Review

Effect of Major Life Events on Travel Behaviours: A Scoping Review

Richard Larouche [1],* , **Ulises Charles Rodriguez [1]**, **Ransimala Nayakarathna [1]** **and David R. Scott [2]**

[1]   Faculty of Health Sciences, University of Lethbridge, Lethbridge, AB T1K 3M4, Canada; u.charlesrodriguez@uleth.ca (U.C.R.); ransi.nayakarathnamu@uleth.ca (R.N.)
[2]   Library, University of Lethbridge, Lethbridge, AB T1K 3M4, Canada; david.scott@uleth.ca
*   Correspondence: richard.larouche@uleth.ca; Tel.: +1-403-332-4439

Abstract: The transportation sector accounts for about a quarter of global greenhouse gas emissions. Previous research suggests that major life events may be "windows of opportunity" for travel behaviour change. Our scoping review examined the effects of seven events (transitions to secondary school, post-secondary studies, labour market, marriage, parenthood, retirement, and relocation) on travel behaviours. Five databases were searched (MEDLINE, APA PsycINFO, Web of Science, SportDISCUS, and ProQuest Dissertations and Theses) and 80 articles met inclusion criteria. Relocation was the most commonly examined event (with 51 studies). Findings illustrate that moving to compact neighbourhoods (with shorter commute distance/travel time, greater walkability/access to destinations) was associated with shifts towards sustainable travel modes (e.g., walking, cycling, and transit). Relocation might be particularly conducive to implementing scalable sustainable transportation interventions, as all six interventions with appropriate statistical power were effective. Entry into the labour market was generally associated with increased car use and declines in sustainable transportation. Qualitative studies suggested that attitudes towards cycling may become negative during adolescence, while attitudes towards driving improve, highlighting a need for concerted action. Evidence for other events was less consistent. Research in developing countries remain scarce and further intervention research is needed to enhance quality of evidence.

Keywords: sustainable transport; commuting; transition periods; life-course approach; walking; cycling; driving; physical activity

1. Introduction

In the Paris Agreement, the United Nations Framework Convention on Climate Change set the target of limiting global heating to well below 2 °C above pre-industrial levels and to pursue efforts to limit it to 1.5 °C [1]. The Intergovernmental Panel on Climate Change estimated that, in order to achieve the target of 1.5 °C, global emissions of CO_2 need to decrease by about 45 percent by 2030 relative to 2010 levels [1]. The transportation sector has a key role to play in efforts to achieve this reduction, because it is responsible for about a quarter of global greenhouse gas emissions [2,3]. Furthermore, estimates suggest that worldwide emissions from the transportation sector have increased by 29% between 2000 and 2016 [4]. Strategies to reduce emissions in the transportation sector can include travel demand management, increasing the costs associated with private vehicle use (e.g., fuel, license, insurance, etc.), investment in low-emission public transit systems, replacement of gasoline-powered vehicles by electric vehicles, and replacement of motorized trips by active transportation (e.g., walking and cycling) [5]. The latter strategy is increasingly regarded as a promising climate change mitigation strategy that can simultaneously benefit population health and the economy [3,5–9].

From a public health perspective, physical inactivity has been recognized as the fourth leading risk factor for premature mortality worldwide and is associated with an estimated 5.2 million deaths annually [10]. Conversely, engagement in sufficient amounts of physical activity (PA) is associated with numerous benefits including reduced risk of obesity, diabetes, and cardiovascular diseases, and better cardiorespiratory fitness and mental health [10,11]. However, PA is known to decline across the lifespan [12,13], to such an extent that Sallis [13] referred to this as "the most consistent finding in physical activity epidemiology". This underscores a need for identifying types of PA that can be sustained over time. Of particular interest, literature reviews have shown that the percentage of daily PA accounted for by active transportation (AT) increases from childhood to adolescence [14,15]. Thus, AT could become an increasingly important source of PA as individuals get older.

In this regard, a substantial body of evidence suggests that transport policies and practices can increase PA, at least in the transport domain [16–19]. For example, Ogilvie [18] conducted a natural experiment on the implementation of a rapid transit system in Cambridge, UK, and they observed that exposure to the intervention was associated with an 80% increase in the proportion of trips involving AT. Nevertheless, systematic reviews examining the effectiveness of AT interventions have reported mixed findings, with some studies showing increases in AT and others showing no effect [20–23]. This inconsistent evidence may be attributable to many issues including differences in study design, type of intervention, use of behaviour change techniques, and inconsistent implementation of interventions [20,21].

Another factor that may undermine the effectiveness of interventions is the importance of habits as a key determinant of travel behaviours [24,25]. Although psychological constructs such as attitudes, motivation, and self-efficacy might explain why individuals choose a particular travel mode for a given purpose, travel behaviour can become a routine that no longer requires conscious deliberation and is activated by habitual cues [25–27]. According to the habit discontinuity hypothesis, major life events (e.g., entering the labour market, parenthood, retirement, etc.) may provide windows of opportunity during which individuals may reconsider their travel behaviours and be more sensitive to behaviour change interventions [28]. Similarly, changes in transport policies could have larger effects among people experiencing major life events.

Some studies indeed reported that individuals are more likely to change their travel behaviours following a major life event [24,29]. Researchers have also reported that as income and working status increase, individuals are likely to purchase a car and, once they develop the habit of driving, they are unlikely to give it up [30]. Following major life events, adults who traveled by car were deemed the least likely to change travel mode [24,29]. These observations emphasize the need to focus on major life events and to promote healthy habits early in life. Major life events may influence travel behaviours in multiple interrelated ways such as changing the roles that individuals play within their family/social network, the resources available for travel (e.g., car ownership), and the context in which travel takes place [24].

To our knowledge, most previous literature reviews that have examined the effect of major life events on travel behaviours have focused on a single life event (e.g., parenthood [31] or relocation [32]) and/or on a specific methodology such as biographical research [33]. Müggenburg et al. [33] defined life events as "key events" if they have a significant meaning for individuals and lead them to reconsider their travel behaviours, potentially leading to behaviour change. Defined this way, major life events can include key transitional events across the lifespan and other context-changing events such as relocation. In their systematic review, Ding et al. [32] noted that relocation presents a unique opportunity for improving the evidence base regarding the impact of changes in built environment on PA, including walking and cycling. However, a key limitation of previous reviews is that they almost exclusively included observational studies, which limits causal inferences [31–33]. Given the growing number of recent studies on major life events and travel behaviours, a scoping review examining multiple major life events without restrictions about methodology appeared timely.

In this context, our scoping review aimed to: (1) summarize previous research on the effects of major life events on travel behaviour; (2) identify research gaps that could be addressed in future research; and (3) provide recommendations for practitioners, policymakers, and researchers. Notwithstanding the increasing amount of research in this area, there is wide heterogeneity in the specific life events that have been investigated. We focused on the effects of seven major life events, namely the transition from primary to secondary school, the beginning of post-secondary studies, entry on the labour market, marriage, parenthood, relocation, and retirement. We selected these events because they were identified as important sources of behaviour change in previous studies and reviews on AT and PA [31–38] and/or there were theoretical reasons to believe that they could lead to travel behaviour change. We conducted our review according to Arksey and O'Malley's framework [39] and followed the PRISMA-ScR reporting guidelines [40].

2. Materials and Methods

2.1. Search Strategy

MEDLINE, APA PsycINFO, Web of Science, and SportDISCUS were initially searched on 7 January, 2019, by a health sciences librarian. ProQuest Dissertations and Theses was searched on 29 January, 2019. To update the results, searches of all databases were run again on 14 April, 2020. Search terms were identified through consultations between the lead author and the librarian and a scan of the titles, abstracts, and subject headings of preliminary search results. To optimize the precision of the searches while maintaining high sensitivity, the search string was revised multiple times in accordance with feedback from the lead author. The search strategy was first developed for APA PsycINFO (Figure 1) and then adapted for the other databases. When possible, subject headings from controlled vocabularies (e.g., MeSH, Thesaurus of Psychological Index Terms) were used in the search. To increase sensitivity, concepts were also entered in the search string as keywords, with truncation (e.g., chang*) and proximity operators (e.g., adj3) when appropriate. Boolean operators connected subject headings and keywords as shown in Figure 1. No limits were placed on publication type or date; however, results were filtered to include only articles published in English or French.

The bibliographic information (e.g., title, abstract, authors, subject headings) for each search result was imported into EndNote X8 for deduplication and review. A total of 3398 results were returned from the five database searches in January 2019. An additional 479 records were retrieved in April 2020. Moreover, 23 articles were identified by scanning reference lists of included articles and a scoping review on major life events and PA [38], the lead author's personal library, and Google Scholar recommendations. After duplicates were removed, 3061 unique records remained for potential inclusion in the study. Additional details about the protocol can be obtained by contacting the lead author.

2.2. Inclusion and Exclusion Criteria

To be eligible for the review, studies had to include at least one of the abovementioned major life events and to report travel behaviours before and after the major life event(s) examined either prospectively or retrospectively. There were no restrictions on the type of measures of travel behaviours. Quantitative, qualitative, and mixed methods designs were all eligible. The following criteria were used to exclude papers that were deemed ineligible: (1) literature reviews, commentaries, and editorials; (2) articles not published in English or French; (3) articles that did not focus on major life events; (4) articles that did not include a measure of travel behaviour before and after one of the abovementioned major life events; (5) articles that only examined travel in the context of tourism. The fourth criterion ruled out cross-sectional studies, because they cannot establish temporal sequence [32]. The fifth criterion was added after starting the screening of titles and abstracts and is justified given the review focus on habitual travel behaviours.

1. exp Transportation/ [SH]
2. exp Traveling/ [SH]
3. exp "Commuting (Travel)"/ [SH]
4. exp Walking/ [SH]
5. ((active or actively) adj2 (transport* or travel* or commut*)).mp.
6. ((travel* or transport* or commut*) adj3 (behavior* or behaviour*)).mp.
7. (walk* or bik* or bicycl*).mp.
8. or/1-7
9. exp Parenthood Status/ [SH]
10. exp Retirement/ [SH]
11. exp Employment Status/ [SH]
12. exp Life Changes/ [SH]
13. (transition* adj5 (school* or education* or universit* or college*)).mp.
14. (life adj3 (chang* or event* or transition*)).mp.
15. (life adj course*).mp.
16. parenthood.mp.
17. (child* adj3 birth).mp.
18. ritir*.mp.
19. or/9-18
20. 8 and 19
21. (mobility adj biograph*).mp.
22. or/20-21
23. limit 22 to (English or French)

Note: SH = subject heading; exp = used with a subject heading to include all narrower terms; .mp = keyword search of title, abstract, heading word, table of contents, key concepts, original title, tests & measures, MeSH; adj = search for records with terms adjacent to each other; adj# = search for records with terms within # words of each other; * after keyword indicates truncation (e.g., retir* will retrieve "retire," "retired," "retiring," "retirement," etc.)

Figure 1. APA PsycINFO Search Strategy.

2.3. Screening Process

First, titles and abstracts of each article identified were screened independently in EndNote by two research assistants trained by the lead author. Full-text copies of each article that passed the first stage of screening were obtained and screened independently by two research assistants. In the second stage, reasons for exclusion were collated in an Excel spreadsheet. Disagreements were resolved in discussion with the lead author.

2.4. Data Extraction, Charting, and Synthesis

The lead author developed a data extraction form in Excel. Data extracted included: lead author, publication year, country, study design, analytical sample size, measures of travel behaviour, follow-up period, major life event examined, and main results. For the first ten articles, data extraction was done independently by the lead author and two research assistants, who then met in person to discuss the extracted data. Subsequently, data extraction was done independently by the lead author and one research assistant. Any substantive disagreement was resolved by consensus. When information to be extracted was missing, the lead author contacted the corresponding author of the original study via email. We grouped included studies by the major life event(s) examined and present a narrative summary of main findings for each major life event.

3. Results

The flow of articles in the review process is depicted in Figure 2. Of the 3061 potentially relevant articles identified, 2770 were excluded based on title and abstract, leaving a total of 291 articles for full-text screening. Two hundred eleven full texts were excluded for the following reasons: ineligible study design (n = 22), no eligible life event examined (n = 133), lack of data on travel behaviour before and after the major life event (n = 98), or focus exclusively on tourism (n = 2). Many articles were excluded for more than one reason. In addition, one paper was excluded because it was impossible to disentangle findings for transportation and leisure cycling, and one was excluded because the authors clustered major life events. Eighty articles were included in the review. Relocation was the most commonly examined major life event with 51 articles, followed by parenthood (n = 23), retirement (n = 23), beginning of secondary school (n = 12), entry into the labour market (n = 10), beginning of post-secondary education (n = 8), and marriage (n = 2). Figure 3 illustrates the location of studies, and Table S1 summarizes their characteristics. Almost all studies were exclusively conducted in high-income countries based on the World Bank classification (n = 76; 95%), while three studies were conducted in China (upper-middle-income), and one study included participants from both the Philippines (lower-middle-income) and the UK. Germany (n = 14), the USA (n = 13), UK (n = 13), and Australia (n = 11) were the countries in which the largest number of studies were conducted. Most studies were quantitative (n = 66), followed by qualitative (n = 12) and mixed methods (n = 2). Only eight studies included an intervention (three randomized controlled trials and five natural experiments), and all of these focused specifically on relocation. Figure 4 shows that all included studies were published after 2002 and most were published in the last decade. Sample size ranged from 20 to 32151 participants, and follow-up period ranged from three months to 50 years.

One study identified participants' travel behaviour using a combination of global positioning systems and accelerometers [41]. All other studies used self-reported measures of travel behaviour obtained via questionnaires, diaries, interviews, focus groups, life course calendars, and videos submitted by participants. Studies operationalized the concept of travel behaviour in many different ways including: mode share or prevalence (e.g., the proportion of trips accounted by a given mode of transportation), daily or weekly time using a given travel mode (e.g., in minutes or hours), participants' main/usual commuting mode, trip rates (e.g., number of trips/day using a given mode), trip entropy (e.g., measures of heterogeneity of travel modes used), trip chains, etc. Other studies assessed transportation PA in MET-hours per week, a common metric in kinesiology and public health that considers intensity, frequency, and duration [42]. For example, walking at a typical speed represents three metabolic equivalents (METs), because the energy expenditure is three times resting energy expenditure. Walking for 30 min five times a week thus represents 7.5 MET-hours (5 * 0.5 h * 3 METs = 7.5). Furthermore, many studies grouped active (e.g., walking, cycling, etc.) and motorized (e.g., car, transit, etc.) modes together for analyses. The following sections summarize the effect of each major life event.
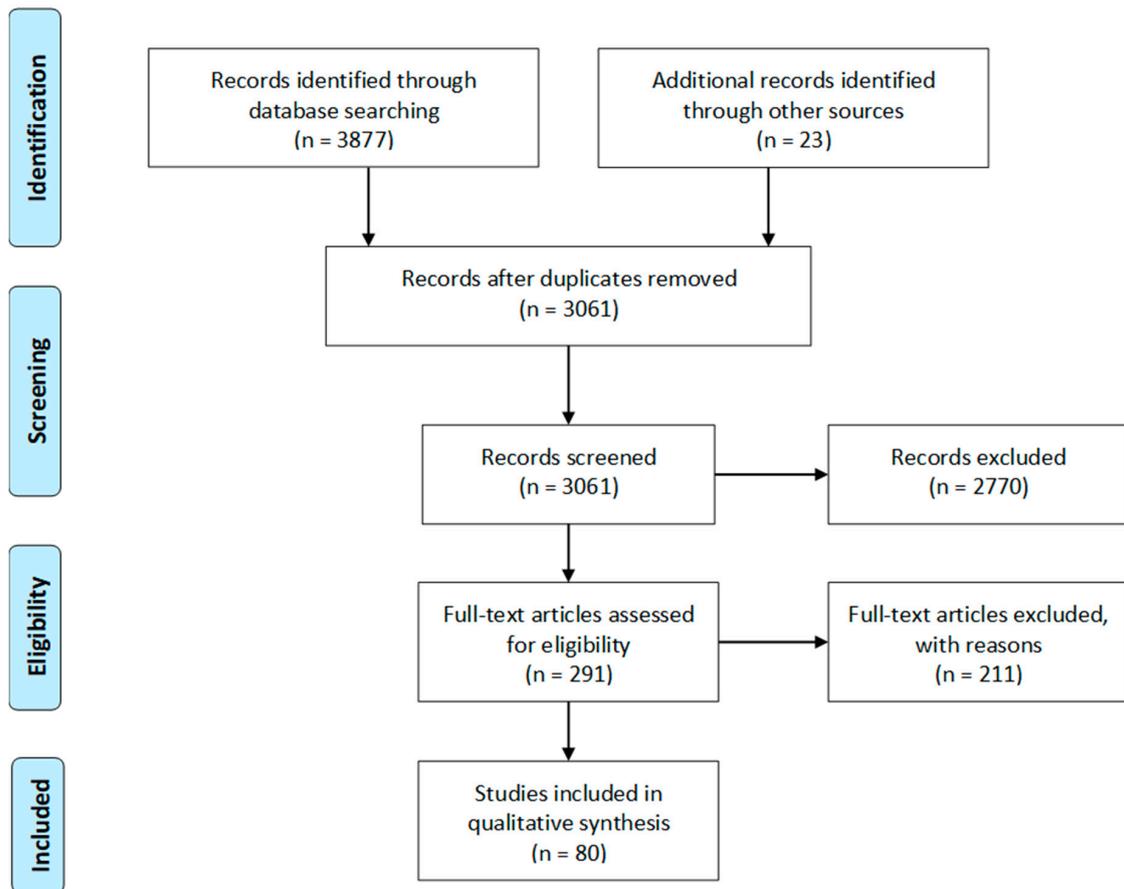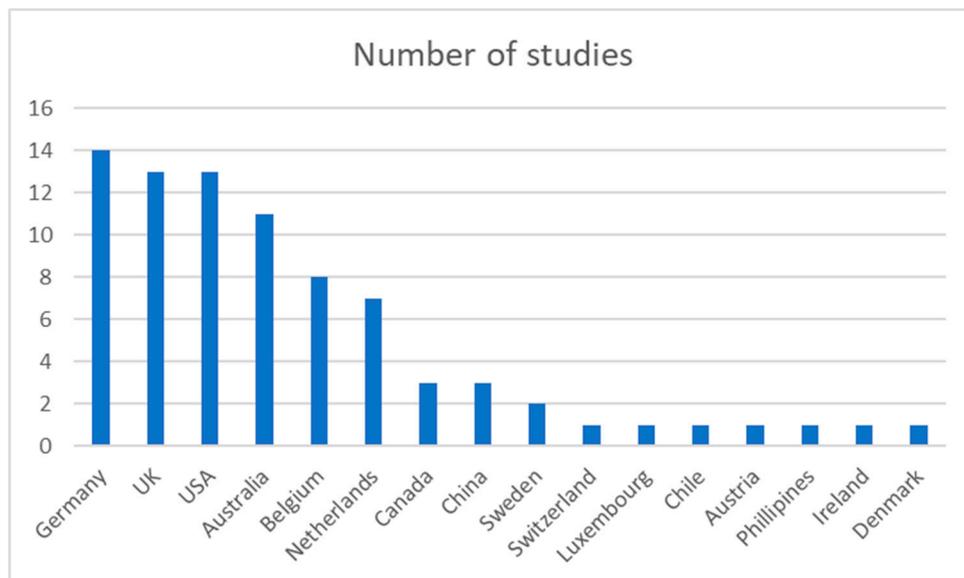
Figure 2. Flow diagram.

Figure 3. Bar chart representing the number of included studies per country.
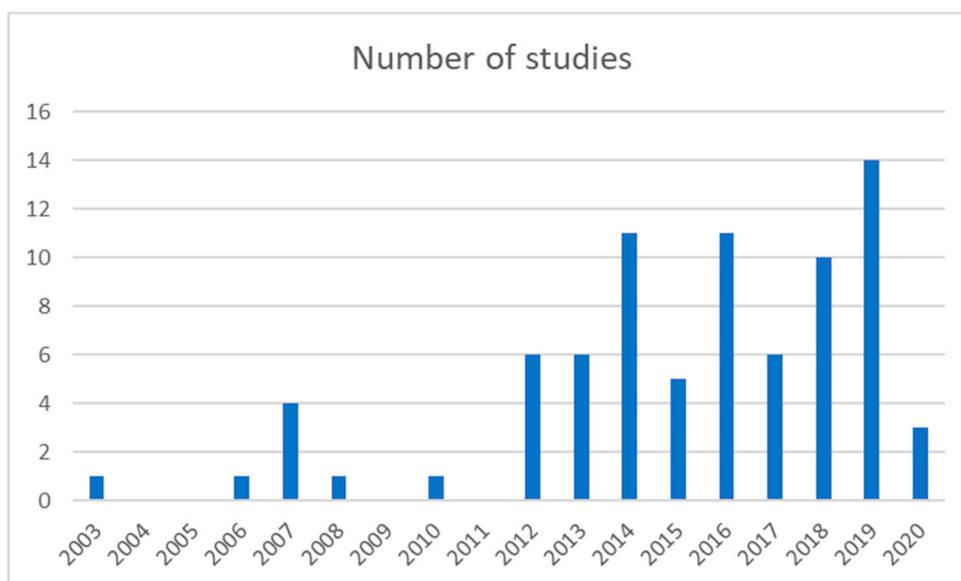
Figure 4. Bar chart representing the number of included studies per year of publication.

3.1. Transition from Primary to Secondary School

As indicated in Table S2, eleven studies reported in twelve publications met inclusion criteria for this event. Eight publications were quantitative [41,43–49] and four were qualitative [50–53]. The quantitative studies generally provided mixed findings. Two studies reported a significant decline in prevalence of AT to/from school across the transition, which was associated with increased home–school distance [44,47]. However, among students who continued to engage in AT, distance increased, leading to an increased contribution of AT to PA [44,47]. Three Belgian studies reported a significant increase in time spent engaging in AT [43,45,46]. Another Belgian study found that the prevalence of AT to/from school remained stable, but fewer students engaged in AT to/from other destinations in secondary school [49]. Marks et al. [48] reported a significant decline in cycling frequency, but no change in walking to/from school among Australian children. Using a combination of accelerometers and GPS, Remmers et al. [41] observed no change in transport-related moderate-to-vigorous PA, an increase in light-intensity PA during school trips, and a decrease in transport-related light-intensity PA on weekend days.

All qualitative studies were conducted in Australia, the UK, and the US, and they focused predominantly on cycling. Despite its contribution to children's independence, they reported a decline in cycling [50,51,53] or an increase in motorized travel [52] across the transition. Participants identified more barriers to cycling in adolescence including longer distance, concerns about traffic, greater time constraints, need to carry heavy items, and the belief that other teenagers perceive cycling as "uncool" [50,51,53].

3.2. Transition from Secondary School to Postsecondary Education

Only eight articles examined this transition, and findings were mixed (Table S3). This included seven quantitative studies [54–60] and one qualitative study [52]. Two studies reported large declines in time spent engaging in AT [54,60] and Deforche et al. [54] also observed a decline in motorized travel. Similarly, Parra-Saldías et al. [56] reported a significant decline in the prevalence of AT to/from school or university, but they also observed an increase in transit use. Conversely, in their descriptive analysis, Rau and Manton [57] noted that the proportion of participants reporting an increase in use of walking, cycling, and transit with the transition to postsecondary education far exceeded the proportion of participants who reported a decrease. They reported the opposite pattern for car driving and carpooling. Sharmeen et al. [59] reported an increase in travel time for subsistence activities

(defined as work and studies) with the beginning of postsecondary studies using a liberal $p < 0.10$ threshold, but the transition had no effect on other types of activities. Using data from the German Mobility Panel, Scheiner [58] reported no change in the frequency of any mode of transportation. Finally, De Paepe et al. [55] found that, following the transition to university, students who lived in university dorms had much higher rates of AT for school, grocery shopping, and "fun shopping" trips than those who commuted to campus (implying longer trips). In the qualitative study [52], limited details were provided about travel mode immediately before the transition.

3.3. Entry into the Labour Market

Of the ten studies that examined this transition (Table S4), two were qualitative [52,61] and the remainder were quantitative [57,58,62–67]. Three studies reported statistically significant increases in driving after entering the labour market [58,63,65]. Busch-Geertsema et al. [63] also observed that changes in travel mode were associated with increased distance, different work requirements (e.g., flexibility and dress code) and opportunities (changed car availability, parking availability, and access to public transit), and changes in attitudes, subjective norm, and perceived behavioural control. Moreover, a series of articles using national data from the German Mobility Panel indicated that entry into the labour market was associated with declines in measures of multimodality (i.e., participants used fewer travel modes) and increases in the number of trips per tour (i.e., greater use of trip chains) [65–67]. A descriptive study also reported a large increase in driving accompanied by declines in walking, cycling, and driving as passenger [57]. While Bopp and colleagues [62] did not examine changes in driving, their results indicate a substantial decline in time spent engaging in AT. They identified a subgroup of participants who maintained a higher level of AT. These participants reported more AT and vigorous PA in college and lived closer to their workplace [62]. Finally, Oakil et al. [64] reported no shift between cycling and other travel modes in the Netherlands.

In Jones' [52] qualitative study, there was some evidence that entry into the labour market was associated with increased driving in the cohorts of Boomer men and Echo women, but changes were less clear in Boomer women and Echo men. Mbabazi [61] noted shifts from AT to transit (associated with perceived distance) and from transit to driving (associated with increased financial resources, access to a company car, and perceived ineffectiveness of public transit). Conversely, short distance was described as an enabler of AT and having a direct route as an enabler of transit [61].

3.4. Marriage

As described in Table S5, only two quantitative studies assessed the effect of marriage on commute mode [68] or distance [69], and the latter found no change. Döring et al. [68] observed that marriage was associated with a substantial increase in car access, which was associated with switching to driving during the year following marriage. This suggests that the effect of marriage could be mediated by car ownership, but no mediation analysis was reported.

3.5. Parenthood

Twenty-two studies reported in 23 articles examined the effect of parenthood on travel behaviour (Table S6). This included seven qualitative papers [50–52,61,70–72] and 16 quantitative papers [24,29,57, 58,64–69,73–78]. Some quantitative studies were only designed to assess the effect of childbirth within the previous year [24,29], whereas qualitative studies provided a richer perspective from childbirth to adolescence [50,51]. Among the quantitative papers, six reported no change in any measure of travel behaviour [24,29,67–69,74], and one found increased odds of shifting from cycling to other modes using a liberal $p < 0.10$ threshold [64]. The other studies reported highly heterogeneous findings. Notably, a series of five studies using different measures of travel behaviour derived from the German Mobility Panel data and different statistical methods obtained divergent results [58,65–67,77]. First, Scheiner and Holz-Rau [58] observed an increase in walking and a decrease in cycling and car use as passenger, but car use as driver and transit use did not change significantly. Scheiner [65] reported an

increase in walking only in women and no changes in use of other travel modes. Scheiner [66] reported a decrease in trip entropy in bivariate analyses, but no effect in multivariate analyses. Using path analyses, Scheiner [77] reported that the birth of a first child had no direct effect on participants' car use, but it was associated with increased car use among their partner, suggesting that interactions within households can influence travel behaviour. Rau and Manton [57] only used descriptive statistics and found increases in walking and driving (either as driver or passenger) and decreases in cycling and transit use. Similarly, McCarthy et al. [76] found an increase in frequent driving and decreases in frequent use of transit and cycling. Gao et al. [75] focused specifically on changes in walking and found a small, but significant, increase in transport walking (+1.54 min/day). De Haas et al. [73] used latent transition analyses and found some changes in cluster membership, notably monomodal car use was more stable over time (Table S6). Finally, Scheiner and Holz-Rau [78] reported a decrease in car use and an increase in walking.

Among the qualitative studies, Bonham and Wilson [50,51] and Janke and Handy [70] focused specifically on cycling and observed a decline with childbirth. However, many participants started to cycle again when their children were older, which allowed them to teach cycling safety. Two studies reported that parenthood had limited impacts on fathers' travel behaviour [52,71]. Women interviewed by Jones [52] reported an increase in walking with childbirth followed by a decrease after they returned to work. Lanzendorf [71] noted a small decrease in the proportion of mothers who primarily used AT or transit. Mbabazi [61] and Nakanishi and Black [72] both reported that childbirth was associated with increased driving and decreased transit use, and many participants emphasized that transit did not meet their needs.

3.6. Retirement

Twenty-two studies reported in 23 articles examined the effect of retirement on travel behaviour (Table S7). This included six qualitative papers [50–52,72,79,80] and 17 quantitative papers [29,57,58, 65–67,73,77,81–89]. Of the quantitative studies, four reported significant declines in AT [76,82,83] or walking for transport [89]. Sprod et al. [88] also reported a significant decline in motorized travel and Siren et al. [86] reported a decline in driving frequency and annual mileage. Interestingly, Van Dyck [89] found a larger decline in motorized transport among participants who had recently retired at baseline compared to those who retired between baseline and the two-year follow-up, suggesting a lagged effect. Laverty and colleagues [85] found that, after retiring, Londoners reported greater odds of beginning or continuing to use transit. Kamruzzaman et al. [84] found that participants who retired during the 2008 financial crisis were more likely to shift to walking and private motor vehicle use, and they were less likely to shift to transit. Rau and Manton's descriptive study [57] suggested a shift towards sustainable modes, but only five participants were retired. Three large prospective studies found that retirement had no effect on travel behaviour [65,82,83], and one found a small effect in only one of eight models [67]. Scheiner and Holz-Rau [68] found no change in trip rates, but mentioned that "in terms of modal shares it [retirement] is associated with less driving and more non-motorised travel" (p. 179). Finally, Scheiner [66] reported a significant decline in trip entropy, especially in men, indicating that retirees used fewer travel modes.

In four qualitative articles, interviewees mentioned that reduced time constraints associated with retirement provided an opportunity to increase walking and/or cycling [50–52,79], but mode shift varied between studies. In Bonham and Wilson's [50,51] study of cycling trajectories among Australian women, retirement was associated with increased cycling, which was described by some participants as an opportunity to reduce their carbon footprint. Swedish retirees mentioned that retirement made it easier to walk, and some participants mentioned walking and/or cycling as a way to get out of the house, get fresh air and exercise, and maintain good health [79]. Finally, English retirees mentioned that they deliberately included walking for transportation or recreation in their routine; however, those who cycled for transportation reported a shift towards cycling for recreation [52]. In Nakanishi and Black's [72] study, the car remained the main travel mode for most

interviewees, although some mentioned that they avoided travelling during peak hour or started to use transit. Finally, in Plyushteva and Schwanen's [80] study, women interviewees in London (UK) and Manila (Philippines) both reported reduced mobility post-retirement, often due to increased perceived vulnerability and declining eyesight and physical abilities. While Londoners took advantage of free transit for older adults, retirees in Manila generally relied on family members for mobility due to the cost of transit [80].

3.7. Relocation

About two thirds of included studies examined the effect of relocation (Table S8). This included two mixed methods papers [90,91], seven qualitative papers [50–52,61,66,92,93] and forty-two quantitative papers [17,24,28,29,57–59,64–69,73–75,78,85,93–117]. Twenty-four quantitative observational studies focused on the direct effects of relocation and reported mixed findings [24,28,29,58,59,64–69, 73,74,78,85,96,100,103,108,109,112,113,116,117]. Of these, nine found no direct effect on travel behaviour [28,58,65–68,74,78,96], and two found changes only when using a liberal significance threshold of $p < 0.1$ [59,64]. Four studies found a higher likelihood of changes among movers compared to non-movers [24,29,100,113]. Two studies focused only on transit and found higher use among movers than non-movers [85,112]. Prillwitz et al. [69] reported a greater increase in commute distance among movers than non-movers. Two Chinese studies found increased car use following relocation [109,117], and one of these [109] also reported that relocation was associated with increased trip frequency, total travel time, non-motorized travel time, and transit travel time. One study found a significant increase in odds of walking for transportation [103]. In Rau and Manton's [57] descriptive study, the proportion of individuals who reported an increase in a given travel mode was generally similar to the proportion reporting a decrease. Two studies used latent transition analyses and found modest changes in membership of some clusters [73,108]. Finally, Yang et al. [116] restricted their sample to participants who actively travelled at baseline. Following relocation to predominantly suburban areas, only 38% of participants remained active travelers [116].

In contrast, many included studies provided evidence that changes in travel behaviour after relocation were associated with specific environmental attributes (Table S8). Notably, when relocation was associated with increased travel time, commute distance, or increased distance relative to the central business district, AT generally decreased and car use increased [24,64,68,74,102,107,116,117]. The opposite was generally found when distance or travel time decreased [24,64,68,74]. Similarly, studies reported that relocating towards less urban or less dense areas was associated with a decrease in AT [74], walking [65,78], or transit use [78,98] or an increase in car use [74,78]. Conversely, relocating towards denser or more urban areas was associated with increased AT [24,74,95], walking [58], transit use [65], or decreased car use [74]. Furthermore, increases in neighbourhood walkability and associated constructs (e.g., density, mixed land use, and access to destinations) was commonly associated with increased walking [17,58,99,103,106], cycling [58,95], AT in general [24,105] and transit use [105], and decreased driving [24,99,105,107].

Higher access to vehicles was a consistent correlate of increased driving post-relocation [68,78,98, 99,101,102,105,107,116,117]. Similarly, Clark et al. [24] noted that individuals who acquired a driver's license were over 16 times more likely to shift from non-car to car travel. Conversely, three studies found that individuals who scored higher on measures of environmental concern or intention to protect the environment were less likely to drive to work after relocation [24,28,115].

Two qualitative studies observed that, in adulthood, relocations to inner suburban areas were associated with taking up or increasing cycling or walking, whereas relocations to outer suburban or rural areas was associated with stopping or decreasing cycling or walking [50–52]. Bonham and Wilson [50,51] also reported that, during childhood, moving to the city was associated with decreased cycling, notably due to safety concerns. Jones and Ogilvie [92] reported that, in many participants' stories, the main reason for moving home was to buy a first or a larger house, which typically involved relocating further from the city centre, implying increased commute distance and a decline in cycling.

When selecting travel mode after relocation, participants were motivated by convenience, cost, speed, and reliability. PA was not a primary motivation for changing mode, but it was discussed as a reason for maintaining AT [92]. In Zarabi and colleagues' [93] study, all interviewees who used AT before relocation reported an increase in distance leading to a shift towards motorized travel modes. However, all participants who travelled by car at baseline continued to do so. In contrast, relocating to Davis, California, which has an exceptionally high prevalence of cycling compared to the rest of the US, was associated with increased cycling [70]. This finding was confirmed in a subsequent quantitative study [104]. Some individuals moved to Davis specifically for the ability to cycle [70]. Self-selection also emerged as a potential explanatory factor in Mbabazi's [61] study wherein participants who travelled by car at the time of the interview reported a large increase in car travel after moving to their current residence. Conversely, participants who used alternative modes at the time of the interview reported a decline in driving [61].

All eight intervention studies included in our review focused on relocation [90,91,94,97,110,111,114,115] and four were published in 2019 [90,97,111,114]. Three interventions were randomized controlled trials focusing on home relocation [94,97,111]. Bamberg [94] offered a one-day free transit ticket and an information package to a subset of participants who relocated to Stuttgart, Germany. Among these participants, transit use increased by 29% compared to only 7% among their control counterparts. Consistent with Ajzen's theory of planned behaviour [118], the effect of the intervention was mediated by intention. Similarly, Ralph and Brown [111] examined the effect of providing a transit information guide to incoming graduate students at the University of California, Los Angeles. The intervention was effective only among students who relocated. In Bhattacharyya and colleagues' [97] study, individuals expecting to move in the next three months were randomly assigned to a "focalism" intervention (designed to identify cognitive biases that individuals have towards certain characteristics of a house), a visualization intervention (designed to help participants identify opportunities for change with relocation), or a control group. The focalism intervention led to significant decreases in commuting time and driving to visit family and friends, and increases in AT to work and to visit family and friends.

Natural experiments focused on changes in travel behaviour following workplace relocation [91,114,115], university campus relocation [110], or moving to neighbourhoods with a car restriction policy [90]. Walker et al. [110] studied the relocation of the World Wildlife Federation's UK Headquarters, which was accompanied by promotion of, and incentives for, train use. The intervention resulted in a remarkable reduction in driving (from 55.0% to 22.6%) and an increase in train use (from 18.5% to 56.1%). Even among employees of a pro-environmental organization, greater environmental concern increased odds of behaviour change. The natural experiments by Johansson et al. [90] and von Behren et al. [114] were small pilot-studies and authors did not provide inferential statistics. Rau et al. [91] observed that a workplace relocation from the inner city to the outskirts of Munich, Germany led to an increase in car travel (from 46% to 71%) and completely eliminated walking and cycling. Finally, Peer [110] found that relocation of an Austrian university campus closer to the city centre was associated with increased cycling.

4. Discussion

Our scoping review examined the effect of major life events on travel behaviour. A total of 80 studies met our inclusion criteria and there was substantial heterogeneity in measures of travel behaviour used, which made comparisons between studies difficult. Nevertheless, a substantial proportion of studies showed that major life events were associated with changes in at least one measure of travel behaviour. Given that previous evidence indicates that travel behaviour is highly habitual [25–27], the frequent occurrence of changes in travel behaviour supports the view that major life events represent a window of opportunity for travel behaviour change. Furthermore, our review suggest that relocation might be a particularly salient time for implementing effective sustainable transportation interventions.

The transition from primary to secondary school was associated with a decline in the prevalence of AT in predominantly English-speaking countries [44,47,50,51,53]. In these countries, qualitative studies have reported an increase in negative attitudes towards walking and cycling [50,51,53,119], and media campaigns promoting safe driving have even contributed to the stigmatization of cycling [120]. In continental European countries where cycling is much more prevalent and socially-normative [19], included studies typically reported an increase in time spent cycling to/from school [38,40,41]. Future interventions could harness this transition as an opportunity to promote AT and PA while addressing negative views towards cycling. Traffic concerns should also be addressed to support children's right to a safe environment [121].

Few studies have examined the transition to postsecondary studies and their findings were generally inconsistent. While screening articles for inclusion, we identified an article that examined the transition from high school to either postsecondary studies or the labour market [122]. They found a large decline in AT associated with increased distance, and a significant increase in transit use. Because we could not disentangle the effect of these two transitions, the article was excluded. The beginning of postsecondary studies may be associated with both relocation and increased decision-making ability for youth in many domains, including travel behaviours. As such, it might be an opportune time to deliver sustainable transportation interventions. For example, the intervention conducted by Ralph and Brown [111] among incoming graduate students could be replicated with students starting undergraduate studies.

Entry into the labour market was generally associated with increases in driving and/or declines in AT or multimodality. Busch-Geertsema et al. [63] identified many predictors of travel behaviour change including changes in distance, attitudes, subjective norm, perceived behavioural control, dress codes, and the availability of cars, parking, and transit. Interventions could be developed to prevent increased driving, particularly among new employees before they establish strong habits. For instance, the availability and convenience of free parking is known to encourage driving to work [123,124]. Workplaces that used a "carrots and sticks" approach involving reduced parking availability while simultaneously offering public transit benefits, showers, and safe bicycle parking have been more successful in encouraging sustainable transportation [124,125].

Interestingly, only two included studies examined the effect of marriage. Marriage was included as a major life event based on previous reviews [34,35,37]. However, based on hindsight gleaned while reviewing articles in this review, marriage per se may have a limited impact on travel behaviour in couples already living together, as it may not involve change in commute distance and other environmental characteristics [69].

Although one may hypothesize that parenthood would be associated with increased driving at the expense of other travel modes, our review illustrates that this scenario is far from universal. Indeed, about half of included studies showed no change in travel behaviour at the $p < 0.05$ threshold, and multiple analyses from the well-powered German Mobility Panel revealed only modest changes in some measures of travel behaviours. A potential reason for the lack of significant changes is that there could be a time lag between parenthood and changes in driving [29,68]. For example, car use could increase only a few years after childbirth when parents accompany their child to various activities (e.g., childcare, school, sport, and leisure). A few quantitative and qualitative studies reported increases in walking [52,65,75], especially in women, suggesting that parents may walk with their children. In some qualitative studies, the inconvenience of using public transit with young children and strollers was discussed by participants [61,72], and many interviewed mothers also mentioned that they cycled less when they had young children [50,51]. Finally, some studies suggested that parenthood tends to affect mothers' travel behaviour to a greater extent than fathers', reflecting traditional gender roles [52,65,71]. Notwithstanding the heterogeneous findings, our review suggests that promoting walking for transportation among new and future parents could be fruitful, if confirmed in intervention studies.

The effect of retirement on travel behaviour was variable with some quantitative studies reporting declines in travel in general (e.g., reduced AT and vehicle miles travelled), whereas other studies found no significant changes. Qualitative studies suggested that retirement was associated with reduced time constraints, thus providing more opportunities for walking or cycling for transport or leisure [50–52,79]. Our review provides some evidence that changes in travel behaviour can also be supported by policy. In England, adults over the age of 60 are eligible for a free transit pass since 2006, and two included studies observed that this measure encourages transit ridership among retirees [80,85]. Plyushteva and Schwanen [80] also concluded that mobility does not change abruptly with major life events (including retirement); it appears to be commonly (re)negotiated within households and families. Few included studies examined the role of reduced physical abilities and whether changes in travel behaviour varied by type of occupation (e.g., blue- vs. white-collar), underscoring a need for future research.

Relocation was by far the most commonly examined event and all eight intervention studies included in this review focused on relocation. Included studies suggest that relocation may prompt a deliberate reflection about travel mode, and the direction of changes in travel behaviour are influenced by factors at the individual (e.g., vehicle ownership, attitudes, habits), interpersonal (e.g., interactions among households), built environment (e.g., commute distance, walkability, level of urbanization, etc.), and policy (e.g., restrictions on car use) levels. Our results suggest that changes in built environment attributes may be particularly salient for behaviour change following relocation. Specifically, moves that resulted in shorter distance, greater walkability/access to destinations, and greater proximity to the city centre were generally associated with increased use of sustainable travel modes and/or decreased car use. These built environment attributes correspond to the "compact cities" model that is increasingly promoted as a way to mitigate the contribution of the transportation sector to global CO_2 emissions while increasing PA [3,126–128]. Our results also extend previous literature by showing that relocation can be an opportune time to deliver low-cost and potentially-scalable interventions to encourage sustainable transportation [94,111,115]. Indeed, all six interventions that were not pilot studies resulted in significant changes in travel behaviour [91,94,97,110,111,115].

4.1. Limitations of Included Studies

Comparison of results across studies remain difficult due to the wide array of measures of travel behaviours. This limitation is compounded by the limited data provided by authors about the psychometric properties of their measure(s). A previous systematic review found that measures for the trip to/from school generally had good reliability and validity, but there was insufficient evidence about the psychometric properties of measures of trips to/from other destinations [129]. Due to their habitual nature, one may expect that trips to/from school or work can be recalled accurately, but less routine trips may be more vulnerable to recall bias. Hence, researchers should use valid and reliable measures of travel behaviours when possible, and develop new measures as needed. Moreover, including both self-reported and device-based measures (e.g., global positioning systems) could help minimize recall and social desirability biases while still collecting contextually relevant data. As noted in the results section, there were large differences between studies in the operationalization of parenthood. In addition, studies typically did not examine changes in travel behaviour during pregnancy.

There remains a clear lack of published studies investigating the effect of major life events on travel behaviour in developing countries. Developing countries are currently experiencing a rapid epidemiological transition characterized by rapid urbanization and motorization, economic growth, and potential adverse changes in greenhouse gas emissions per capita and in the prevalence of physical inactivity and chronic diseases [130–132]. For instance, Yang et al. [133] reported a sevenfold increase in the proportion of Chinese schoolchildren commuting by motor vehicle between 1997 and 2011 (from 4.2% to 30.7%). Echoing these findings, the three Chinese studies included in our review consistently indicated that relocation to suburban neighbourhoods was associated with increasing car use [109,116,117].

4.2. Strengths and Limitations of the Review

Strengths of our review included the systematic search of five databases representing multiple academic disciplines (including the ProQuest database that captures grey literature), the consideration of seven major life events across the lifespan, and the involvement of at least two reviewers for all stages of screening and data extraction. The inclusion of qualitative studies also helped make sense of the mixed findings reported in quantitative studies for most of the major life events.

However, we did not use an instrument to systematically assess the quality of each included studies. This is consistent with the scoping review approach [39], and we believe that no single quality assessment tool could have fairly assessed qualitative studies, observational studies, and randomized controlled trials. However, we have discussed shortcomings of current evidence in general. Another limitation is that there is no standard definition of major life events; hence, different authors could have included different events. The decision to focus on seven major life events represented a pragmatic trade-off between breadth and depth [39], and the selected events had been shown to be important in PA and/or transportation research [17,31–38]. It is also worth noting that individuals do not necessarily experience major life events in a linear fashion and events may co-occur such as relocation associated with beginning post-secondary studies, entering the labour market, or parenthood. This can make it difficult to attribute changes in travel behaviour to a single life event and few, if any, included studies were designed to tease out co-occurrence of major life events. The review was restricted to articles published in English or French, so it is possible that some relevant papers were excluded.

5. Conclusions

Our findings suggest that major life events are indeed "windows of opportunity" for travel behaviour change given the large proportion of studies showing statistically significant changes. However, the direction of changes in travel behaviour was highly variable, and it may depend on a wide range of contextual factors. Thus, our findings highlight the need for studies on the effects of major life events to measure a broader range of factors that can influence the direction of changes. Researchers could draw on models such as the theory of planned behaviours [118] and/or social-ecological models [6]. There is also a need for more intervention studies to provide clearer evidence of causality and for more studies in developing countries.

The negative attitudes towards cycling identified in qualitative studies are concerning and suggest a need for concerted action to address social norms. This could include social marketing campaigns (perhaps engaging youth and "grassroots" organizations) to promote sustainable transportation, while addressing barriers to cycling at the school environment, built environment, and policy levels. Promoting sustainable transportation early in life seems critical as many studies found that driving habits were the least likely to change with major life events. Finally, we found that factors commonly associated with changes in travel mode with relocation (among other major life events) include shorter distance, greater urbanization and walkability, and lower car ownership. These findings are consistent with the broader literature on correlates of adults' travel behaviour [126]. Conversely, issues such as long distance, limited access to destinations, and poor transit service were associated with lower use of sustainable transportation modes. Therefore, urban planners and policymakers should address such indicators in an effort to facilitate healthy and sustainable travel behaviours.

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References

1. International Panel on Climate Change. Special Report: Global Warming of 1.5 °C. 2018. Available online: https://www.ipcc.ch/sr15/download/ (accessed on 6 October 2020).
2. International Transport Forum. *Reducing Transport. Greenhouse Gas. Emissions: Trends and Data*; International Transport Forum: Leipzig, Germany, 2010.
3. Tranter, P.; Tolley, R. *Slow Cities: Conquering our Speed Addiction for Health and Sustainability*; Elsevier: Amsterdam, The Netherlands, 2020.
4. Low Carbon Transport (SLoCaT). Transport. and Climate Change: Global Status Report. 2018. Available online: https://www.changing-transport.org/wp-content/uploads/TCC-GSR2018-May9-web.pdf (accessed on 6 October 2020).
5. Larouche, R. The environmental and population health benefits of active transport: A review. In *Greenhouse Gases—Emissions, Measurement and Management*; Liu, G., Ed.; InTech: Rijeka, Croatia, 2012; pp. 413–440.
6. Larouche, R. *Children's Active Transportation*; Elsevier: Cambridge, MA, USA, 2018.
7. Patz, J.A.; Frumkin, H.; Holloway, T.; Vimont, D.J.; Haines, A. Climate change: Challenges and opportunities for global health. *JAMA* **2014**, *312*, 1565–1580. [CrossRef]
8. Whitelegg, J. *Mobility: A New Urban Design and Transport Planning Philosophy for a Sustainable Future*; Createspace Independent Publishing Platform: Scotts Valley, CA, USA, 2016.
9. Woodcock, J.; Edwards, P.; Tonne, C.; Armstrong, B.G.; Ashiru, O.; Banister, D.; Beevers, S.; Chalabi, Z.; Chowdhury, Z.; Cohen, A.; et al. Public health benefits of strategies to reduce greenhouse-gas emissions: Urban land transport. *Lancet* **2009**, *374*, 1930–1943. [CrossRef]
10. Lee, I.M.; Shiroma, E.J.; Lobelo, F.; Puska, P.; Blair, S.N.; Katzmarzyk, P.T.; Lancet Physical Activity Series Working Group. Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. *Lancet* **2012**, *380*, 219–229. [CrossRef]
11. Haskell, W.L.; Lee, I.-M.; Pate, R.R.; Powell, K.E.; Blair, S.N.; Franklin, B.A.; Macera, C.A.; Heath, G.W.; Thompson, P.D.; Bauman, A. Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation* **2007**, *116*, 1081–1093. [CrossRef]
12. Caspersen, C.J.; Pereira, M.A.; Curran, K.M. Changes in physical activity patterns in the United States, by sex and cross-sectional age. *Med. Sci. Sports Exerc.* **2000**, *32*, 1601–1609. [CrossRef]
13. Sallis, J.F. Age-related decline in physical activity: A synthesis of human and animal studies. *Med. Sci. Sports Exerc.* **2000**, *32*, 1598–1600. [CrossRef]
14. Martin, A.; Kelly, P.; Boyle, J.; Corlett, F.; Reilly, J.J. Contribution of walking to school to individual and population moderate-vigorous intensity physical activity: Systematic review and meta-analysis. *Pediatr. Exerc. Sci.* **2016**, *28*, 353–363. [CrossRef]
15. Voss, C. Public health benefits of active transportation. In *Children's Active Transportation*; Larouche, R., Ed.; Elsevier: Cambridge, MA, USA, 2018; pp. 1–20.
16. Badland, H.; Mavoa, S.; Boulangé, C.; Eagleson, S.; Gunn, L.; Stewart, J.; Davis, S.; Giles-Corti, B. Identifying, creating, and testing urban planning measures for transport walking: Findings from the Australian national liveability study. *J. Transp. Health* **2017**, *5*, 151–162. [CrossRef]
17. Giles-Corti, B.; Bull, F.; Knuiman, M.; McCormack, G.; Van Niel, K.; Timperio, A.; Christian, H.; Foster, S.; Divitini, M.; Middleton, N.; et al. The influence of urban design on neighbourhood walking following residential relocation: Longitudinal results from the RESIDE study. *Soc. Sci. Med.* **2013**, *77*, 20–30. [CrossRef]

18. Ogilvie, D.; Panter, J.; Guell, C.; Jones, A.; Mackett, R.; Griffin, S. Health impacts of the Cambridgeshire Guided Busway: A natural experimental study. *Public Health Res.* **2016**, *4*, 1. [CrossRef]

19. Pucher, J.; Buehler, R. Making cycling irresistible: Lessons from the Netherlands, Denmark and Germany. *Transp. Rev.* **2008**, *28*, 495–528. [CrossRef]

20. Bird, E.L.; Baker, G.; Mutrie, N.; Ogilvie, D.; Sahlqvist, S.; Powell, J. Behavior change techniques used to promote walking and cycling: A systematic review. *Health Psychol.* **2013**, *32*, 829–838. [CrossRef]

21. Larouche, R.; Mammen, G.; Rowe, D.A.; Faulkner, G. Effectiveness of active school transport interventions: A systematic review and update. *BMC Public Health* **2018**, *18*, 206. [CrossRef]

22. Ogilvie, D.; Foster, C.E.; Rothnie, H.; Cavill, N.; Hamilton, V.; Fitzsimmons, C.F.; Mutrie, N.; Scottish Physical Activity Research Collaboration. Interventions to promote walking: Systematic review. *Br. Med. J.* **2007**, *334*, 1204. [CrossRef]

23. Yang, L.; Sahlqvist, S.; McMinn, A.; Griffin, S.J.; Ogilvie, D. Interventions to promote cycling: Systematic review. *Br. Med. J.* **2010**, *341*, c5293. [CrossRef]

24. Clark, B.; Chatterjee, K.; Melia, S. Changes to commute mode: The role of life events, spatial context and environmental attitude. *Transp. Res. Part A* **2016**, *89*, 89–105. [CrossRef]

25. Gardner, B.; Abraham, C. Psychological correlates of car use: A meta-analysis. *Transp. Res. Part F* **2008**, *11*, 300–311. [CrossRef]

26. Aarts, H.; Verplanken, B.; Knippenberg, A.V. Predicting behavior from actions in the past: Repeated decision making or a matter of habit? *J. Appl. Soc. Psychol.* **1998**, *28*, 1355–1374. [CrossRef]

27. Verplanken, B.; Orbell, S. Reflections on past behavior: A self-report index of habit strength. *J. Appl. Soc. Psychol.* **2003**, *6*, 1313–1330. [CrossRef]

28. Verplanken, B.; Walker, I.; Davis, A.; Jurasek, M. Context change and travel mode choice: Combining the habit discontinuity and self-activation hypotheses. *J. Environ. Psychol.* **2008**, *28*, 121–127. [CrossRef]

29. Clark, B.; Chatterjee, K.; Melia, S.; Knies, G.; Laurie, H. Life events and travel behavior: Exploring the interrelationship using UK Household Longitudinal Study data. *Transp. Res. Rec.* **2014**, *2413*, 54–64. [CrossRef]

30. Dargay, J.M. The effect of income on car ownership: Evidence of asymmetry. *Transp. Res. Part A* **2001**, *35*, 807–821. [CrossRef]

31. McCarthy, L.; Delbosc, A.; Currie, G.; Molloy, A. Factors influencing travel mode choice among families with young children (aged 0–4): A review of the literature. *Transp. Rev.* **2017**, *37*, 767–781. [CrossRef]

32. Ding, D.; Nguyen, B.; Learnihan, V.; Bauman, A.E.; Davey, R.; Jalaludin, B.; Gebel, K. Moving to an active lifestyle? A systematic review of the effects of residential relocation on walking, physical activity and travel behaviour. *Br. J. Sports Med.* **2018**, *52*, 789–799. [CrossRef] [PubMed]

33. Müggenburg, H.; Busch-Geertsema, A.; Lanzendorf, M. Mobility biographies: A review of achievements and challenges of the mobility biographies approach and a framework for further research. *J. Transp. Geogr.* **2015**, *46*, 151–163. [CrossRef]

34. Corder, K.; Ogilvie, D.; Van Sluijs, E.M.F. Invited commentary: Physical activity over the life course—Whose behavior changes, when, and why? *Am. J. Epidemiol.* **2009**, *170*, 1078–1081. [CrossRef]

35. Hirvensalo, M.; Lintunen, T. Life-course perspective for physical activity and sports participation. *Eur. Rev. Aging Phys. Act.* **2011**, *8*, 13–22. [CrossRef]

36. Larouche, R.; Laurencelle, L.; Shephard, R.J.; Trudeau, F. Life transitions in the waning of physical activity from childhood to adult life in the Trois-Rivières study. *J. Phys. Act. Health* **2012**, *9*, 516–524. [CrossRef]

37. Raymore, L.A.; Barber, B.L.; Eccles, J.S. Leaving home, attending college, partnership and parenthood: The role of life transition events in leisure pattern stability from adolescence to young adulthood. *J. Youth. Adolesc.* **2001**, *30*, 197–223. [CrossRef]

38. Gropper, H.; John, J.M.; Sudeck, G.; Thiel, A. The impact of life events and transitions on physical activity: A scoping review. *PLoS ONE* **2020**, *15*, e0234794. [CrossRef]

39. Arksey, H.; O'Malley, L. Scoping studies: Towards a methodological framework. *Int. J. Soc. Res. Methodol.* **2005**, *8*, 19–32. [CrossRef]

40. Tricco, A.C.; Lillie, E.; Zarin, W.; O'Brien, K.K.; Colquhoun, H.; Levac, D.; Moher, D.; Peters, M.; Horsley, T.; Weeks, L.; et al. PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Ann. Intern. Med.* **2018**, *169*, 467–473. [CrossRef] [PubMed]

41. Remmers, T.; Van Kann, D.; Kremers, S.; Ettema, D.; De Vries, S.I.; Vos, S.; Thijs, C. Investigating longitudinal context-specific physical activity patterns in transition from primary to secondary school using accelerometers, GPS, and GIS. *Int. J. Behav. Nutr. Phys. Act.* **2020**, *17*, 1–14. [CrossRef] [PubMed]

42. Ainsworth, B.E.; Haskell, W.L.; Herrmann, S.D.; Meckes, N.; Bassett, D.R., Jr.; Tudor-Locke, C.; Greer, J.L.; Vezina, J.; Whitt-Glover, M.C.; Leon, A.S. 2011 Compendium of physical activities: A second update of codes and MET values. *Med. Sci. Sports Exerc.* **2011**, *43*, 1575–1581. [CrossRef]

43. Cardon, G.M.; Maes, L.R.D.; Haerens, L.L.; De Bourdeaudhuij, I.M.M. Bicycling to school during the transition from childhood into adolescence: A six-year longitudinal study. *Pediatr. Exerc. Sci.* **2012**, *24*, 369–383. [CrossRef]

44. Cooper, A.R.; Jago, R.; Southward, E.F.; Page, A.S. Active travel and physical activity across the school transition: The PEACH project. *Med. Sci. Sports Exerc.* **2012**, *44*, 1890–1897. [CrossRef]

45. D'Haese, S.; De Meester, F.; Cardon, G.; De Bourdeaudhuij, I.; Deforche, B.; Van Dyck, D. Changes in the perceived neighborhood environment in relation to changes in physical activity: A longitudinal study from childhood into adolescence. *Health Place* **2015**, *33*, 132–141. [CrossRef]

46. De Meester, F.; Van Dyck, D.; De Bourdeaudhuij, I.; Deforche, B.; Cardon, G. Changes in physical activity during the transition from primary to secondary school in Belgian children: What is the role of the school environment? *BMC Public Health* **2014**, *14*, 261. [CrossRef]

47. Larouche, R.; Faulkner, G.E.J.; Tremblay, M.S. Assessing the influence of the transition from primary to secondary school on the volume of active school transport and physical activity: A prospective pilot-study. *Bioenergetics* **2013**, *2*, 1.

48. Marks, J.; Barnett, L.M.; Strugnell, C.; Allender, S. Changing from primary to secondary school highlights opportunities for school environment interventions aiming to increase physical activity and reduce sedentary behaviour: A longitudinal cohort study. *Int. J. Behav. Nutr. Phys. Act.* **2015**, *12*, 59. [CrossRef]

49. Vanwolleghem, G.; Van Dyck, D.; De Meester, F.; De Bourdeaudhuij, I.; Cardon, G.; Gheysen, F. Which socio-ecological factors associate with a switch to or maintenance of active and passive transport during the transition from primary to secondary school? *PLoS ONE* **2016**, *11*, e0156531. [CrossRef] [PubMed]

50. Bonham, J.; Wilson, A. Women cycling through the life course: An Australian case study. In *Cycling and Sustainability*; Parkin, J., Ed.; Emerald Group Publishing: Bingley, UK, 2012; pp. 59–81.

51. Bonham, J.; Wilson, A. Bicycling and the life course: The start-stop-start experiences of women cycling. *Int. J. Sustain. Transp.* **2012**, *6*, 195–213. [CrossRef]

52. Jones, H.N. Understanding Walking and Cycling Using a Life Course Perspective. Ph.D. Thesis, University of the West of England, Bristol, UK, 2013.

53. Underwood, S.K.; Handy, S.L.; Paterniti, D.A.; Lee, A.E. Why do teens abandon bicycling? A retrospective look at attitudes and behaviors. *J. Transp. Health* **2014**, *1*, 17–24. [CrossRef]

54. Deforche, B.; Van Dyck, D.; Deliens, T.; De Bourdeaudhuij, I. Changes in weight, physical activity, sedentary behaviour and dietary intake during the transition to higher education: A prospective study. *Int. J. Behav. Nutr. Phys. Act.* **2015**, *12*, 16. [CrossRef]

55. De Paepe, L.; De Vos, J.; Van Acker, V.; Witlox, F. Changes in travel behavior during the transition from secondary to higher education. *J. Transp. Land Use.* **2018**, *11*, 477–498. [CrossRef]

56. Parra-Saldías, M.; Castro-Piñero, J.; Castillo Paredes, A.; Palma Leal, X.; Díaz Martínez, X.; Rodríguez-Rodríguez, F. Active commuting behaviours from high school to university in Chile: A retrospective study. *Int. J. Environ. Res. Public Health* **2019**, *16*, 53. [CrossRef]

57. Rau, H.; Manton, R. Life events and mobility milestones: Advances in mobility biography theory and research. *J. Transp. Geogr.* **2016**, *52*, 51–60. [CrossRef]

58. Scheiner, J.; Holz-Rau, C. A comprehensive study of life course, cohort, and period effects on changes in travel mode use. *Transp. Res. Part A* **2013**, *47*, 167–181. [CrossRef]

59. Sharmeen, F.; Arentze, T.; Timmermans, H. Incorporating time dynamics in activity travel behavior model a path analysis of changes in activity and travel time allocation in response to life-cycle events. *Transp. Res. Rec.* **2013**, *2382*, 54–62. [CrossRef]

60. Van Dyck, D.; De Bourdeaudhuij, I.; Deliens, T.; Deforche, B. Can changes in psychosocial factors and residency explain the decrease in physical activity during the transition from high school to college or university? *Int. J. Behav. Nutr. Phys. Med.* **2015**, *22*, 178–186. [CrossRef]

61. Mbabazi, E. The Travel Script: Exploring the Construction and Engagement of a Mental Structure as the Link Between the Influence of Situational and Social-Psychological Factors in Commuting Decisions Along a Life Course. Ph.D. Thesis, Heriot-Watt University, Edinburgh, UK, 2016.

62. Bopp, M.; Wilson, O.W.; Duffey, M.; Papalia, Z. An examination of active travel trends before and after college graduation. *J. Transp. Health* **2019**, *14*, 100602. [CrossRef]

63. Busch-Geertsema, A.; Lanzendorf, M. From university to work life—Jumping behind the wheel? Explaining mode change of students making the transition to professional life. *Transp. Res. Part A* **2017**, *106*, 181–196. [CrossRef]

64. Oakil, A.T.M.; Ettema, D.; Arentze, T.; Timmermans, H. Bicycle commuting in the Netherlands: An analysis of modal shift and its dependence on life cycle and mobility events. *Int. J. Sustain. Transp.* **2016**, *10*, 376–384. [CrossRef]

65. Scheiner, J. Gendered key events in the life course: Effects on changes in travel mode choice over time. *J. Transp. Geogr.* **2014**, *37*, 47–60. [CrossRef]

66. Scheiner, J. The gendered complexity of daily life: Effects of life-course events on changes in activity entropy and tour complexity over time. *Travel Behav. Soc.* **2014**, *1*, 91–105. [CrossRef]

67. Scheiner, J.; Chatterjee, K.; Heinen, E. Key events and multimodality: A life course approach. *Transp. Res. Part A* **2016**, *91*, 148–165. [CrossRef]

68. Döring, L.; Kroesen, M.; Holz-Rau, C. The role of parents' mobility behavior for dynamics in car availability and commute mode use. *Transportation* **2019**, *46*, 957–994. [CrossRef]

69. Prillwitz, J.; Harms, S.; Lanzendorf, M. Interactions between residential relocations, life course events, and daily commute distances. *Transp. Res. Rec.* **2007**, *2021*, 64–69. [CrossRef]

70. Janke, J.; Handy, S. How life course events trigger changes in bicycling attitudes and behavior: Insights into causality. *Travel Behav. Soc.* **2019**, *16*, 31–41. [CrossRef]

71. Lanzendorf, M. Key events and their effect on mobility biographies: The case of childbirth. *Int. J. Sustain. Transp.* **2010**, *4*, 272–292. [CrossRef]

72. Nakanishi, H.; Black, J.A. Travel habit creation of the elderly and the transition to sustainable transport: Exploratory research based on a retrospective survey. *Int. J. Sustain. Transp.* **2016**, *10*, 604–616. [CrossRef]

73. De Haas, M.C.; Scheepers, C.E.; Harms, L.W.J.; Kroesen, M. Travel pattern transitions: Applying latent transition analysis within the mobility biographies framework. *Transp. Res. Part A* **2018**, *107*, 140–151. [CrossRef]

74. Fatmi, M.R.; Habib, M.A. Life-oriented approach of modeling commute mode loyalty and transition behavior. *Transp. Res. Rec.* **2016**, *2565*, 37–47. [CrossRef]

75. Gao, J.; Kamphuis, C.B.; Ettema, D.; Helbich, M. Longitudinal changes in transport-related and recreational walking: The role of life events. *Transp. Res. Part D* **2019**, *77*, 243–251. [CrossRef]

76. McCarthy, L.; Delbosc, A.; Currie, G.; Molloy, A. 'Transit Faithfuls' or 'Transit Leavers'? Understanding mobility trajectories of new parents. *Transp. Pol.* **2019**, *78*, 105–112. [CrossRef]

77. Scheiner, J. Changes in travel mode use over the life course with partner interactions in couple households. *Transp. Res. Part A* **2020**, *132*, 791–807. [CrossRef]

78. Scheiner, J.; Holz-Rau, C. Changes in travel mode use after residential relocation: A contribution to mobility biographies. *Transportation* **2013**, *40*, 431–458. [CrossRef]

79. Berg, J.; Levin, L.; Abramsson, M.; Hagberg, J.E. Mobility in the transition to retirement—The intertwining of transportation and everyday projects. *J. Transp. Geogr.* **2014**, *38*, 48–54. [CrossRef]

80. Plyushteva, A.; Schwanen, T. Care-related journeys over the life course: Thinking mobility biographies with gender, care and the household. *Geoforum* **2018**, *97*, 131–141. [CrossRef]

81. Barnett, I.; Van Sluijs, E.; Ogilvie, D.; Wareham, N.J. Changes in household, transport and recreational physical activity and television viewing time across the transition to retirement: Longitudinal evidence from the EPIC-Norfolk cohort. *J. Epidemiol. Community Health* **2014**, *68*, 747–753. [CrossRef]

82. Jones, S.A.; Li, Q.; Aiello, A.E.; Angela, M.O.; Evenson, K.R. Correlates of changes in walking during the retirement transition: The multi-ethnic study of atherosclerosis. *Prev. Med. Rep.* **2018**, *11*, 221–230. [CrossRef]

83. Jones, S.A.; Li, Q.; Aiello, A.E.; Angela, M.O.; Evenson, K.R. Physical activity, sedentary behavior, and retirement: The multi-ethnic study of atherosclerosis. *Am. J. Prev. Med.* **2018**, *54*, 786–794. [CrossRef] [PubMed]

84. Kamruzzaman, M.; Yigitcanlar, T.; Washington, S.; Currie, G.; Turrell, G. Australian baby boomers switched to more environment friendly modes of transport during the global financial crisis. *Int. J. Environ. Sci. Technol.* **2014**, *11*, 2133–2144. [CrossRef]

85. Laverty, A.A.; Webb, E.; Vamos, E.P.; Millett, C. Associations of increases in public transport use with physical activity and adiposity in older adults. *Int. J. Behav. Nutr. Phys. Act.* **2018**, *15*, 31. [CrossRef] [PubMed]

86. Siren, A.; Haustein, S. How do baby boomers' mobility patterns change with retirement? *Ageing Soc.* **2016**, *36*, 988–1007. [CrossRef]

87. Slingerland, A.S.; Van Lenthe, F.J.; Jukema, W.; Kamphuis, C.B.; Looman, C.; Giskes, K.; Huisman, M.; Narayan, K.M.; Mackenbach, J.P.; Brug, J. Aging, retirement, and changes in physical activity: Prospective cohort findings from the GLOBE Study. *Am. J. Epidemiol.* **2017**, *165*, 1356–1363. [CrossRef] [PubMed]

88. Sprod, J.; Olds, T.; Brown, W.; Burton, N.; Van Uffelen, J.; Ferrar, K.; Maher, C. Changes in use of time across retirement: A longitudinal study. *Maturitas* **2017**, *100*, 70–76. [CrossRef]

89. Van Dyck, D.; Cardon, G.; De Bourdeaudhuij, I. Longitudinal changes in physical activity and sedentary time in adults around retirement age: What is the moderating role of retirement status, gender and education level? *BMC Public Health* **2016**, *16*, 1125. [CrossRef]

90. Johansson, F.; Henriksson, G.; Envall, P. Moving to private-car-restricted and mobility-served neighborhoods: The unspectacular workings of a progressive mobility plan. *Sustainability* **2019**, *11*, 6208. [CrossRef]

91. Rau, H.; Popp, M.; Namberger, P.; Mögele, M. Short distance, big impact: The effects of intra-city workplace relocation on staff mobility practices. *J. Transp. Geogr.* **2019**, *79*, 102483. [CrossRef]

92. Jones, C.H.D.; Ogilvie, D. Motivations for active commuting: A qualitative investigation of the period of home or work relocation. *Int. J. Behav. Nutr. Phys. Act.* **2012**, *9*, 109. [CrossRef] [PubMed]

93. Zarabi, Z.; Manaugh, K.; Lord, S. The impacts of residential relocation on commute habits: A qualitative perspective on households' mobility behaviors and strategies. *Travel Behav. Soc.* **2019**, *16*, 131–142. [CrossRef]

94. Bamberg, S. Is a residential relocation a good opportunity to change people's travel behavior? Results from a theory-Driven intervention study. *Environ. Behav.* **2006**, *38*, 820–840. [CrossRef]

95. Beenackers, M.A.; Foster, C.; Kamphuis, C.B.M.; Titze, S.; Divitini, M.; Knuiman, M.; Van Lenthe, F.J.; Giles-Corti, B. Taking up cycling after residential relocation: Built environment factors. *Am. J. Prev. Med.* **2012**, *42*, 610–615. [CrossRef] [PubMed]

96. Beige, S.; Axhausen, K.W. The dynamics of commuting over the life course: Swiss experiences. *Transp. Res. Part A* **2017**, *104*, 179–194. [CrossRef]

97. Bhattacharyya, A.; Jin, W.; Le Floch, C.; Chatman, D.G.; Walker, J.L. Nudging people towards more sustainable residential choice decisions: An intervention based on focalism and visualization. *Transportation* **2019**, *46*, 373–393. [CrossRef]

98. Cao, J.; Ermagun, A. Influences of LRT on travel behavior: A retrospective study on movers in Minneapolis. *Urban Stud.* **2017**, *54*, 2504–2520. [CrossRef]

99. Cao, X.; Mokhtarian, P.L.; Handy, S.L. Do changes in neighborhood characteristics lead to changes in travel behavior? A structural equations modeling approach. *Transportation* **2007**, *34*, 535–556. [CrossRef]

100. Dargay, J.; Hanly, M. Volatility of car ownership, commuting mode and time in the UK. *Transp. Res. Part A* **2007**, *41*, 934–948. [CrossRef]

101. Gerber, P.; Ma, T.Y.; Klein, O.; Schiebel, J.; Carpentier-Postel, S. Cross-border residential mobility, quality of life and modal shift: A Luxembourg case study. *Transp. Res. Part A* **2017**, *104*, 238–254. [CrossRef]

102. Haque, M.B.; Choudhury, C.; Hess, S.; Dit Sourd, R.C. Modelling residential mobility decision and its impact on car ownership and travel mode. *Travel Behav. Soc.* **2019**, *17*, 104–119. [CrossRef]

103. Hirsch, J.A.; Diez Roux, A.V.; Moore, K.A.; Evenson, K.R.; Rodriguez, D.A. Change in walking and body mass index following residential relocation: The multi-ethnic study of osteoporosis. *Am. J. Public. Health* **2014**, *104*, e49–e56. [CrossRef] [PubMed]

104. Janke, J.; Thigpen, C.G.; Handy, S. Examining the effect of life course events on modality type and the moderating influence of life stage. *Transportation* **2020**, 1–36. [CrossRef]

105. Klinger, T.; Lanzendorf, M. Moving between mobility cultures: What affects the travel behavior of new residents? *Transportation* **2016**, *104*, 243–271. [CrossRef]

106. Knuiman, M.W.; Christian, H.E.; Divitini, M.L.; Foster, S.A.; Bull, F.C.; Badland, H.M.; Giles-Corti, B. A Longitudinal analysis of the influence of the neighborhood-built environment on walking for transportation: The RESIDE Study. *Am. J. Epidemiol.* **2014**, *180*, 453–461. [CrossRef]

107. Krizek, K.J. Residential relocation and changes in urban travel—Does neighborhood-scale urban form matter? *J. Am. Plann. Assoc.* **2003**, *69*, 265–281. [CrossRef]

108. Kroesen, M. Modeling the behavioral determinants of travel behavior: An application of latent transition analysis. *Transp. Res. Part A* **2014**, *65*, 56–67. [CrossRef]

109. Lin, T.; Wang, D.G.; Zhou, M. Residential relocation and changes in travel behavior: What is the role of social context change? *Transp. Res. Part A* **2018**, *111*, 360–374. [CrossRef]

110. Peer, S. To bike or not to bike?—Evidence from a university relocation. *Transp. Res. Part D* **2019**, *70*, 49–69. [CrossRef]

111. Ralph, K.M.; Brown, A.E. The role of habit and residential location in travel behavior change programs, a field experiment. *Transportation* **2019**, *46*, 719–734. [CrossRef]

112. Smart, M.J.; Klein, N.J. Remembrance of cars and buses past: How prior life experiences influence travel. *J. Plan. Educ. Res.* **2018**, *38*, 139–151. [CrossRef]

113. Soltani, A.; Allan, A.; Nguyen, H.A. Developing a behavioral model for modal shift in commuting. In *Computational Urban Planning and Management for Smart Cities*; Geertman, S., Zhan, Q., Allan, A., Pettit, C., Eds.; Springer: Cham, Switzerland, 2019; pp. 347–371.

114. Von Behren, S.; Puhe, M.; Chlond, B. Office relocation and changes in travel behavior: Capturing the effects including the adaptation phase. *Transp. Res. Proc.* **2018**, *32*, 573–584. [CrossRef]

115. Walker, I.; Thomas, G.O.; Verplanken, B. Old habits die hard: Travel habit formation and decay during an office relocation. *Environ. Behav.* **2015**, *47*, 1089–1106. [CrossRef]

116. Yang, M.; Wu, J.J.; Rasouli, S.; Cirillo, C.; Li, D.W. Exploring the impact of residential relocation on modal shift in commute trips: Evidence from a quasi-longitudinal analysis. *Transp. Policy* **2017**, *59*, 142–152. [CrossRef]

117. Zhao, P.J.; Zhang, Y.X. Travel behaviour and life course: Examining changes in car use after residential relocation in Beijing. *J. Transp. Geogr.* **2018**, *73*, 41–53. [CrossRef]

118. Ajzen, I. The theory of planned behavior. *Org. Behav. Hum. Decis. Process.* **1991**, *50*, 179–211. [CrossRef]

119. Lorenc, T.; Brunton, G.; Oliver, S.; Oliver, K.; Oakley, A. Attitudes to walking and cycling among children, young people and parents: A systematic review. *J. Epidemiol. Community Health* **2008**, *62*, 852–857. [CrossRef]

120. Larouche, R.; Abbott, R. Promoting car driving safety behaviours should not stigmatize cycling as an alternative mode of transportation. *Aust. N. Z. J. Public Health* **2012**, *36*, 193–194. [CrossRef]

121. Clark, H.; Coll-Seck, A.M.; Banerjee, A.; Peterson, S.; Dalglish, S.L.; Ameratunga, S.; Balabanova, D.; Bhan, M.K.; Bhutta, Z.A.; Borrazzo, J.; et al. A future for the world's children? A WHO–UNICEF–Lancet Commission. *Lancet* **2020**, *395*, 605–658. [CrossRef]

122. Molina-García, J.; Queralt, A.; Castillo, I.; Sallis, J.F. Changes in physical activity domains during the transition out of high school: Psychosocial and environmental changes. *J. Phys. Act. Health* **2014**, *12*, 1414–1420. [CrossRef]

123. Bopp, M.; Sims, D.; Colgan, J.; Rovniak, L.; Matthews, S.A.; Poole, E. An examination of workplace influences on active commuting in a sample of university employees. *J. Public Health Manag. Pract.* **2016**, *22*, 387–391. [CrossRef] [PubMed]

124. Hamre, A.; Buehler, R. Commuter mode choice and free car parking, public transportation benefits, showers/lockers, and bike parking at work: Evidence from the Washington, DC region. *J. Public Transp.* **2014**, *17*, 4. [CrossRef]

125. Petrunoff, N.; Rissel, C.; Wen, L.M.; Martin, J. Carrots and sticks vs carrots: Comparing approaches to workplace travel plans using disincentives for driving and incentives for active travel. *J. Transp. Health* **2015**, *2*, 563–567. [CrossRef]

126. Giles-Corti, B.; Vernez-Moudon, A.; Reis, R.; Turrell, G.; Dannenberg, A.L.; Badland, H.; Foster, S.; Lowe, M.; Sallis, J.F.; Stevenson, M.; et al. City planning and population health: A global challenge. *Lancet* **2016**, *388*, 2912–2924. [CrossRef]

127. Sallis, J.F.; Cerin, E.; Conway, T.L.; Adams, M.A.; Frank, L.D.; Pratt, M.; Salvo, D.; Schipperijn, J.; Smith, G.; Cain, K.L.; et al. Physical activity in relation to urban environments in 14 cities worldwide: A cross-sectional study. *Lancet* **2016**, *387*, 2207–2217. [CrossRef]

128. Stevenson, M.; Thompson, J.; De Sá, T.H.; Ewing, R.; Mohan, D.; McClure, R.; Roberts, I.; Tiwari, G.; Giles-Corti, B.; Sun, X.; et al. Land use, transport, and population health: Estimating the health benefits of compact cities. *Lancet* **2016**, *388*, 2925–2935. [CrossRef]

129. Larouche, R.; Oyeyemi, A.L.; Prista, A.; Onywera, V.; Akinroye, K.K.; Tremblay, M.S. A systematic review of active transportation research in Africa and the psychometric properties of measurement tools for children and youth. *Int. J. Behav. Nutr. Phys. Act.* **2014**, *11*, 129. [CrossRef]

130. Broyles, S.T.; Denstel, K.D.; Church, T.S.; Chaput, J.P.; Fogelholm, M.; Hu, G.; Kuriyan, R.; Kurpad, A.; Lambert, E.V.; Maher, C.; et al. The epidemiological transition and the global childhood obesity epidemic. *Int. J. Obes. Suppl.* **2015**, *5*, S3–S8. [CrossRef]

131. Katzmarzyk, P.T.; Mason, C. The physical activity transition. *J. Phys. Act. Health* **2009**, *6*, 269–280. [CrossRef]

132. Oyeyemi, A.L.; Larouche, R. Prevalence and correlates of active transportation in developing countries. In *Children's Active Transportation*; Larouche, R., Ed.; Elsevier: Cambridge, MA, USA, 2018; pp. 173–191.

133. Yang, Y.; Hong, X.; Gurney, J.G.; Wang, Y. Active travel to and from school among school-aged children during 1997–2011 and associated factors in China. *J. Phys. Act. Health* **2017**, *14*, 684–691. [CrossRef]