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School choice, distance to school and travel to school patterns among adolescents

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ABSTRACT

Introduction: The absence of school zoning and availability of school choice in some countries leads to increasing travel distance to school, reduced active transport and increased motorized transport to school. This study compared sociodemographic characteristics, reasons for school choice and school transport patterns among urban adolescents based on their enrolment in the closest or a non-closest school and living within walkable or non-walkable distance to school.

Methods: Adolescents ($n = 2869$) from all twelve secondary schools in Dunedin, New Zealand completed an online questionnaire about school choice and school transport in 2014–2015 and 2020–2022. Participants were categorized into four groups based on home-to-school distance and school enrolment: enrolled in the closest school within walking distance (≤ 2.25 km) ('closest + walkable'; 22.7%) or not ('closest + non-walkable'; 20.3%), and enrolled in a non-closest school within walking distance ('non-closest + walkable'; 6.2%) or not ('non-closest + non-walkable'; 50.1%).

Results: Overall, 43% of adolescents initially enrolled in the closest school, and only half of those lived within walking distance to school. Enrolment in a co-educational school, a non-special character school and a lower decile school and choosing a school because of proximity and social connections were more common among those who enrolled in the closest versus a non-closest school (all $p < 0.05$). Rates of active transport were higher among those living within walkable distance to school, irrespective of enrolment in the closest or a non-closest school ($p < 0.001$).

Conclusions: These findings show that distance to school is more consequential than school choice itself regarding how adolescents travel to school.

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1. Introduction

In Aotearoa New Zealand – as with many high-income countries - the transport system is dominated by high private vehicle ownership (Te Manatū Waka Ministry of Transport, n.d.; The Organisation for Economic Co-operation and Development (OECD), 2017), limited public transport system availability and utilization, and low levels of active transport (Macmillan et al., 2021). A transport system with these features has a range of negative impacts on population health, including mental health (e.g. (Wild et al., 2021),) and wellbeing, as well as social and health equity consequences (Shaw and Tiatia-Seath, 2022) and direct implications for climate change mitigation efforts (Chapman, 2022). Yet New Zealand represents an extreme case, often listed amongst the countries with the highest rates of car ownership and use per capita (Te Manatū Waka Ministry of Transport, n.d.; The Organisation for Economic Co-operation and Development (OECD), 2017). When coupled with urban sprawl and educational policies that support school choice, the private motor vehicle dominance is also reflected in transport to school trends in New Zealand, which show a significant increase in the rates of adolescents being driven to secondary school from 21% in 1989/1990 to 32% in 2010–2014 (Ministry of Transport, 2015).

In recent decades, educational reforms in some developed countries (The Organisation for Economic Co-operation and Development (OECD), 2019a), including New Zealand (Stewart et al., 2021), have allowed a shift away from neighborhood schools. School choice education policies create complicated socio-cultural, economic and political effects (Fiske and Ladd, 2000; Jabbar et al., 2022; Winchell Lenhoff, Singer, Stokes, Mahowald and Khawaja, 2022). Access to education, and particularly access to schools perceived as good, is strongly related to transport, housing and spatial form (e.g. (DeLuca and Rosenblatt, 2010; Dougherty et al., 2009; Müller et al., 2008; Phillipppo and Griffin, 2016; Wilson et al., 2010). Existing evidence shows the strong relationship between school choice policies, increased school travel distances, decreased rates of active transport to school (ATS) and increased rates of motorized transport (Wilson et al., 2007; Yang et al., 2012). Increased reliance on private vehicles for school travel reduces opportunities for children and adolescents to be physically active (Kek et al., 2019; Khan et al., 2020), contributes to increasing traffic volume and traffic congestion around schools at drop-off and pick up times, increases air pollution, and exacerbates safety concerns for walking and cycling to school (Eyler et al., 2008; Frank and Engelke, 2007; Keall et al., 2020; Maibach et al., 2009; Parusel and McLaren, 2010). Globally, four out of five adolescents are not sufficiently physically active (Guthold et al., 2020). In New Zealand, 62% of 11- to 14-year-olds and 46.8% of 15- to 17-year olds self-reported meeting minimal physical activity recommendations and only 31% of children and adolescents used active transport to/from school based on national data sources between 2019 and 2020 (Wilson et al., 2023). A recent New Zealand report indicates an urgent need for supporting active transport to school, including investment in multi-sectoral approaches, urban planning, school- and community-led initiatives and social marketing campaigns (Wilson et al., 2023), which aligns with key policy recommendations for increasing active transport in the country (Mandic et al., 2020).

In New Zealand, a series of studies reported school choice-related findings from the city of Dunedin, a mid-sized city on the lower South Island. A 'school zoning' policy guarantees students living within a school's home zone to have a place in their local school, which is often the closest school for students. In Dunedin regular public secondary schools without school zoning had just half of adolescents enrolled in the closest school ([Mandic et al., 2017]). The most common reasons for school choice reported by adolescents included a preference for a co-educational school, friends' enrolment, school's facilities and positive comments from parents/students at a particular school (Mandic et al., 2018). Social factors and school programs/facilities, rather than proximity to home, were related to school choice decisions (Mandic et al., 2018). Adolescents who enrolled in the closest school had five times higher rates of active transport (46.5% vs. 8.8%) and lower rates of motorized transport to school (40.3% vs. 68.8%) compared to their counterparts (Mandic et al., 2017]). Over one in ten car trips and 12.5% of car distance driven during school pick-up and drop-off times were related to travel to secondary schools, approximately half of which involved trip-chaining (Keall et al., 2020). A simulation showed that city-wide enrolment in the closest secondary school would be associated with a 7% city-wide reduction in private vehicle travel during school travel time (Keall et al., 2020). Interviews with school principals showed the tension between school policies that could be used to encourage healthy lifestyles (such as ATS), and school choice policies (Sandretto et al., 2020). School leaders considered that transport to/from school was a family decision and choice rather than a school decision, making the issue of ATS beyond the scope of the school policy-making (Sandretto et al., 2020). School principals expressed willingness to intervene to address safety-related barriers to ATS but were reluctant to introduce policies that might impact student or parental choice (Sandretto et al., 2020). Taken together, those findings suggest that school choice policies have implications not only for education, but also for transport, health and the environment.

From this research, it has been argued that strategies aimed at increasing rates of ATS should look beyond transport and also take into account school choice policies in countries where such policies exist. However, research examining the impact of school choice on adolescents' transport to school conducted to date has not explored the interplay between relevant factors such as enrolment in the closest versus a non-closest school, living within walkable distance versus living beyond walkable distance to school, the reasons for school choice, and adolescents' transport to school patterns. This limits our understanding of the implications of school choice for adolescents' ATS and the configuration and patterning of variables potentially associated with such choice in this age group.

Distance to school is the strongest correlate of ATS (Ikeda et al., 2018; McDonald, 2007). For adolescents, 'reasonable' walking distance to school is thought to range from 1.3 km to 3 km (Bere, van der Horst, Oenema, Prins and Brug, 2008; Chillón et al., 2015; Nelson, Foley, O'Gorman, Moyna and Woods, 2008; Pocock et al., 2019). 'Reasonable' cycling to school distances for this age group is considered to be from 4 km to 8 km (Bere et al., 2008; D'Haese et al., 2011; Nelson et al., 2008; Van Dyck, De Bourdeaudhuij, Cardon and Deforche, 2010). However, cycling is a less common mode of transport to school than walking in many developed countries (Chillón et al., 2009; McDonald, 2007; Murtagh et al., 2016), including New Zealand (Mandic et al., 2017). To examine the complex interplay between school choice, distance to school and school travel, this study compared sociodemographic characteristics, reasons

for school choice and transport to school patterns among urban adolescents based on their enrolment in the closest or a non-closest school and living within walkable or non-walkable distance to school.

2. Methods

2.1. Setting

This study involved secondary analysis of data collected from adolescents from all twelve secondary schools in the city of Dunedin (population: $\approx 120,000$), Aotearoa New Zealand who participated in the Built Environment and Active Transport to School (BEATS) Study (Mandic et al., 2016) in 2014–2015 (1780 adolescents) or BEATS Natural Experiment (Mandic et al., 2020) in 2020–2022 (1828 adolescents). Dunedin has 12 public secondary schools (five co-educational schools, three single-sex boys' schools and four single-sex girls' schools) and no private schools. School ranged in size from 360 to 872 in 2014/2015 and 400 to 831 in 2021/2022 for school years 9–13 only. Four out of twelve secondary schools are integrated schools (i.e., a special character school) whereas eight are non-integrated schools. In 2014–2015, six out of twelve schools had an enrolment scheme in place due to the potential for over enrolment (two non-integrated and four integrated schools). In 2020–2022, an enrolment scheme was present in four non-integrated and four integrated schools.

2.2. Participants

Study protocols providing details on participant recruitment and study procedures for both BEATS Study (Mandic et al., 2016) and BEATS Natural Experiment (Mandic et al., 2020) have been published elsewhere. Briefly, adolescents (age: 13–18 years; school years 9–13) were recruited through their school. Adolescents received study-related information through their school and if interested signed written consent prior to participation. For adolescents under 16 years of age, parental opt-in or opt-out consent was used in the BEATS Study, based on the school's preference. Parental consent was not required in the BEATS Natural Experiment. Research protocols and both projects received ethical approval from the University of Otago Human Ethics Committee (BEATS: 13/203; BEATS

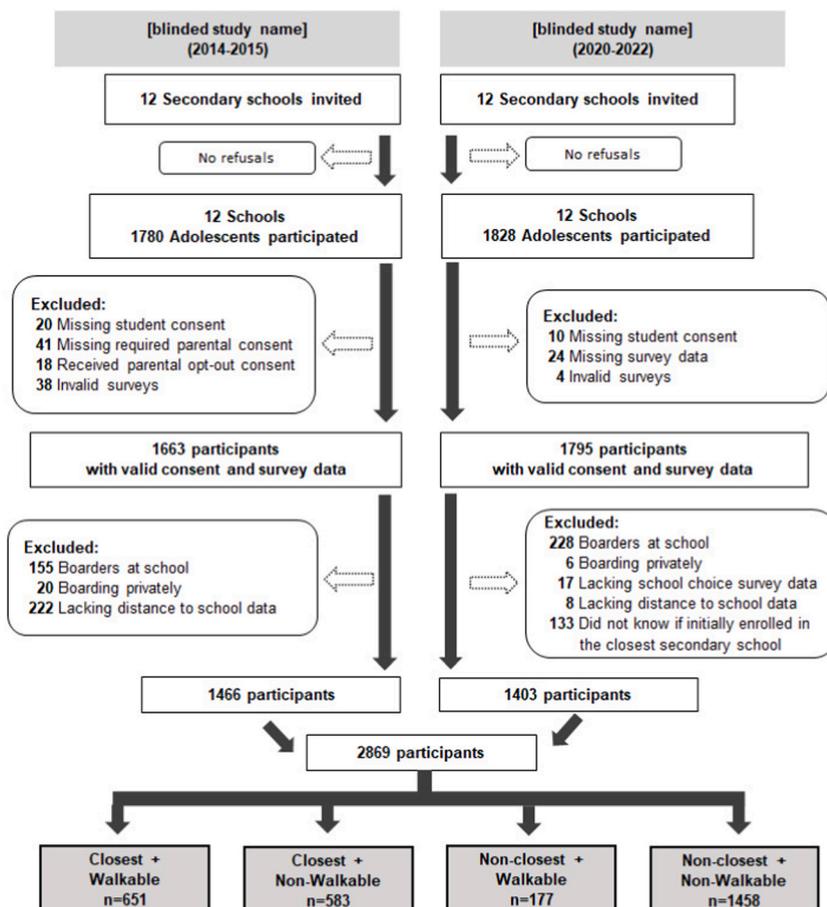


Fig. 1. Participant recruitment and selection.

Natural Experiment: 17/188) and Auckland University of Technology Ethics Committee (BEATS Natural Experiment: 21/314). Data from 2869 participants were included in this analysis (see Fig. 1).

2.3. Survey

In both studies, participants completed a 30- to 40-min online survey during school time, under supervision of research staff. Participants self-reported their sociodemographic characteristics and home address. The shortest network home-to-school distance was calculated using Geographic Information Systems (GIS) for the BEATS Study (Mandic et al., 2016) and Google Maps for the BEATS Natural Experiment. Survey items related to school choice and adolescents' usual modes of transport to school were used in the analysis for this article and are described in more detail below.

School-related factors. School-related variables included co-educational status (co-educational schools; single-sex boys' or single-sex girls' schools), school's character (integrated (i.e., special character school) versus non-integrated (regular) school), and school decile (which is used as a funding mechanism for New Zealand schools (Ministry of Education, 2019)). In New Zealand, integrated schools were private and now form part of the state system and receive government funding. Integrated schools teach the New Zealand curriculum and frequently have a special character such as a religious belief (Ministry of Education, 2022). Funding according to school decile is based on the proportion of students with low socioeconomic status at each school as defined by the student's residential address. The 10% of schools with the highest proportion of students from low socioeconomic communities across New Zealand are classified as decile 1 schools. Decile 10 schools have the lowest proportion of students from low socioeconomic communities. School decile data were obtained from the New Zealand Ministry of Education website for 2015 for the BEATS Study and for 2021 for the BEATS Natural Experiment.

School choice. Survey questions related to school choice were designed by the BEATS research team based on input and feedback from Dunedin secondary schools and school principals, as described previously (Mandic et al., 2017; Mandic et al., 2018). Adolescents were asked about who chose the school and whether they initially enrolled in the closest secondary school. Using a 5-point Likert scale (ranging from 1 = strongly disagree to 5 = strongly agree) and additional "I don't know" response category, adolescents rated how much they agreed or disagreed with 14 items related to school choice, including proximity to home, preference for co-educational status of the chosen school, social connections (siblings/friends/parents attending/attended), positive comments about the school from parents/students at that school and negative comments from parents/students at the closest school. Participants were also given an opportunity to specify other reasons in open-ended comments. "I don't know" responses were excluded from the analysis.

Transport to school. Usual mode(s) of transport to school and categorization of adolescents into 'active', 'motorized' and 'mixed' transport users were determined based on transport mode(s) that adolescents used 'most of the time' or 'all of the time', as described previously (Mandic et al., 2017). In addition, more detailed analysis of the dominant transport to school modes was used to categorize adolescents into one of six common transport modes ('on foot', 'by bicycle', 'by bus and on foot', 'by car and on foot', 'by car (driven by others or driving)' and 'by bus (public or school bus)' and 'other mode(s) or combinations' category (for details see (Mandic et al., 2023)). Adolescents were also asked about who made the decision about their mode of transport to school.

2.4. Study groups

Based on adolescents' survey response to whether they enrolled in the closest school and a threshold of ≤ 2.25 km to define a reasonable walking home-to-school distance (Pocock et al., 2019), participants were categorized into one of four groups.

- a) enrolled in the closest school within walking distance from home (≤ 2.25 km) ('closest + walkable');
- b) enrolled in the closest school which was not within walking distance from home ('closest + non-walkable');
- c) enrolled in a non-closest school within walking distance from home ('non-closest + walkable'); or
- d) enrolled in a non-closest school which was not within walking distance from home ('non-closest + non-walkable').

Due to school locations in the study city, students might elect to enroll in a school that is not the closest but still within walkable distance from their home.

2.5. Data analysis

Differences between the four study groups were compared using χ^2 tests for categorical variables and ANOVA for continuous variables with Scheffé post-hoc comparisons (or Tamhane's T2 post-hoc multiple comparisons when the variances were unequal). School choice items related to siblings' enrolment and preference for single-sex and co-educational school were analyzed only for adolescents who had at least one sibling and who attended single-sex or co-educational school, respectively. P-level of less than 0.05 was considered statistically significant. Categorical variables are reported as frequency (percentage) whereas continuous variables are reported as mean \pm SD. Because distance to school was not normally distributed, distance is also reported as median (interquartile range). Data were analyzed using SPSS Statistical Package, Version 27.0.

3. Results

3.1. Sociodemographic characteristics

Among the 2869 adolescents (age: 15.0 ± 1.4 years), 52.0% were females, 69.7% identified as New Zealand European, 55.6% attended a single-sex school and 30% attended an integrated school (Table 1). Overall, 43.0% of adolescents initially enrolled in the closest secondary school. In the total sample, 46.9% of students lived within walking distance to either the school they enrolled in or the closest non-integrated school. The mean distance to school was 6.8 ± 7.7 km (median: 4.2 km; interquartile range: 6.9 km) and 28.5% of adolescents in the total sample lived within walking distance from their school.

The number of participants across the four study groups were as follows: 651 (22.7%) 'closest + walkable', 583 (20.3%) 'closest + non-walkable', 177 (6.2%) 'non-closest + walkable' and 1458 (50.1%) 'non-closest + non-walkable' (Table 1). Adolescents' age, gender, ethnicity and average number of people living in a household did not differ significantly across the four study groups, but the groups differed with respect to average distance to school (as expected), school characteristics and who chose the school. Adolescents enrolling in the closest school more frequently enrolled in a co-educational school (versus single-sex school), a non-integrated school (versus integrated school) and a lower decile school compared to their peers who enrolled in the non-closest school. While the proportion of school choice decisions made jointly by adolescents and their parents was similar across the four groups, the 'non-closest +

Table 1
Sociodemographic, family and school characteristics of student participants in the total sample and by four study groups.

	Total sample	Closest school within walkable distance	Closest school beyond walkable distance	Non-closest school within walkable distance	Non-closest school beyond walkable distance	p-value
	n = 2869	n = 651	n = 583	n = 177	n = 1458	
Age (years)	15.0 ± 1.4	15.0 ± 1.3	15.0 ± 1.4	15.1 ± 1.5	15.0 ± 1.4	0.513
Gender [n (%)]						
Boys	1339 (46.7%)	295 (45.3%)	262 (44.9%)	84 (47.5%)	698 (47.9%)	
Girls	1493 (52.0%)	351 (53.9%)	308 (52.8%)	93 (52.5%)	741 (50.8%)	
Gender diverse	37 (1.3%)	5 (0.8%)	13 (2.2%)	0 (0.0%)	19 (1.3%)	0.138
Ethnicity [n (%)]	(n = 2862)	(n = 649)	(n = 581)	(n = 177)	(n = 1455)	
New Zealand European	1996 (69.7%)	436 (67.2%)	403 (69.4%)	119 (67.2%)	1038 (71.3%)	
Māori	367 (12.8%)	88 (13.6%)	77 (13.3%)	21 (11.9%)	181 (12.4%)	
Other	499 (17.4%)	125 (19.3%)	101 (17.4%)	37 (20.9%)	236 (16.2%)	0.462
Distance to current school (km)						
Average (km)	6.8 ± 7.7	1.2 ± 0.6 ^{b,c,d}	7.4 ± 7.7 ^{a,c,d}	1.5 ± 0.6 ^{a,b,d}	9.8 ± 8.1 ^{a,b,c}	<0.001
Median (interquartile range) (km)	4.2 (6.9)	1.3 (0.9)	4.4 (6.4)	1.6 (1.0)	6.8 (8.8)	N/A
Number of people in a household (n)	4.3 ± 1.3	4.2 ± 1.2	4.3 ± 1.3	4.2 ± 1.1	4.3 ± 1.2	0.479
Number of vehicles in a household (n)	2.1 ± 1.0	1.9 ± 0.9 ^{b,d}	2.1 ± 1.0 ^a	1.9 ± 0.9 ^d	2.2 ± 0.9 ^{a,c}	<0.001
Co-education school status [n (%)]						
Single sex school ('0')	1596 (55.6%)	319 (49.0%)	150 (25.7%)	139 (78.5%)	988 (67.8%)	
Co-educational school ('1')	1273 (44.4%)	332 (51.0%)	433 (74.3%)	38 (21.5%)	470 (32.2%)	<0.001
School decile (1–10)	7.5 ± 1.8	7.1 ± 1.7 ^{b,c,d}	6.6 ± 1.4 ^{a,c,d}	8.6 ± 1.6 ^{a,b,d}	7.9 ± 1.8 ^{a,b,c}	<0.001
Integrated school [n (%)]						
Yes	861 (30.0%)	117 (18.0%)	46 (7.9%)	98 (55.4%)	600 (41.2%)	
No	2008 (70.0%)	534 (82.0%)	537 (92.1%)	79 (44.6%)	858 (58.8%)	<0.001
Who chose a secondary school [n (%)]						
Student	1006 (35.1%)	212 (32.6%)	191 (32.8%)	57 (32.2%)	546 (37.4%)	
Parent	557 (19.4%)	148 (22.7%)	131 (22.5%)	37 (20.9%)	241 (16.5%)	
Student and parent together	1287 (44.9%)	288 (44.2%)	257 (44.1%)	83 (46.9%)	659 (45.2%)	
Somebody else	19 (0.7%)	3 (0.5%)	4 (0.7%)	0 (0.0%)	12 (0.8%)	0.016

^ap < 0.05 vs. closest school within walkable distance; ^bp < 0.05 vs. closest school beyond walkable distance; ^cp < 0.05 vs. non-closest school within walkable distance; ^dp < 0.05 vs. non-closest school beyond walkable distance.

non-walkable' group had a higher proportion of adolescent-only and lower proportion of parent-only decisions compared to the other three groups.

3.2. Reasons for school choice

Reasons for school choice also differed significantly between the four groups (Table 2). Choosing school because of its proximity to home was reported more frequently in the 'closest + walkable' group followed by 'closest + non-walkable', 'non-closest + walkable' and 'non-closest + non-walkable' groups (all comparisons: $p < 0.05$). Social connections were more frequently cited as a reason for school choice among the two groups that enrolled in the closest school irrespective of the home-to-school distance, whereas facilities, sport programmes and negative comments about the closest school were more commonly reported as reasons for school choice among the 'non-closest + non-walkable' group.

3.3. Transport to school

The usual modes of transport to school differed significantly across the groups (Table 3). Rates of walking to school were highest in the 'closest + walkable' group (60.9%) followed by 'non-closest + walkable' group (50.8%) and considerably lower in 'closest + non-walkable' (9.3%) and 'non-closest + non-walkable' (3.7%) groups. Rates of private vehicle travel showed the inverse trend across the four groups (Table 3). School-level rates of ATS (mostly walking) ranged between 12.3% and 37.8% in the total sample and between 33.3% and 71.7% among adolescents who lived withing walkable distance to their school (data not presented). Adolescent-only decisions about how they travelled to school were predominant among those who enrolled in the schools within walkable distance from their home (58.7% in the 'closest + walkable' and 50.0% in the 'distant-walkable' groups), whereas parental-only decisions were predominant in the 'closest + non-walkable' (43.1%) and 'non-closest + non-walkable' (53.7%) groups ($p < 0.001$; Table 3).

3.4. Profiles of participant groups based on study variables

This section describes profiles of four study groups with respect to sociodemographic and school characteristics, reasons for school

Table 2
Reasons for school choice in the total sample and across four study groups.

	Closest school within walkable distance n = 651	Closest school beyond walkable distance n = 583	Non-closest school within walkable distance n = 177	Non-closest school beyond walkable distance n = 1458	p-value
Proximity to home					
Closest school to home	4.1 ± 1.1 ^{b,c,d}	3.8 ± 1.2 ^{a,c,d}	2.5 ± 1.2 ^{a,b,d}	1.6 ± 0.9 ^{a,b,c}	<0.001
Co-educational status					
Preferred a co-educational school** (n = 1218)	3.9 ± 1.2	4.0 ± 1.1	4.1 ± 1.1	4.0 ± 1.1	0.471
Preferred a single-sex school*** (n = 1552)	3.0 ± 1.2	2.8 ± 1.2	2.9 ± 1.3	2.8 ± 1.2	0.155
Social connections					
friends were going to this school	3.5 ± 1.4 ^{c,d}	3.4 ± 1.5 ^{c,d}	2.9 ± 1.5 ^{a,b}	2.9 ± 1.5 ^{a,b}	<0.001
Child's siblings went or go to this school* (n = 2671)	2.9 ± 1.7 ^{c,d}	2.9 ± 1.7 ^{c,d}	2.3 ± 1.6 ^{a,b}	2.2 ± 1.6 ^{a,b}	<0.001
Parents or other family members went to this school	2.5 ± 1.5 ^{c,d}	2.5 ± 1.6 ^{c,d}	2.1 ± 1.5 ^{a,b}	2.2 ± 1.5 ^{a,b}	<0.001
Programmes and facilities					
Facilities at this school	3.4 ± 1.2 ^d	3.2 ± 1.2 ^{c,d}	3.6 ± 1.2 ^b	3.5 ± 1.2 ^{a,b}	<0.001
Sports programmes at this school	3.2 ± 1.3	3.1 ± 1.3 ^d	3.3 ± 1.4	3.3 ± 1.3 ^b	0.011
Cultural programmes at this school	3.0 ± 1.3	3.0 ± 1.2	3.0 ± 1.3	2.9 ± 1.3	0.235
Positive comments about the school					
Positive comments from parents of this school	3.4 ± 1.1	3.3 ± 1.2 ^d	3.5 ± 1.1	3.5 ± 1.2 ^b	0.021
Positive comments from students of this school	3.4 ± 1.1	3.3 ± 1.2 ^d	3.4 ± 1.2	3.5 ± 1.2 ^b	0.007
Negative comments about the closest school					
Negative comments from parents at closest school	1.8 ± 1.0 ^d	1.8 ± 1.0 ^d	2.0 ± 1.2	2.1 ± 1.2 ^{a,b}	<0.001
Negative comments from students at closest school	1.8 ± 1.0 ^d	1.8 ± 1.0 ^d	2.1 ± 1.2	2.1 ± 1.2 ^{a,b}	<0.001
Other reasons	1.1 ± 0.7 ^d	1.1 ± 0.7 ^d	1.2 ± 0.8	1.3 ± 1.0 ^{a,b}	<0.001

^a $p < 0.05$ vs. closest school within walkable distance; ^b $p < 0.05$ vs. closest school beyond walkable distance; ^c $p < 0.05$ vs. non-closest school within walkable distance; ^d $p < 0.05$ vs. non-closest school beyond walkable distance.

Table 3

Distance to school and transport to school patterns in the total sample and across four study groups.

	Closest school within walkable distance n = 651	Closest school beyond walkable distance n = 583	Non-closest school within walkable distance n = 177	Non-closest school beyond walkable distance n = 1458	p-value
Distance to school (km)					
Walkable distance (≤ 2.25 km) (%)	651 (100.0%)	0 (0.0%)	177 (100.0%)	3 (0.2%)	
Cyclable distance (> 2.25 – 4.0 km) (%)	0 (0.0%)	255 (43.7%)	0 (0.0%)	318 (21.8%)	
Beyond cyclable distance (> 4.0 km) (%)	0 (0.0%)	328 (56.3%)	0 (0.0%)	1137 (78.0%)	<0.001
Usual transport modes to school (used “most of the time” or “all of the time” (%)					
On foot	394 (60.9%)	54 (9.3%)	90 (50.8%)	54 (3.7%)	
By bicycle	8 (1.2%)	9 (1.6%)	2 (1.1%)	7 (0.5%)	
By bus and on foot	0 (0.0%)	53 (9.1%)	2 (1.1%)	101 (7.0%)	
By car and on foot	47 (7.3%)	38 (6.6%)	16 (9.0%)	119 (8.2%)	
By car (driven by others or driving)	155 (24.0%)	273 (47.1%)	60 (33.9%)	881 (60.7%)	
By bus (public or school bus)	9 (1.4%)	90 (15.5%)	0 (0.0%)	176 (12.1%)	
Other mode(s) or combinations	34 (5.3%)	63 (10.9%)	7 (4.0%)	114 (7.9%)	<0.001
Transport to school categorization (%)					
Active transport only	412 (65.4%)	67 (11.9%)	94 (54.3%)	63 (4.5%)	
Motorized transport only	166 (26.3%)	384 (68.3%)	60 (34.7%)	1100 (78.1%)	
Combined active and motorized transport	52 (8.3%)	111 (19.8%)	19 (11.0%)	245 (17.4%)	<0.001
Who decided how student travels to school					
Student	378 (58.7%)	168 (29.2%)	88 (50.0%)	315 (21.8%)	
Parent	153 (23.8%)	248 (43.1%)	46 (26.1%)	777 (53.7%)	
Student and parent together	101 (15.7%)	146 (25.4%)	40 (22.7%)	346 (23.9%)	
Other(s) or circumstances	12 (1.9%)	13 (2.3%)	2 (1.1%)	9 (0.6%)	<0.001

^a $p < 0.05$ vs. closest school within walkable distance; ^b $p < 0.05$ vs. closest school beyond walkable distance; ^c $p < 0.05$ vs. non-closest school within walkable distance; ^d $p < 0.05$ vs. non-closest school beyond walkable distance.

choice and common modes of transport to school.

‘Closest + Walkable’ group (22.7% of the total sample): Less than one-quarter of adolescents enrolled in the closest school within walking distance from their home. In this group, most adolescents attended a non-integrated school (82%) with an approximately even split of adolescents attending co-educational or single-sex schools (Table 1). On average, this group lived closest to school (Table 1), enrolled in lower decile schools (Table 1) and had the highest proportion of adolescents reporting proximity as a reason for school choice (Table 2). Compared to their peers who enrolled in a non-closest school, a greater proportion of adolescents in this group reported social connections to the school as reasons for school choice and fewer reported sports facilities and negative comments about the closest school (Table 2). This group had the highest rate of ATS (65.4%) and the lowest rate of motorized transport for school travel (26.3%) (Table 3).

‘Closest + Non-walkable’ group (20.0% of the total sample): One fifth of adolescents enrolled in the closest school located beyond walking distance from their home. In this group, three-quarters of adolescents enrolled in a co-educational school, most (92%) attended a non-integrated school and on average attended the lowest school decile (Table 1). This group had the second highest proportion of adolescents who reported proximity as a reason for school choice (Table 2). Compared to their peers who enrolled in a non-closest school, a greater proportion of adolescents in this group reported social connections to the school as reasons for school choice and fewer reported facilities, sports programs, positive comments about their school and negative comments about the closest school (Table 2). In this group, the median distance to school was 4.4 km, 44% of adolescents lived within cycling distance to school (up to 4 km) (Nelson et al., 2008), 11% used ATS, 68% relied on motorized transport, and school travel decisions were dominated by parental choice (Table 3).

‘Non-closest + Walkable’ group (6.0% of the total sample): Less than one in ten adolescents enrolled in a non-closest school that was located within walking distance from their home. In this group, 79% of adolescents enrolled in a single-sex school, 55% attended an integrated school and on average school decile was highest compared with other groups (Table 1). Despite living within walking distance to school, this group reported proximity to home and social connections as reasons for school choice less frequently as compared to the two groups that enrolled in the closest school (Table 2). School facilities were more frequently reported as reasons for school choice in this group compared with the ‘closest + non-walkable’ group (Table 2). This group had the second highest rates of ATS (54%), second lowest rates of motorized transport to school (35%), and adolescents’ choice dominated school travel decisions (50%) (Table 3).

‘Non-closest + Non-walkable’ group (50.0% of the total sample): Half of adolescents enrolled in the non-closest school located beyond walking distance from their home. In this group, one third of adolescents (35.5%) lived within walking distance to the closest

non-integrated school corresponding to their gender, whereas two-thirds (64.5%) did not have a non-integrated school located within walking distance from their home. Overall, 68% of adolescents enrolled in a single sex school and 59% enrolled in a non-integrated school (Table 1). The average school decile in this group was higher compared to the two groups that enrolled in the closest school but lower than the 'non-closest + walkable' group. Compared to their peers who enrolled in the closest school, reasons for school choice in this group were more frequently focused on school facilities, sports programs, positive comments from students and parents at the school and negative comments about the closest school (Table 2). This group also travelled the longest distance to school (median distance: 6.8 km), 78% of students relied on motorized transport to school, only 5% used ATS, and 54% of school travel decisions were made by parents only (Table 3). In the 'Non-closest + Non-walkable' group, proximity to school was less frequently reported as a reason for school choice among adolescents who lived within walking distance to the closest non-integrated school compared to their counterparts who did not have such a school within walking distance from their home (1.5 ± 0.9 versus 1.7 ± 0.9 ; $p < 0.001$) whereas no difference between those groups was observed for other reasons for school choice.

4. Discussion

Key findings of this study are: a) overall, 43% of adolescents initially enrolled in the closest school and only half of them (22.7% of the total sample) lived within walking distance to their school; b) compared to their peers who enrolled in a non-closest school, adolescents who enrolled in the closest school more frequently enrolled in a co-educational, non-integrated, lower decile school and reported proximity and social connections as reasons for school choice, irrespective of whether the chosen school was located within walking distance from their home or not; c) transport to school patterns were similar among adolescents who lived within walking distance to their school, regardless of whether they enrolled in the closest school or not; and d) overall, half of adolescents enrolled in a non-closest school located beyond walking distance from their home and over three-quarters of adolescents in this group relied on motorized transport to school (mostly by private vehicles). Taken together, these findings suggest that distance to school is more consequential than school choice itself regarding how adolescents travel to school.

In this study, two out of five adolescents enrolled in the closest school and only half of them lived within walking distance to their school. Previous studies demonstrated the strong relationship between school choice policies, increased school travel distances and decreased rates of ATS (Mandic et al., 2017; Wilson et al., 2010; Wilson et al., 2007; Yang et al., 2012). The findings of the present study have significant implications for strategies and programs aimed at promoting ATS in urban areas without school zoning. The findings show that whether enrolment in the closest school enables reliance on ATS depends on the school location relative to where adolescents live. Those factors should be taken into account when developing school travel plans for existing schools, planning locations of new schools and designing public transport routes in urban areas.

Greater distance to school and low home neighborhood intersection density (which is often a characteristic of sprawling neighborhoods) were associated with higher likelihood of adolescents relying on private vehicle travel to school in a recent New Zealand-based meta-analysis (Mandic et al., 2020). With the urban sprawl tendencies of modern cities, adolescents may not have other options but to use motorized transport to travel to school. Coupled with the frequently cited convenience of trip chaining while travelling by private vehicle (Gustat et al., 2015), time constraints of modern families (Skarin et al., 2017), adolescents' preference for car-based transport and their intention to learn to drive (Hopkins et al., 2019) and limited availability and/or suitability of public transport in some urban areas (Mindell et al., 2021), it is not surprising that the rates of private vehicle travel to school are high in countries like New Zealand.

Walking is the most common mode of ATS among adolescents in many countries (Chillón et al., 2009; McDonald, 2007; Murtagh et al., 2016), including New Zealand (Mandic et al., 2023). Reasonable distance for adolescents' walking to school range from 1.3 km to 3.0 km (Bere et al., 2008; Chillón et al., 2015; Nelson et al., 2008; Pocock et al., 2019). Therefore, location of schools, urban sprawl and school choice policies – all of which have consequences for distance to school – play an important role in enabling or limiting ATS. In the present study, among adolescents who attended school within walking distance from their home, over three-quarters enrolled in the closest school and less than a quarter enrolled in a non-closest school, with a statistically significant difference in school characteristics and reasons for school choice between the two groups. Nevertheless, the two groups of adolescents who attended a school within walking distance from their home had similar transport to school patterns and decision making, with a predominant use of ATS, less reliance on motorized transport and greater adolescents' autonomy in deciding how they travelled to school compared to their peers who attended school beyond walking distance from their home. These findings show that from a transport perspective, school choice policies can have a significant negative impact on ATS when the selected non-closest schools are located beyond walking distance from the adolescents' home (He and Giuliano, 2018).

Adolescents who enrolled in the closest school enrolled more frequently in a co-educational, non-integrated, lower decile schools. Some authors (Lubienski et al., 2013) have identified the role that schools play in drawing home zones that may exclude some students from "choosing 'up'" (Gordon, 2015), or choosing a school of a higher decile/socioeconomic status. In the present study, adolescents who enrolled in their closest school had fewer cars suggesting that some students and families may have had fewer choices than others (Te Manatū Waka Ministry of Transport, n.d.).

Compared to their peers who enrolled in the closest school, adolescents who enrolled in the non-closest school more frequently reported choosing school because of its programs and facilities rather than proximity to home and social connections. Previous New Zealand studies showed that parental school choice is often driven by social factors such as characteristics of the school population, reputation, school's academic achievement, environment and safety rather than proximity to home (Gordon, 2015). Other research also showed that reputation, social factors (such as positive comments from parents or students and friends' enrolment) and school programs and facilities play a role in school choice decision making (Bosetti and Pyryt, 2007; Kosunen, 2014). Research from the

United States speculated that although parents may prefer to send their children to a neighborhood school, other types of schools may offer curriculum, academic quality and other aspects that overpower parental desire to enroll their child into the closest school (Wilson et al., 2010). (For example, magnet schools that offer a specialized curriculum or programs that parents can choose instead of the neighborhood school in the public school system in some US school districts.) Policy implications of those findings extend beyond transport to school (Wilson et al., 2010).

In this study, one-quarter of adolescents enrolled in the closest school located within walking distance from their home (median distance: 1.3 km). In this group, three-quarters of adolescents used ATS and over half made decisions themselves about how they travel to school. These results show that adolescents attending schools in their home neighborhood have high rates of ATS and autonomy related to school travel decisions. These findings emphasize the need for integrated cross-sector efforts that (re)consider educational policies, urban planning, school travel planning and the need for changing societal norms – in addition to school-based active transport promotion initiatives (e.g., walk and wheel days, cycle skills training (Sersli et al., 2019), built environment changes in the home and school neighborhoods (Carlson et al., 2014) and safe walking and cycling school routes (Rahman et al., 2020). ATS initiatives focusing on social support and encouragement from peers, parents and schools and built environment changes in home and school neighborhoods and along common routes to school should target preferentially adolescents who live within reasonable walking - and if applicable, cycling – distance to their school (Mandic et al., 2023).

In the present study, half of adolescents in the study city enrolled in a non-closest school located beyond walking distance from their home and over three-quarters of these adolescents relied on motorized transport to school (mostly by private vehicles). This has substantial implications for travel patterns and traffic volume across the city – especially at the school commute times. Previous research in the same city estimated that 12% of car trips during school pick-up and drop-off times were related to adolescents' travel to schools and that enrolment in the closest school would reduce private vehicle travel by 7% city-wide (Keall et al., 2020). Programs and initiatives aimed at promoting ATS in cities like Dunedin where a large proportion of adolescents enrolls in a non-closest school beyond walking distance from their home need to be tailored to target specific groups of adolescents with monitoring and evaluation customized to the targeted groups. For example, strategies aimed at minimizing barriers to public transport to school should be aimed at adolescents who live beyond walking distance to school. In contrast, the creation of safe walking routes to school should target adolescents who live within walking distance from their school. In a similar vein, monitoring and evaluation efforts should ideally align with a realist perspective aiming to understand not only if these strategies work but how do they work, for whom, and under what circumstances (Jagosh, 2019).

4.1. Implications of study findings

From transport and public health perspectives, the present findings further emphasize the importance of considering walkable distance to school in the design of educational policy with regard to school choice, especially in countries and cities where rates of cycling to school are low and where public transport may not be considered by adolescents and their parents as suitable for school travel. Since distance to school is the strongest correlate of ATS in adolescents (McDonald, 2007), it is not surprising that adolescents in this study who attended the closest or a non-closest school within walking distance from their home had 16-fold and 9-fold higher rates of walking to school, respectively, and half of the rates of private vehicle travel to school compared with their peers who enrolled in a non-closest school beyond walking distance from their home.

School choice policies create both supply and demand effects (Thomson, 2010). Perceptions of school quality (Phillippo and Griffin, 2016), academic achievement (Sattin-Bajaj, 2014) and reputation (Reay and Lucey, 2000) influence parental and adolescent choices. At the same time, schools can enable or constrain choice (Lubienski et al., 2013). When developing school choice policies, the implications on school travel, adolescents' physical activity and health, greenhouse gas emissions and house pricing in school areas (Marshall et al., 2010; West, 2006; Wilson et al., 2010) need critical consideration to attend to the broad implications of such policies and their impact on other sectors (Wilson et al., 2010).

The findings of this study also show that enrolment in the closest school is not sufficient for achieving high rates of ATS if the closest school is located beyond walking distance from adolescents' homes. These findings further emphasize that to maximize ATS, location of schools should be evenly distributed in space and children should be allocated to attend the closest school (Yang and Diez-Roux, 2013). Such approach would require greater collaboration between local and regional planners and education policy makers (McDonald, 2010). However, how students travel to school is determined by a complex interplay of various aspects of the external context, urban environment, the household, the child, and family travel practices (Mitra, 2013) and school leaders show reluctance to introduce policies that might impact on student or parental choice of how adolescents travel to school (Sandretto et al., 2020). Therefore, suggesting a simplistic one-size-fits-all approach will not be sufficient to increase rates of ATS among adolescents.

In 2019, a cross-sectoral working party which involved some of the authors released policy recommendations with an ambitious plan to increase active transport in New Zealand (Mandic et al., 2020). The plan presented policymakers with a four-part strategy to curb the tide of car-based travel and amplify the tide of sustainable and active modes of transport. Increasing active transport to school is an important element of that plan, and no less urgent now than it was in 2019. Amongst the far-reaching recommendations was the suggestion that every school be required to have a school travel plan. This will require collaborative policy-making with mana whenua (Indigenous Māori who have particular rights in the Aotearoa New Zealand context under Te Tiriti o Waitangi (Kidd et al., 2022)), schools, parents, and adolescents, as well as the Ministry of Education.

4.2. Study strengths and limitations

The strengths include a large representative sample of adolescents from the study city, 100% school recruitment rate, comprehensive assessment of reasons for school choice and objectively measured distance to school. Study limitations include the cross-sectional study design that does not allow inferences to be made about causality, data collection in a single city that may limit the generalizability of findings, and the reliance on quantitative data that may not provide insights into the motivations and incentives underlying the reasons for school choice reported by study participants. Future studies examining prospectively the associations between school choice, distance to school, and travel to school patterns will make a valuable contribution to the literature by allowing researchers to determine if changes in school choice decisions are associated with changes in travel to school patterns over time. In addition, prospective studies using a mixed methods design integrating quantitative and qualitative data will facilitate gaining a deeper understanding of the issues at stake.

5. Conclusions

In this study, two out of five adolescents initially enrolled in the closest school and only half of them lived within walking distance to their school. Among adolescents who lived within walking distance to their school (irrespective of whether they enrolled in the closest school), more than half used ATS and most school travel decisions were made by adolescents. However, half of all surveyed adolescents enrolled in a non-closest school located beyond walking distance from their home and over three-quarters of adolescents in this group relied on motorized transport to school, mostly by private vehicles. Taken together, these findings show that school choice coupled with urban design and planning have implications not only for education but also for transport, health and the environment. Cross-sector efforts and collaborations will be essential for guiding the development of future strategies and initiatives to minimize the negative consequences of school choice on increased reliance on motorized transport to school for adolescents with the downstream effects of increasing traffic volumes in urban areas during school commute times, negative impact on the environment and reduced opportunities for physical activity in this age group.

Ethical approval and consent to participate

Research protocols and both projects were performed in compliance with relevant laws and institutional guidelines and received ethical approval from the University of Otago [Ethics Committee (BEATS: 13/203; BEATS Natural Experiment: 17/188) and Auckland University of Technology Ethics Committee (BEATS Natural Experiment: 21/314)]. All adolescent participants signed written consent prior to participation. For adolescents under 16 years of age, parental opt-in or opt-out consent was used in the BEATS Study, based on the school's preference. Parental consent was not required in the BEATS Natural Experiment.

Availability of data and materials

Data used in data analysis for this project will not be shared due to sensitivity of the collected data as well as participants having been given assurances that the collected data will not be shared.

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Authors statement

Mandic: Conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, supervision, visualization, writing – original draft, writing – review & editing. **Sandretto:** Funding acquisition, methodology, writing – review & editing. **Hopkins:** Funding acquisition, methodology, writing – review & editing. **Wilson:** Investigation, methodology, resources, writing – review & editing. **Kidd:** Investigation, methodology, resources, writing – review & editing. **García Bengoechea:** Funding acquisition, methodology, writing – review & editing.

Declaration of competing interest

Sandra Mandic is the founder and the director of the research consultancy AGILE Research Ltd. (www.agileresearch.nz) and Team Leader Transport Strategy at Wellington City Council (Wellington, New Zealand). Other authors have no conflict of interest.

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Abbreviations

ATS	Active transport to school
BEATS	Built Environment and Active Transport to School
GIS	Geographic Information Systems

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