

Six-Year Trend in Active Commuting to School in Spanish Adolescents

The AVENA and AFINOS Studies

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Abstract

Background Promoting daily routine activities, such as active commuting to school, may have important health implications for young people.

Purpose The aim of the study was to examine the secular trend of active commuting to school in Spanish adolescents over a 6-year period (2001–2002 to 2006–2007). We also examined several factors that might explain this trend.

Methods Data comes from two separate cross-sectional studies, both representatives from the city of Madrid (Spain): AVENA and AFINOS studies. These took place in 2001–2002 and 2006–2007 and included 415 (198 girls) and 891 (448 girls) adolescents aged 13–17, respectively. Commuting to school was assessed using a standardized question about their habitual mode of transportation to school: walking, cycling, bus/subway, car, or motorcycle. Chi-square and binary logistic regression were used.

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Results Percentage of active commuting girls decreased significantly from 61 % to 48 % ($p=0.002$) from 2001–2002 to 2006–2007. Walking declined from 61 % to 46 % and the use of bus/subway increased from 25 % to 37 % in girls. Girls belonging to average/small families had lower odds of being active commuters than girls of large families (OR, 95 % CI: 0.69, 0.48 to 0.98). There were no significant differences in mode of commuting to school for boys ($p=0.269$).

Conclusion Spanish adolescent girls in 2007–2008 had lower levels of active commuting to school, mainly walking, than their counterparts 6 years before. Belonging to a large family was related with higher active commuting in girls.

Keywords Adolescence · Active commuting to school · AVENA · AFINOS

Introduction

Promoting daily routine activities, such as active commuting to school, may have important health implications for young people. Active commuting to school provides an opportunity for increasing levels of total physical activity on school days [1–5] and, therefore, to enhance fitness [1, 6–8] which is a marker of health in young people [9]. Also, it has been suggested that active transportation to school is associated with a healthier weight status and body composition in youth [10], mainly when active commuting is bicycling [11, 12]. Furthermore, active commuting has shown to have social benefits (e.g., facilitate contacts between neighbors) to people and environmental benefits (e.g., less carbon dioxide emissions) for the society [13].

Although there is little evidence available, several studies have consistently demonstrated a decline in the last decades in the prevalence of active commuting to school among young people in the United States [14], Australia [15], Canada [16], and the United Kingdom [17]. A study from the USA included data about the mode of commuting to school from 1969 to 2001 in young people from 5 to 18 years old. They reported a decrease of 23 % in the prevalence of active commuting to school [14]. A study from Australia included data from 1971 to 2003 in children aged 5 to 9 years old and 10 to 14 years old [15]. They reported a decrease of 32.2 % and 23 %, respectively, for each age group. A study from Canada included data from 1986 to 2006 in children from 11 to 13 years old and adolescents from 14 to 15 years old [16]. They reported a decrease of 10.5 % and 8 %, respectively, for each age group. A study from the UK included data from 1975 to 1994 in children from 5 to 10 years old [17]. They reported a decrease of 9.4 % in the prevalence of active commuting to school.

A longer distance to school in the USA [14] and a reduction of the walkable distance in the UK [17], seemed to be the main causes of their negative trends in active commuting to school. However, other potential predictors of youth's active commuting behaviors that were not examined, including individual characteristics (e.g., gender and age), family characteristics (e.g., socioeconomic status and parent's perceptions), school characteristics (e.g., location and administration), and physical and social environment characteristics (e.g., transport infrastructure and social norms), might be influencing these detrimental trends [2, 18]. Information on trends and causes in active commuting to school in Southern Europe are still lacking.

The aim of this study was to examine the secular trend of active commuting to school in Spanish adolescents over a 6-year period (2001–2002 to 2006–2007). We also examined several factors that might explain this trend of active commuting to school.

Methods

In this study, we considered data from two separate cross-sectional studies, both representatives from the city of Madrid (Spain). Data for the first measurement point were obtained during the years 2001–2002 as part of the AVENA (Food and Assessment of the Nutritional Status of Spanish Adolescents) study [19]. The AVENA study was performed in five Spanish cities (Granada, Madrid, Murcia, Santander, and Zaragoza) and designed to assess the nutritional status of a representative sample of adolescents from Spain. The population was selected by multiple-step, simple random sampling, first taking into account location and then by random assignment of schools. The socioeconomic variable was also randomly assigned, since the selection of schools was done by random selection proportionally to the number of schools in each city district guaranteeing the presence of almost one school per district. The socioeconomic level of the AVENA sample is similarly distributed than in the Spanish society [20]. For the present study, we selected 415 adolescents (198 girls) aged 13–17 from the city of Madrid. Data for the second measurement point was obtained during the years 2007–2008 as part of the AFINOS (Physical Activity as a Preventive Measure Against Overweight, Obesity, Infections, Allergies, and Cardiovascular Disease Risk in Adolescents) study [21]. The AFINOS study was designed to assess health status and lifestyle factors through a survey completed by adolescents from the Madrid region (rural areas, suburbs, and Madrid City). A randomized cluster sample procedure was used to select the sample. Ten schools were selected in the city of Madrid by random selection proportionally to the number of public and private schools in the city. The second level of sampling

was school classroom/grade (four levels) [22]. For the present study, we selected 891 adolescents (448 girls) aged 13–17 only from the city of Madrid.

Parents/guardians and adolescents from both studies gave their written informed consent for participation. The AVENA study was approved by the Review Committee for Research Involving Human Subjects of the Hospital Universitario Marqués de Valdecilla (Santander, Spain). The AFINOS study was approved by the Ethics Committee of the Puerta de Hierro Hospital (Madrid, Spain) and the Bioethics Committee of the Spanish Research Council.

The assessment of commuting to school was similar in both studies using a standardized question for Spanish adolescents [20, 22]: “How do you usually travel to school?” and response options were: “car, walking, cycling, bus/subway, motorcycle, other.” The active commuting to school group were those adolescents who walked or cycled to school. The passive commuting to school group were those adolescents who used the bus/subway or car or motorcycle. The duration of the habitual journey to school was: “How long does it usually take you to travel from home to school?” and response options were: “15 minutes or less, from 15 to 30 minutes, from 30 minutes to 1 hour, more than 1 hour.” Answers were categorized in two groups: 15 min or less and more than 15 min.

Several sociodemographic characteristics collected similarly in both studies were selected: age, type of school, family structure, and family size. Age was categorized in five groups: 13, 14, 15, 16, and 17 years. The type of school was categorized on the basis of being administered by the national government (public schools) or not (private schools). Family structure was self-reported by adolescents and was categorized as having both parents at home and another option (i.e., mother or father or neither at home). Family size was self-reported by adolescents answering the number of brothers/sisters in their family and it was categorized according to the Spanish government criteria: large family if ≥ 3 children or average/small family if ≤ 2 children.

Statistical Analyses

Differences in sociodemographic (age, type of school, family structure, and family size) and commuting characteristics (commuting to school, time of commuting) between both measurement points in boys and girls were assessed by chi-square. Mode of commuting to school between both measurement points was described for the whole sample, boys and girls. Associations of active commuting to school (active vs. passive) with the measurement point (2001–2002 vs. 2007–2008) and with sociodemographic characteristics (age, type of school, family structure, and family size) were studied using binary logistic regression. Active commuting to school was entered into the models as the dependent

variable (active=1, passive=0) and measurement point (the reference group was the measurement in 2007–2008) as the independent variable. The analysis was controlled for age, type of school, family structure, and family size, which were included as categorical variables. The analysis was done separately for boys and girls. The significance level was 5 % and all calculations were performed using SPSS v.18.0 software for Windows.

Results

Sociodemographic and commuting characteristics (age, commuting to school, time of commuting, type of school, family structure, and family size) in both measurement points are presented in Table 1. Percentage of active commuting in boys did not change substantially (from 44 % to 49 %, $p=0.269$), but percentage of active commuting in girls decreased significantly from 61 % to 48 % ($p=0.002$), from 2001–2002 to 2006–2007.

Percentages of commuting modes to school in the study population by measurement point are shown in Fig. 1 for all the sample, boys and girls. Walking declined from 61 % to 46 % and the use of bus/subway increased from 25 % to 37 % in girls between the two measurement points. Biking had a very low use: 0.2 % of adolescents in 2001–2002 and 2 % in 2006–2007.

Logistic regression analysis confirmed these trend in both boys (OR, 95 % CI: 1.45, 0.95 to 2.21) and girls (OR, 95 % CI: 0.67, 0.45 to 0.99) after adjusting for age, type of school, family structure, and family size (Table 2). Boys with one or no parents at home had lower odds of being active commuters than boys with both parents at home (OR, 95 % CI: 0.61, 0.40 to 0.93). Girls belonging to average/small families also had lower odds of being active commuters than girls of large families (OR, 95 % CI: 0.69, 0.48 to 0.98).

Additional analysis indicated that more than 80 % of the active commuters from both studies reported to spend less than 15 min in the journey to school. There was a significant increasing trend of the journey duration in active girls between 2001–2002 and 2007–2008. The percentage of active girls reporting a journey longer than 15 min increased from 10 % in 2001–2002 to 23 % in 2007–2008 ($p=0.003$).

Discussion

The results of the present study showed that Spanish adolescent girls in 2007–2008 had lower levels of active commuting to school, mainly walking, than their counterparts 6 years before. Belonging to a large family was related with higher active commuting in girls; it might have contributed

Table 1 Sociodemographic and commuting characteristics in adolescents from Madrid in 2001–2002 and 2006–2007

	Boys (%)				Girls (%)			
	Number	2001–2002	2006–2007	<i>P</i>	Number	2001–2002	2006–2007	<i>P</i> ^a
Age (years)	660			0.968	646			0.009
13		17.5	19.0			14.1	15.2	
14		25.3	26.0			23.2	25.2	
15		20.3	21.0			34.3	21.7	
16		24.4	22.3			20.2	24.3	
17		12.4	11.7			8.1	13.6	
Commuting to school	657			0.269	643			0.002
Active		44.4	49.0			61.0	47.8	
Passive		55.6	51.0			39.0	52.2	
Time of commuting (min)	657			0.319	645			<0.001
≤15		55.6	51.5			74.1	53.6	
>15		44.4	48.5			25.9	46.4	
Type of school	657			<0.001	644			<0.001
Public		16.4	70.9			29.1	68.3	
Private		83.6	29.1			70.9	31.7	
Family structure	626			<0.001	624			0.189
Mother and father		90.2	75.4			79.5	74.6	
1/no parent		9.8	24.6			20.5	25.4	
Family size	626			0.010	622			0.217
≥3 children		38.3	27.8			34.9	29.8	
≤2 children		61.7	72.2			65.1	70.2	

^a *P* values were calculated using chi-square tests

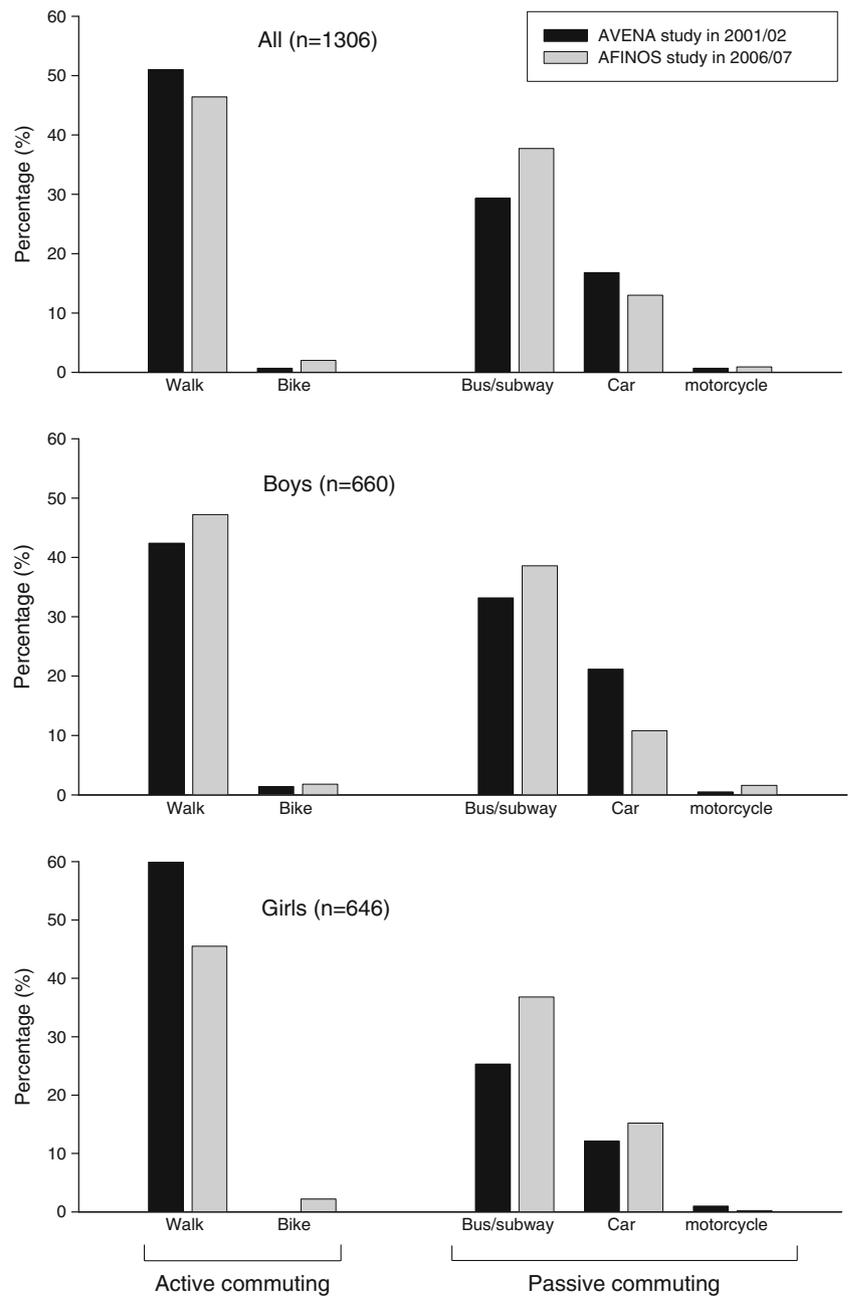
Significant *P* values ($p < 0.05$) are highlighted in bold text

to explain this trend. Because active commuting to school has evident health implications in adolescence, policy efforts should be focused on stopping this trend, especially in girls.

According to our results, similar secular changes have been reported in the rate of active commuting to school among boys and girls from the USA [14], Australia [15], Canada [16], and the UK [17]. Data from USA and UK used national databases, data from Australia used a state database from New South Wales, and data from Canada used a database from the Greater Toronto Area. Data from the USA [14] reported that in 1969, 41 % of students walked or biked to school and by 2001, only 13 % did. It means a decrease of 0.8 % per year. The private vehicle (mainly car) use increased from 17 % to 55 % from 1969 to 2001. Data from Australia observed a decrease in children aged 10–14 years from 44 % to 21 % in walking, that is, a decrease of 0.4 % per year [15]. The use of a car increased from 12 % to 48 %. In Canada [16], walking to school declined from 53 % to 43 % for 11–13-year-olds and from 39 % to 31 % for 14–15-year-olds, between 1986 and 2006. It means a decrease of 0.6 % per year. The car use increased from 15 % to 20 % for 11–13-year-olds and from 16 % to 19 % for 14–15-year-

olds. Data from the UK [17] included children aged 5–10 years from 1975 to 1995. They observed a decrease of 9 % in walking (from 71 % to 62 %), which means 0.5 % per year. Car use increased in 13 % but the distance driven decreased. In the current study, girls reported a decrease in active commuting to school of 13 % in 6 years, which means 0.5 % per year. It is similar to girls and boys from the UK [17], slightly higher than Australia [15] and lower than Canada [16] and the USA [14]. None of these studies found gender differences in the different measurement points. The studies from the UK [17] and from Canada [16] studied boys and girls together. The study from Australia [15] studied boys and girls separately but both showed mostly similar results and pooled data were shown. They only found one gender difference: girls aged 10–14 years were more frequently driven from school in 1971 (8.6 % and 4.9 % for girls and boys, respectively). The study from the USA [14] showed the results for the whole sample and for boys and girls separately; they did not find gender differences. In 1977, 24.7 % of the boys and 22.2 % of the girls showed active commuting to school; in 2001, these percentages decreased and only 13.4 % of boys and 12.5 % of girls showed active commuting to school.

Fig. 1 Commuting modes to school



Comparisons must be taken cautiously because of methodological and specific country differences. Moreover, the averages trend per year calculated above are theoretical, since trends do not change constantly every year.

It seems that the decrease in active commuting is mirrored by a rise in driving to school. This rising is highly evident in the USA and Australia with rates of 38 % and 36 %, respectively. In the current study, motorized transportation increases more moderately from 48 % in 2001–2002 to 52 % in 2006–2007. A similar increasing rate (4 %) was found in Canada and lightly higher (13 %) among the UK population.

A longer distance to school in the USA [14] and a reduction of the walkable distance in the UK [17] seemed to be the main causes of this negative trend in active commuting to school. Actually, distance has been reported to be the main predictor of active commuting to school [2, 23, 24]. Moreover, distance between home and school is mostly related with urban plans and policies. The USA, which is a big country, has more open spaces and most people live in single houses; the density population in all USA is 33 people per square kilometer (World Population Prospects, 2008) [25]. However, density population in overall Spain is 90 people per square kilometer and in Madrid City increases

Table 2 Odds ratio for active commuting to school in adolescent boys and girls from Madrid in 2001–2002 and 2006–2007

	Commuting to school (active vs. passive)					
	Boys (<i>n</i> =621)			Girls (<i>n</i> =618)		
	OR	95 % CI	<i>P</i>	OR	95 % CI	<i>P</i>
Measurement point						
2001–2002	1	Reference		1	Reference	
2006–2007	1.45	0.95–2.21	0.083	0.67	0.45–0.99	0.047
Age (years)						
13	1	Reference		1	Reference	
14	1.33	0.82–2.16	0.245	0.98	0.58–1.67	0.963
15	1.22	0.73–2.03	0.447	0.97	0.57–1.65	0.922
16	0.59	0.35–0.99	0.046	0.95	0.56–1.63	0.861
17	0.96	0.53–1.74	0.906	0.64	0.34–1.21	0.176
Type of school						
Public	1	Reference		1	Reference	
Private	1.13	0.77–1.65	0.529	1.32	0.93–1.89	0.122
Family structure						
Mother and father	1	Reference		1	Reference	
1/no parent	0.61	0.40–0.93	0.022	0.970	0.66–1.42	0.878
Family size						
≥3 children	1	Reference		1	Reference	
≤2 children	1.23	0.86–1.75	0.258	0.690	0.48–0.98	0.040

All the analysis were controlled for age, type of school, family structure, and family size

Significant *P* values ($p < 0.05$) are highlighted in bold text

to 5,209 people per square kilometer. Walking and biking rates are higher in denser neighborhoods [26].

Apart from distance, there are other personal (i.e., parental safety concerns and sociodemographic characteristics) and environmental factors (i.e., connectivity of the route and major road crossings) that might individually affect the decision of active commuting to school [27, 28]. In the current study with Spanish adolescents, the percentage of active girls decreased but their journey duration increased. The fact that the duration increased suggests that the commuting distance increased in active girls. Focusing on examining what factors could determine the decrease in active-commuter girls from 2001–2002 to 2006–2007, we found an interesting association with family size. A higher percentage of girls whose family had three or more children used active modes (57.5 %) rather than passive modes (42.5 %). It may be speculated that adolescent girls from large families are more independent to actively commute to school because: (1) their parents are busy commuting younger children and adolescents go on their own, (2) parents encourage their children to actively commute to school when two or more siblings go together, and/or (3) parents encourage their children to actively commute to school because their older children used to do it with success and

they are used to it. Since the number of children per family has decreased from 2001–2002 to 2006–2007, we might consider that this fact has contributed to decrease active-commuter girls.

The gender differences observed in the current study when examining the trends in active commuting to school have not been observed in other trend studies. It may be related to the independent mobility and perceptions in the built environment among adolescents or their parents when they actively commute to school. Independent mobility has been reported to be higher in boys than girls [29]. Perception of the built environment is a subjective issue. Actually, everyday risk discourses is constructed according to gender and generation, and they are most significant in shaping mobility [30]. Maybe, the current parents assume a lower independent mobility in their girls than previous generations. Crime rates and traffic, among other perceptions, might contribute to a perceived dangerous environment. However, the crime rate in Madrid has lightly decreased from 2001–2002 to 2006–2007. Data from the European Commission indicated that the rate of crime (number of recorded crimes per 1,000 population) was 38.8 in the period 1999–2002 and 36.7 in the period 2003–2006 [31]. Therefore, this rate does not seem to explain the results in

the current study. Parent's perception about the environment and danger might differ from objective data. It is plausible that perceived danger is more influential on active commuting to school than objective danger.

These results are important, since there is strong evidence that adolescent girls in Spain participate in lower levels of leisure-time physical activity than boys in both AVENA [32, 33] and AFINOS studies [34]. Boys reported approximately 1.5-fold higher levels of participation in leisure-time physical activity than girls in 2001–2002 and 2006–2007. This result together with the main finding in the current study, glimpses that adolescent girls from Spain are at risk of not achieving the minimum recommended levels of physical activity [35].

Public Health Strategies

The observed transition from active to inactive modes of commuting to school has negative implications for both human and environmental health. Firstly, walking to and from school seems a feasible opportunity to be physically active on 5 days of the week. It has been suggested that walking to school might also stimulate further physical activity [36]. Secondly, the motorization of short trips has an adverse impact on health and the environment [37]. Environmental factors such as air pollution and climate change, decreasing petrol and gas reserves, noise, and traffic congestions near schools must be considered [15]. Furthermore, active commuting to school has been associated with environmental, family, and personal barriers [23, 24, 27]. Taking into account these studies, the authors suggest that these two strategies might be prioritized for promoting physical activity when commuting to school among adolescents: (1) an educational initiative focusing on school communities, including teachers, parents, and students, i.e., teach parents and young people the safest way to school, how to be a good pedestrian and cyclist, and benefits of walking and cycling to school and (2) an environmental initiative focusing on local governments strategies, i.e., build crosswalks, sidewalks, and bike lanes on the way to school. These strategies should be addressed within an interdisciplinary framework including policy makers, public health professionals, transport and land use planners, and community and school engagement.

Strengths and Limitations

The main strength of this study is the inclusion of two samples of Madrid City studied 6 years apart. It is of interest to study the secular trend in other countries' capitals to confirm or contrast the decline in active commuting to school in the last years in large urban areas. To the best of our knowledge, these are the first data on trends of

commuting to school in Spain. The main limitation is that sampling procedures of both studies were not identical. Although participants from different types of school were invited to participate in a representative proportion for Madrid City, some schools rejected to participate and the final number of public and private schools differed between the studies. To deal with this limitation, statistical analyses were adjusted for type of school (private vs. public) and additional analyses were conducted separating adolescents from private and public schools. Results confirmed that the decreasing trend of active commuting to school among girls occurred only in private schools and not in public schools; however, these results must be interpreted cautiously because of the low number of public schools from the AVENA study. Other limitations were the low number of confounders used, since only identical variables from both studies could be included for studying the secular trend and that measures of socioeconomic status such as parent educational and professional levels were available in the AVENA study but they were not available in the AFINOS study [22]. Furthermore, the question used to measure the mode of commuting to school only reported the way to school; information about the way from school is lacking.

Conclusion

This study suggested a decline in active commuting to school, mainly walking, in girls from Madrid City from 2001–2002 to 2006–2007. Future studies should investigate in-depth factors determining this decline. Since active commuting to school is an important health behavior in young people, public health strategies must promote this opportunity to increase the physical activity levels in adolescents, especially in girls. The findings of this study have important implications for health and both education and urban policies. Public authorities in the fields of education and city planning have clear evidence about the benefits of promoting active commuting to school behaviors among young people. Moreover, there is evidence that percentage of active commuters to school are decreasing.

Acknowledgments We thank the adolescents and teachers who participated in these studies. The AVENA study was supported by the Spanish Ministry of Health, FEDER-FSE funds FIS no. 00/0015 and grants from Panrico S.A., Madaus S.A., and Procter and Gamble S.A. The AFINOS study was supported by the Spanish Ministry of Education and Science (DEP2006-56184-C03-02/PREV) and an E.U. funding (FEDER). DMG had a grant from the Spanish Ministry of Education and Science (AP2006-02464). FBO is supported by grants from the Spanish Ministry of Education (EX-2008-0641; RYC-2011-09011) and the Swedish Heart-Lung Foundation (20090635).

Disclosure The content of this paper reflects only the authors' view and the rest of AVENA and AFINOS study members are not responsible for it. The writing group takes sole responsibility for the content of this article.

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