Low cognitive performance and low self-esteem can be influenced by nutritional factors, such as dietary deficiencies, as well as socio-economic aspects including the level of education and economic status. These elements can interact in complex ways, contributing to variations in cognitive performance and self-esteem. It is important to consider all aspects of mental and physical health to fully understand this relationship.

A sample of 174 urban schoolchildren, aged between 15 and 19, and hailing from modest socio-economic backgrounds, participated in the study. They underwent a cognitive test (the Raven test) to evaluate their intellectual induction abilities. Additionally, a questionnaire was administered to gauge their socio-economic status. Nutritional status was assessed through various indices, including weight, height, and indicators such as weight-for-age, height-for-age, and emaciation. Self-esteem was measured using the French translation of Pelham and Swann’s self-assessment questionnaire, completed by the students.

Neurocognitive abilities exhibited significant correlations with gender, mathematical performance, nutritional status, and the educational level of mothers. Conversely, self-esteem demonstrated correlations with parental education levels and the presence of emaciation.

The results of this study highlight a significant relation between malnutrition and neurocognitive abilities, as well as self-esteem in schoolgirls. These findings suggest that nutritional management could play an essential role in preventing self-esteem problems and cognitive difficulties among schoolchildren.

**Key Words:** neuropsychological, raven, malnutrition, anthropométrie, self-esteem Kenitra
INTRODUCTION

The persistence of malnutrition remains a public health challenge, exerting a negative impact on neurocognitive abilities worldwide [1]. Recently, attention has focused on the influence of diet on cognition and mental health. Various nutritional aspects, such as the risk of skipping meals or a monotonous diet, can alter potentially brain structure and function. Studies show that malnutrition affects neurocognitive aspects, including academic performance, attention and memory [2-3]. The links between cognitive abilities and various factors, including socioeconomic status, have intrigued researchers for many years, with concerns dating back to Binet in 1910 [4].

Research findings also point to gender disparities and highlight the importance of socio-economic status in areas, such as cognitive skills, academic achievement and physical and mental health [5]. The relationship between self-esteem and malnutrition can be reciprocal. Malnutrition, by affecting physical and mental health, can negatively influence self-esteem [6].

The physical effects of malnutrition, such as weight or energy loss, can contribute to a negative self-perception. In addition, the psychological implications of malnutrition, such as mental fatigue, can also influence self-esteem. Conversely, low self-esteem can contribute to problematic eating behaviors, such as inappropriate dieting or nutritional neglect, which can exacerbate malnutrition. Thus, these two aspects can interact in a complex cycle.

This dynamic highlights the importance of holistic approaches in the management of malnutrition, taking into account both physical and psychological aspects to promote overall well-being.

The aim of this study is to explore the socio-economic and nutritional determinants influencing cognitive status and self-esteem in schoolchildren aged between 15-19 years from the urban area of Kenitra (Morocco). This age range aligns with the groups defined by the World Health Organization (WHO) as “adolescents” (10-19 years) [7].

MATERIAL AND METHODS

Sample

The present study was conducted from the beginning of May 2018 to the end of January 2020, involving a sample of 174 schoolchildren enrolled in a public high school located in the city of Kenitra, situated in the northwest of Morocco. The selection of schoolchildren was done randomly.

Instrument and procedure: Sociodemographic data, academic performance and anthropometric measurements.

Sociodemographic data, academic performance, and anthropometric measurements of schoolchildren were assessed using a self-questionnaire:

• Socio-demographic and socio-economic characteristics: This includes informa-
tion on age, sex, household size, parental occupation, and parental education level.

• **Academic performance**: Determined based on the general average of the participants’ Mathematics module, categorized as follows: low level (< 10), average (= 10), fairly good (<=12), good (<=14), and excellent level (>14).

• **Anthropometric measurements**: The adolescent’s weight was measured with a reliable mechanical scale, with a precision of 0.5 kg, and height was recorded in centimeters using a measuring rod with a precision of 0.1 cm. Dates of birth were verified from written documents, such as birth certificates. Anthropometric measurements were taken following the standards of the World Health Organization and the United Nations Children’s Fund (UNICEF) [1,8,9]. These measurements are crucial for assessing malnutrition using anthropometric indices, specifically height for age and body mass index (BMI).

  Height for age and BMI for age were determined by Z scores calculated using Epi Info 2000 (Dean, 2000). Short stature and thinness are defined as < -2 Z-score of height-for-age and BMI-for-age, respectively. The overweight risk indicator is indicated as > +1 Z score and ≤ +2 Z score, while obesity is specified as > +2 Z score [10].

**Assessment of cognitive performance**

Cognitive performance was assessed using Raven’s progressive matrices (PM 38). This tool, developed by John Carlyle Raven in 1936 [11], represents the most used tool in the world to assess intelligence, intellectual capacity and general mental ability.

**Self-esteem assessment**

For the assessment of self-esteem, the French translation of Pelham and Swann’s [12] self-assessment questionnaire, developed by C. Maintier and D. Alaphilippe, was employed. This questionnaire allowed students to gauge their self-esteem levels, considering both academic and relational dimensions. Responses were rated using an attitude scale (No marked as 0 and Yes marked as 1). The sum of the responses to the seven items provided an overall self-esteem score for each participant.

  Students were categorized based on their self-esteem scores as follows:

  • Low self-esteem: Scores less than or equal to 3.
  • Average self-esteem: Scores between 3 and 5.
  • Good self-esteem: Scores greater than or equal to 5.
  • The median self-esteem score that a participant could achieve was set at 4.

**Statistical analysis**

The data were entered and statistically analyzed by XLSTAT software. Results are presented as Mean ± Standard Deviation (M ± SD) for quantitative variables. The difference was considered significant at a p value less than 0.05.
RESULTS

Sociodemographic, educational and anthropometric characteristics

Table 1 presents information on the sociodemographic status of the respondents. The sample comprises 174 high school students, with 98 girls (56.32%) and 76 boys (43.67%). The table also includes details on academic performance, specifically the Math scores. The results indicate that 41.95% of the participants have a low level in math, 18.39% an average level, 13.22% a good level, and only 10.92% excel in mathematics. Notably, girls demonstrated a higher level in math compared to boys (11.301 ± 4.1618 for girls, 9.7829 ± 3.6561 for boys).

Turning to the anthropometric parameters outlined in Table 3, the average Z score for height for age is -1.27 ± 1.01, for weight for age is -0.73 ± 1.13, and for wasting is +0.09 ± 0.05.

Anthropometric status of participants by gender and age

This survey unveiled the following prevalences of malnutrition among the surveyed students: statural insufficiency was observed in 7.5% of pupils, underweight in 13.21%, and wasting in 3.44%. The frequency of statural and underweight malnutrition exhibited a significant increase, particularly in boys compared to girls (p < 0.05). Moreover, the prevalence of malnutrition increased with age for both sexes (p < 0.05) (see table 2).

Comparison of participants’ performance in Raven’s progressive matrices according to gender

The results obtained concerning the participants’ performances in Raven’s progressive matrices are presented in Table 3. These results show that girls score remarkably higher than boys for the three scores but without significant difference for the D.E scores and the total score (p>0.05), while the difference is highly significant for the A.B.C score (p<0.001).

Table 1. Sociodemographic, educational and anthropometric characteristics of participants

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean ± standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
</tr>
<tr>
<td>Girls</td>
<td>16.48 ± 1.22 (98)</td>
</tr>
<tr>
<td>Boys</td>
<td>17.02 ± 1.11 (76)</td>
</tr>
<tr>
<td><strong>Note « mathématique »</strong></td>
<td></td>
</tr>
<tr>
<td>Weak</td>
<td>6.80 ± 2.18 (73)</td>
</tr>
<tr>
<td>Medium</td>
<td>10.88 ± 0.54 (32)</td>
</tr>
<tr>
<td>Pretty good</td>
<td>12.68 ± 0.62 (27)</td>
</tr>
<tr>
<td>Good</td>
<td>14.49 ± 0.52 (23)</td>
</tr>
<tr>
<td>Very good</td>
<td>17.39 ± 1.01 (19)</td>
</tr>
<tr>
<td><strong>Weight (Kg)</strong></td>
<td>54.43 ± 7.87</td>
</tr>
<tr>
<td><strong>The size (Cm)</strong></td>
<td>165.09 ± 12.11</td>
</tr>
<tr>
<td><strong>Weight-for-age (average z rating)</strong></td>
<td>-0.73 ± 1.13</td>
</tr>
<tr>
<td><strong>Size-for-age (average z rating)</strong></td>
<td>-1.27 ± 1.01</td>
</tr>
<tr>
<td><strong>BMI (average z rating)</strong></td>
<td>+0.09 ± 0.05</td>
</tr>
</tbody>
</table>

*(N is the number of participants)*
The 174 participants exhibit a relatively average self-esteem (3.829 ± 1.642). A descriptive analysis of the distribution of participants based on their levels of self-esteem reveals that 13.79% (N=24) have a good self-esteem, 41.95% (N=73) have a low self-esteem, and 44.25% (N=77) have an average self-esteem. Notably, girls demonstrate a relatively higher self-esteem (4.97 ± 1.13) compared to boys (3.002 ± 0.76). This difference is statistically significant (p = 0.00341).

The statistical analysis, employing the ANOVA test, indicated a significant effect of intelligence on overall self-esteem. Participants reporting high intelligence demonstrated higher scores (5.22 ± 1.11) compared to those reporting low intelligence (2.739 ± 1.054).

On the other hand, no significant relationship was observed between sports participation and self-esteem, despite sports participants having a higher mean score (4.152 ± 1.603) compared to non-sports participants (2.5 ± 1.069). The statistical analysis also revealed a significant effect of school performance on self-esteem. Further, employing the ANOVA test, it was determined that no significant relationship existed between the dimensions of the relational domain (reading pleasure, ability to express oneself, relationships with adults, ability to have friends) and self-esteem (P > 0.05).
Cognitive performance, self-esteem according to Raven’s matrix and nutritional status

Cognitive performance, as evaluated by Raven’s matrix, and anthropometric characteristics of participants are presented in Table 3. The findings indicate that height-for-age and emaciation were significantly related to students’ cognitive performance ($p < 0.05$). On the other hand, for weight-for-age, significance was observed only for the DE and total scores ($p < 0.01$), with no significant difference noted for the ABC score ($p > 0.05$). In terms of self-esteem, the results reveal significant associations with wasting only, while no significance was observed for weight-for-age and height-for-age.

Cognitive performance, self-esteem according to Raven’s matrix and socioeconomic level

The results of the Raven matrix assessment of cognitive abilities, socioeconomic level, and self-esteem are presented in Table 4. The findings indicate that the father’s level of education is significantly related with both the pupils’ self-esteem and cognitive performance ($p < 0.05$). Conversely, for the mother’s level of education, a significant link was observed with self-esteem, but no significant difference was noted in relation to cognitive performance.

Table 4. Cognitive performance, self-esteem according to Raven’s matrix and socioeconomic level

<table>
<thead>
<tr>
<th>Features Socioeconomic</th>
<th>Raven test (ABC)</th>
<th>Raven test (DE)</th>
<th>Raven test (total score)</th>
<th>Self-esteem score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father’s education level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate (N=34)</td>
<td>25.68 ± 7.54</td>
<td>11.34 ± 2.57</td>
<td>38.37 ± 6.39</td>
<td>2.89 ±1.13</td>
</tr>
<tr>
<td>Primary and more (N=140)</td>
<td>29.67 ± 2.53</td>
<td>14.00 ± 3.37</td>
<td>43.97 ± 8.35</td>
<td>3.77±1.29</td>
</tr>
<tr>
<td>P value</td>
<td>0.00143</td>
<td>0.00078</td>
<td>0.0031</td>
<td>0.027</td>
</tr>
<tr>
<td>mother education level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate (N=47)</td>
<td>27.33 ± 6.17</td>
<td>11.98 ± 3.38</td>
<td>40.79 ± 6.98</td>
<td>2.98±1.17</td>
</tr>
<tr>
<td>Primary and more (N=127)</td>
<td>30.16 ± 7.27</td>
<td>14.93 ± 4.44</td>
<td>44.57 ± 7.02</td>
<td>3.37±1.75</td>
</tr>
<tr>
<td>P value</td>
<td>0.087</td>
<td>0.056</td>
<td>0.0671</td>
<td>0.0337</td>
</tr>
<tr>
<td>Household size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 5 (N=147)</td>
<td>29.71 ± 5.71</td>
<td>14.03 ± 4.22</td>
<td>43.97 ± 7.14</td>
<td>3.666±1.11</td>
</tr>
<tr>
<td>&lt;=5 (N=27)</td>
<td>32.37 ± 6.39</td>
<td>16.00 ± 3.78</td>
<td>44.99 ± 6.11</td>
<td>3.0065±1.09</td>
</tr>
<tr>
<td>P value</td>
<td>0.07699</td>
<td>0.6347</td>
<td>0.07776</td>
<td>0.066</td>
</tr>
</tbody>
</table>

Table 5. Correlation analysis

<table>
<thead>
<tr>
<th>The variables</th>
<th>Coefficient</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stature insufficiency</td>
<td>-0.292</td>
<td>0.013</td>
</tr>
<tr>
<td>Underweight</td>
<td>-0.1663</td>
<td>0.037</td>
</tr>
<tr>
<td>Thinness</td>
<td>-0.241</td>
<td>0.043</td>
</tr>
<tr>
<td>Performances in math</td>
<td>0.306</td>
<td>0.0227</td>
</tr>
<tr>
<td>Father’s educational level</td>
<td>0.237</td>
<td>0.045</td>
</tr>
<tr>
<td>Mother’s educational level</td>
<td>-0.0231</td>
<td>0.5091</td>
</tr>
<tr>
<td>Household size</td>
<td>-1.0986</td>
<td>0.8607</td>
</tr>
</tbody>
</table>
Pearson correlation

Table 5 presents the correlation between cognitive performance (total score) and various variables, including insufficient stature, underweight, thinness, performance in maths, level of education of parents, and household size. The analysis reveals that variables such as short stature, underweight, thinness, performance in maths, and father’s educational level are significantly correlated with cognitive performance (p < 0.05).

DISCUSSION

In this study conducted in the Al Gharb region, Kenitra province, Morocco, involving a population of 175 high school students (56.32% girls and 43.67% boys) with an average age of 16.716 years, various variables were examined. These included mathematics grade, stature deficiency, underweight, leanness, and socioeconomic level (parental education level and household size).

Regarding school results, the average mathematics score was (10.6379 ± 3.9981), indicating that girls scored higher than boys, although this difference was only significant for the ABC score.

With regard to the nutritional condition of the pupils in our study, we found height deficiency in 7.5% of pupils, underweight in 13.21%, and wasting in 3.44%. The prevalence of stature and weight deficits increases significantly in boys compared to girls, and with age for both sexes. Statural stunting appears to begin very early, at around age 3, reflecting an early form of malnutrition. Dietary diversification and environmental health play a crucial role at this stage. Statistical analysis indicates an increase in the prevalence of stunting and underweight with age for both sexes, corroborating the results of a study conducted by el Hioui et al. [13] in a rural school in the town of Kenitra, Morocco. These findings are in line with the literature, which points to a tendency for stunting to increase with age in children. Possible explanations include a lack of complementary infant nutrition, both in terms of quantity and quality. It also seems that the transition to the family meal is not always beneficial, highlighting the importance of dietary diversification associated with children’s growth, as suggested by Aboussaleh et al. [14].

Boys performed less well than girls, an observation also confirmed by Ming-Ling et al [15], [16]. In general, Raven’s matrix scores increase as mathematical performance improves. Neurocognitive abilities were significantly correlated with mathematical performance (P<0.05), particularly for ABC and Total scores on Raven’s PM 38 matrix, although no significant difference was observed for the DE score.

The effect of nutritional status and father’s level of education on schoolchildren’s cognitive performance was confirmed in our study as a causal effect by statistical analysis (student test), while there was no significant relationship between household size and mother’s level of education and schoolchildren’s cognitive performance.

Using a correlation matrix, we examined the relationships between all the variables in our study, including math score, stature, underweight, thinness, socioeconomic determinants of cognitive status and self-esteem
economic level (represented by parental education) and household size, as well as cognitive performance measured by the Raven matrix total score.

However, no significant correlation was observed between cognitive performance and two specific variables, namely household size and mother’s education level.

The relationship between malnutrition, socio-economic conditions and schoolchildren’s self-esteem is complex and multifactorial. Malnutrition can have harmful physical and psychological effects, which can influence the self-esteem of schoolchildren. The physical consequences of malnutrition, such as stunted growth and low weight, can contribute to a negative self-perception. In addition, psychological effects, such as mental fatigue, can also influence self-esteem [18]. Socioeconomic conditions also play a crucial role. A precarious socio-economic context can limit access to adequate nutrition and educational opportunities, affecting the physical and mental development of schoolchildren. These limitations can impact self-esteem, creating obstacles to personal fulfilment and educational opportunities.

Participants exhibited very average self-esteem (3.829 ± 1.642), with girls demonstrating relatively higher self-esteem (4.97 ± 1.13) compared to boys (3.002 ± 0.76). This difference is statistically significant (p = 0.00341). Additionally, academic dimensions such as intelligence, sports participation, and academic performance are significantly related to self-esteem.

On the other hand, no significant relationship was observed between the dimensions of the relational domain (enjoyment of reading, ability to express oneself, relationships with adults, ability to have friends) and self-esteem (P > 0.05). Self-esteem demonstrated significant relationships only with parental education, and no significance was observed with other study variables, including malnutrition and socio-economic conditions. The relationship between malnutrition, socio-economic conditions, and schoolchildren’s self-esteem is acknowledged as complex and multifactorial. Malnutrition can exert harmful physical and psychological effects, influencing the self-esteem of schoolchildren. Physical consequences like stunted growth and low weight may contribute to a negative self-perception. Additionally, psychological effects, such as mental fatigue, can also impact self-esteem [17]. Socioeconomic conditions play a crucial role, as a precarious socio-economic context may limit access to adequate nutrition and educational opportunities, thereby affecting the physical and mental development of schoolchildren. These limitations can have repercussions on self-esteem, creating obstacles to personal fulfillment and educational opportunities. Emaciation showed a relationship with self-esteem, but no significance was recorded with other study variables.

Although this study is, to our knowledge, the first to examine socio-economic and nutritional determinants influencing cognitive function and self-esteem, it is essential to consider certain limitations related to the cross-sectional design of the study when interpreting the results. Thus, while this research has identified factors associated with low cognitive performance and low self-esteem, it is impor-
tant to recognize the limitations inherent in this approach and to consider further longitudinal studies for a more thorough understanding of causal relationships.

Limited resources, unequal access to education, and inadequate nutrition can indeed contribute to cognitive difficulties and have a substantial impact on self-perception. Microgenetic theory of the Integrated System of the Self [18,19,20] might explain these results. Individual, social and cultural self are associated with three basic self subsystems (cf. Fig. 1):

1. **Awareness** that relates to the most frequently asked question about our identity: Who am I? In terms of civil law, this means sex, place of birth, origin, occupation, etc. This basic level of consciousness is often disturbed in the case of brain damage, as a result of which, e.g. the afflicted, after waking up from a coma, do not know who they are.

2. **Self-awareness**, i.e., awareness of myself and the state of my own mind, which mainly involves the questions: What am I? And how do other people see me? Answering these questions requires a developed skill of introspection, or insight into yourself. It is also strongly associated with personality. In the cultural aspect, what is particularly important is how others see us, because this fact significantly affects our self-esteem. This process reflects the popular saying that “other people are our mirror.”

3. **Meta-consciousness**, involving questions: What values do I recognize? What is my place in the world? The answer to the question about recognized values determines our perception of ourselves, the world and our behaviour. In turn, the answer to the question about our place in the world has a social and cultural aspect (see also: Pachalska 2022).

It should be stressed that recognized values are strongly embedded on one hand in biological self (the organism) which is related among others to adequate nutrition [20] and on the other hand is in culture and next to other cultural factors influence the shaping of our meta-consciousness and therefore to self-perception and self-esteem.

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**Fig. 1. Individual and cultural conditions of the self system**

Source: M. Pachalska 2019 [19]
To address these challenges, a comprehensive approach is necessary. Integrating educational programs and nutritional initiatives becomes essential to mitigate these effects and promote healthy development both cognitively and emotionally. By addressing the interplay between education and nutrition, we can work towards fostering an environment that supports the holistic well-being of individuals, ensuring they have the resources and opportunities needed for optimal cognitive and emotional growth.

REFERENCES


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