Piggiga Pendlare: conditions for increased use of winter tires on bicycles

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As Europe pushes for more sustainable and active transportation, cycling emerges as a viable solution to address public health, traffic congestion, and environmental concerns. However, winter months see a decline in cycling participation in Nordic countries, primarily due to the associated discomforts and risks of cycling on icy/snowy roads. In Sweden, falls due to slippery conditions account for a significant portion of cycling-related injuries.

One potential solution is the use of winter bicycle tires, designed to provide better traction in these conditions. Despite their proven benefits, the adoption rate of these tires remains low, attributed to factors like cost, availability, and lack of awareness.

This report compiles findings from various stakeholders in Sweden, including municipalities, transport agencies, and cycling organisations, to understand the landscape of winter tire usage. Surveys and focus group discussions reveal barriers to adoption and potential strategies to promote winter tire use.

The overarching conclusion underscores the need for a multi-faceted approach, combining awareness campaigns, economic incentives, and public-private partnerships, to foster a culture of safe winter cycling in Sweden.

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2 BACKGROUND

2.1 INCREASING CYCLING UPTAKE IN THE WINTER MONTHS

Increased cycling uptake is being targeted across Europe as a means of promoting sustainable transportation, improving public health, and reducing traffic congestion and air pollution. Accordingly, Sweden has implemented cycling infrastructure, policies, and other initiatives aimed at encouraging people to cycle. However, in Sweden and other Nordic countries, cycling participation decreases during the winter months (Bergström & Magnusson, 2003; Öberg et al., 1996). This can be explained by a combination of discomforts associated with the lower temperatures, higher levels of precipitation and wind, and poorer road surface conditions (ibid.). Increased physical effort and rolling resistance when cycling on winter surfaces is also a deterrent (Fenre & Klein-Paste, 2021).

In Sweden, single bicycle crashes comprise roughly 80% of serious injuries to cyclists (Eriksson et al., 2022; Niska et al., 2013), and falls due to slipping on snow/ice account for 59% of these (Eriksson et al., 2022). This situation is mirrored across Nordic countries, and other countries with relatively high cycling participation levels and similar winter climates (Myhrmann et al., 2021; Ohlin et al., 2019; Olesen et al., 2021; Utriainen, 2020). Furthermore, both past experience of being in a collision, and the perceived risks for future collisions act as cycling deterrents (Bergström & Magnusson, 2003; Gieøer et al., 1998; L Fraser & Meuleners, 2020). Therefore, to improve both cycling participation and safety, prevention strategies should be aimed at reducing the occurrence of falls on snow/ice.

2.2 MEASURES TO IMPROVE TRACTION AND WINTER BICYCLE TIRES

A large share of these falls relates to a lack of operational maintenance of cycle paths (Niska et al., 2013), and it is thought that improving maintenance, i.e., snow clearance and skid control measures, may also increase willingness to cycle during the winter months (Bergström & Magnusson, 2003). Snow clearance is the most important measure for areas with a large amount of snow build-up (e.g., Luleå), whereas the application of thawing agents, salt, or grit is more important in areas with significant ice formation (e.g., Linköping) (ibid.).

Winter bicycle tires are tires designed for use in cold weather conditions. These tires are typically made from a softer, more pliable rubber compound that provides better traction on cold, slippery surfaces such as snow and ice. Some winter tires also have studs or metal spikes to provide additional grip on packed snow and ice (Figure 1). Additionally, many winter tires feature a more aggressive tread pattern that helps to displace snow and slush and provide better grip. Extensive testing in VTI and elsewhere has shown that winter bicycle tires effectively improve grip on ice/snow surfaces (studded tires in particular) which should have a positive effect on the cyclist's stability and reduce the risk of single bicycle crashes (Niska et al., 2018; Rekilä & Klein-Paste, 2016).
However, based on survey data, only 10% of winter cyclists in Sweden use winter tires (Bergström & Magnusson, 2003). Accordingly, the Swedish Traffic Administration's strategy for safe cycling highlights winter tire use as an important area of action (Trafikverket, 2018).

### 2.3 BARRIERS AND INCENTIVES FOR WINTER TIRE USAGE

The use of winter tires by cyclists may be influenced by a range of factors, including cost, availability, inconvenience, perception of low risk, and lack of awareness. In Table 1, potential barriers and associated incentives for winter bicycle tire use are listed. One of the primary reasons for the limited use of winter tires among cyclists is likely the cost (Chapman & Larsson, 2021). Winter tires are often more expensive than traditional tires, and cyclists may not be willing to invest in a set of tires that will only be used for a portion of the year. Additionally, the limited availability of winter tires for certain tire sizes and types of bikes can also be a barrier to their use. Another factor that can discourage the use of winter tires is the inconvenience of changing tires seasonally. This process either requires the ability to mount and dismount tires, or the need to visit a bicycle shop.

Furthermore, as indicated by Bergström & Magnusson, (2003), and Öberg et al., (1996), some cyclists may not perceive the need for winter tires, particularly if they do not plan to ride in severe winter weather conditions. They may believe that their regular tires will be sufficient in light snow and slush, which can lead to a false sense of security. Finally, a lack of awareness about the benefits of winter tires and the dangers of riding in winter weather conditions with regular tires can also limit their use.
Table 1: Potential barriers and incentives for winter bicycle tire use.

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lack of awareness</td>
<td>1. Education and awareness campaigns</td>
</tr>
<tr>
<td>2. Perception of low risk</td>
<td>2. Initiatives to improve availability and convenience</td>
</tr>
<tr>
<td>3. Availability and Inconvenience</td>
<td>3. Cost reduction initiatives</td>
</tr>
</tbody>
</table>

2.4 STUDY AIMS

The aim of this project is to address the barriers to winter tire use is important for cycling safety, especially in regions with challenging winter conditions. The implementation of targeted promotion strategies can not only improve the safety of cyclists but also foster a culture of cycling during the colder months. However, there remains a gap in our understanding of the primary barriers for winter tire use. This project aims to establish a prioritised list of these barriers, and to devise effective actions that encourage the widespread use of winter tires among cyclists.
3 METHODS

3.1 COMPILATION OF FINDINGS FROM RELEVANT ACTORS IN SWEDEN

To comprehensively understand the landscape of winter tire usage among cyclists in Sweden, findings from past works were compiled. First, a list of relevant actors, including local municipalities, cycling associations, and state organisations, was established. Contact was made with these actors, and any existing reports, studies, or publications from these actors related to winter cycling were reviewed (Table 2). The results are provided in section 4.

Table 2: Measures undertaken by various Swedish actors to promote the uptake of winter bicycle tires.

<table>
<thead>
<tr>
<th>Actor</th>
<th>Actions to increase the uptake of winter tires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regions and municipalities</td>
<td>Vintercyklist (winter cyclist) campaigns targeted at cyclists or car commuters. Winter tires are offered to participants as part of a wider encouragement effort to increase winter cycling.</td>
</tr>
<tr>
<td>Swedish Transport Administration</td>
<td>Provide some general information about winter cycling and aim to increase their measures. However, few actions taken so far.</td>
</tr>
<tr>
<td>NTF (The National Society for Road Safety)</td>
<td>Conduct studies to increase knowledge of barriers (including the use of winter bicycle tires) that prevent increased winter cycling. Also spreads consumer-oriented information to increase winter cycling.</td>
</tr>
<tr>
<td>Bicycle suppliers</td>
<td>Recommend buying and using winter tires to customers who cycle during the winter months.</td>
</tr>
<tr>
<td>If Skadeförsäkring (insurance company)</td>
<td>General information to the public about safe winter cycling. Conduct annual surveys investigating winter cycling and use of studded tires among swedes and distributes the results through press releases.</td>
</tr>
<tr>
<td>Cykelfrämjandet (The Swedish national cycling advocacy organisation)</td>
<td>Provide general information on their homepage about safe winter cycling, where they mention winter tires among other things.</td>
</tr>
</tbody>
</table>

3.2 SURVEY OF WINTER CYCLISTS

To investigate the barriers to the use of winter tires among winter cyclists, we approached Region Gävleborg, another which was conducting the vintercyklist project. Region Gävleborg is situated in east-central Sweden, serving as a transitional zone between the cold conditions of the northern parts of the country and the more temperate climates of the south. The sample included 199 cyclists who actively cycled during the winter months of 2022/23. These cyclists were provided with winter bicycle tires and other essential equipment to ensure their safety and comfort during the winter cycling season. At the end of February, a survey was dispatched to these cyclists, which incorporated
questions from our research as well as from the \textit{vintercyklist} project. The survey aimed to gather insights into the cyclists' experiences and perceptions after a season of cycling with the provided equipment. The results are provided in section 5.

### 3.3 FOCUS GROUP

To explore strategies that can be employed to promote and incentivise the use of winter bicycle tires, a focus group was organised comprising representatives from various municipalities in Sweden. The discussion was open, but was centred around four primary questions:

1. How can we foster public-private partnerships to increase the availability, accessibility, and affordability of winter bicycle tires for a broader range of cyclists?
2. What educational and awareness campaigns can be developed to highlight the benefits and importance of using winter bicycle tires during the colder months?
3. How can we collaborate with local cycling organisations, community groups, and businesses to create a comprehensive approach to promoting winter bicycle tire use?
4. Are there any other existing policies or initiatives that have successfully increased the adoption of winter bicycle tires?

The results are provided in section 6.
4.1 REGIONS AND MUNICIPALITIES

Many municipalities, regions and a few regional public transport organisations conduct mobility management projects aimed at increasing sustainable travel use. One measure is the *vintercyklist* (winter cyclist) project that aims to encourage more people to cycle during the winter months. A good example of a campaign for winter tires that could be considered for expansion is conducted by *Västrafik* annually, where participants are offered winter tires and a tire change in exchange for a "contract" that states that you must cycle to work at least three days per week. A similar project called *Elcyklist* (electric cyclist) offers electric bikes equipped with studded tires to employees at large workplaces who are allowed to test the bikes for five weeks.

In general, 4 out of 5 participants state that they continue to cycle several times per week after participating in projects such as *Vintercyklist* or *Elcyklist*. Qualitative statements from the participants indicate good experiences from winter cycling and from using studded tires.

4.2 SWEDISH TRANSPORT ADMINISTRATION

The Swedish Transport Administration highlights important areas of action for safe cycling, and increased use of winter tires on bicycles is one such measure (Trafikverket, 2018). However, in Trivector's mapping of various information initiatives for safer cycling, it is stated that there is little experience from efforts to increase the use of winter tires (Wennberg et al., 2022).

4.3 NTF (THE NATIONAL SOCIETY FOR ROAD SAFETY)

In October 2020, NTF conducted two online surveys with cyclists (n=838) and bicycle dealers (n = 32) respectively regarding winter cycling and studded tires (NTF, 2020). The purpose of the questionnaires was to gather experiences about winter cycling and studded tyres. The survey to cyclists was advertised via Facebook to the target group of cyclists. The sample was thus not representative of the entire population. The questionnaire to bicycle dealers was sent via email to bicycle dealers who are NTF certified, as well as to a couple of large retail chains.

Findings from the survey include:

- Basically everyone (99%) knows that there are studded tires for bicycles.
- Of those who answered, most also cycle during the winter season, November-March. (53% state that they cycle daily, 30% a few times a week, 9% a few times a month and 8% never.)
- 26% use summer/all-round tires also in winter, 70% use studded tires and 3% use winter tires without studs. Of those who use summer/all-round tires, 17% state that they do so because they cannot afford to change tires, 32% that it is cumbersome and 24% that it makes the bike sluggish or impairs the feeling of driving. 56% think it works well with summer/all-round tires and therefore do not change.
• 54% have tight spacings between the studs, 40% have sparse spacings.
• The majority are satisfied with their studded tires (64%) or fairly satisfied (34%). 2% are somewhat or directly dissatisfied.
• Those who have studded tires with tight studs are somewhat more satisfied.

The free text responses could be compiled into the following themes:

• Difficult to change studded tires, strategies:
  o Change wheels in winter road conditions, only have studs on the front tyre, change to a bike with studs.
  o Reduce the air pressure in the all-round tire instead of changing to winter tires.
  o Bike with wide tires.

• Some do not think studded tires are necessary because they ride carefully or have learned to ride on ice and snow. Others live where it rarely snows and leave the bike parked on days when the street is icy.

• Many do not think that studded tires are needed when the road is salted. They prefer reduced rolling resistance.

Another project, "De borde cykla själva" (They should cycle themselves), which relates to winter cycling, was carried out by NTF during spring-winter 2021 in Umeå and Västerås (NTF, 2021). The aim was to inspire more people to cycle even in the winter. NTF therefore brought together winter cyclists and those responsible for road maintenance, as well as those responsible for planning and designing pedestrian and cycle paths in the municipalities. Together with the media, they cycled and talked about the maintenance and design of cycle paths locally. The dialogue on the bike rides was documented and followed up by having the participants answer questions about what they learned. The project received good media coverage and the dialogue between cyclists and officials from the municipalities was rewarding for both parties. The cyclists highlighted the problems with high snowbanks, ruts, wet leaves and puddles. Freezing slush is especially problematic when hidden by snow, even if the cyclist are equipped with studded tires. The importance of quickly sweeping away both leaves and gravel from footpaths and cycle paths was also discussed. The officials from the municipalities stated that they received valuable information that can be used in the continued work of developing the municipality's bicycle work.

4.4 BICYCLE SUPPLIERS

In the survey by NTF regarding how bicycle dealers work with winter tires, 32 suppliers answered of which all stated to sell winter tires and 63% of these sells studded tires only while the other 38% sell studded tires as well as studless winter tires. All the suppliers recommend studded tires to customers who cycle during the winter months, but they differ in the type of tire they recommend, where 61% recommend studded tires with tight studs, 18% recommend sparse studs and 21% give no recommendation about this. It is the general opinion among the suppliers that customers who buy winter tires, with or without studs, are satisfied. The tires that perform best in the test by VTI, the Schwalbe and Suomi tight-studded tires, are also the ones that most suppliers say they recommend.
4.5 IF SKADEFÖRSÄKRING (INSURANCE COMPANY)

If Skadeförsäkring provide general information to the public about safe winter cycling. They also conduct annual surveys investigating winter cycling and use of studded tires among Swedish cyclists and distribute the results through press releases. According to If, there seem to be a trend of increased winter cycling in Sweden, but the use of studded tires is continuing to be low at around 10-15%, agreeing with previous findings in the literature (Bergström & Magnusson, 2003).

4.6 CYKELFRÄMJANDET (THE SWEDISH NATIONAL CYCLING ADVOCACY ORGANISATION)

Cykelfrämjandet provide general information to the public about safe winter cycling. They also provide tips on their homepage regarding how to bike safely in winter. In 2021, they conducted a survey among cyclists in Sweden asking about winter cycling, although not specifically about winter tires (Cykelfrämjandet, 2021).
5 RESULTS FROM THE SURVEY

5.1 HOW DO YOU THINK THE SNOW REMOVAL AND ANTI-SLIP WORK HAVE WORKED ON THE CYCLE PATHS?

The majority of the respondents rated the snow removal and anti-slip measures on the cycle paths as "Godtagbart" (Acceptable), followed closely by "Bra" (Good) (Figure 2). This suggests that, in terms of operational maintenance, while many find the measures satisfactory, there is still room for improvement.

![Figure 2: Distribution of Responses to the Question 'How do you think the snow removal and anti-slip measures have worked on the cycle paths?'](image)

5.2 WHAT WAS THE MOST COMMON REASON WHY YOU DID NOT CYCLE ON THE DAYS YOU INTENDED TO CYCLE?

A large share of respondents indicated that they cycled every day they intended to (N=56, 28%), suggesting that many have either overcome barriers to winter cycling or didn't face significant challenges (Figure 3). However, practical/utility reasons such as the need to run errands using a car (N=34, 17%), dropping off or picking up children (N=13, 7%), or job-related tasks (N=8, 4%) emerged as the largest deterrents to cycling. Slippery conditions, indicative of safety concerns during winter, also deterred a notable number of respondents (N=22, 11%). The rise of remote work has led some to work from home, reducing the need to commute (N=17, 9%). The number of responses in the "Other" category suggest unique reasons that would benefit from further investigation (N=38, 19%) (see below).
Within the open text responses for the "Other" category of reasons for not cycling, several distinct themes emerged. A large share highlighted technical issues with the cycling app. Road conditions, particularly unplowed roads or icy surfaces, were frequently cited as deterrents to winter cycling. Safety concerns, especially regarding the perceived risks of cycling in certain winter conditions were also expressed. Health issues, including bouts of illness and the effects of COVID-19, prevented some from taking their usual rides. Family responsibilities, e.g., the care of sick children or the logistical challenges of transporting children and pets, emerged as another significant factor. A subset of respondents indicated they were unable to cycle due to being away on travel or vacation.

5.3 HAVE YOU HAD AN ACCIDENT/INCIDENT AS A WINTER CYCLIST?

The majority of respondents (N=159, 80%) indicated that they have not experienced any accidents or incidents while cycling during winter (Figure 4). However, a notable portion (N=40, 20%) encountered safety issues. Addressing these concerns could be important for promoting winter cycling and ensuring the safety of cyclists.
Based on the open text responses provided by those who had experienced a collision/incident, the most common reasons appear to be:

1. *Halka* (Slippery conditions due to ice): Many respondents mentioned falling or nearly falling due to icy conditions, even when using winter tires. Phrases like "halka", "isfläck", "blankis", "slirade omkull", and "cyklade omkull" frequently appear, indicating that icy conditions are a significant concern.

2. *Dåligt röjd väg* (Poorly cleared roads): Several respondents mentioned issues with roads that were not properly cleared of snow and ice. Terms like "dåligt röjd väg", "snömodd", "oplogad gata", and "dåligt plogat" suggest that inadequate snow removal is a common problem.

3. Interactions with motor vehicles: Several incidents involved interactions with cars. Phrases like "nästan påkörd", "krock med bil", "bilister", and "bil" indicate that close calls or collisions with motor vehicles are a concern.

4. Theft and Vandalism: A small number of respondents mentioned issues not directly related to road safety, such as having their bike stolen or vandalised.

**5.4 SUPPOSE YOU ARE THINKING ABOUT CYCLING THIS COMING WINTER. HOW DO YOU FEEL ABOUT THE FOLLOWING STATEMENTS ABOUT STUDED TIRES?**

A significant proportion of respondents believe that the cost of switching to studded tires is too high (N=64, 32%), indicating potential economic barriers to adopting this safety measure (Figure 5). However, when it comes to the availability of studded tires, most respondents feel that there is a good selection available. Interestingly, the complexity of changing to studded tires seems to be a concern for many (N=77, 39%), suggesting a need for more accessible and user-friendly solutions. Lastly, a significant segment of respondents feel that they might not require studded tires as they anticipate not cycling during risky winter conditions (N=171, 87%). This could imply a general apprehension about winter cycling safety or a lack of awareness about the benefits of studded tires in enhancing grip and stability.
Figure 5: Respondents' perceptions regarding studded tires for winter cycling. The figure presents the distribution of responses to four different statements about studded winter tires: “Assuming you are considering cycling this coming winter. How do you feel about the following statements about studded winter tires?”

- "The cost of switching to studded tires is too high"
- "The range of studded tires available is extensive"
- "Switching to studded tires is cumbersome"
- "It will be unnecessary to switch to studded tires as I probably won't cycle in risky winter conditions"
5.5 I SEE THIS AS A BARRIER FOR ME TO CYCLE IN WINTER

It is clear that the most significant barrier to winter cycling is the increased physical effort required in winter conditions (N=184, 93% of respondents agreed that it was a barrier) (Figure 6). The challenges posed by colder temperatures, potentially icy conditions, and the need for additional exertion made winter cycling a more strenuous activity. The risk of injury was another major concern, indicating that apprehension about potential slips, or falls on icy roads is a substantial deterrent for many (N=144, 73%).
Figure 6: Barriers to winter cycling. The chart illustrates the primary concerns of participants when considering cycling during winter months.
5.6 HOW DID YOU EXPERIENCE CYCLING WITH STUDDED TIRES?

Results indicate a predominantly positive perception of studded tires among the respondents (Figure 7). A significant majority, 83% (N=166), felt that it was safe, underscoring the confidence that such tires can provide in potentially slippery conditions. Additionally, 42% (N=83) of the participants found the experience smooth, further emphasizing the comfort and stability these tires offer. However, there was a notable portion, 22% (N=43), who felt that cycling with studded tires made the ride slower, suggesting some trade-offs in terms of speed for the added safety. Only a minimal number of respondents found the tires to be unnecessary or uncomfortable, 2% (N=4) and 0.5% (N=1), respectively.

![How did you experience cycling with studded tires?](image)

Figure 7: Distribution of perceptions regarding cycling with studded tires.

5.7 RANK THE EQUIPMENT YOU RECEIVED. WHAT WAS THE BEST?

The findings indicate a clear preference among respondents for studded tires as their top-ranked piece of equipment provided to them (Figure 8). A significant majority (N=180, 90%) chose studded tires as their primary choice.
Figure 8: Ranking of cycling equipment by respondents.
6 RESULTS FROM THE WORKSHOP

This section presents the results of a workshop conducted on promoting the use of winter cycling tires in Sweden. The workshop focused on identifying measures to increase the uptake of winter cycling tires, departing from the following topics: increase collaboration between the public and private sectors, develop education and awareness campaigns, collaborate with local cycling organisations, civil society, and companies, and explore new policies and initiatives that can help promote the use of winter cycling tires.

6.1 PROMOTING COLLABORATION BETWEEN PUBLIC AND PRIVATE SECTORS

Several ways were suggested to promote collaboration between the public and private sectors to increase the accessibility of winter cycling tires to the general public. One suggestion was to identify the different actors in the market and their roles in reaching out to cyclists. Participants also recommended working closely with bike shops to create opportunities for collaboration with the private sector, such as service-oriented initiatives, tire storage facilities, and pop-up workshops for tire changes. Furthermore, the workshop participants suggested that the public sector should take responsibility for the promotion of winter cycling tires and collaborate with private companies to reach out to consumers.

6.2 DEVELOPING EDUCATION AND AWARENESS CAMPAIGNS

Ideas to develop effective education and awareness campaigns to promote the benefits and importance of using winter cycling tires during the winter months were explored. They suggested that such campaigns could target not only regular cyclists but also children, the elderly, and workforces such as home care services. Furthermore, participants suggested that the government should take responsibility for improving infrastructure and launching a national campaign to provide information to citizens and road users. Participants also recommended using workplaces to promote safe cycling practices and to raise awareness among the general public.

6.3 COLLABORATING WITH LOCAL CYCLING ORGANISATIONS, CIVIL SOCIETY, AND COMPANIES

The importance of collaborating with local cycling organisations, civil society, and companies to create a comprehensive approach to promoting the use of winter cycling tires was discussed. Participants suggested working with workplaces and property owners to create cycling-friendly environments that encourage and support cycling. Participants also recommended exploring opportunities to collaborate with organisations such as the Swedish National Pensioners’ Organisation (PRO) to reach out to a wider audience. They suggested that, for some individuals, having a dedicated set of winter wheels or a winter bike could be more feasible than switching tires themselves.
6.4 EXPLORING NEW AND EXISTING POLICIES AND INITIATIVES

Existing policies and initiatives that have been successful in promoting the use of winter cycling tires were explored. Some of the successful policies and initiatives include ambulatory tire change, pop-up tents with tire change service that generate interest among people passing by, and region-based initiatives that take advantage of improved road safety. Furthermore, participants suggested that initiatives should include a health perspective and the use of positive incentives to encourage more cycling. The participants also recommended focusing on developing infrastructure that supports cycling and a system-wide approach that recognises the social and economic benefits of cycling.

6.5 CONCLUSION

The workshop participants identified several strategies to promote the use of winter cycling tires in Sweden. These included collaborating with the public and private sectors, developing education and awareness campaigns, collaborating with local cycling organisations, civil society, and companies, and exploring existing policies and initiatives. The findings suggest that a comprehensive approach is needed that recognises the social, economic, and environmental benefits of cycling and that initiatives need to be implemented in collaboration with various stakeholders.
7 DISCUSSION AND CONCLUSIONS

7.1 BARRIERS TO THE USE OF WINTER TIRES

The survey results in section 5 provide a comprehensive understanding of the challenges and barriers faced by cyclists when considering cycling in the winter, and the use of studded winter tires. One of the most significant findings from section 5.4 is the perception of the cost associated with switching to studded tires. A substantial 32% of respondents (N=64) believe that the cost is prohibitive, indicating potential economic barriers to adopting this safety measure (Figure 5). This economic concern is further compounded by the complexity of changing to studded tires, with 39% (N=77) of respondents expressing reservations about the process.

Moreover, a significant segment of the respondents, 87% (N=171), feels that they might not require studded tires as they anticipate not cycling during risky winter conditions. This sentiment could be attributed to a combination of factors, including apprehensions about winter cycling safety and a potential lack of awareness about the benefits of studded tires in enhancing grip and stability on icy roads (Figure 5).

Another barrier, as highlighted in section 5.5, is the increased physical effort required to cycle in winter conditions. A staggering 93% (N=184) of respondents view this as a significant deterrent, emphasising the challenges posed by colder temperatures and potentially icy conditions (Figure 6). The risk of injury, with 73% (N=144) of participants expressing concern, further underscores the apprehension surrounding winter cycling.
The overwhelmingly positive perception of studded tires, as detailed in section 5.6, offers a promising starting point. A significant 83% (N=166) of respondents felt that cycling with studded tires was safe, and 42% (N=83) found the experience smooth (Figure 7). Furthermore, a significant majority of survey respondents, 90% (N=180), ranked studded tires as their top equipment choice (Figure 8). These findings suggest that once cyclists experience the benefits of studded tires firsthand, they are likely to have a favourable view of them.

The use of winter bicycle tires may be increased through several strategies, including education and awareness, availability and accessibility, cost reduction, and encouragement. Given the barriers identified, strategies to promote the use of winter tires can be explored.

7.2.1 EDUCATION AND AWARENESS RAISING

Promoting the benefits of studded tires, especially in terms of safety, could play an important role. These campaigns could be used to educate cyclists about the benefits of winter tires and the dangers of riding in winter weather conditions with regular tires, through road safety programs, educational materials, and online resources. Similar promotional campaigns have been used with success for bicycle helmet use, however, there are limited knowledge-raising and behaviour-influencing interventions for increased winter tire use for bicycles (Wennberg et al., 2022). Encouragement from cycling organisations may also play a role in promoting the use of winter tires. Cycling organisations, such as bicycle clubs and advocacy groups, could use their networks and memberships to promote their benefits. Workplace campaigns may also be a fruitful approach.

7.2.2 WORKPLACE CAMPAIGNS

Along similar lines, workplace campaigns to increase bicycle commuting have included the provision of electric bicycles to employees, i.e., the Elcyklist (electric cyclist) campaign (Söderberg, 2021). For this project, 100 employees (regular drivers with 5-12 km to the workplace) at Volvo Powertrain in Skövde were given the opportunity to test electric bikes to/from work for five weeks. The effects were investigated in a randomised controlled trial. The results showed that car journeys decreased by an average of 13 km per person per day and the proportion of cycling increased by 20%. This project did not include offering the participants winter tires, but that would be a future possibility. Many bicycle helmet campaigns carried out in Sweden and other countries have had the workplace as a forum (Wennberg et al., 2022). Increased use of winter tires on bicycles could be encouraged within the framework of existing mobility management projects aimed at increasing sustainable travel use. One such candidate is the vintercyklist (winter cyclist) project that is currently carried out in many municipalities and regions with the goal encouraging more people to cycle during the winter months. A good example of a campaign for winter tires that could be considered for expansion is conducted by Västtrafik annually, where participants are offered winter tires and a tire change in exchange for a "contract" that states that you must cycle to work at least three days per week.
7.2.3 AVAILABILITY AND ACCESSIBILITY

Improving the availability and accessibility of winter tires is likely another effective strategy for increasing their use. This may be achieved by partnering with local bike shops and bike manufacturers to make winter tires readily available. By making winter tires more accessible, cyclists may be more likely to invest in them. As suggested by Chapman & Larsson, 2021, cost reduction can also be a significant factor. This could be achieved through bulk purchasing programs, partnerships with tire manufacturers, or government incentives. By reducing the cost of winter tires, more cyclists may feel the cost as less of a disincentive and be encouraged to use them.

It may also be interesting to investigate the possibility of winter service package solutions with service and tire replacement through bicycle dealers. Since the complexity and effort associated with changing bicycle tires was identified as a barrier, workshops or tutorials on how to fit winter tires, perhaps offered at local cycling shops or community centres, could demystify the process. As suggested in the workshop (section 6), this could take the form of an ambulatory/pop-up service centre on popular cycling routes.

7.2.4 ALTERNATIVE IDEAS

During the workshop, an idea was also raised about the potential for cyclists to maintain a dedicated pair of wheels fitted with winter tires, or even a separate bicycle equipped with winter tires exclusively for winter use. However, the associated costs of this suggestion might render it impractical for a significant portion of the population.

One alternative approach which may provide protection to a certain extent is to reduce the air pressure in all-round tires. By doing so, a larger surface area of the tire comes into contact with the ground, potentially increasing traction on slippery surfaces. Another alternative is the use of wider tires, which distribute the bike's weight over a larger area, which can improve stability and grip on snowy or icy roads. However, the protective effects for these options in comparison to studded winter tires must be investigated. Using winter tires all year round may also an option, since, as opposed to winter tires on motorised vehicles, winter bicycle tires do not perform any worse in warmer/drier conditions (Niska et al., 2018). However, trade-offs exist; firstly, the rolling resistance of winter tires is much higher than summer tires (ibid.), which is known to discourage cycling (Fenre & Klein-Paste, 2021), and secondly, wear is an issue for studded tires, and the effectiveness of studless counterparts are lower (Niska et al., 2018). Some innovative solutions have also been proposed in the past that could facilitate/reduce the need for tire changes. For example, in a previous Skyltfonds project, a conceptual design was developed for removable studded tire surfaces that are mounted directly on existing summer tires (Idesign, 2016). In another project funded by the Swedish Traffic Administration, temperature-sensitive rubber materials were tested that harden and push out metal studs at lower temperatures and soften and 'hide' the studs when it gets warmer (Bohlén, 2019).
The behavioural or risk compensatory effect refers to the road safety phenomenon where road users compensate for the perceived increased safety of intervention with a corresponding increase in risky behaviour. In other words, if a cyclist/driver feels that their equipment is safer, they may be more likely to engage in risky behaviours. This compensatory effect can offset the benefits of safety features, and can potentially increase the risk of crashes.

For example, Sagberg et al. (1997) investigated the behavioural adaptation of drivers using airbags and antilock braking systems (ABS) in Oslo, Norway. The study found that taxis with ABS had significantly shorter time headways than those without, leaving less of a gap with the vehicle ahead, suggesting a potential behavioural compensation. On the other hand, Rumar et al. (1976) explored the driving behaviours for drivers of vehicles with studded tires versus those without in icy conditions in Uppsala, Sweden. The findings indicated that while drivers with studded tires drove somewhat faster in icy conditions, indicating an element of behavioural compensation, it did not negate the safety enhancements provided by the improved traction of winter tires.

In the realm of cyclist safety, a study involving a bicycle instrumented with an ultrasonic distance sensor collected passing vehicle passing distances in Salisbury and Bristol, United Kingdom, found that wearing a bicycle helmet led to traffic passing closer when overtaking (Walker & Robinson, 2019). Another study in Victoria, Australia, found that drivers afford less space when passing cyclists in marked on-road bicycle lane as compared to roads without a marked cycle lane, likely due to drivers' safety perceptions (Beck et al., 2019). On the other hand, potential compensatory effects of cyclists wearing helmets (on the part of the cyclist themselves) have been well-investigated, with most studies (N = 18 out of 23) having findings that do not support the risk compensation hypothesis, i.e., the majority of research does not support the theory that cyclists engage in riskier behaviours when wearing helmets (Esmaeilikia et al., 2019).

These studies demonstrate that while certain safety features or devices can lead to behavioural compensation effects, not all do, and it may not result in a reduced overall effectiveness of the feature. The authors of this report have not found any studies that deal with behavioural compensatory effects associated with winter bicycle tire use. However, a study in Stockholm, Sweden, has demonstrated that cyclists adapt to winter cycling conditions by cycling slower (Shoman et al., 2023). While it is very unlikely that drivers would afford less space to cyclists using winter tires in traffic, it is possible that there are compensatory effects that mirror those for vehicle drivers using winter tires, e.g., cyclists may travel faster or generally be less careful when using them. In line with winter tires on vehicles, it is not expected that any potential compensatory effects would be sufficient to offset improvements in traction provided by winter tires, leading to a reduction in safety, however, this has not yet been adequately studied.
Ultimately, considerations towards increasing the use of winter tires on bicycles should not be limited individual actions, but should instead be thought of in terms of a combinational approach. In conclusion, while barriers to the use of winter tires exist, the positive perceptions surrounding them, combined with targeted interventions, can pave the way for their increased adoption.

Based on this scoping study, the following key recommendations and proposed work are outlined to promote winter cycling and the use of winter bicycle tires in Sweden:

1. **Awareness and Education:**
   a. Launch nationwide campaigns emphasising the safety benefits of winter bicycle tires.
   b. Collaborate with schools and universities to integrate winter cycling safety into their curriculum or extracurricular activities.

2. **Economic Incentives:**
   a. Introduce subsidies or discounts on winter tires to make them more affordable.
   b. Partner with local businesses and tire manufacturers to offer bulk purchasing programs or loyalty discounts.

3. **Collaboration and Partnerships:**
   a. Foster public-private partnerships to increase the availability, accessibility, and affordability of winter bicycle tires.
   b. Engage with local cycling organisations, community groups, and businesses to create a comprehensive approach to promoting winter bicycle tire use.

4. **Research and Development:**
   a. Investigate innovative tire designs that can adapt to both summer and winter conditions, reducing the need for seasonal tire changes.
   b. Investigate the behavioural compensatory effects associated with the use of winter tires to ensure that safety benefits are not offset by riskier cycling behaviours.
REFERENCES


