# Facing malnutrition and poverty: evaluating the CONIN experience

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*The Undernutrition Prevention Center (UPC) of the Corporation for Childhood Nutrition (CONIN) assists children from 0–3 years of age who present with primary or secondary undernutrition. The aim of the retrospective study reported here was to complete a nutritional, cognitive, and social evaluation of UPC children in Mendoza, Argentina, from 1996 to 2005. During the study period, a total of 478 schoolchildren aged 5–17 years (186 in the CONIN group and 292 in the non-CONIN group) were evaluated. Although no differences in weight and height were found between the groups, the percentage of children below the cutoff level for the maturity test was significantly lower in the CONIN group (10.8% versus 17.6%;* $P = 0.043$*). CONIN provides important social support to families through work qualification programs and health education.*



## INTRODUCTION

The first United Nations (UN) Millennium Development Goal is to eradicate extreme poverty and hunger and the second is to ensure that all children complete primary level schooling.[1] Improving early childhood development is clearly an important step toward reaching these goals. At present, 854 million people suffer from chronic undernutrition, and 146 million of them are children; this represents more than a quarter of the children in the developing world, especially those who live in rural areas and those who do not attend school. These are the population groups at greatest risk, since hunger, malnutrition, illiteracy, and the lack of education create a vicious circle that is practically impossible to eradicate, and cognitive capacities are severely affected in the early years of life.[2–4]

Undernutrition during pregnancy and the first year of life has structural and metabolic effects on the child that persist throughout life; these include anthropometric alterations together with metabolic and cerebral changes.[5,6] Restricted caloric intake during the initial stages of life unleashes survival mechanisms that alter the energy balance to a lower level of consumption. The rhythm of physical growth is also affected, provoking smaller stature, which can take more than one generation to recover. Moreover, the adverse environment (undernutrition, abandonment, violence, and marginality) has an impact on normal brain development, which manifests later in life, especially during the educational process.[7,8] The brain's rapid growth during the first months of life is principally due to the intense development of the neuronic connections.[9,10] Several studies have demonstrated

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that appropriate neuronal development depends on the quantity and quality of sensory stimuli coming from the environment.[11,12] A deficiency in the quality of the stimuli causes irreparable damage that is reflected later in poor intellectual performance, emotional disturbances, or behavioral disorders.[13–15] The sensitive conditions during the initial stages of life allow adverse environmental factors to produce damage that manifests at subsequent ages; this underscores the importance of maximizing efforts to prevent infant undernutrition.[16,17]

The Corporation for Childhood Nutrition (CONIN), founded in Chile in 1975, has worked to assist the recovery of children between the ages of 0 and 3 years who present with primary or secondary undernutrition.[18,19] In 1993, the project was extended to the province of Mendoza, Argentina, where the CONIN Foundation (Cooperative for Childhood Nutrition), and the Undernutrition Prevention Center (UPC) were created.[20] In this center, strategies to promote health and prevent undernutrition are developed and enacted.[20] The main objective of the study presented here was to quantify the impact of this center's integrated strategy on the prevention of infant undernutrition and its determinants. The specific objective was to realize a nutritional, cognitive, and social evaluation of the children who presented to the CONIN UPC during the period 1996–2005.

## STUDY DESIGN AND METHODOLOGY

A retrospective cohort study was designed in which the children who attended the CONIN UPC (Mendoza, Argentina) during the period 1996–2005 comprised the exposed group ($n = 186$) and children from the same geographical area who did not attend CONIN UPC during the same period of time comprised the non-exposed group ($n = 292$). Since almost all of the children who attended CONIN UPC are students at the Capitán Candelaria School (Mendoza, Argentina) located near the CONIN UPC, all of this school's students from kindergarten through 9$^{th}$ grade in May and June 2006 were studied ($n = 478$). Details about the study were explained to all families and informed consent was obtained.

### Nutritional evaluation

Each child was evaluated by measuring the main anthropometric parameters: weight (kg), height (cm), mid-upperarm circumference (cm), tricep skinfold (mm), and subscapular skinfold (mm). A pilot study to evaluate nutritional risk was also carried out using the short test *Krece Plus*,[21] as used in the Spanish study *enKid*,[22] adapted to our study population. This test has 16 items that are scored from +1 to −1, and it classifies children into the following three categories: high nutritional level or low nutritional risk (test score $\geq 9$), middle nutritional level (test score 6–8), and low nutritional level or high nutritional risk (test score $\leq 5$).

### Social evaluation

A standardized questionnaire was used to obtain information on each student's family and living conditions. The questionnaire results in a social risk score that allows classification of families into the following categories: high-risk family, family at risk, or family without risk (Table 1).

### Cognitive evaluation

Several tests (Raven, Caras, Koppitz, and Beta test) were used to evaluate the children's language and understanding as well as their intellectual capacity and learning potential. The Raven test[23] is graphic (not verbal); it is a factorial intelligence test and the result is expressed as a capacity diagnostic score. The Caras test[24] evaluates attention and difference perception and the results are expressed in percentiles. Since sight problems can modify the results of this test, all of the children in the study received an additional ophthalmologic assessment. The draw-a-man test (Koppitz)[25] analyzes drawings made by children aged between 5 and 12 years and tabulates their evolutionary (maturation) and projective aspects with scoring systems standardized for both factors; the results are expressed as a capacity diagnostic. The Beta test[26] evaluates receptive language and sentence comprehension and results in a score that expresses the child's maturity level between 3 and 17 years.

### Statistical analysis

Continuous variables were summarized by means and standard deviations (SD) or medians and interquartile ranges and compared with the Student's *t*-test or a non-parametric test, when appropriate. Categorical variables were resumed as percentages and compared using the chi-square test. Those factors that showed univariate association with the CONIN intervention were then entered into a multiple logistic regression analysis. A selection was carried out using a retrospective method based on Akaike's information criterion. For the resulting model, adjusted odds ratios were obtained for the selected factors and estimated using 95% confidence intervals. For the variables of weight and height, Z-scores (Z = parameter-P50/SD) were obtained referring to percentile 50 of the reference data provided by the Argentinean Paediatric Society. For the variables triceps skinfold, subscapular skinfold, and mid-upperarm

*Table 1* **Social risk score for classifying families at high risk, at risk, or without risk.**

| Factor | Risk indicator | Score* |
|---|---|---|
| Social security coverage | Does not have | x |
| Family group | Single parent | x |
| Head of household's occupation | Unemployed | x |
| | Self-employed | x |
| Size of household | 3–5 people/worker | x |
| | 6 or more/worker | xx |
| | Household without worker | xxx |
| Overcrowding | 2–3 people/room | x |
| | 4–5 people/room | xx |
| | 6 or more/room | xxx |
| Studies | Primary | x |
| | Primary incomplete | xx |
| | Illiterate | xxx |
| Early maternity | Adolescent mother | xx |
| Children aged 0–13 year | One point for each child | x |
| Family dynamic | Altered by violence | x |
| | Altered by death | x |
| | With judicial intervention | x |

* Score results: ≥8 points = high-risk family; 4–7 points = family at risk; ≤3 points = family without risk.

circumference, the age-adjusted means for each group were estimated and classified by intervention status. Adjustments were made through the additive generalized models. Statistical significance was set at $P < 0.05$. Data were analyzed using the SPSS statistical program (13.0, SPSS, Chicago, USA).

## RESULTS

This retrospective cohort study was based on 478 students aged 5–17 years; 186 belonged to the CONIN group and 292 belonged to the non-CONIN group. Only four families declined to participate in the study. Baseline characteristics were similar for the CONIN and non-CONIN groups (Table 2).

According to the social family score results, there were no subjects without social risk in either group. The percentages of families at risk were 32.4% and 34.8% for the CONIN and non-CONIN groups, respectively. The percentages of high-risk families were 65.8% and 65.2% for the CONIN and non-CONIN groups, respectively.

No significant differences were found between the two groups for weight-for-age Z-scores and height-for-age Z-scores (Figure 1). The mean weight-for-age Z-scores were –0.06 (SD = 1.2) in the CONIN group and 0.12 (SD = 1.3) in the non-CONIN group. The mean height-for-age Z-scores were –0.39 (SD = 0.9) in the CONIN group and –0.39 (SD = 1.0) in the non-CONIN group. Differences between groups were found in tricep skinfold measurement, with a mean of 12.9 (95% CI = 11.8–14.1) for the CONIN group and 14.2 (95% CI = 13.1–15.2) for the non-CONIN group ($P = 0.031$). No significant differences between groups were found in the measurement of subscapular skinfold, which was 10.0 (95% CI = 8.9–11.1) for the CONIN group and 11.0 (95% CI = 10.0–12.0) for the non-CONIN group ($P = 0.067$), nor in the measurement of mid-upperarm circumference, which was 22.6 (95% CI = 21.2–24.0) for the CONIN group and 21.1 (95% CI = 20.9; 23.4) for the non-CONIN group ($P = 0.584$) (Figure 2).

A pilot study to evaluate nutritional risk found that none of the children had a low level of nutritional risk (test score ≥9), while the percentages of children with a medium level of nutritional risk (test score 6–8) in the CONIN and non-CONIN groups were 33.3% and 46.7%, respectively. The percentages of children with a high level of nutritional risk (test score ≤5) were 66.7% for the CONIN group and 53.3% for the non-CONIN group. The results of this test showed that the percentage of children in the CONIN group that did not have breakfast was higher (26.7% versus 6.7% for the non-CONIN group), as was the percentage of those not having dinner daily (53.3% versus 20.0% for the non-CONIN group).

Table 3 shows the social support provided to the families through CONIN's work qualification programs, literacy programs for mothers and adolescents (18% of mothers who attended CONIN learned how to read and write at the center), and health education programs that prepared mothers to be the main health agent of the family.

The rate of visual impairment was 12.9% in CONIN children compared to 6.7% in the control children, which represents a statistically significant difference ($P = 0.023$).

*Table 2* **Characteristics of the population studied.**

| Characteristic | CONIN ($n = 186$) | Non-CONIN ($n = 292$) | *P*-value* |
|---|---|---|---|
| Age of children (%) | | | |
| 5–9 year | 33 | 41 | 0.255 |
| 10–13 year | 46 | 40 | |
| 14–17 year | 21 | 19 | |
| Age of mother† | 35.3 ± 7.0 | 35.0 ± 7.1 | 0.689‡ |
| Birthweight (%) | | | |
| ≤2500 g | 5 | 7 | 0.369 |
| >2500 g | 95 | 93 | |
| Mother employed (%) | 52 | 45 | 0.152 |
| Mother's educational level (%) | | | |
| Illiterate | 3 | 6 | 0.163 |
| Primary incomplete | 46 | 49 | |
| Primary | 47 | 39 | |
| Secondary | 4 | 6 | |
| Type of family (%) | | | |
| Single-parent | 15 | 15 | 0.876 |
| Two-parent | 82 | 83 | |
| Other | 3 | 2 | |
| Children's nutritional index (%) | | | |
| Obesity | 17 | 23 | 0.361 |
| Overweight | 10 | 11 | |
| Normal | 54 | 52 | |
| Undernutrition I | 15 | 12 | |
| Undernutrition II | 4 | 2 | |

* *P*-value obtained using the chi-square test.
† Mean ± standard deviation.
‡ *P*-value obtained using the Student's *t*-test.

The rate of visual acuity in the left eye was slightly higher in the control children (97.9%) compared with the CONIN children (94.3%), and this difference was moderately significant ($P = 0.042$). Absence from school was more frequent in the CONIN children, who missed a median of 18 days compared to a median of 14 days in the control group, which represents a clearly significant difference ($P < 0.001$). The CONIN children also showed lower levels of school achievement than the control children. The average level of education attained by the control children was school grade 8.01 (SD = 0.87) as opposed to 7.81 (SD = 0.78) for the CONIN children, representing a significant difference ($P = 0.01$). In the Caras test, the median score estimated for the CONIN group was 15, which is clearly lower than the median of 23 for the control children and also represents a significant difference ($P = 0.001$).

Multidimensional logistic regression analysis revealed that visual impairment and the Caras test were both independent factors associated with the CONIN intervention, with higher scores recorded for males from the CONIN group than from the control group (OR = 1.533; 95% CI = 1.022–2.299). An increased risk of visual impairment was also observed in the CONIN group (OR = 2.383; 95% CI = 1.151–4.931). The independent factor of cognitive evaluation shown in the multidimensional analysis was the Caras test. For every unit decrease in the test score, the likelihood that the child was from the CONIN group increased (OR = 0.986; 95% CI = 0.976–0.995) (data not shown). The age of maturity was lower than the chronological age in both groups (by around 3 years), but significant differences were not observed among the groups (Figure 3). Nevertheless, the percentage of children below the cutoff for the maturity test was significantly lower in the CONIN group (Table 4).

## DISCUSSION

This retrospective cohort study is the first to be carried out in CONIN UPC and was based on a previously conducted socioeconomic evaluation.[27] An important function of CONIN is the literacy and health education of mothers. Several studies have pointed out that maternal schooling is a protective factor for ensuring a child's healthy development; this is true for both overall health and specific areas, as reflected in increased vocabulary acquisition and intelligence scores.[28,29] CONIN develops a holistic strategy of intervention in the area of community nutrition, which functions as a tool for health promo-

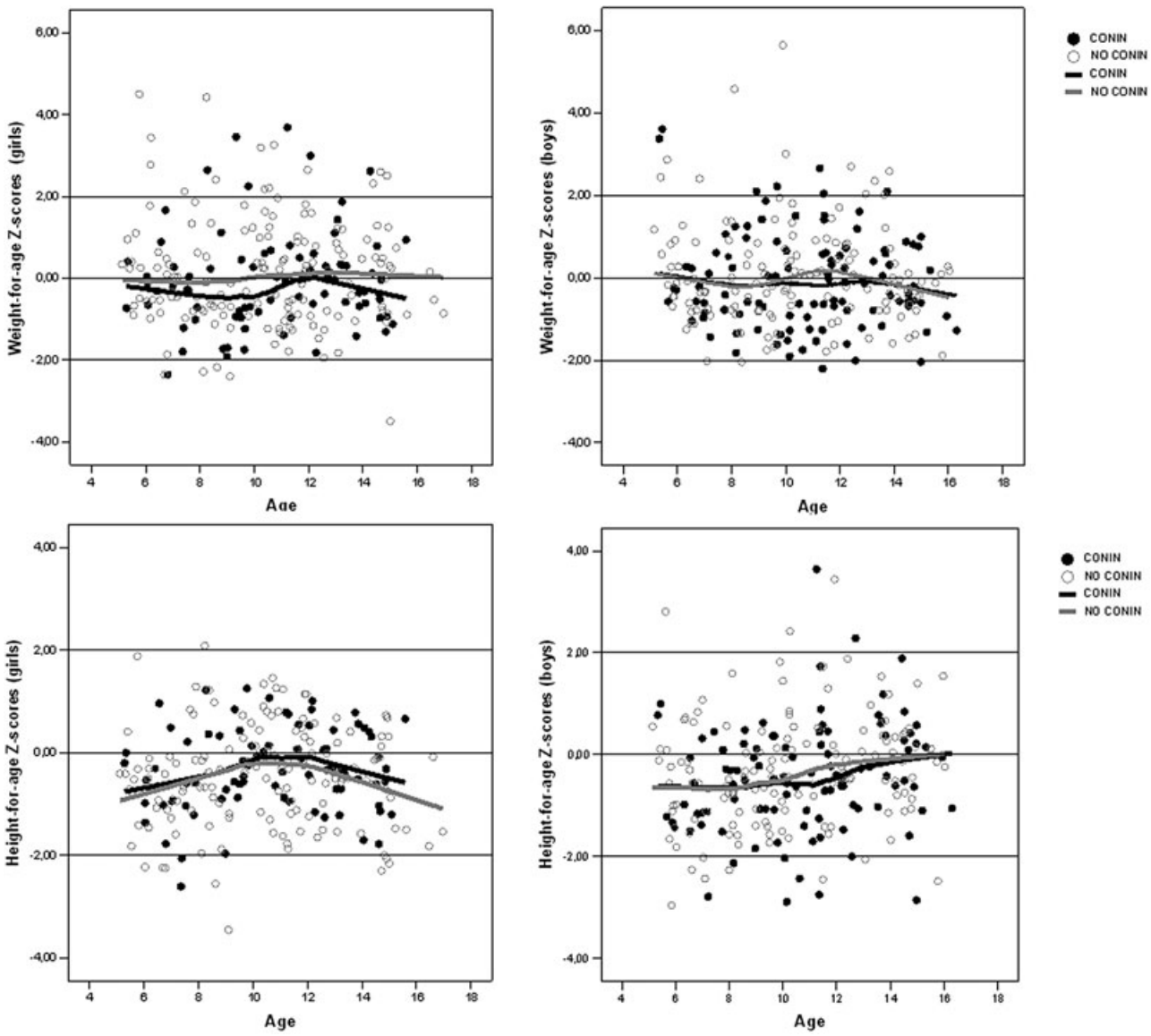


*Figure 1* **Distribution of weight-for-age Z-scores and height-for-age Z-scores by sex and intervention group.**

tion.[30] It empowers families and their environments to serve as the foundation for the healthy physical and intellectual development of children in conjunction with an adequate nutrient supply.[31,32]

Significant differences for the weight-for-age Z-scores and height-for-age Z-scores were not observed between the two study groups. However, the anthropometric evaluation showed the presence of type II undernutrition coexisting with overweight at a prevalence of approximately 20% in each group. These results are in line with the nutrition transition that has been observed in Latin American countries.[33]

The social information collected in this study confirmed that all of the children had similar living and family conditions. Nevertheless, the results of the nutritional test showed that 26.7% of children in the CONIN group did not have breakfast regularly and 53.3% did not have dinner regularly, which suggests less economic resources are available in these families for the acquisition of food. The people who attend the CONIN prevention center in Mendoza, Argentina, have very scarce and unstable resources and a high rate of unemployment. The income in each home mainly comes from work in brick furnaces (the principal economic activity of the area), in agriculture, or in temporary labor. The children are generally alone throughout the day, lacking the care and affection of an adult. They display developmental difficulties due to a general lack of healthcare and of checkups during the mother's pregnancy, as well as malnutrition and undernutrition during the first years of life (the

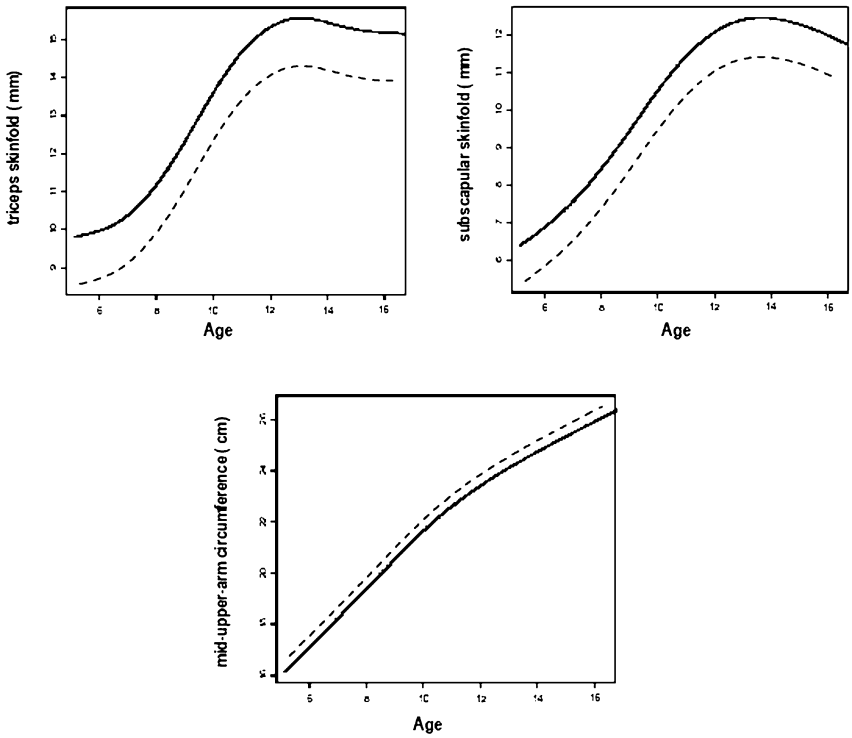


*Figure 2* **Triceps skinfold, subscapular skinfold, and mid-upperarm circumference for age.**
(– – –) CONIN; (—) Non-CONIN.

results of poverty, poor nutritional habits, and the prioritizing of secondary necessities).[34,35]

Regarding personality or emotional factors analyzed by means of the draw-a-man test, no differences were observed between groups. However, the CONIN cohort had higher rates of visual impairment and lower levels of intellectual performance.

It is possible that CONIN children have a more disadvantaged psychophysical background that was not rectified (in its entirety) by the intervention. Moreover, the cognitive recovery of children requires a longer period of time than nutritional recovery. Therefore, CONIN's early stimulation efforts, including promoting the child's motor, cognitive and perceptive development, communication and language skills, and socialization and personal autonomy, should be complemented by external programs implemented during the child's scholastic stage.

*Table 3* **Family participation in social assistance programs.**

| Support | CONIN ($n = 186$) (%) | Non-CONIN ($n = 292$) (%) | *P** |
|---|---|---|---|
| The family received support for its legalization | 46 | 7 | <0.001 |
| The family received support for addiction prevention | 43 | 3 | <0.001 |
| The family received help from CONIN for clothing | 80 | 9 | <0.001 |
| The mother learned how to read and write at CONIN | 18 | 3 | <0.001 |
| The mother received some work qualification training | 69 | 22 | <0.001 |
| The mother received information about healthy feeding for her children | 91 | 37 | <0.001 |
| The family received illness prevention information | 90 | 34 | <0.001 |
| The family received educational information for their children | 88 | 34 | <0.001 |
| The family received information about family violence | 79 | 19 | <0.001 |
| The mother attends her children's school functions | | | 0.043 |
| Always | 50 | 39 | |
| Sometimes | 44 | 49 | |
| Never | 6 | 12 | |

* *P*-value obtained using the chi-square test.

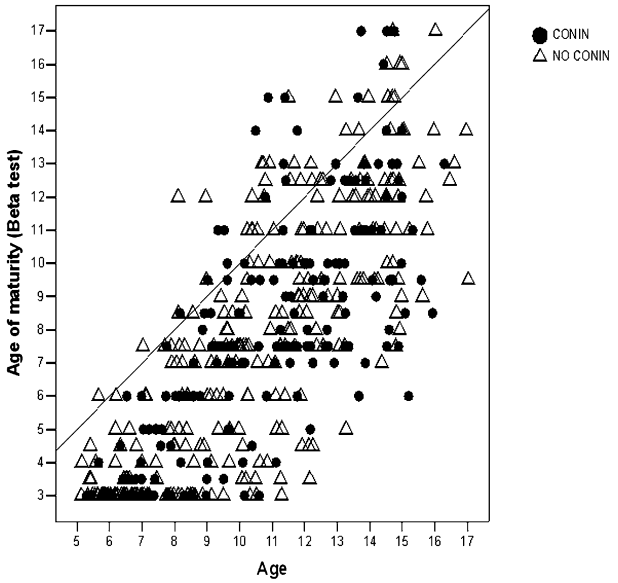


*Figure 3* **Relationship between chronological age and age of maturity (Beta test).**

## CONCLUSION

In the development of preventive programs, the challenge continues to be to find ways to educate families and to induce them to modify their lifestyle in order to improve health and education. For this reason, efforts should not only be directed towards children; attempts should also be made to guide and prepare mothers to serve as the main health agent of the family, as well as to gain the commitment of parents to learning how to be the principal source of attention and agents of stimulation for their children. In this context, community nutrition based on the participation and empowerment of the community should assume a predominant role in public health and development initiatives. Investment in human capital early in life will optimize the growth and the social and economic development of children, families, and communities, thus helping to break the intergenerational transmission of poverty. In the future, prospective cohort studies should be developed and the method of data collection in CONIN UPC will have to be improved in order to optimize the work and research carried out in such studies.

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*Table 4* **Cognitive evaluation, emotional indicator, and ophthalmologic assessment.**

| Parameters | CONIN $n = 176$ | Non-CONIN $n = 262$ | *P* value |
|---|---|---|---|
| Repeating student (%) | 11.4 | 8.8 | 0.373 |
| Absence from school* | 18 (9–28) | 14 (7–22) | <0.001 |
| Average grade attained† | 7.81 ± 0.78 | 8.01 ± 0.87 | 0.011 |
| Raven test (%) | | | |
| High | 15.8 | 21.2 | 0.301 |
| Medium | 19.7 | 20.5 | |
| Low | 64.5 | 58.3 | |
| Caras test* | 15 (10–30) | 23 (11–45) | 0.001 |
| Difference between chronological age and maturity age† | 2.86 ± 2.36 | 2.78 ± 2.29 | 0.690 |
| Children classified below the cutoff of the Beta test (%) | 10.8 | 17.6 | 0.043 |
| Emotional indicators (%) | | | |
| Impulsive | 5.4 | 2.7 | 0.140 |
| Insecure | 4.3 | 4.1 | 0.919 |
| Anxious | 5.4 | 4.8 | 0.776 |
| Timid | 7.0 | 7.9 | 0.720 |
| Aggressive | 3.2 | 3.4 | 0.906 |
| Evasive | 1.6 | 2.1 | 0.729 |
| Visual impairment (%) (convergence insufficiency, strabismus or blepharitis) | 12.9 | 6.7 | 0.023 |
| Visual acuity (right) (%) normal | 93.8 | 96.8 | 0.118 |
| Visual acuity (left) (%) normal | 94.3 | 97.9 | 0.042 |

* Median (interquartile range).
† Mean ± standard deviation.

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