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Attitudes towards cycle skills training in New Zealand adolescents

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ABSTRACT

Introduction: Cycle skills training (CST) increases cycling skills in children. Whether CST could be beneficial to adolescents and whether adolescents would be interested in taking on such training remains unknown. This study examined correlates of adolescents' perception that CST could make them safer in traffic.

Materials and methods: A total of 1453 adolescents (age: 15.1 ± 1.4 years; 44.9% boys) from 12 secondary schools in Dunedin (New Zealand) participating in the BEATS Study completed an online survey in 2014–2015. Questions assessed demographics, travel to school habits, attitudes towards cycling and CST, normative beliefs, perceived behavioural control and behavioural intention for cycling to school. Data were analysed using linear mixed models.

Results: Out of 38.5% of adolescents who perceived that CST could make them safer in traffic, nearly half would take CST at their school (43.1%). In a multivariate analysis, enjoying cycling for recreation, perceiving cycling to school as being useful, cycling frequently with parents, school's encouragement, and desire to cycle to school were positively associated with adolescents' perception that CST could make them safer in traffic (all $p < .05$).

Conclusion: Enjoyment of cycling for recreation, finding cycling to school useful, desire to cycle to school, frequent cycling with parents, and encouragement from schools were associated with favourable perceptions of CST in adolescents. Therefore, raising adolescents' awareness of the benefits of CST and potentially offering such training in secondary schools could be beneficial. Future interventions should involve parents and schools and aim to increase adolescents' interest in taking CST at school.

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1. Introduction

Although walking is a popular form of active transport to school, cycling to school is less common among adolescents in many developed countries (Chillon et al., 2009; Larsen et al., 2009; Leslie, Kremer, Toumbourou, & Williams, 2010; Mandic, Leon de la Barra, et al., 2015; Mandic, Mountfort, et al., 2015; McDonald, 2007; Nelson, Foley, O'Gorman, Moyna, & Woods, 2008) and has been declining over the last two decades (McDonald, 2007; Ministry of Transport, 2015a). Traffic safety is one of the key concerns regarding cycling for transportation among all segments of the population (Department for Transport, 2015; Krizek, Forsyth, & Baum, 2009; Sallis et al., 2013), but especially in children and adolescents. High rates of bicycle-related injuries in young people have been reported in the United States (National Highway Traffic Safety Administration, 2015) and European Union (Candappa et al., 2012). In the United States, children under 15 years of age and adolescents (15–19 years of age) accounted for 7% and 8% of all cyclists killed and for 11% and 15% of those injured in traffic crashes, respectively, in 2013 (National Highway Traffic Safety Administration, 2015). Among adolescents, in the European Union, cycling fatalities peak between the ages 12 and 17 years when adolescents are likely to increase their independent, solo cycle travel (Candappa et al., 2012). In New Zealand (Ministry of Transport, 2015b) and Australia (Boufous, Rome, Senserrick, & Ivers, 2011), adolescents have the highest rates of bicycle-related accidents compared to other age groups. In New Zealand, 22% of cyclists killed or injured in traffic crashes are aged 10–19 years (Ministry of Transport, 2015b). When the time spent cycling among different age groups was taken into account, New Zealand cyclists 13–17 years of age and 18–44 years of age were at a greater risk of being in a collision with a motor vehicle compared to other age groups (Ministry of Transport, 2015b).

Many factors contribute to trends in bicycling fatalities, including the prevalence of bicycling, road design and engineering, traffic law enforcement, driver and bicyclist behaviour, helmet use, and traffic volume (Krizek et al., 2009). Government interest in road safety and alternatives to motorized transport has created a focus on aspects of bicycle safety, including cycle skills training. Bicycle riding is a motor skill which requires a large amount of practice to make movements efficient and automatic (Ellis, 2014). Cycling in traffic also requires cognitive skills and considerable alertness for the successful selection of task-relevant information in complex traffic situations (Ellis, 2014). Children with inadequate cycle skills have much higher accident rates compared to other children, even though they may cycle less frequently (Preston, 1980). Moreover, parental confidence in the child's cycle skills is one determinant of cycling to school levels in children (Ducheyne, De Bourdeaudhuij, Spittaels, & Cardon, 2012; Trapp et al., 2011) and mediates the association between parental perceptions of safety and cycling in children (Trapp et al., 2011). Therefore, in addition to making the environment safer, development of cycling skills is an important strategy to help minimize parental safety concerns and increase rates of cycling in children and adolescents.

The over-arching aim of CST courses is to give children the skills and confidence to cycle safely in an environment with traffic. Cycle training programmes differ in duration, content, and training type (Ellis, 2014), with the most effective approaches involving repetition of safety-related messages and multiple practice opportunities (Macarthur, Parkin, Sidky, & Wallace, 1998). Classroom-based (Nagel, Hankenhof, Kimmel, & Saxe, 2003) and internet-based (McLaughlin & Glang, 2010) education programmes are effective in teaching bicycle safety behaviours to kindergarten and grade 1–3 children. Programmes with a practical component expose children (age 8–10 years) to cycling in a traffic-free environment (i.e. playground) (Ducheyne, De Bourdeaudhuij, Lenoir, & Cardon, 2013; van Schagen & Brookhuis, 1994) and/or cycling on the road with traffic (Colwell & Culverwell, 2002). In most but not all studies (Macarthur et al., 1998) CST programme conducted in a traffic-free environment increased knowledge (McLaughlin & Glang, 2010; van Schagen & Brookhuis, 1994) and improved cycling skills (Ducheyne, De Bourdeaudhuij, Lenoir, & Cardon, 2014; Ducheyne et al., 2013; van Schagen & Brookhuis, 1994) in primary school children. However, a recent systematic review found that although CST interventions may increase the knowledge of cycling safety, this did not seem to translate into reduced rates of injuries or improved bicycle handling skills and attitudes toward safe cycling in young people (Richmond, Zhang, Stover, Howard, & Macarthur, 2014). Educational programs aimed to make cycling to school safer for children should develop motor skills (such as pedalling, balancing, steering and braking) and cognitive skills (such as concentration, attention and judgment), as well as provide education about the road rules, the right protective gear and bicycle maintenance (Ellis, 2014; Trapp et al., 2011).

Compared to children, adolescents have more developed motor and cognitive skills. However, factors related to social influences and risk-taking may have different impact at different ages (Ellis, 2014) and may contribute to the high risk of bicycle-related injuries observed in adolescents. One study found that 12-year old children cycled faster and made more mistakes in a simulated traffic environment compared to 8-year and 10-year old children (Briem, Radeborg, Salo, & Bengtsson, 2004). Children and adolescents tend to imitate peers irrespective of whether they demonstrate safe riding or engage in risky cycling behaviour (Babu et al., 2011; Ellis, 2014). Bicycle crashes often occur because children and adolescents engage in risky behaviours on their bicycles (Ellis, 2014). Risk-taking is heightened during adolescence (Ellis, 2014). Particularly in adolescent boys (Colwell & Culverwell, 2002). Self-efficacy towards safe cycling skills is negatively correlated with risky cycling behaviour and risky cycling intentions in adolescents from the Netherlands (Feenstra, Ruiter, & Kok, 2010). A study from London, UK, revealed no effects of CST on accidents or adolescents' attitudes towards safe cycling behaviour (Colwell & Culverwell, 2002). Taking or passing a CST programme was not associated with the reduced likelihood of cycling-related injury in adolescents (Colwell & Culverwell, 2002). Consequently, programmes that improve the knowledge of road safety

and teach safe cycling behaviour should form part of a comprehensive approach for reducing cycle-related injuries in adolescents (Boufous et al., 2011).

Only limited evidence exists in relation to adolescents' attitudes towards CST and the effects of such training in adolescents have not been studied. Colwell and Culverwell (2002) found that 39% of adolescents in London, UK, perceived that CST was teaching real life skills and making them a safer road user. In New Zealand, CST programmes are currently offered only in primary schools and teach the theory of safe cycling followed by off-road and on-road experiences. Whether CST could be beneficial to adolescents and whether adolescents would be interested in taking on such training remains unknown. Raising adolescents' awareness of the benefits of CST and potentially offering such training in secondary schools could be part of comprehensive efforts to improve the safety of cycling and ultimately encourage cycling for transport in adolescents. Such efforts could include effective use of bicycle helmets, increasing the visibility of child and adolescent cyclists, integrating safe and user-friendly cycling routes to school. Efforts could also include infrastructure changes such as safe crossings, traffic calming measures, school speed zone restrictions and cycle lanes and paths, using a context sensitive approach (Dondi, Simone, Lantieri, & Vignali, 2011). This study examined correlates of adolescents' perceptions that CST could make them safer in traffic.

2. Materials and methods

2.1. Participants

A total of 1780 adolescents (13–18 years of age) from all 12 secondary schools in Dunedin, New Zealand, completed an online survey as a part of the Built Environment and Active Transport to School (BEATS) Study in 2014/2015 (Mandic, Leon de la Barra, et al., 2015; Mandic, Mountfort, et al., 2015; Mandic et al., 2016). Adolescents with invalid surveys (n = 38), incomplete consents (n = 79), missing data (n = 48) and boarders (n = 162) were excluded from the analysis. Therefore, a total of 1453 adolescents were included in the current analysis.

2.2. Procedures

Adolescents completed an online questionnaire (30–40 min) during class time. All students signed consent for taking part in the study. For adolescents under 16 years of age, parents signed either parental opt-out or parental opt-in consent depending on the school's preference. The study was approved by the University of Otago Ethics Committee.

2.3. Questionnaire

The questionnaire included information about demographics, travel to school habits and questions informed by the Theory of Planned Behaviour (Ajzen, 1991) regarding past behaviour attitudes (general and specific attitudes towards cycling), normative beliefs for parents, peers, and schools, perceived behavioural control (capability, ability, confidence, and personal control), and intention to cycle to school.

Questions about *demographics* included age, gender, ethnicity, school year, school and number of bicycles at home. *Travel to school habits* were assessed using the question "How do you usually travel to school?" for different transport modes with five response categories ("never", "rarely", "sometimes", "most of the time", "all of the time"). Dominant modes of transport to school (used "most/all of the time") and multi-modal transport were used to classify adolescents into active transport, motorized transport or combined motorized and active transport.

According to the Theory of Planned Behaviour (Ajzen, 1991), *past behaviour, attitudes towards cycling, subjective norm, perceived behavioural control and behavioural intentions* were measured with standard items (see Appendix A for item details). Most questions were adapted from Armitage C.J. (Armitage, 2005) and had a good internal reliability (Armitage, 2005). Additional items developed specifically for this study (marked with an asterisk in Appendix A) included perceptions of cycling safety, frequency of cycling with parents and peers, school's encouragement to cycle to school and items related to general attitudes towards cycling and cycle skills training. A definition of cycle skills training was included in the questionnaire: "Cycle skills training is a short interactive course that teaches road awareness and how to cycle on the road."

Briefly, *past behaviour* was measured using a question: "Think about the last two weeks. How many times did you cycle to school?" *Attitudes* towards both cycling to school and cycling in general were assessed. Given the conceptual similarities, and to avoid collinearity issues in the multivariate analyses, the scores for the perceptions of cycling as interesting, pleasant and stimulating, were summed and then averaged to create a composite score interesting/pleasant/stimulating (Cronbach's alpha = .94). Similarly, given the conceptual similarities of the cycling capability items (capability, ability and confidence to cycle to school), and to avoid collinearity issues in the multivariate analyses, the scores for these items were summed and then averaged to create a composite score (Cronbach's alpha = .88). *Subjective/perceived norm* (injunctive (i.e., what people ought to do) and descriptive (i.e., what people do) aspects) was assessed for parents and friends. *Behavioural intentions* were measured using two standard items (Armitage, 2005).

2.4. Data analysis

Demographic characteristics were analysed using descriptive statistics. To identify correlates of positive attitudes towards CST, linear mixed models were created, adjusting for the clustering effect of school. The models assumed a variance components covariance type for the random intercept effects and used maximum likelihood as the estimating method. First, bivariate correlates were examined including sociodemographic characteristics, travel to school habits, attitudes towards cycling in general and cycling to school, subjective norms, perceived behavioural control and intentions. Significant bivariate correlates were subsequently entered into a multivariate model. *P*-value <0.05 was considered statistically significant. Descriptive data were reported as frequencies (percentage) for categorical variables and mean ± standard deviation for continuous variables. *P*-value less than 0.05 was considered statistically significant. Data analysis was performed using SPSS Statistical Package version 22.0.

3. Results

Sociodemographic characteristics are presented in Table 1. Overall, transport to school included 24.2% active transport, 60.1% motorized transport and 15.7% combined active and motorized transport. Only 1.9% of adolescents cycled to school almost every day in the previous two weeks. Average distance to school was 6.2 ± 7.4 km. Overall, 69.2% had two or more vehicles at home, 76.3% had a bicycle available at home (Table 1) and 38.5% perceived that CST could make them safer in traffic (Fig. 1). Nearly half of adolescents who perceived CST as beneficial would take such training at their school (43.1%) (Fig. 2).

Table 1
Sociodemographic characteristics of study participants.

	Total sample *n* = 1453
Age (years)	15.1 ± 1.4
Gender [*n* (%)]	
Boys	652 (44.9)
Girls	801 (55.1)
Ethnicity [*n* (%)]	
NZ European	1077 (74.1)
Māori	146 (10.0)
Other	230 (15.8)
Neighbourhood deprivation score [*n* (%)]	
1 (least deprived)	442 (30.4)
2	350 (24.1)
3	294 (20.2)
4	206 (14.2)
5 (most deprived)	127 (8.7)
Number of bikes available to use to get to school (*n*)	
None	345 (23.7)
One	291 (20.0)
Two or more	817 (56.2)
Number of vehicles at home (*n*)	
None	48 (3.3)
One	400 (27.5)
Two or more	1005 (69.2)
Frequency of cycling to school in the previous two weeks	
Never	1363 (93.8)
Almost never	31 (2.1)
Sometimes	32 (2.2)
Almost every day	16 (1.1)
Every day	11 (0.8)
Cycle skills training could make me safer in traffic	
Strongly agree	139 (9.6)
Somewhat agree	420 (28.9)
Somewhat disagree	334 (23.0)
Strongly disagree	560 (38.5)

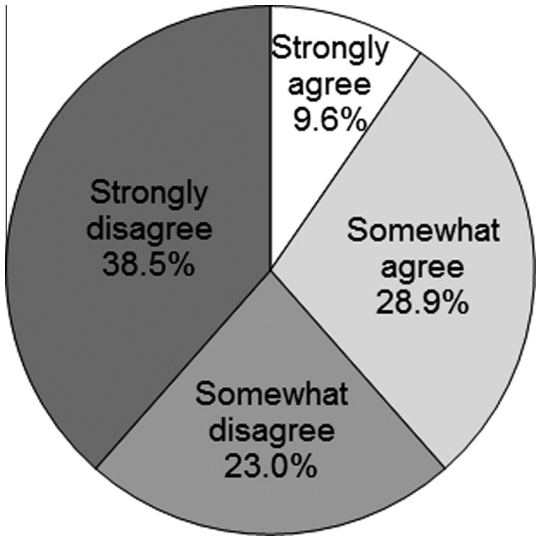

Fig. 1. Adolescents' perception that cycle skills training would make them safer in traffic (n = 1453).

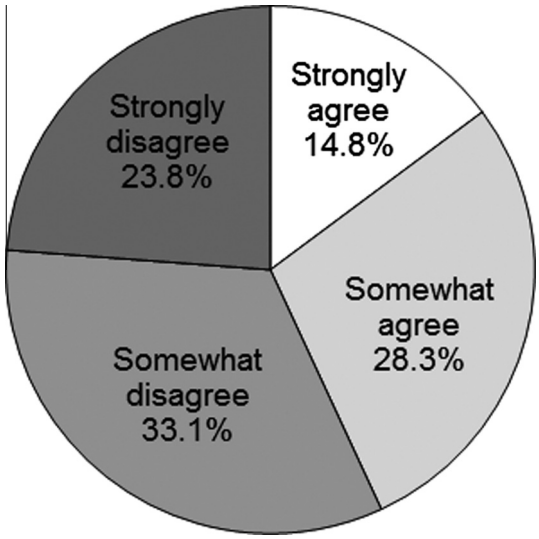

Fig. 2. Adolescents' interest in taking up cycle skills training at school among adolescents who perceived such training as beneficial (n = 559).

In the bivariate regression models, significant correlates of the perception that CST could make adolescents safer in traffic included: access to a bicycle; cycling to school habits; cycling for recreation; perception of cycling to school as being inter esting/pleasant/stimulating, healthy, good, and useful; intention and desire to cycle to school; confidence/perceived ability to cycle to school; and parent(s) cycling frequently, cycling frequently with parents and friends, and encouragement from school (data not shown). Age, gender, ethnicity, socioeconomic status and number of vehicles at home were not significant in the bivariate regression models and therefore were not included in the multivariate model in the next step of the analysis.

In a multivariate model, enjoyment of cycling for recreation, cycling to school being perceived as useful, desire to cycle to school, cycling frequently with parents, and schools' encouragement to cycle to school remained significantly and positively associated with the perception that CST could make adolescents safer in traffic (Table 2).

Table 2
Multivariate correlates of adolescents' perception that cycle skills training could make them safer in traffic.

	Beta	Std. error	*p*-value	95% Confidence interval	
				Lower bound	Upper bound
Number of bikes available to use to get to school (ref: none)					
One	.09	.08	.224	−.06	.24
Two or more	.06	.07	.336	−.07	.19
Transport to school (ref: active transport only)					
Combined active and motorized transport	.13	.08	.114	−.03	.28
Motorized transport only	−.02	.06	.752	−.14	.10
Frequency of cycling to school regularly (ref: never)					
Rarely or sometimes	−.09	.10	.366	−.29	.11
Most/all of the time	−.14	.26	.577	−.65	.36
Frequency of cycling to school in the previous two weeks (ref: never)					
At least sometimes	.14	.12	.274	−.11	.38
I like bike riding for recreational purposes	.21	.03	.000	.15	.27
Cycling to school is interesting/pleasant/stimulating	−.01	.02	.487	−.05	.03
Cycling to school is healthy	.03	.02	.168	−.01	.06
Cycling to school is good	.01	.02	.593	−.03	.05
Cycling to school is useful	.05	.02	.016	.01	.09
One or both of my parents or guardians cycle frequently	−.02	.02	.321	−.05	.02
I often cycle with my parents	.13	.03	.000	.06	.20
I often cycle with my friends	.04	.03	.251	−.03	.11
My school encourages me to cycle to school	.11	.03	.000	.05	.17
Ability/confidence	−.02	.01	.117	−.05	.01
I have complete control over whether or not I cycle to school	−.02	.01	.098	−.04	.00
I want to regularly cycle to school	.07	.02	.002	.03	.11
I intend to walk/cycle to school frequently	−.02	.03	.471	−.07	.03

Note: Only significant bivariate correlates were included in the model.

4. Discussion

This study examined correlates of the perception that CST could make adolescents' safer in traffic. Key findings of the present study are: (1) overall, 38.5% of adolescents perceived that CST could make them safer in traffic and nearly half of adolescents who perceived CST as beneficial would take such training at their school; (2) enjoyment of cycling for recreation, cycling to school being perceived as worthwhile, desire to cycle to school, frequent cycling with parents, and schools' encouragement were positively associated with the perception that CST could make adolescents safer in traffic. The overall goal of CST courses is to give young people the skills and confidence to cycle safely in a traffic environment. Therefore, raising adolescents' awareness of the benefits of CST and potentially offering such training in secondary schools could be a part of comprehensive efforts to improve the safety of cycling and ultimately increase the rates of cycling to school in this vulnerable age group.

In the present study, 39% of adolescents perceived that CST could make them safer in traffic. Colwell and Culverwell (2002) studied adolescents' perceptions of potential benefits of CST in 336 13-year to 16-year olds from London (UK). In their study, 46% of surveyed adolescents took CST, 41% had taken the course on public roads and 39% of adolescents perceived that CST was teaching real life skills and making them a safer road user (Colwell & Culverwell, 2002), which is consistent with the findings of the current study. Colwell and Culverwell (2002) also reported that adolescents with a history of cycling accidents had significantly less safe cycling behaviours. Taken together, these findings suggest that future interventions should raise adolescents' awareness of the benefits of CST and should emphasize safe cycling attitudes.

Among adolescents who perceived that CST would make them safer in traffic, 43.1% of adolescents would take CST if it was available at their school. Previous research from the United States suggests that peers can serve as models for safe behaviours (Babu et al., 2011). Therefore, it may be beneficial for adolescents to participate in CST together with their peers (Ellis, 2014) and this could be achieved by offering such training in a school environment. However, it is important to note that over half of adolescents who perceived that CST would make them safer in traffic were not interested in taking such training at school. Therefore, other alternatives for delivering such training to adolescents should be considered.

Previous studies in children showed that the improvements in knowledge and cycling skills are maintained at 5 months (Ducheyne et al., 2014) and 2 years after CST (Savill, Bryan-Brown, & Harland, 1996). Given the large amount of practice required to make cycling efficient and automatic (Ellis, 2014), and a need to minimize risky cycling behaviour in adolescents (Ellis, 2014) offering CST in both primary and secondary schools as a continuous teaching process, may be an effective

intervention as part of a comprehensive approach aiming to improve the safety, knowledge of road rules and reinforcing safe cycling behaviour. In children, CST was not effective in increasing rates of cycling to school, even with parental involvement in such training (Ducheyne et al., 2014). Whether CST could increase the rates of cycling to school in adolescents remains to be determined.

In the present study, parental behaviour and school's encouragement were positively associated with the perception that CST could make adolescents safer in traffic. Cycling frequently with parents and encouragement from schools represent aspects of a socialization process where messages about safety may be conveyed that adolescents are ready to internalize. The importance of parental involvement in children's bicycle safety education has been emphasized previously (Ellis, 2014). Involvement of parents in CST through homework tasks was not effective in increasing rates of cycling to school in children (Ducheyne et al., 2014), suggesting that more extensive involvement of parents may be required. The quality of parent, schools and community involvement and their interactions have been emphasized for interventions aiming to improve active transport to school (Chillon, Evenson, Vaughn, & Ward, 2011). Therefore, working closely with parents and schools to raise awareness in adolescents about the importance of CST for safety purpose may be a promising avenue for future interventions aimed at improving the safety of cycling. The CST might be aimed at both parents and their teenage children together to build confidence between them regarding the safety issues.

The results showed that adolescents who perceived cycling to school as being worthwhile and had a desire to cycle to school were more likely to perceive that CST could make them safer in traffic. However, it is important to note that only 4% of adolescents in the present study had the intention to cycle to school, suggesting that other factors, such as social and environmental factors, may also need to be addressed to encourage cycling in adolescents.

The findings of the present study, in addition to previous findings, have significant implications for the design and implementation of CST in adolescent. A good quality CST program for children should include a variety of age-appropriate cycling exercises and take into account the feasibility for a real life implementation at schools (Ducheyne et al., 2013). The same considerations should be taken into account when designing CST for adolescents. In addition, since adolescents have more developed motor and cognitive skills compared to children, CST should involve more extensive on-road practice. CST for adolescents should involve parents to reinforce or promote the practice of cycling frequently, and safely, with their teens, and take advantage of existing structures and opportunities offered by schools while helping them to craft appropriate messages to encourage cycling to school. Training needs also to take into account that CST is likely to attract adolescents who enjoy cycling for recreation and intend to cycle to school. Therefore, appropriate messages may need to be developed to effectively target other adolescents who would benefit from CST.

Study limitations: The present study did not explore attitudes towards risky cycling behaviour, number of cycle crashes that adolescents had been involved in, perceptions of safe or unsafe cycling behaviour of their peers, and actual cycle skills in adolescents. Future studies examining adolescents' perceptions of CST should address those areas. Despite these limitations, this study included a large representative sample of adolescents from one city and, to the best of our knowledge, is the first to investigate factors affecting adolescents' perception that CST could make them safer.

5. Conclusion

Nearly 40% of surveyed adolescents perceived that CST could make them safer in traffic and nearly half of these students indicated they would take such training if it was offered at their school. Enjoyment of cycling for recreation, finding cycling to school useful, desire to cycle to school, frequent cycling with parents, and encouragement from schools were associated with positive perceptions of CST in adolescents. Therefore, raising adolescents' awareness of the benefits of CST and potentially offering such training in secondary schools could be a part of comprehensive efforts to improve the safety of cycling and ultimately encourage cycling for transport in adolescents. Future interventions should involve parents and school and aim at increasing adolescents' interest in uptake of CST at school. Future studies should inform the design of an age-appropriate CST program for adolescents and examine the effects of such training on cycle skills, knowledge of road rules, safe cycling behaviour, and cycling habits for recreation and transportation in adolescents.

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