Walking or Bicycling to School and Weight Status Among Adolescents From Montería, Colombia

Carlos Mario Arango, Diana C. Parra, Amy Eyler, Olga Sarmiento, Sonia C. Mantilla, Luis Fernando Gomez, and Felipe Lobelo

Background: Active school transport (AST) is a recommended strategy to promote physical activity (PA) and prevent overweight (OW) in school-aged children. In many developing countries, such as Colombia, this association has not been well characterized. Objective: To determine the association between AST and weight status in a representative sample of adolescents from Montería, Colombia. Methods: Participants were 546 adolescents (278 boys) aged 11 to 18 years old from 14 randomly selected schools in Montería, Colombia in 2008. The PA module of the Global School Health Survey (GSHS-2007) was used to determine the prevalence of AST. To identify OW, participants were classified according to CDC 2000 criteria (BMI ≥85th percentile). Association between AST and OW was determined by binomial logistic regression. Results: Odds ratios adjusted for age, sex, location of school, compliance with PA, and screen time recommendations showed that adolescents who reported AST had a significantly lower likelihood to be OW compared with adolescents who reported nonactive transportation (OR = 0.5, 95% CI 0.3–0.8, \( P < .05 \)). Conclusions: These results support the importance of AST as a useful PA domain with potential implications for overweight prevention, in rapidly developing settings. Further epidemiologic and intervention studies addressing AST are needed in the region.

Keywords: health behavior, physical activity

The increasing rate of obesity among children and adolescents has reached epidemic proportions worldwide,\(^1,2\) in the United States\(^3\) and more recently in Latin America.\(^4\) Much of this growing epidemic is due to excessive consumption of foods with high caloric density and reduced participation in physical activity (PA).\(^5\) During childhood and adolescence PA has been recommended through programs like walk or bike to school, physical education, and organized sports.\(^5,2\) However, the participation in these PA modes is declining, thereby leading to decreased daily energy expenditure.\(^9\) Active school transport (AST) is one of the PA domains and it is a term used to describe travel between home and school by walking, cycling and other nonmotorized means of transportation.\(^9\) AST is an important strategy to promote PA among children and adolescents, and potentially reduce the dependence on motor vehicles for transportation purposes.\(^10\) Likewise, AST is considered a low-cost mobility strategy, reduces traffic congestion and is associated with lower environmental costs.\(^11,12\) Recent publications concluded that AST is associated with greater PA participation,\(^13,14\) and higher cardiovascular fitness among children and youth.\(^15,16\) Other studies have found that adolescents who cycle to school had significantly higher fitness than those who used motorized transport,\(^9\) and that AST was predictive of a lower BMI \( z \)-score among children.\(^17\) Some studies suggest that AST can potentially have a positive effect on lifelong PA patterns,\(^18\) and therefore, lead to improvements in health status on the long-term.\(^19,20\) Finally, walking to school was found to be associated with positive interaction with neighbors and friends which may have a potential influence on social capital.\(^21\)

In Latin America, AST promotion is particularly relevant due to low car ownership and social and cultural characteristics that are conducive to AST. Even though there are many enablers to AST in Latin America, promotion remains complex and involves more than just changing the physical environment such as building a walking path.\(^22\) Stakeholders from the community, schools, and families need to be involved in AST initiatives if they are to be effective. More local data are needed to quantify

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AST correlates and its association with important health-related outcomes such as weight status to encourage increased support from these stakeholders, especially in Latin American cities, characterized by a rapid and unplanned urban development.23

Therefore, the objective of the study was to determine the association between AST and weight status in a representative sample of adolescents between 11 and 18 years old from a rapidly developing city (Montería) in Colombia.

Methods

Study Settings

The study was conducted in Montería, a city located in the Caribbean coast of Colombia and the capital city of the state of Córdoba. Montería has a population of approximately 382,000 inhabitants. Montería is one of the regions of Colombia constantly exposed to harsh economic, social and political conditions, which have a direct influence in its environment. The armed conflict that the country has experienced during several decades creates continuous exodus and internal displacement of large proportions of the rural population to capital cities like Montería, thereby increasing the demands and pressures on the city which is not prepared to receive this displaced population that will most likely suffer from unemployment, deprivation and extreme poverty. As a means to survive, there has been an explosion of informal employment in the city, for example there is a large reliance on the use of motorcycles as a way to provide public means of transportation to the population and proliferation of small fast food stands and establishments throughout the city. In addition, the city has an important deficit of public infrastructure for the promotion of PA. In consequence, a large proportion of children and adolescents’ leisure time is spent in sedentary activities such as watching TV and playing computer games. Results from a national survey in Colombia show that the prevalence of watching TV 2 or more hours per day in Colombia is 60.7% among 9 to 12 year old children.24 This scenario creates an obesogenic environment for children and adolescents, leading to negative health consequences for current and future generations due to the increased risk of chronic diseases. According to the nutritional survey of the country in 2005, the prevalence of overweight among children between 10 and 17 years old in Córdoba, the state in which Montería is located, was 7.2%.24

Sampling Design

A secondary analysis was made from a cross-sectional study conducted in Montería, Colombia, between June and September 2008. The study involved 546 adolescents aged 11 to 18 years. The study protocol was previously approved by the Central Research Committee of Universidad de Córdoba IRB. Informed consent was obtained before delivering the questionnaire from selected students and their parents. Students could voluntarily not to participate in the project. According to the municipal secretary of education from Montería in 2007 there were 53,319 students (74.2% in the urban sector) between 11 and 18 years old enrolled in 44 urban schools and 29 in rural public school. For this study, schools with enrolments of less than 120 students were excluded, resulting in a sampling frame of 32 urban schools (37,623 students) and 23 rural schools (13,696 students). Based on this sampling frame a multistage sampling design was used. In the first stage 10 urban schools (71%) and a remaining 4 rural schools were selected as the primary sampling unit. The number of schools selected was proportional to the size of the sector in the sampling frame. The sample was 9662 in the 10 urban schools and 3751 in the 4 rural schools. The total population was 13,413 students enrolled. In the second stage, students were selected as the secondary sampling unit. To ensure the representativeness of the sample a total of 578 students were invited to participate in the study. The number of students selected in each school was proportional to the size of student enrollment in each school selected. Finally, in the third stage, a simple random sampling strategy was used to select a proportional number of students enrolled in each school by age and sex. For this purpose, the enrollment report of each school was examined. This analysis included data from 546 students, who had complete information in all measurements.

Measurements

Children completed a self-reported PA questionnaire including items describing travel to school behaviors, overall physical activity, and television viewing time. Students were asked to report, how they traveled to and from school in a usual week. A checklist of 6 modes of transport was provided (walk, bicycle, car, bus, motorcycle, and other). This item is similar to the one used by the Centers for Disease Control and Prevention,25 except for the option “motorcycle” which was added due to the particular cultural characteristics of Montería. Participants were categorized as AST if they answered walking or bicycle. All other responses were classified as nonactive school transportation. Other measured variables were included overall PA and television (TV) viewing time. PA was determined by the following question: During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? (Add up all the time you spent in any kind of physical activity that increased your heart rate and made you breathe hard some of the time.); response options were: 0 days, 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, and 7 days. Participants were categorized as active if they reported 5 days or more of PA. All other responses were categorized as inactive. TV viewing time was determined by asking the following question: On an average school day, how many hours do you watch TV? Response options were: I do not watch TV on an average school day, less than 1 hour per day, 1 hour per day, 2 hours per day, 3 hours
per day, 4 hours per day, and 5 or more hours per day. Responses were categorized into 2 groups, taking into account the current public health and clinical recommendations regarding TV viewing in the pediatric setting, those who reported TV viewing time < 2 hours per day, and those who reported TV viewing ≥ 2 hours per day. Reliability of this questionnaire was evaluated through a test-retest and adequate reproducibility (kappa = 61%–100%) was found.

Anthropometric measurements were taken by trained staff. Height was measured to the nearest millimeter in bare feet with a transportable stadiometer (SECA), and weight was measured to the nearest 0.1 kg using a calibrated beam scale (Health-O-Meter). Body mass index (BMI, calculated as weight in kilograms divided by height in meters squared) percentiles were calculated according to the Centers for Disease Control and Prevention guidelines using growth reference data from 2000, and participants were classified as overweight if they were above the 85th percentile of BMI based on sex and age.

Data Analysis

The association between AST and BMI status was analyzed using binary logistic regression while adjusting for potential confounders (sex, age, school location, PA, and TV viewing). Odds ratios (OR) with 95% confidence intervals as a measure of strength of association were calculated. Several interaction terms including AST*Sex, AST*School location, and AST*Age group were added to the models and tested for statistical significance. Analyses were conducted using SPSS version 14.0 (SPSS Inc., Chicago, IL).

Results

Of the eligible 578 students that were invited to take part of the study, 546 completed the questionnaire, and anthropometric measurements. Demographic information, prevalence of overweight and modes of transportation used to travel to school by sex, age group, and location are summarized in Table 1. The mean age was 14.8 ± 1.9 years; this did not differ by sex or location. Boys had a significantly higher means for height (t = 6.396, P < .0005), weight (t = 2.508, P < .05), and body mass index (BMI) (t = −2.436, P < .05), compared with girls. Overweight was found in 16.1% of the children with no significant differences by any of the demographic characteristic.

One in four students (24.7%) reported to be active at least 60 minutes a day for the last 5 days before the survey. Boys were more active than girls (χ² = 9.174, P < .005); older students reported being more active than those under 15 years old (χ² = 5.663, P < .05); and rural students were more active than urban students (χ² = 5.857, P < .05). A percentage of 62.6% students reported TV viewing time for more than 2 hours per day, and there were not statistically significance differences by demographic characteristic.

An overall prevalence of 66.3% of AST was found in this study, with a significantly higher prevalence in rural school locations (χ² = 18.14, P < .0005). Walking was the most common form of travel to school among children (51.1%), followed by cycling (15.2%), traveling by car (11.7%), traveling by bus (10.3%), and traveling by motorcycle (10.1%). Boys had a significantly higher prevalence of cycling (χ² = 12.352, P < .0005) and motorcycle travel (χ² = 49.8, P < .046) compared with girls. Children from rural schools reported significantly higher prevalence of school transport in the modalities of cycling (χ² = 14.99, P < .0005), car (χ² = 28.23, P < .0005), bus (χ² = 15.75, P < .0005), and motorcycle (χ² = 3.9049.8, P < .048), compared with children from the urban schools.

Overall, the results of the regression analysis are shown in Table 2. Crude odds ratio and adjusted odds ratio by sex, age group, school location, PA level, and TV viewing, showed that adolescents who reported active transportation had a lower likelihood to be overweight compared with children who reported nonactive transportation (OR = 0.5, 95% CI 0.3–0.8, P < .05). Several interaction terms (AST*Sex, AST*School location, and AST*Age group) were included in the models but not significant association was detected. Children from rural schools whom reported walking or biking to school had a significantly lower likelihood of being overweight compared with children from urban schools.

Discussion

This study, in a rapidly developing city such as Montería, found a high prevalence of AST and a reduced likelihood of overweight among children who walked or bike to school. Our results are consistent with the hypothesis that active travel may potentially lead to lower rates of overweight and obesity among children and adolescents. One of the possible explanations supported in previous studies is that active commuters tend to be overall more physically active than passive commuters. The prevalence of AST found in this study was remarkably well above those found in other studies including Australia, some European countries, the United States, and Brazil. However, different criteria for the classification of children as active travelers versus nonactive travelers can explain these differences as well as environmental, social and cultural differences between populations.

This study found a prevalence of overweight of 16.1% in Montería. This is well above the 7.2% found among children 10 to 17 years old in 2005 from Cordoba, the state in which Montería is located. Montería is the largest city and the capital city of Cordoba. The environmental characteristics and social changes experienced might explain the higher prevalence of overweight in children.

This study showed a significantly higher prevalence of AST among children in rural areas compared with children in urban areas. Similar results have been reported.
Table 1  Sample Characteristics by Sex, Age Group, and Location

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Female</th>
<th>Male</th>
<th>11–14 years</th>
<th>15–18 years</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>n (%)</td>
<td>546</td>
<td>49.1%</td>
<td>50.9%</td>
<td>49.6%</td>
<td>50.4%</td>
<td>69.8%</td>
<td>30.2%</td>
</tr>
<tr>
<td>Age (years) mean (SD)</td>
<td>14.8 (±1.9)</td>
<td>15 (±1.9)</td>
<td>14.9 (±1.9)</td>
<td>13.4 (±1.0)</td>
<td>16.6 (±1.0)</td>
<td>14.9 (±1.9)</td>
<td>15.2 (±1.9)</td>
</tr>
<tr>
<td>High (cm) mean (SD)</td>
<td>157 (±10.2)</td>
<td>154.3 (±7.1)</td>
<td>160 (±11.9)**</td>
<td>152 (±8.8)</td>
<td>162 (±9)**</td>
<td>158 (±10.3)</td>
<td>155 (±9.6)**</td>
</tr>
<tr>
<td>Weight (kg) mean (SD)</td>
<td>49.3 (±10.5)</td>
<td>48.2 (±8.5)</td>
<td>50.5 (±12.1)*</td>
<td>44.3 (±9.2)</td>
<td>54.3 (±9.3)**</td>
<td>50.4 (±11)</td>
<td>47 (±9.3)**</td>
</tr>
<tr>
<td>BMI (Kg/m²) mean (SD)</td>
<td>19.3 (±2.8)</td>
<td>19.6 (±2.9)</td>
<td>19 (±2.7)*</td>
<td>18.5 (±2.8)</td>
<td>20.1 (±2.7)**</td>
<td>19.5 (±3)</td>
<td>18.9 (±2.5)**</td>
</tr>
<tr>
<td>Overweight (%)</td>
<td>88 (16.1%)</td>
<td>15.7</td>
<td>16.5</td>
<td>16.2</td>
<td>16</td>
<td>16.5</td>
<td>15.2</td>
</tr>
<tr>
<td>Activea (%)</td>
<td>135 (24.7%)</td>
<td>19.0</td>
<td>30.2*</td>
<td>29.2</td>
<td>20.4*</td>
<td>21.8</td>
<td>31.5*</td>
</tr>
<tr>
<td>TV viewing timeb (%)</td>
<td>342 (62.6%)</td>
<td>62.3</td>
<td>62.9</td>
<td>63.1</td>
<td>62.2</td>
<td>65.1</td>
<td>57</td>
</tr>
<tr>
<td>School transport (%)</td>
<td>362 (66.3%)</td>
<td>62.7</td>
<td>69.8</td>
<td>63.5</td>
<td>69.1</td>
<td>60.6</td>
<td>79.4**</td>
</tr>
<tr>
<td>ASTc</td>
<td>279 (51.1%)</td>
<td>53</td>
<td>49.3</td>
<td>49.4</td>
<td>52.7</td>
<td>49.3</td>
<td>55.2</td>
</tr>
<tr>
<td>Bike</td>
<td>83 (15.2%)</td>
<td>9.7</td>
<td>20.5**</td>
<td>14</td>
<td>16.4</td>
<td>11.3</td>
<td>24.2***</td>
</tr>
<tr>
<td>Car</td>
<td>64 (11.7%)</td>
<td>12.7</td>
<td>10.8</td>
<td>11.1</td>
<td>12.4</td>
<td>16.5</td>
<td>0.6**</td>
</tr>
<tr>
<td>Bus</td>
<td>56 (10.3%)</td>
<td>10.1</td>
<td>10.4</td>
<td>11.8</td>
<td>8.7</td>
<td>13.6</td>
<td>2.4**</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>55 (10.1%)</td>
<td>12.7</td>
<td>7.6*</td>
<td>11.4</td>
<td>8.7</td>
<td>8.4</td>
<td>13.9*</td>
</tr>
<tr>
<td>Other</td>
<td>9 (1.6%)</td>
<td>1.9</td>
<td>1.4</td>
<td>2.2</td>
<td>1.1</td>
<td>0.8</td>
<td>3.6</td>
</tr>
</tbody>
</table>

a Those who reported to be active at least 60 minutes a day for the last 5 days before the survey.
b Those who reported > 2 hours per day of TV viewing in a normal school day.
c Those who reported walking or bicycling to and from school.
Abbreviations: AST, Active school transport.
* P < .05; ** P < .005.
in other studies. However, studies conducted in developed countries show that students from rural areas are less likely to travel actively to school due to low street connectivity and low residential density, thus increasing dependency on the automobile. However, rural environments in Colombia differ significantly from the rural environments in high income countries. In this sense, the important deficit in public transportation and the low socioeconomic status of the population in rural areas from Colombia could increase the reliance on active means of transportation such as walking and bicycling among school children.

In this study, boys reported higher proportion of bicycle use compared with girls. Similar results have been reported among children in studies from the United States, and among adults in studies from Colombia. A qualitative study conducted in the capital city of Bogotá to understand the use of the bicycle among adults, found important social and cultural differences by sex. The study reported that boys had an earlier learning experience of bicycle use and that boys were more encouraged by their parents to use the bicycle compared with girls, in part explained by safety issues. However, gender disparities in bicycle use are not fully understood and are a topic of discussion that warrants further exploration.

The prevalence of motorcycle use was of particular interest in this study due to its large use as a means of transportation in populations from low- and middle-income countries. One in every three students who reported using motorized transportation to school was transported by motorcycle. This proportion was significantly higher in girls and in children from rural areas. Few studies have included motorcycle use when assessing AST. Only 1 study from Brazil among school children included this information. That study found that 33% of surveyed students reported having used the motorcycle as a means of transportation in the last 30 days. In addition, a study from a nationally representative sample of Colombian adults found that men who owned a motorcycle had an increased likelihood of overweight, obesity and abdominal obesity.

Some limitations of this study need to be addressed. First, the cross sectional nature of the study does not allow establishing the temporality of the relationship between AST and BMI. It is impossible to determine whether active travelers are overall more active, or if more active children choose active means of transportation. Second, due to the measurement characteristic of the independent variable is not possible to assess the potential dose–response relationship in terms of distance traveled, duration, or frequency of AST. Distance to school has been identified as a strong predictor of active commuting and is associated with lower prevalence of AST. However, distance to school may not be a limiting factor among children from poor rural communities, who choose to engage in walking or bicycling to school regardless of distance due to the lack of other options such as public or private transportation. An important limitation of this

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>% OW</th>
<th>Crude OR</th>
<th>95% CI</th>
<th>Adjusted OR</th>
<th>95% CI</th>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Female</td>
<td>268</td>
<td>15.7</td>
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<td>—</td>
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<tr>
<td>Male</td>
<td>278</td>
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<td>0.6-1.5</td>
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<td>0.6-1.4</td>
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<tr>
<td>Age group</td>
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<td>&gt;15 years</td>
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<td>—</td>
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<tr>
<td>≤15 years</td>
<td>271</td>
<td>16.2</td>
<td>1.0</td>
<td>0.6-1.6</td>
<td>0.9</td>
<td>0.6-1.6</td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>165</td>
<td>15.7</td>
<td>1</td>
<td>—</td>
<td>1</td>
<td>—</td>
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<tr>
<td>Urbana</td>
<td>381</td>
<td>16.5</td>
<td>1.1</td>
<td>0.7-1.8</td>
<td>0.9</td>
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<tr>
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<tr>
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<td>411</td>
<td>15.8</td>
<td>1</td>
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<td>1</td>
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<tr>
<td>Active</td>
<td>135</td>
<td>17.0</td>
<td>0.9</td>
<td>0.5-1.5</td>
<td>0.9</td>
<td>0.5-1.6</td>
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<tr>
<td>TV viewing time</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>≤2 hours/day</td>
<td>204</td>
<td>14.2</td>
<td>1</td>
<td>—</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>&gt;2 hours/day</td>
<td>342</td>
<td>17.3</td>
<td>1.2</td>
<td>0.7-2.0</td>
<td>1.1</td>
<td>0.6-1.7</td>
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<td>AST</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>No</td>
<td>184</td>
<td>22.8</td>
<td>1</td>
<td>—</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Yes</td>
<td>362</td>
<td>12.7</td>
<td>0.5</td>
<td>0.3-0.8</td>
<td>0.5</td>
<td>0.3-0.8</td>
</tr>
</tbody>
</table>

Abbreviations: PA, physical activity; AST, active school transport; OW, overweight; OR, odds ratio.

Note. Bold data indicates statistical significant association at $P < .05$. All odds ratios are adjusted for sex, age group, location, PA level, TV viewing time, and AST.
study was the inability to classify the population by socio economic status (SES) in a reliable manner. SES could be an important confounder in the relationship between AST and overweight.\textsuperscript{50,51} People from low SES report higher levels of occupational and transportation related physical activity while individuals from high SES tend to report higher leisure time physical activity.\textsuperscript{52}

Several strengths of the study can be mentioned. This is one of the few studies to explore the association between AST and weight status among children in Latin-America. According to recent reviews, there is weak evidence linking active commuting to healthy BMI.\textsuperscript{16} Finally, the representativeness of the sample and the inclusion of both urban and rural areas strengthen the results of this study.

Conclusions

This study found a significant association between AST and reduced likelihood of overweight and obesity among Colombian adolescents living in a rapidly developing area. These findings support the need to advocate to local authorities for the implementation of strategies that promote safe walking and bicycling to school among children. Although there has been a considerable advance in understanding the determinants of AST, it is important to strengthen the body of knowledge in this area through high-quality research in particular in low-to-middle income countries. A first step in this direction could be to develop standardized instruments and variable definitions to allow for comparative studies,\textsuperscript{16} as well as the implementation of randomized control trials. Given that randomization is not always possible, quasi-experimental design studies and natural experiments offer a useful alternative, to gain a greater understanding in the causal determinants of AST. In addition, examining the potential negative effects and unwanted consequences of AST promotion such as traffic related injuries and safety issues should be evaluated and taken into account when designing and implementing AST strategies.

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References


