

Health benefits of the HIKO e-bike programme: a qualitative study

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ABSTRACT

AIMS: This paper aims to explore the relationship between e-biking and health in the context of a novel, marae-led e-biking programme for Māori and Pacific adults in a suburban community.

METHODS: Focus groups were conducted with participants in an e-biking programme (n=20) prior to receiving e-bikes, and individual interviews were conducted with participants at approximately 6 months (n=23) and 12 months (n=22).

RESULTS: Wanting to improve health was a motivation for trying e-biking. E-biking supported better physical and mental health, including self-reported improvement in a range of long-term conditions. E-biking was often possible and enjoyable for people who experienced barriers to physical activity, although poor health could also act as a barrier to e-biking. Factors that supported ongoing e-biking included having someone to ride with, the enjoyable nature of e-biking, and integrating e-biking for active travel.

CONCLUSIONS: This study suggests that e-biking is possible and beneficial for a wide range of people who do not currently cycle. Recommendations from individual health practitioners are likely to be important alongside community and population level interventions to support the uptake of cycling. Practice points to support individual health practitioners to discuss e-biking are provided.

Increasing physical activity (PA) is one of the most effective approaches to improve population health. Higher levels of PA are associated with a wide range of positive outcomes for both physical and mental health. These outcomes include a range of cancers, cardiovascular disease, diabetes, osteoarthritis and depression.¹⁻³ PA not only reduces disease incidence and mortality, but also improves quality of life (for example, through reductions in pain and severity of depressive symptoms).¹

There has been a range of approaches to increasing PA over recent decades (e.g., through policy frameworks such as Healthy Eating – Healthy Action, through the establishment of organisational infrastructure such as Healthy Families NZ, through Sport New Zealand), and increasing PA remains a priority of the current government.⁴ Despite this, population PA has consistently declined. New Zealand Health Survey data show that in 2011/2012 54.4% of adults had sufficient levels of PA, however by 2023/2024 this had reduced to 46.6%,⁵ and Ministry of Health – Manatū Hauora officials expect this to decrease further.⁶ Due to the dose-response association between PA and health, even those considered to have sufficient levels of PA in the New Zealand Health Survey definition would still experience health benefits from becoming more active.^{2,3}

Cycling, particularly for transport (e.g., to work,

to shops), has significant potential to increase population PA.⁷ Most people travel every day, and the way people travel tends to be highly habituated, meaning change may be more sustainable than more effortful forms of PA such as going to the gym or playing sport. Moreover, transport-related PA does not displace other forms of PA, thus increasing total PA.⁸ Cycling for transport is currently uncommon in Aotearoa New Zealand, although historically that has not been the case.⁹ The barriers to cycling, particularly for transport, are well understood.¹⁰ Furthermore, these barriers are amenable to policy interventions, as evidenced by multiple examples of increases in cycling globally in recent years.¹¹

Given the topography, weather and (lack of) urban density of Aotearoa New Zealand, e-bikes are likely to be required to substantially increase population levels of cycling. In terms of individual health benefits, a recent systematic review found that e-bikes provide moderate PA similar to activities such as recreational lap swimming and slow running.^{12,13} There is also evidence that people ride for longer distances on e-bikes than on regular bikes.¹⁴ As well as direct health benefits to individuals,¹⁵ there other potential social, economic and health benefits from higher levels of cycling (both electric and non-electric) in the community. These include reductions in air pollution, overall (net) burden of transport-related injury,

greenhouse gas emissions, travel time, car ownership and costs of road maintenance.¹⁶⁻¹⁹

Despite the potential health benefits there is limited qualitative research on how people experience e-bikes from a health perspective. The international research has mainly been in specific patient groups, for example diabetics, women being treated for breast cancer, people who are physically inactive and people with high BMI.²⁰⁻²³ By and large these small studies all suggest e-biking could have a role in supporting people who may find it challenging to be physically active. For example, women being treated for breast cancer considered e-biking an acceptable and enjoyable form of activity. E-biking overcame health related barriers such as fatigue from treatment as well as the more traditional cycling barriers that e-bikes overcome (e.g., feeling safer in traffic because of the speed of e-bikes).²³ McVicar et al. recruited participants who were physically inactive and had a BMI between 28 and 38. They found that participants cycled an average 50km a week on their loaned e-bikes and noted improvements in physiological markers such as diastolic blood pressure.²²

There is a small body of literature from Aotearoa New Zealand about e-bikes, which have focussed mainly on how e-bikes could support cycling in groups with traditionally lower levels of cycling.^{24,25} Neither of these papers specifically considered health, although participants in one of these studies (an e-bike loan pilot project in Māngere, South Auckland) highlighted the mental and physical health benefits of their riding.

The purpose of this paper is to explore the effects of e-biking on physical and mental health in an e-bike pilot programme in a Māori community. This work is part of research component of an e-bike pilot programme that ran in 2023/2024.²⁶ While another paper covers the outcomes of the programme more generally,²⁷ this one specifically focusses on physical and mental health.

Methods

HIKO is an e-bike support programme in Wainuiomata, Wellington Region, which is operated by a marae-led Māori health and social service provider. HIKO participants were recruited through the networks of this organisation. The programme co-ordinator identified potential participants who were likely to make use of and benefit from e-biking. Participants were not recruited in their role as patients and nor

were they recruited for specific health conditions. Ethical approval was granted by the University of Otago Human Ethics Committee (22/127).

HIKO participant inclusion criteria were:

- Māori or Pacific peoples
- Aged 16+
- Living in Wainuiomata
- Having a secure place to store an e-bike
- Not currently cycling on a regular basis

An exclusion criterion was having a health condition that would prevent a participant from cycling safely.

Participants were given the long-term loan of an e-bike and wrap-around support for riding, including cycling skills training, mechanical support and equipment for safe e-biking (helmet, pannier, lock, high-visibility gear and, where requested, a handlebar mirror). Focus groups were conducted with HIKO participants prior to their receiving e-bikes, then participants were interviewed individually at approximately 6 months and 12 months. Focus groups were conducted in person at two marae and began with mihimihi and whakawhanaungatanga (welcome and relationship building). Focus groups concluded with kai (food) to take away (a modified approach due to COVID-19 considerations). The audio recorded portion of the focus groups took between 36 and 47 minutes. Interviews were conducted both in person and by phone, according to participants' preferences and availability. Interviews lasted between 17 and 58 minutes. All authors were involved in facilitating the focus groups (with 2-3 facilitators for each group), and the first author conducted the 6- and 12-month interviews.

Focus groups explored current travel patterns, perceptions and past experiences of cycling, and anticipated e-bike use, barriers and benefits of e-biking. Interviews explored experiences of e-biking, barriers, benefits and facilitators of e-bike use, and perceptions of the HIKO programme (full focus group and interview guides available in Osborne et al.²⁶). While the HIKO programme is ongoing, this study focusses on the first 12 months of its operation. All participants in the first 12 months of the HIKO programme were invited to participate in this research, and all participants took part in at least one interview or focus group.

We analysed the data using a qualitative, pragmatist approach.²⁸ The first author coded the overall dataset using an inductive approach, with all three authors meeting regularly to discuss the

analysis. For this paper, we identified participants' accounts of the relationship between biking and physical/mental health as an area of interest then selectively revisited and described parts of the dataset relating to these topics of health. We have presented these findings using intervention-oriented thematic sentences,²⁹ with a view to framing the participants' accounts of the relationship between e-biking and health in ways that may be usable in health professional practice.

Results

Participants

Of the 26 HIKO participants, 20 participated in the focus groups, 23 in the 6-month interviews and 22 in the 12-month interviews. Participants ranged in age from 16–69, 36% were men and 64% women. All participants identified as either Māori (90%) and/or Pacific peoples (19%), with 19% of participants also identifying as New Zealand European and 5% as Chinese (some participants identified multiple ethnicities).

Anticipated health gains motivated people to try e-biking

Wanting to improve health was a major motivation for trying e-biking. Several participants described the programme co-ordinator who recruited them to take part in HIKO as being familiar with their personal health goals (e.g., quitting smoking, weight loss, being more active) and challenges (e.g., pain, depression, limited mobility). This relational approach, which centred participants' goals in the recruitment process, was important for participants' openness to considering an unfamiliar activity such as e-biking as potentially being a good fit for their health needs: *“to get motivated like I did, yeah, and to lose weight ... [project co-ordinator] is amazing, you know, always thinking about the whānau ... even to offer us to be part of the research. I was really blown away when she said to me, would you like an e-bike?”* (Participant 8). Many participants commented that they had not cycled for many years and had no prior experience with e-bikes either personally or through friends/whānau. Other participants had biked occasionally, particularly through occasional recreational rides with children.

Prior to receiving the e-bikes, participants anticipated that e-biking could contribute to better overall physical and mental wellbeing and could support specific health goals, including motivating

quitting smoking: *“I’m hoping the biking will just give me enough of a cough attack to want to stop”* (Focus group 2), or losing weight: *“I’d like to lose some weight and yeah, better quality of life”* (Focus group 1). They also viewed e-biking as potentially being a way of staying active in middle and older age: *“knees are just about shot, so this is some ways to keep that momentum going without thrashing your body too much”* (Focus group 3). Several participants described e-biking as an activity which would not aggravate *“old age injuries”*, particularly hip, back and knee pain, in the way that some higher-impact activities did. One participant anticipated that e-biking could mitigate incontinence as a barrier to being active (less stress on bladder compared to walking, being able to get to a toilet more quickly). Other anticipated health benefits of e-biking were role modelling a healthy and physically active lifestyle for whānau: *“For Māori and Pasifika ... we’re role modelling for our kids, our tamariki and our mokopuna”* (Focus group 1).

E-biking had a wide range of health benefits

In follow up interviews at 6 and 12 months, participants described e-biking as leading to better mental and physical health both overall and in relation to a range of chronic health conditions: *“There’s been so many other wins with getting out and being active ... the weight loss and my diabetes, my gout. Being able to manage my health”* (Participant 15). This description of e-biking as contributing to multiple health outcomes including ability to make further changes to take care of one's health is characteristic of the way many participants described e-biking. Participants often characterised the mental health benefits of being active and being outdoors as particularly significant: *“It’s just where you have a moment in time where you are not thinking about work, not thinking about problems of the world ... obviously you get the physical benefits but ... it’s what it does for me mentally”* (Participant 6). Across all participants, self-reported improvements in health included mental health/depression, joint pain/osteoarthritis (particularly hip and knee pain), type 2 diabetes, gout, hypertension, insomnia, perimenopause and asthma and other respiratory conditions. These self-reported improvements in these chronic conditions are consistent with established benefits of increasing levels of moderate PA.^{1,30–32} Participants also described e-biking as supporting other aspects of a healthy lifestyle, including weight

loss or maintaining a stable weight, providing an incentive to make dietary changes and building fitness to engage in more vigorous PA. Several participants described e-biking as part of their planned or successfully implemented strategy for quitting smoking: *“I gave up smoking without putting on weight ... [e-biking has] introduced a healthier lifestyle and a way to get rid of your cravings ... instead of chocolate or lollies or food”* (Participant 12). Participants described e-biking as supporting smoking cessation through several mechanisms: displacing cravings, disincentivising smoking as it made cycling harder, and as a way of not gaining weight while quitting.

E-biking was possible and enjoyable for people who experienced barriers to being active

Several HIKO participants who experienced health- or weight-related barriers to being active described e-biking as an achievable and enjoyable form of PA. E-biking was described as well-suited to the needs of older riders, “bigger” riders and people with chronic conditions, especially joint pain: *“I’m an old lady, so if I can do it anyone can do it, and it’s good for my arthritis”* (Participant 12). A number of participants recounted times earlier in their lives where they had been very active, but had stopped after injuries or illnesses, which had led to weight gain, which made it harder to resume being active: *“I did use to ride [a non-electric bicycle] to work ... but then I did my Achilles in and then that was the end of it. I just got bigger and bigger and bigger and decided then I wasn’t going to cycle because I was too big”* (Participant 25).

As a manageable form of PA, e-biking disrupted this “vicious circle”³³ of barriers to being active: *“I’m sort of, like, a bit of a big unit so, walking up the hill is a bit of a, it’s more of a challenge for me, and the bike has made it a lot easier”* (Participant 18). While participants described e-bikes as overcoming physical barriers, some participants experienced whakamā (shame, embarrassment) associated with exercising in public as a bigger person. However, having a group in the same community riding together helped to reduce whakamā as a barrier to riding.

The HIKO e-bikes were set up to meet the needs of diverse riders. Step-through frames and handlebar mirrors made bicycle handling easier, which supported participants’ confidence in cycling. In response to participant feedback during the early stages of the programme, mirrors were sourced

for the e-bikes. Mirrors made the experience of cycling more like driving: *“you could see the traffic behind you in the mirror. You could see as if you were driving a car”* (Participant 9). These features were especially useful for participants who had a limited range of motion or impaired balance. One of the models of e-bike included in HIKO was selected for having a higher rider weight limit, and participants were provided with comfortable saddles as a default option. The HIKO programme also included training for participants through an accredited provider, which included techniques for easier bike handling.

Health could occasionally be a barrier to e-biking

Poor health or (non-cycling related) injuries were also a barrier to e-biking for some participants. Two participants stopped riding because of events (stroke, injuries from a fall) which impacted their balance and grip, and thus their ability to ride safely. Other participants described respiratory illnesses, combined with environmental triggers such as cold weather or air pollution, as barriers to cycling: *“I hated riding a bike during peak hour because of the car fumes. They wreak bloody havoc on the asthma”* (Participant 6). One participant described a range of symptoms associated with menopause as a barrier to riding, including heavy bleeding and increased sensitivity to cold weather. Other than long-term respiratory conditions, the health conditions that prevented participants from riding were largely unexpected, emergent issues over the e-bike loan period. In addition to personal illness, some participants also described caregiving commitments as a barrier to e-biking as much as they wished: *“I’m a full-time caregiver for my sister who has Alzheimer’s. So, if I do go out, I usually have to take her in the car but if I don’t have to take her then definitely, I’d opt for the bike”* (Participant 25). However, participants with caregiving responsibilities also described the riding they were able to do as particularly restorative and as an important break from caregiving work.

E-biking was fun, social and sometimes practical, which supported continuing to be active

Maintaining consistent levels of PA is challenging; however, people are more likely to persist with activities which are enjoyable and supported by others.³⁴ Incidental PA through active travel also supports overall levels of PA.⁸ As in other qualitative studies examining enjoyment of e-biking,^{35,36}

participants described e-biking as enjoyable because it could be done with others, was outside, was moderately but not overly challenging and it facilitated adventures in participants' communities. Some participants compared e-biking favourably with other low-impact activities such as aqua-jogging or using a stationary bike, which were seen as less interesting and therefore harder to sustain: *"I don't want to sit in a gym ... I don't want to walk on a treadmill. I need something that's going to be interesting ... How can you get bored when every bike ride is different?"* (Participant 2).

For many participants, having someone to ride with recreationally was an important aspect of persisting with e-biking. Some participants established regular social e-biking groups, and others e-biked regularly with a friend or whānau member. E-biking meant that people with different levels of fitness or ability could ride together comfortably at the same pace by using different levels of assistance: *"It didn't matter what your fitness levels were, if you knew how to ride your bike and you used the right power level we could stay together"* (Participant 9). This inclusive approach of people with different skills being able to ride together was consistent with participants' values: *"forming a rōpū [group] that is all about manaaki [care], all about non-judgemental stuff"* (Participant 6). This emphasis on supportive social connections, manaakitanga and whānau is consistent with existing literature on preferred ways of being physically active (including cycling) for Māori and Pacific peoples.^{34,37,38} Participants also e-biked with others (especially children) who were using non-electric bikes or scooters. Having someone else to ride with (friend, family or riding group) helped to maintain motivation for e-biking over the year. Conversely, a few participants who stopped e-biking during the year commented that not having someone to ride with was a barrier to e-biking.

Participants who used their e-bikes for transport cycling (e.g., commuting, running errands, visiting friends and family) appreciated integrating incidental PA into their daily routines: *"You don't have to find extra time and you get a bit of mental health in there. You get a bit of physical health in there and you're getting to work"* (Participant 21).

Discussion

Summary of findings

We have described participants' accounts of the relationships between health and e-biking in

the HIKO programme. Seeking to improve one's health was a key motivation for initially trying e-biking, and participants described a range of ways their physical and mental health had improved as a result of e-biking in the 6- and 12-month interviews. These benefits included improved mental wellbeing, managing long-term conditions, reducing pain and supporting smoking cessation. E-biking was generally an accessible and enjoyable form of PA for people who experienced health-related barriers to exercising, and e-bikes could be set up to accommodate different individual requirements. However, some participants also found that poor health, particularly unexpected illness or injuries, could be a barrier to e-biking. Participants who continued to e-bike throughout the year identified a combination of enjoyment, social connections and utility of e-biking for short trips as factors that supported them to persist with a new activity.

Implications for policy and practice

Encouraging e-biking has promise as an effective and sustainable way to increase PA and harness associated health and wider economic and social benefits for individuals and wider society.^{16,17,39} Health professionals are likely to have an important role in recommending e-biking for their individual patients: people in this study were willing to take up e-biking when it was suggested as suitable for their personal situation by someone who was familiar with their health needs. We have included practice points below (based on the results of this study and/or other literature) for health professionals when thinking about advising people on e-biking for PA.

Individual health professional recommendation alone will not achieve the higher levels of uptake and use of e-bikes (and bikes) needed to increase population PA.^{7,43-45} Policy is needed in two key areas to support uptake and use of e-bikes. This would include, firstly, addressing the lack of safe infrastructure to cycle on and, secondly, targeted e-bike support packages. Networks of high quality, safe infrastructure (a combination of cycle paths and low traffic neighbourhoods) have been shown to increase cycling and walking in urban areas.^{46,47} E-bike support packages would aim to increase low-cost access to e-bikes (e.g., through loans, subsidies, etc.) and provide additional support such as training, mechanical support and group rides. This more holistic support was essential to the success of both HIKO and a pilot in South Auckland,^{25,26} recognising that in low-income, low-

Table 1: Practice points for health professionals advising individual patients.

<p>Who could benefit from e-biking?</p> <ul style="list-style-type: none"> • E-biking is both possible and enjoyable for people who would not be willing to ride a non-electric bike.²⁵ • E-biking provides moderate physical activity.¹² • E-biking is associated with a range of self-reported improvements in physical and mental health and wellbeing, consistent with the literature on increasing physical activity. • E-biking may be especially well suited to the needs of people with long term conditions, including joint pain.^{15,21,23} • The electrical assistance can also enable bigger people to ride comfortably.^{15,20,22} • E-biking is suitable for and enjoyed by older people.^{22,40,41}
<p>What do people need to take up and maintain e-biking?</p> <ul style="list-style-type: none"> • Social support: for many people, having someone to ride with is important. This could be achieved by riding with a family member or a social cycling group. The electrical assistance provided by e-bikes means that people with lower levels of fitness can cycle at the same pace as friends and family members. • E-bike selection and set-up: e-bikes have different frame shapes and sizes, and they can be customised to meet individual needs (e.g., fitting mirrors or changing contact points such as pedals, seats and grips). • Cycle skills training: bike-handling and on-road-skills training may be useful for people who wish to start cycling. Accredited cycle-skills training is available across the country, often at no cost.⁴²

cycling communities there are multiple barriers to cycling. This kind of support package should be targeted towards those who would benefit most, for example through green prescriptions and community service card users.

Conclusion

For participants in the HIKO e-bike programme, improving health and modelling healthy behaviours for whānau were motivators to consider and initiate an unfamiliar activity. Once

started, the subjective health benefits in a wide range of conditions were a motivator to continue. Moreover, e-biking was suitable for individuals who would not consider non-electric cycling and who had physical health issues that prevented other forms of PA. The role of trusted leaders (e.g., health professionals) in suggesting e-biking as a suitable form of PA was important. However, to improve PA on a larger scale, individual recommendations by health professionals would need to be accompanied by policy and infrastructure to support cycling.

COMPETING INTERESTS

The NZ Transport Agency Waka Kotahi funded this research project (TAR21-12). The results of this work do not reflect the views of the NZ Transport Agency Waka Kotahi.

ACKNOWLEDGEMENTS

The authors would like to thank the HIKO whānau (participants) and wider HIKO team for their involvement in this research project.

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<https://nzmj.org.nz/journal/vol-139-no-1630/health-benefits-of-the-hiko-e-bike-programme-a-qualitative-study>

CITATION

Osborne E, Davies C, Shaw C. Health benefits of the HIKO e-bike programme: a qualitative study. *N Z Med J.* 2026 Feb 27;139(1630):13-21. doi: 10.26635/6965.7008.

REFERENCES

1. Posadzki P, Pieper D, Bajpai R, et al. Exercise/physical activity and health outcomes: an overview of Cochrane systematic reviews. *BMC Public Health.* 2020 Nov 16;20(1):1724. doi: 10.1186/s12889-020-09855-3.
2. Garcia L, Pearce M, Abbas A, et al. Non-occupational physical activity and risk of cardiovascular disease, cancer and mortality outcomes: a dose-response meta-analysis of large prospective studies. *Br J Sports Med.* 2023 Aug;57(15):979-989. doi: 10.1136/bjsports-2022-105669.
3. Pearce M, Garcia L, Abbas A, et al. Association Between Physical Activity and Risk of Depression: A Systematic Review and Meta-analysis. *JAMA Psychiatry.* 2022 Jun 1;79(6):550-559. doi: 10.1001/jamapsychiatry.2022.0609.
4. Minister of Health. Government Policy Statement on Health 2024–2027 [Internet]. Wellington, New Zealand: Ministry of Health – Manatū Hauora; 2024 Jun 30 [cited 2025 Apr 8]. Available from: <https://www.health.govt.nz/publications/government-policy-statement-on-health-2024-2027>.
5. Ministry of Health – Manatū Hauora. New Zealand Health Survey: Annual Data Explorer [Internet]. Wellington, New Zealand: Ministry of Health – Manatū Hauora; 2023 [cited 2024 Aug 16]. Available from: <https://www.health.govt.nz/publications/annual-update-of-key-results-202324-new-zealand-health-survey>.
6. Old A. Briefing: Introduction to nutrition and physical activity [Internet]. Wellington, New Zealand: Ministry of Health – Manatū Hauora; 2024 [cited 2024 Nov 13]. Available from: <https://www.health.govt.nz/system/files/2024-08/h2024036866-briefing-introduction-to-nutrition-and-physical-activity.pdf>.
7. Zukowska J, Gobis A, Krajewski P, et al. Which transport policies increase physical activity of the whole of society? A systematic review. *J Transp Health.* 2022 Sep;27:101488. doi:10.1016/j.jth.2022.101488.
8. Wanjau MN, Dalugoda Y, Oberai M, et al. Does active transport displace other physical activity? A systematic review of the evidence. *J Transp Health.* 2023 Jul;31:101631. doi: 10.1016/j.jth.2023.101631.
9. Shaw C, Russell M, van Sparrentak K, et al. Benchmarking cycling and walking in six New Zealand cities: Pilot study 2015 [Internet]. Wellington, New Zealand: New Zealand Centre for Sustainable Cities; 2016 [cited 2024 May 20]. Available from: https://rcaforum.org.nz/sites/public_files/images/Benchmarking-cycling-and-walking-in-six-NZ-cities.pdf.
10. Logan G, Somers C, Baker G, et al. Benefits, risks, barriers, and facilitators to cycling: a narrative review. *Front Sports Act Living.* 2023 Sep 19;5:1168357. doi: 10.3389/fspor.2023.1168357.
11. Buehler R, Pucher J. COVID-19 and cycling: a review of the literature on changes in cycling levels and government policies from 2019 to 2022. *Transport Reviews.* 2023 Apr;44(2):299-344. doi: 10.1080/01441647.2023.2205178.
12. McVicar J, Keske MA, Daryabeygi-Khotbehsara R, et al. Systematic review and meta-analysis evaluating the effects electric bikes have on physiological parameters. *Scand J Med Sci Sports.* 2022 Jul;32(7):1076-1088. doi: 10.1111/sms.14155.
13. Herrmann SD, Willis EA, Ainsworth BE, et al. 2024 Adult Compendium of Physical Activities: A third update of the energy costs of human activities. *J Sport Health Sci.* 2024 Jan;13(1):6-12. doi: 10.1016/j.jshs.2023.10.010.
14. Bourne JE, Cooper AR, Kelly P, et al. The impact of

- e-cycling on travel behaviour: A scoping review. *J Transp Health*. 2020 Dec;19:100910. doi: 10.1016/j.jth.2020.100910.
15. Bini R, Collins B, Hunter J, et al. Associations between e-bike travel distance and changes in health. *J Transp Health*. 2024 Nov;39(S1):101925. doi: 10.1016/j.jth.2024.101925.
 16. Ding D, Luo M, Infante MFP, et al. The co-benefits of active travel interventions beyond physical activity: a systematic review. *Lancet Planet Health*. 2024 Oct;8(10):e790-e803. doi: 10.1016/S2542-5196(24)00201-8.
 17. Shaw C, Mizdrak A, Gage R, et al. Policy approaches to decarbonising the transport sector in Aotearoa New Zealand: modelling equity, population health, and health-system effects. *Lancet Planet Health*. 2024 Sep;8(9):e647-e656. doi: 10.1016/S2542-5196(24)00171-2.
 18. Aldred R, Goodman A. Low traffic neighbourhoods, car use, and active travel: evidence from the people and places survey of outer London active travel interventions. *Findings*. 2020 Sep. doi: 10.32866/001c.17128.
 19. Te Manatū Waka Ministry of Transport. Domestic Transport Costs and Charges (DTCC) Study – Health impacts of active transport, Working Paper D3 [Internet]. Wellington, New Zealand: Te Manatū Waka Ministry of Transport; 2023 Jun [cited 2024 Nov 20]. Available from: <https://www.transport.govt.nz/assets/Uploads/DTCC-WP-D3-Health-Impacts-of-Active-Transport-June-2023.pdf>.
 20. Anderson CC, Clarkson DE, Howie VA, et al. Health and well-being benefits of e-bike commuting for inactive, overweight people living in regional Australia. *Health Promot J Austr*. 2022 Oct;33 Suppl 1(Suppl 1):349-357. doi: 10.1002/hpja.590.
 21. Bourne JE, Leary S, England C, Searle A. "I felt marvellous e-cycling. If I had long hair I would have flicked it": a qualitative investigation of the factors associated with e-cycling engagement among adults with type 2 diabetes. *Front Sports Act Living*. 2023 Sep 29;5:1150724. doi: 10.3389/fspor.2023.1150724.
 22. McVicar J, Keske MA, O'Riordan SF, et al. Exploring the feasibility of a 6-week electric-bike intervention with behavioural support in Australia. *J Transp Health*. 2023 Nov;33:101706. doi: 10.1016/j.jth.2023.101706.
 23. Way KM, Bourne JE, Armstrong MEG. "I'm Hooked on e-cycling, I Can Finally Be Active Again": Perceptions of e-cycling as a Physical Activity Intervention during Breast Cancer Treatment. *Int J Environ Res Public Health*. 2023;20(6):5197. doi: 10.3390/ijerph20065197.
 24. Wild K, Woodward A, Shaw C. Gender and the E-bike: exploring the role of electric bikes in increasing Women's access to cycling and physical activity. *Active Travel Studies*. 2021;1(1). doi: 10.16997/ats.991.
 25. Witten K, Opit S, Mackie H, Raja A. Challenging the inequities of ebike access: An investigation of a community-led intervention in a lower-income neighbourhood in Aotearoa-New Zealand. *J Transp Health*. 2024;39:101891. doi: 10.1016/j.jth.2024.101891.
 26. Osborne E, Davies C, Keall M, Shaw C. E-bike support schemes and transport equity [Internet]. Wellington, New Zealand: NZ Transport Agency Waka Kotahi; 2025 Mar [cited 2025 Apr 8]. Available from: <https://nzta.govt.nz/assets/resources/research/reports/732/732-e-bike-support-schemes-and-transport-equity.pdf>.
 27. Osborne E, Davies C, Raerino K, Shaw C. "It's good for the community to see real people like them on the bike": Exploring e-bike support in Aotearoa New Zealand. *J Transp Health*. 2025 Aug 3;43:102061. doi: 10.1016/j.jth.2025.102061.
 28. Allemang B, Sitter K, Dimitropoulos G. Pragmatism as a paradigm for patient-oriented research. *Health Expect*. 2022 Feb;25(1):38-47. doi: 10.1111/hex.13384.
 29. Sandelowski M, Leeman J. Writing usable qualitative health research findings. *Qual Health Res*. 2012 Oct;22(10):1404-13. doi: 10.1177/1049732312450368.
 30. Kanaley JA, Colberg SR, Corcoran MH, et al. Exercise/Physical Activity in Individuals with Type 2 Diabetes: A Consensus Statement from the American College of Sports Medicine. *Med Sci Sports Exerc*. 2022 Feb 1;54(2):353-368. doi: 10.1249/MSS.0000000000002800.
 31. Jablonski K, Young NA, Henry C, et al. Physical activity prevents acute inflammation in a gout model by downregulation of TLR2 on circulating neutrophils as well as inhibition of serum CXCL1 and is associated with decreased pain and inflammation in gout patients. *PLoS One*. 2020 Oct 1;15(10):e0237520. doi: 10.1371/journal.pone.0237520.
 32. Godoy-Izquierdo D, de Teresa C, Mendoza N. Exercise for peri- and postmenopausal women: Recommendations from synergistic alliances of women's medicine and health psychology for the promotion of an active lifestyle. *Maturitas*. 2024 Jul;185:107924. doi: 10.1016/j.maturitas.2024.107924.
 33. Holmgren M, Sandberg M, Ahlström G. The complexity of reaching and maintaining a healthy

- body weight - the experience from adults with a mobility disability. *BMC Obes.* 2018 Dec 3;5:33. doi: 10.1186/s40608-018-0212-6.
34. Warbrick I, Wilson D, Boulton A. Provider, father, and bro--Sedentary Māori men and their thoughts on physical activity. *Int J Equity Health.* 2016 Feb 4;15:22. doi: 10.1186/s12939-016-0313-0.
35. Spencer B, Jones T, Leyland L-A, et al. 'Instead of "closing down" at our ages... we're thinking of exciting and challenging things to do': Older people's microadventures outdoors on (e-) bikes. *J Adventure Educ Outdoor Learn.* 2019;19(2):124-139. doi: 10.1080/14729679.2018.1558080.
36. Wild K, Woodward A. Why are cyclists the happiest commuters? Health, pleasure and the e-bike. *J Transp Health.* 2019 Sep;14:100569. doi: 10.1016/j.jth.2019.05.008.
37. Jones R, Kidd B, Wild K, Woodward A. Cycling amongst Māori: Patterns, influences and opportunities. *N Z Geogr.* 2020;76(3):182-93. doi: 10.1111/nzg.12280.
38. Thorne R, Fanueli E, Wild K, et al. 'Everyone rides together, everyone rolls together': exploring walking and cycling cultures in South Auckland. *Mobilities.* 2023 Dec;19(3):1-17. doi: 10.1080/17450101.2023.2289441.
39. McQueen M, MacArthur J, Cherry C. The E-Bike Potential: Estimating regional e-bike impacts on greenhouse gas emissions. *Transp Res Part D Transp Environ.* 2020 Oct;87:102482. doi: 10.1016/j.trd.2020.102482.
40. Leger SJ, Dean JL, Edge S, Casello JM. "If I had a regular bicycle, I wouldn't be out riding anymore": Perspectives on the potential of e-bikes to support active living and independent mobility among older adults in Waterloo, Canada. *Transp Res Part A Policy Pract.* 2019;123(C):240-254. doi: 10.1016/j.tra.2018.10.009.
41. Van Cauwenberg J, De Bourdeaudhuij I, Clarys P, de Geus B, Deforche B. E-bikes among older adults: benefits, disadvantages, usage and crash characteristics. *Transportation.* 2019 Dec;46(6):2151-2172. doi: 10.1007/s11116-018-9919-y.
42. NZ Transport Agency Waka Kotahi. Cycle skills training courses: what's involved 2023 [Internet]. Wellington, New Zealand: NZ Transport Agency Waka Kotahi; 2024 [cited 2024 Mar 22]. Available from: <https://www.bikeready.govt.nz/adults/cycle-skills-training-opportunities/cycle-skills-training-courses-whats-involved/>.
43. Roaf E, Larrington-Spencer H, Lawlor ER. Interventions to increase active travel: A systematic review. *J Transp Health.* 2024 Sep;38(9):101860. doi: 10.1016/j.jth.2024.101860.
44. Xiao C, Sluijs EV, Oglivie D, et al. Shifting towards healthier transport: carrots or sticks? Systematic review and meta-analysis of population-level interventions. *Lancet Planet Health.* 2022 Nov;6(11):e858-e869. doi: 10.1016/S2542-5196(22)00220-0.
45. Dođru OC, Webb TL, Norman P. What is the best way to promote cycling? A systematic review and meta-analysis. *Transp Res Part F Traffic Psychol Behav.* 2021 Jun;81(9):144-157. doi: 10.1016/j.trf.2021.06.002.
46. Aldred R, Goodman A, Woodcock J. Impacts of active travel interventions on travel behaviour and health: Results from a five-year longitudinal travel survey in Outer London. *J Transp Health.* 2024;35. doi: 10.1016/j.jth.2024.101771.
47. Mueller N, Rojas-Rueda D, Salmon M, et al. Health impact assessment of cycling network expansions in European cities. *Prev Med.* 2018 Apr;109:62-70. doi: 10.1016/j.ypmed.2017.12.011.