not working outside the home were significantly associated with higher NC. Similarly, in the urban 12- to 23-month analysis, child registration compared with no registration in the Child Growth, Development and Care Program ( $t = 4.856$ ,  $p \leq .001$ ) and household wealth ( $t = 5.966$ ,  $p \leq .001$ ) were significantly associated with higher NC level. In addition, both mothers with incomplete secondary education ( $t = 2.295$ ,  $p \leq .05$ ) and complete or higher education ( $t = 4.496$ ,  $p \leq .001$ ) compared with mothers with no or primary education were significantly associated with higher level of NC. In the urban 6- to 11-month adjusted analyses, only maternal decision latitude ( $t = 2.401$ ,  $p \leq .05$ ) and complete secondary or higher education compared with no or primary education ( $t = 2.934$ ,  $p \leq .05$ ) were significantly associated with higher level of NC.

In the rural 0- to 5-month sample, child registration compared with no registration in the Child Growth, Development and Care Program ( $t = 2.506$ ,  $p \leq .05$ ) and maternal decision latitude ( $t = 2.303$ ,  $p \leq .05$ ) were significantly associated with higher level of NC. Similarly, results were demonstrated in the 6- to 11-month and 12- to 23-month rural samples. In the rural 6- to 11-month adjusted analyses, child registration compared with no registration in the Child Growth, Development and Care Program ( $t = 2.791$ ,  $p \leq .001$ ) and maternal decision latitude ( $t = 1.965$ ,  $p \leq .05$ ) were significantly associated with higher level of NC, in addition to household wealth ( $t = 2.897$ ,  $p \leq .001$ ). In the rural 12- to 23-month adjusted analyses, child registration compared with no registration in the Child Growth, Development and Care Program ( $t = 5.121$ ,  $p \leq .001$ ) and maternal decision latitude ( $t = 2.704$ ,  $p \leq .01$ ) were significantly associated with higher level of NC, in addition to household wealth ( $t = 4.141$ ,  $p \leq .001$ ). No interaction effects of the maternal resources were observed in the urban or the rural sample (results not shown).

## 5 | DISCUSSION

NC can be measured as a one-dimensional construct, despite differences in the nature and the prevalence of the component care behaviours. The intercorrelations among the care variables were modest, and the Cronbach's alphas for the indexes were also modest. This is not unexpected, because the resources needed to support various types of care are diverse. For example, providing cognitive stimulation to a child requires caregiver time and knowledge or motivation, while providing a high quality diet requires access to and availability of diverse foods. Yet both types of care are invaluable for child health and development.

The NC indexes developed in this study are related to maternal resources, and this supports the construct validity of the NC, because the underlying theoretical premise is that families with greater access to resources can provide more comprehensive childcare. We surmise that the same or similar NC indexes could be used in any LMICs. Yet

the Colombia 2010 DHS is unique in its inclusion of a wide range of care variables with which to construct the NC index. Extension of this method of measuring NC to other LMICs would therefore require some additions to survey instruments.

Multiple regression analyses showed that a greater range of maternal resources was related to NC in the 12- to 23-month age groups in both urban and rural samples, compared with the younger age groups. As care becomes more demanding from infancy to young childhood, demand on maternal resources understandably appears to increase. This supports the utility of differentiating between the infant and the very young child in the computation of NC indexes.

The most consistent significant independent variable for NC level was having the child registered in the national Child Growth, Development and Care Program—a finding of substantial significance from a health promotion standpoint, because the effectiveness of the programme is reported in previous research (Carrillo et al., 2014; Padilla & Trujillo, 2015).

Maternal education was significantly associated with NC in the urban sample for the 6- to 11-month and 12- to 23-month age groups, which is partly in line with the few previous studies using childcare indexes in social determinant of health research (Amar-Klemesu et al., 2000; Nti & Lartey, 2008). The differences in the role of maternal education in childcare in urban and rural samples might be related to how urban and rural contexts differ in the resources available to support optimal childcare (Fox & Heaton, 2012), to better access to services and other resources (Smith et al., 2005), and to higher income that can benefit the child (Garrett & Ruel, 1999). The lack of an association with maternal education in rural areas may reflect that education is not sufficient to improve childcare in areas where access to services, infrastructure, and food and care products can be limited.

Maternal decision latitude was significantly associated with childcare in all except the urban 0- to 5-month and 12- to 23-month age group, suggesting that a woman's status in the household and the community is an important determinant of her ability to deliver childcare, independent of other maternal resources. This aligns with previous research (Becker, Fonseca-Becker, & Schenck-Yglesias, 2006; Bégin, Frongillo, & Delisle, 1999; Mistry, Galal, & Lu, 2009; Smith, Ramakrishnan, Ndiaye, Haddad, & Martorell, 2003). Women who have a certain level of decision-making power might take better advantage of limited resources and services in rural areas. Conversely, in urban areas, the level of maternal decision latitude might be higher, as shown in our study.

The main advantage of the Colombia 2010 DHS dataset in the study of NC is its relatively comprehensive measurement of childcare behaviour. Yet the 2010 Colombia DHS does not include all recommended indicators in the FCI (Kariger et al., 2012). Other limitations of self-report survey data are evident; for example, hygiene practices are preferably measured through spot-check observations, rather than self-report (M. Ruel & Arimond, 2003). Further, a limitation of the cross-sectional study design is that mothers reported illness symptoms only during the 2 weeks before the survey; therefore, prior illnesses were not reported resulting in likely underreporting of longer term child illness. Immunization status is determined via the child's health card or, if health card is not available, through maternal self-report. This combination of information sources is not ideal, and the

limitation of self-report due to incorrect recall is evident. However, 87% of mothers in the sample for the current study had a health card that was shown to the interviewer, which leaves a relatively low proportion with self-report on immunization status. Lastly, the construction of the NC as a one-dimensional index with equal weighting of the component measures is not uncontroversial. One might expect childcare to be somewhat multidimensional, for example, with physical care and psychosocial care identifiable as separate dimensions. There is modest evidence for this in the present data. However, the childcare construct as defined in this study emphasizes the importance of each care behaviour as making a distinct contribution to the overall quality of care. The low internal consistency of the care index in this study reflected by the low Cronbach's alpha value warrants further research on the development of NC measures.

In conclusion, this study demonstrates the feasibility of constructing summary indexes of nurturing childcare using data from the 2010 Colombia DHS. The NC scores varied significantly with several maternal resources, and the significance of the relationships varied with child age and with urban-rural residence. The utility of an index such as the NC would be enhanced if used repeatedly over time, to help ascertain trends in childcare in sociodemographic subgroups within and between LMICs. Such data could assist decision makers to create and adjust child health initiatives to better effect. The implication is that national child health surveys in LMICs should consider expanding their measurement of childcare to at least the level accomplished by the 2010 Colombia DHS.

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## CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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