STANDARD OF MAINTENANCE OF PEDESTRIAN AND BICYCLE ROUTES AND A SURVEY OF FALLS SUFFERED BY PEDESTRIANS AND CYCLISTS IN FINLAND

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1. INTRODUCTION

A serious attempt has been made to improve the importance and status of walking and cycling as part of the traffic system over the last few years in Finland. Finland's Ministry of Transport and Communications has set as a target the doubling of cycling from the 1986 level by 2005.

Walking and cycling are modes of travel connected in particular with short journeys and they form part of every Finn's life. The under 18s and non-car owners especially walk, cycle, or use public transport a lot. Approximately 80% of Finns own a bicycle. According to the passenger traffic survey of 1998-1999, 11% of all journeys made by over 6 year-olds are made by bicycle and 24% on foot. There is a good deal of scope for increasing walking and cycling, since around 43% of Finnish passenger car journeys are less than 5 km long, and 28% are under 3 km long. The average cycle trip is 3 km long.

In Finland, the winter snow season in South Finland lasts from December to March, and in North Finland from October to April. Thus, for approximately one third of the year the conditions for walking and cycling are weakened due to possible slippery conditions and snow and the uneven surface this produces. Winter sets challenges for pedestrian and bicycle route maintenance in regard to creating safe and unhampered mobility. The most important maintenance procedures are snow clearance and the combating of slippery conditions.

By law, street maintenance is mainly the responsibility of the municipality. The owner of a premises is obliged to keep the pavement (sidewalk) in front of the property in a usable condition by removing snow and ice and controlling slippery conditions. The removal of piled snow is also the responsibility of the owner of the property. Individual cases of falls by pedestrians and cyclists are not considered road accidents, so that nobody registers them in a comprehensive manner. Since there is no data available on the incidences of such falls and we have only scanty knowledge of the costs they cause, there is no information to fall back on when planning routes and their maintenance. Thus far, preventing such falls from happening has not been considered important from the standpoint of the community, nor regarded as a profitable undertaking.

In cases where pedestrians have suffered falls, these have frequently been older people. Ageing of the population will continue in the future and it is estimated that by 2020 every fifth Finn will be over 65 years old. It is feared that the number of falls will rise faster than the ageing of the population. The number of cases of falls involving people aged fifty years or more requiring medical treatment almost quadrupled from 1970 to 1995, incidences being highest in the older age groups. If the growth in the number of cases needing treatment and ageing of the population continue at this rate, by 2030 in Finland some 61,000 persons (approx. 1.2 % of the population) over the age of fifty will be treated at health centres as patients suffering from falls.

2. STUDY ON THE STANDARD OF MAINTENANCE OF PEDESTRIAN AND BICYCLE ROUTES

2.1 Aims of the study and its accomplishment

The aim of the study on the standard of maintenance of pedestrian and bicycle routes was to determine the standard of maintenance in the city areas of Oulu, Jyväskylä and Helsinki and to compare the standard observed with the quality requirements set and users' expectations. In Helsinki, there is less winter snow and the temperature often fluctuates on either side of zero, causing slippery conditions. In Jyväskylä, there is a lot of winter snow and the hilly terrain causes mobility problems. Despite its prolonged winter, Oulu has a large number of winter cyclists. The study began with summer checks in May 1999, while the winter checks took place from the first half of October 1999 to May 2000. In the present paper we confine ourselves to the results of the winter study. Maintenance standards were studied at predetermined monitoring points (approximately 30 per city area), using technical inspections carried out by experts. In Finland, areal contracting is only just being introduced, so that at the moment pedestrian and bicycle routes are looked after by several different maintenance teams. Consequently, sections of the routes maintained by different parties were selected as monitoring points.

Users' opinions were solicited by means of roadside questionnaires (3 interview points per city area) and in Oulu also by means of a cyclist and pedestrian route study in the 1999-2000 winter (5 separate survey occasions). Another aim was to elucidate the accomplishment and the costs of maintaining pedestrian and bicycle routes from the different city areas.

Figure 1. The city areas studied.

2.2 Results of the winter study

2.2.1 Standard inspections at the monitoring points

The general standard of winter maintenance was investigated by means of so-called standard inspections which it was the intention to continue at regular intervals throughout the winter period. In the early winter, the standard inspections took place every two weeks, but in the spring the interval between inspections was shortened to one week, or even less with changes in the weather. In the different city areas a total of 61 standard inspections were carried out on different days, when 1,191 observations on the route condition or trafficability were made at the monitoring points.

In the standard inspections the slipperiness at the point and the trafficability were assessed. No great differences can be observed between the friction figures for the different city areas. The average values for friction among the monitoring points for all the road maintenance parties were slightly

below the approved level. The worst grades were often obtained on days that were difficult owing to the weather conditions.

From the trafficability standpoint the points in the Oulu city area obtained the best grades (Figure 2). In the city of Oulu the trafficability standards at points maintained by properties were markedly lower than at points maintained by maintenance teams in the Oulu city area. The trafficability standards at points in the Jyväskylä city area were satisfactory, but on average worse than those of the other city areas. In Helsinki, the trafficability at inspection points on average was of a good standard.

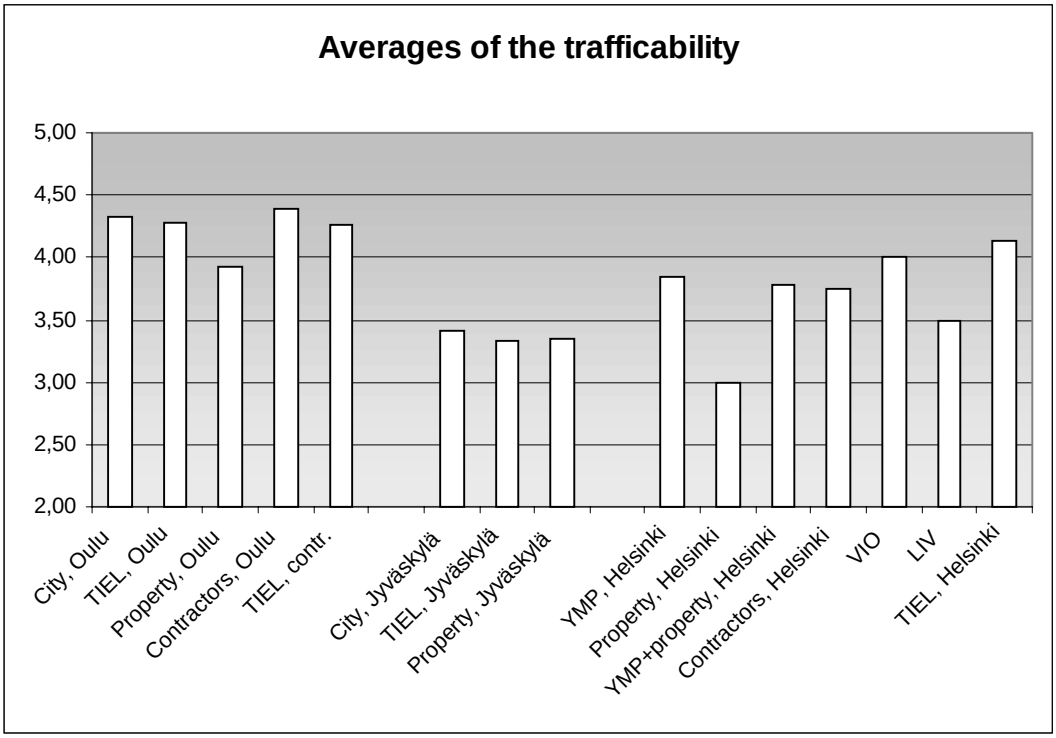

Figure 2. Averages of the trafficability measured by standard inspections at the monitoring points in the different city areas in the 1999-2000 winter on a scale of 1-5 (1 = extremely poor, 5 = extremely good). TEIL = Finnra (Finnish National Road Administration), YMP = environmental production, VIO = green department, LIV = sports department.

2.2.2 Audits on the continuity of the procedures

The periodical accomplishment of individual winter maintenance procedures (clearing of snow and slush, control of slippery conditions, elimination of surface unevenness, removal of piled snow) was audited by means of separate inspections. These inspections were carried out when the interval between procedures set by the maintenance procedure quality standards had elapsed. Altogether 725 observations were made on the continuity of winter maintenance procedures in the three city areas. Around 70% of the procedures were carried out according to the quality objectives at the set intervals (Figure 3). The poorest procedure standards in each of the city areas were in the control of slippery conditions and snow clearance carried out during the daytime. Slight under-achievement was recorded in 8%, and extreme over-achievement in 22%, of the observations. A good deal of under-achievement was observed at the points maintained by Finnra for properties in the Helsinki city area and the city of Oulu. At points in the city of Helsinki few cases of under-achievement were noted, as the intervals between the procedure are appreciably longer than those of Finnra and the other city areas. Moreover, at points in the city of Helsinki, snow clearance was not attended to after snow had fallen in the afternoon, the continuity of which in the other city areas proved problematical.

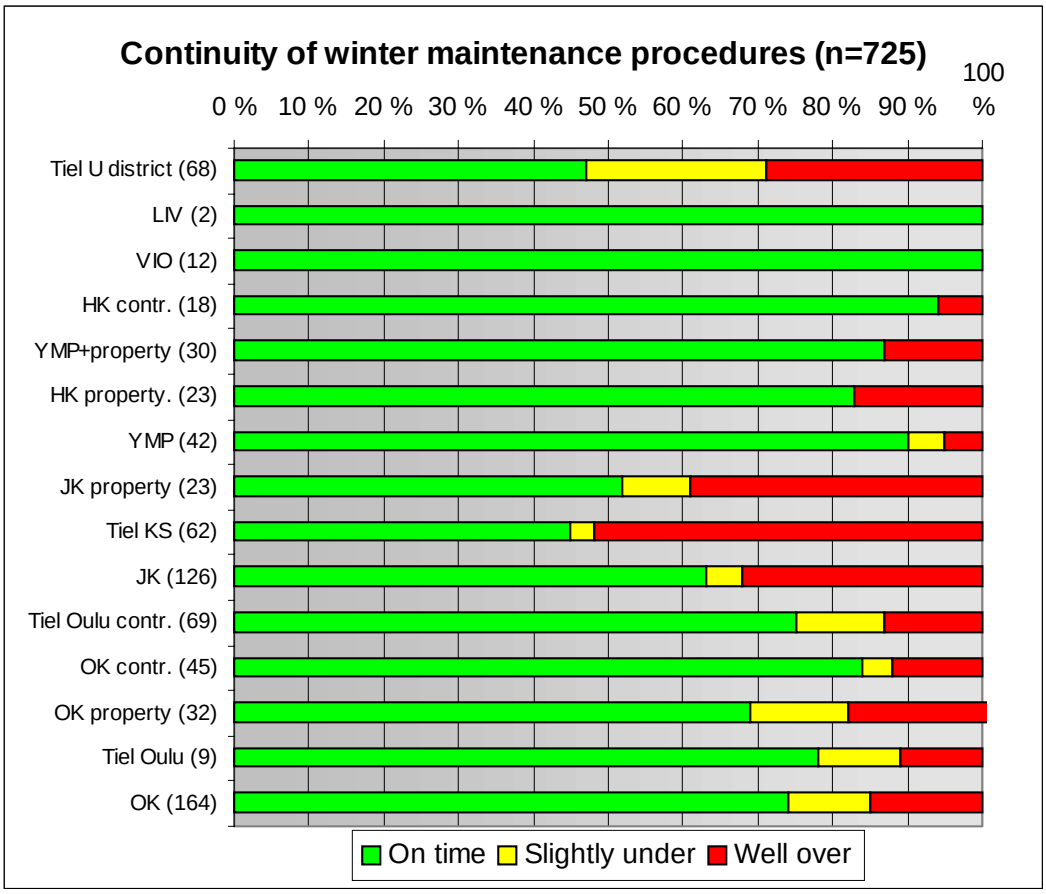

Figure 3. Continuity of winter maintenance procedures in the monitored city areas by a road maintenance team during the 1999-2000 winter. In brackets the number of observations. TIEL = Finnra (Finnish National Road Administration), KS = Keski-Suomi, OK = City of Oulu, JK = City of Jyväskylä, HK= City of Helsinki, YMP = environmental production, VIO = green department, LIV = sports department.

2.2.3 Interviews with users

In the interviews conducted during the winter, users of the Oulu city area gave the best grades for snow clearance on pedestrian and bicycle routes, the control of slippery conditions and surface evenness (Figure 4). In Jyväskylä, the users of pedestrian and bicycle routes are the least satisfied with winter road maintenance. In the feedback, in particular improvements were hoped for in the elimination of slippery conditions (29% of all respondents) and in snow clearance (29 %).

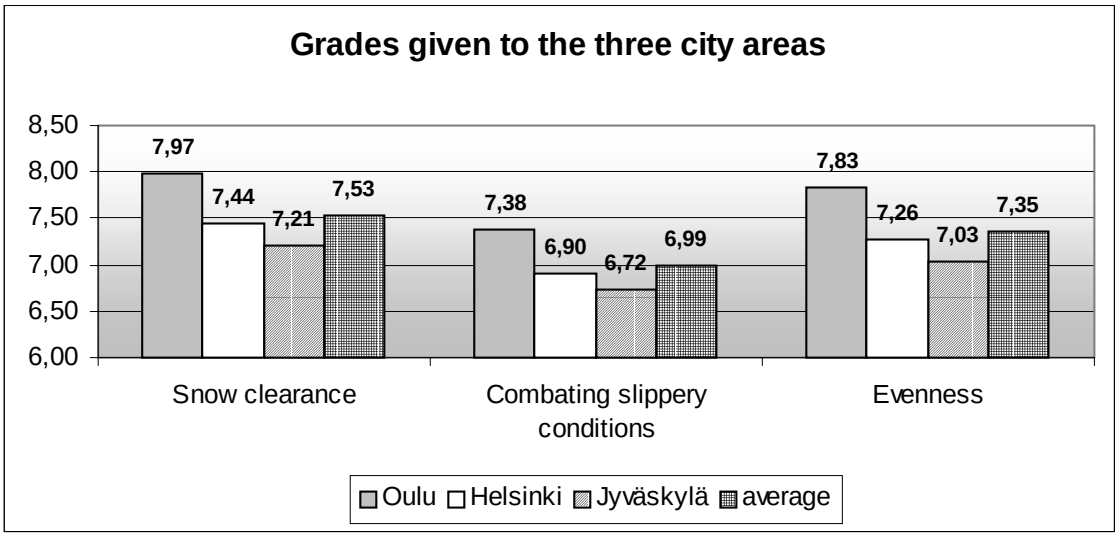

Figure 4. Results of interviews by city area on a scale of 4-10.

2.2.4 Cycling and walking study

In the cycling and walking study undertaken in Oulu during the 1999-2000 winter a study group of approximately 24 persons were requested to assess the trafficability of selected locations on a scale of 1-5 and to indicate the factors hampering trafficability. As a result of this study, a graphic winter maintenance classification was created based on users' opinions for both cycle tracks and pedestrian routes (Figures 5,6,7 and 8).

The cycling study indicated that the following factors influence the class of pedestrian and bicycle routes in terms of their condition:

- Type of route. On a raised pedestrian and bicycle route snow/ splashing slush from the road affects trafficability.Amount of traffic on route. Busy pedestrian and bicycle routes require gritting and grading more often, even when the weather conditions do not alter. Consequently, it is important to determine the amount of traffic on such routes in winter.
- Width of route. In winter the routes become even narrower, especially when snow carried on to them is not effectively dealt with. On the narrow pedestrian and bicycle routes of the city centre snow clearance using robust machinery is difficult and the surface of the route cannot be made sufficiently level. In time, slippery patches form on an uneven surface in winter.
- The surroundings of the route. For example, melting snow from a bank above the route makes the latter slippery. Similarly, overshadowing trees and buildings may create unexpected patches along a traffic route of otherwise even quality.
- Location of the route. For instance, a route situated on a north-facing slope requires longer maintenance than a pedestrian and bicycle route lying in a place warmed by the sun.

Figure 5. A cycle track maintained in an exemplary manner. Figure 6. A cycle track in an exceptionally bad condition.

In the pedestrian study the standard of maintenance was recorded as variable, even within the space of a single block. In the opinion of the study group, the most serious maintenance problem in pedestrian routes are the unevenness and slipperiness of the routes.

On top of everything, these problems frequently occurred simultaneously. Pedestrian route surfaces with patches of packed snow must be roughened with a blade in conjunction with snow clearance to prevent uneven surfaces from forming as the patches are worn down. For this reason, even a small

amount of snow should be cleared off routes in the city centre area. With weather conditions fluctuating on either side of zero, patches of packed snow easily form. Spreading grit on top of these patches is not alone sufficient, since the grit is easily dislodged into depressions in the surface and the higher slippery spots become bare and thus dangerous (Figures 9 and 10).

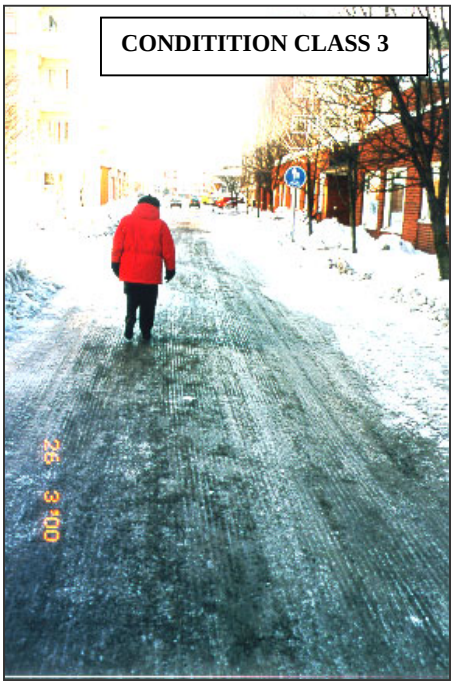

Figure 7. Extremely good pavement (sidewalk). *Figure 8. Extremely poor pavement (sidewalk).*

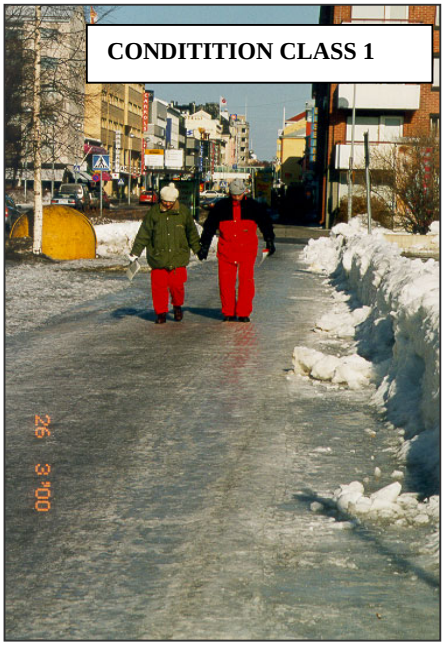

Figure 9. An ungraded pavement received better marks … Figure 10 … than a graded one.

In the cycling study the same sections were repeatedly in bad condition. Repeatedly problematical and hazardous sections should be determined and the appropriate maintenance procedures carried out on these, or an effort made to eliminate the construction faults that are often the cause of the trouble (Figures 11 an 12). In this way, the standard of maintenance could be raised and safety improved.

Figure 11. Water coming from snow melted by the sun refreezes on the route at night.

Figure 12. A problematical pedestrian and cyclist underpass

2.3 Conclusions

Based on the study, it can be concluded that the opinions of road users well reflect the conditions on pedestrian and bicycle routes. Those maintaining the roads frequently understate users' opinions, saying that they are unfounded. Although this may be the case in isolated cases, when the opinions of a large group of people are solicited, the results closely parallel those of technical experts. In interviews, pedestrians and cyclists continue to hope for improvements in the control of slippery conditions and in snow clearance.

In the summer interviews, in addition to improvements in winter maintenance the respondents hoped for improvements in the evenness of surfaces, cleaner conditions, and more pedestrian and bicycle routes.

A more difficult problem connected with the maintenance of pedestrian and bicycle routes during the summer period according to the study was the continuity of repairs to individual broken patches. There are still too many broken patches in pedestrian and bicycle routes. If the authorities wish to increase the amount and status of traffic of this kind, the maintenance of surfaces on the routes and the general comfort must be improved.

In the winter period the continuity of the control of slippery conditions must be improved in all three of the city areas, as also the clearing of snow falling during the daytime. The standard of winter maintenance varied greatly among the city areas and among the parties carrying it out. In Finland, responsibility for keeping the pavements clean and for winter maintenance as a general rule rests with the property owners, and in the case of separate pedestrian and bicycle routes with either the municipality or Finnra. Since the party responsible for maintenance in the city centres may thus change many times along the course of a single block, the quality of the route may also vary in the same way. The timing of the work is also extremely difficult among the different parties involved. Particularly in regard to the pavements in the city centres this is an obvious problem that needs resolving, if walking is to be promoted. A precedent set by the Higher Court for transferring more of the maintenance responsibility to the property owners may not necessarily be the best thing from the standpoint of safe mobility.

Most cases of falls or slipping occur on the pavements of the city centres. To ensure safer mobility the busier pavements should be maintained at regular intervals to prevent them becoming slippery due to scuffing by pedestrians. Winter maintenance should be stepped up in the city centres and in areas where old people live and move about. An appreciable proportion of falls during the winter period occur on so-called “peak days” when the weather conditions acutely affect the conditions for movement. By improving the predictability of bad weather conditions and concentrating maintenance activities on such days it would be possible to considerably reduce the number of falls (precision maintenance)

Developing areal contracting is seen as one solution to faster and more even quality pedestrian and bicycle route maintenance in the city centre areas. Options are to improve the present practice by combining winter maintenance practices by property owners (training, information), and stepping up the supervision of winter maintenance (police). In addition, there should be standardisation of the quality targets among the different parties maintaining the routes in each city area.

Knowledge about pedestrian and cycle traffic is still virtually non-existent. The actual numbers of users, especially in winter, are unknown. Again, there is no data on division by gender for the different trip categories (work, school, shopping and personal business, leisure time, physical exercise). Problems in maintaining pedestrian and bicycle routes should be determined and investigations carried out on the impact of improved maintenance on cases of falls and the number of users. Currently, only estimates are available on the costs of maintaining pedestrian and bicycle routes. According to the study, the costs of maintaining pedestrian and bicycle routes come to less than 10 % of the annual costs of falls and slipping. By stepping up the maintenance of pedestrian and bicycle routes it would be possible to achieve considerable savings for the society.

3. ACCIDENTS INVOLVING FALLS AMONG PEDESTRIANS AND CYCLISTS

3.1 Purpose and accomplishment of the study

The purpose of this study was to determine with the aid of a customer questionnaire in the same city areas as for the maintenance study accidents involving slipping or falling by pedestrians or cyclists outdoors on a road or street, or in a yard area. The questionnaire was arranged at the health centres and first aid centres (operating on the rota principle) of the different cities.

In the study the aim was to determine:

- the incidence and abundance of accidents involving falls by age group among women and men
- the reason for the fall by mode of travel at different seasons (summer/winter)
- factors leading to accidents involving falls
- places where accidents involving falls occurred and the conditions at the site
- the annual costs of the accidents.

Only those falls in which injury has necessitated medical treatment have been included in the study. Injuries caused by falls and the need for medical treatment were studied in Helsinki and Jyväskylä. The data gathered using the patient questionnaire was supplemented in Jyväskylä by accounts of patients given later in regard to those days on which there were a particularly high number of accidents involving falls.

In Espoo the study period was six months, in Helsinki and Oulu one calendar year, and in Jyväskylä nine months.

3.2 Number of cases of falls

Altogether there were 2,923 cases of falls meeting the definition set for the project. Of those sustaining falls, 58% were women (1,685) and 41% men (1,205). One percent of those injured failed to indicate their gender.

The abundance of accidents involving falls was estimated from the material gathered over nine months in Jyväskylä and then extrapolated to cover the whole country. More accidents involving falls are known to occur under urban conditions than in the countryside. The number of falls occurring over the entire country was estimated by using coefficients based on the patient's home location and the commonness of walking and cycling injuries.

Expressed for Finland as a whole, the frequency of pedestrian and bicycle accidents in which no motorised vehicle is involved amounts to 13.6 accidents per thousand inhabitants, which means a total of around 70,000 injuries a year. Finland's population is approximately 5.5 million.

3.3 People injured as a result of a fall

Previous studies have revealed that older women are often injured as a result of falls. In the study data the proportion of women over 50 years of age among those injured was 2.7 times that of men in the corresponding age group. In relation to the total population, on average 48 women and 25 men over 50 years of age were injured per 10,000 inhabitants. In the under 50 year-old age class the proportion injured was 63%. In this class, men and women were injured as a result of falls equally often.
Of the falls (n= 2,923) in the data, 31 % occurred to cyclists and 66% to pedestrians. Pedestrians suffered falls when walking (84%), running or jogging (8), on roller blades (6%) and on skateboards (2%).

3.4 Fluctuations in number of falls at different times of year

Examined from the seasonal standpoint, cases of falls occurred in summer almost as often to women and men, as both pedestrians and cyclists. In winter, there were twice as many women as men injured as a result of falls. In all the cities, the most common reason for a fall in winter was slipping by a woman pedestrian (Figure 13).

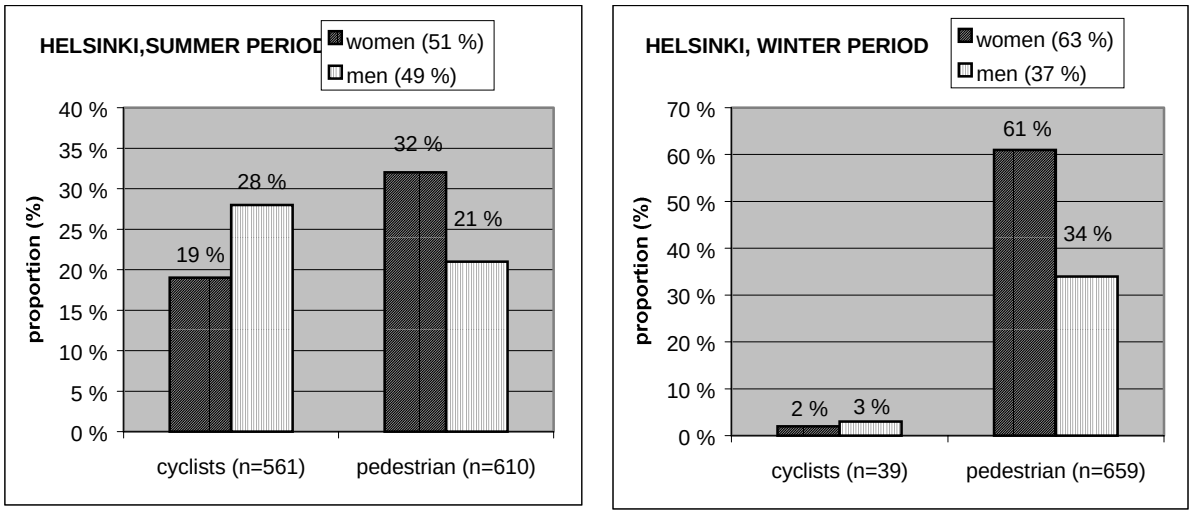

Figure 13. Distribution of cases of falls by women and men by mode of travel in summer and winter in Helsinki.

3.5 Reasons for falls

In the study, single cases of falls by pedestrians and cyclists in which no motorised vehicle was involved were examined. Such cases constituted 91% of the total. In those falls in which two pedestrians or cyclists, or one of each, were involved the most common form of accident was a collision between two cyclists (4%), or a collision between a cyclist and a pedestrian (2%). The majority of falls by pedestrians were due to slipping (57%). In winter slipping was the most common cause of falls (87%) and in summer stumbling or tripping (55%).

The greatest single environmental cause of a fall were slippery conditions and the lack of their control.

Based on the conditions at places where accidents involving falls took place it would be possible through winter maintenance to prevent such falls. In winter, 30% of the falls happening in yards and on pedestrian and bicycle routes occurred on icy surfaces where no grit had been spread. On city surfaces on which grit had been spread 9% of falls occurred.

The most common reason for a fall by a cyclist was either the wrong speed for the situation or a collision. Often the reason given was also an uneven surface or so-called pot holes in the surface. In winter the reason for a fall was often a slippery surface. Environmental factors most frequently causing falls by cyclists were elements of the street construction and the lack of maintenance.

In the Jyväskylä data, 21 (5%) of those suffering a fall felt that alcohol had contributed to the accident. The doctors' assessment in regard to the effect of alcohol almost completely paralleled that of the patients. According to doctors' views, 23 patients (6%) had had an accident while under the influence of alcohol. Only 2% of falls were considered to be attributable to some illness or another.

3.6 Effect of weather

Based on the results it was possible to isolate typical weather conditions which make people's mobility outdoors difficult or impossible:

- temperature fluctuates on either side of zero (+2º - -2ºC)
- cold air grows warmer or warm weather rapidly grows colder
- heavy snowfalls.

During the winter period 1.11.1999 - 31.3.2000 in Helsinki there were on average 4.7, in Jyväskylä 1.9, and in Oulu 1.6, cases of falls a day. In Helsinki around one-third of all cases of falls occurred on 20 peak days, while in Jyväskylä and Oulu one-third of the falls took place during a period of half this length, i.e. 10 days.

3.7 Places in which falls occurred

With the aid of the questionnaire, it was possible to pinpoint around three-quarters of the places where falls had occurred.

most falls occur in the city centres, on the busiest routes. The majority of cases of falls by pedestrians and cyclists occur on routes or street lanes intended specifically for them (62% and 69%). Altogether 76% of falls by pedestrians and 84% of falls by cyclists occurred in general traffic areas.

Most of the cases in which pedestrians were injured happened on pavements (35%, 623/1773). The next highest rate of occurrence was in yards (307) and on pedestrian and bicycle routes (300), both of these accounting for approximately 17%. Almost half of the cases where cyclists were injured happened on combined pedestrian and bicycle routes.

When pedestrians suffered a fall in Jyväskylä in winter the location was snow covered and not mechanically cleared in 36% of all cases, and equally as often also icy and not gritted. On the other hand, 8% of the cases occurred in yards that were icy but not gritted.

Correspondingly, 26% of falls by pedestrians took place on pedestrian and bicycle routes which were snow covered and not mechanically cleared. Altogether 27% of falls occurred on icy routes without gritting, but icy, gritted routes accounted for only 10%. Maintenance can be used as a means to preventing falls, even though these cannot be entirely avoided.

3.8 Injuries sustained as a result of falls, their seriousness and the need for medical attention

In Jyväskylä the injuries most commonly sustained as a result of falls (n=451) were a broken wrist (16%), concussion (7%), a head injury or superficial injury (6%), a broken ankle (4%), and an abrasion to an upper arm (4%).

Of the injuries, 44% comprised contusions, sprains or dislocations. There were almost as mainly bone fractures (42%). Around 14% of the injuries consisted of superficial injuries and wounds.

Cyclists sustaining serious injuries (AIS3) accounted for 11% of the total. A total of 33% of the injured cyclists and 17% of joggers sustained severe injuries (AIS4). The 30-49 year-olds were over-represented in regard to severe, critical and fatal injuries. A significant correlation was observed between the seriousness of the injury and age ($p=.025$). Despite the injuries being mainly slight or moderate, there was definite proof that one person in Jyväskylä died and one was fatally injured as a result of a fall.

There was a significant correlation between the quality of route maintenance and the injuries sustained. The correlation between winter maintenance estimated as being below standard and unevenness of the surface on the route and injuries to the head ($p=.011$), arm ($p=.000$), wrist ($p=.007$) and ankle ($p=.015$) was significant.

Almost one-fifth of those injured sustained a head injury. Among cyclists, head injuries were sustained significantly more often than among pedestrians. The use of a helmet would protect the head from injury. In the answers given by cyclists a noticeable deficiency was failure to use a helmet. Those using helmets most frequently were residents of the Helsinki city area. In Jyväskylä, the tendency not to use a helmet was most common.

3.9 Need for medical attention

Among the Jyväskylä data, 44% of those suffering falls needed to consult a doctor at a health centre without the need for further examination, while 34% also required an X-ray in association with their visit (extended visits). Special medical treatment was required by 30% of those injured, while 19% had to be admitted to a hospital ward for special treatment. Altogether 885 treatment days were required in this connection. The period spent in a ward varied from a one night observation to permanent care. The average period spent in hospital was 11 days.

A total of 15% of those injured needed surgery. The most common reason for this was a bone fracture. In the Jyväskylä data the total period of recovery required by 231 patients was 6,698 days. There were 295 people of working age and 172 of these were given sick leave totalling 4,468 days.

3.10 Costs caused by falls

The costs due to falls were calculated separately for medical care, loss of work, and loss of good health.

The costs of the inability to do work were determined based on the amount of sick leave in days indicated on a doctor’s certificate. The costs of health loss were calculated using Finnra’s unit cost calculated for personal injury in road accidents.

Examination and care costs in Jyväskylä came to € 317,335 for 418 injured, i.e. an average of € 760 per injured person.

The most expensive diagnoses connected with cases of falls in Jyväskylä were:

ICD10	Diagnosis	€
S06.3	Local brain injury	34,334
S72.1	Fracture of the femur passing through the muscle insertion protuberance	8,436
S06.5	Traumatic haemorrhage of the sclera	6,666
S82.2	Fracture of the shaft of the tibia	4,295
S72.0	Fracture of the femoral neck	3,835
S32.5	Fracture of the pubic bone	2,809
S82.3	Fracture of the lower part of the tibia	2,682
S82.8	Fracture of part of the knee or lower leg	2,331
S82.5	Fracture of the inner ankle bone	2,040

The total number of days of sick leave among those of working age (15-64 year-olds) prescribed by doctors was 4,468. The costs due to the inability to perform work due to sick leave came to € 563,598. Thus, the cost due to lost work days for an average person suffering a fall in Jyväskylä was about € 1,348.

Of the 449 cases of falls occurring in Jyväskylä, the costs of health loss totalled € 1.7 million, i.e. an average of € 3,878 per injured person.

Altogether falls in Jyväskylä cost around € 10 million a year. When the average costs of medical care, loss of work and health loss are added together per injured person, the average cost caused by one fall comes to approximately € 6,000.

We can estimate that in Finland around 70,000 people a year are injured in falls. The costs of medical care and loss of work in total amount to € 151 million, and the costs of health loss to some € 269 million a year. Altogether, falls by pedestrians and cyclists in Finland lead to costs amounting to around € 420 million.

The estimated costs of road accidents leading to 6,997 cases of personal injury in 1999 were approximately € 820 million; in these accidents 431 people died and 9,052 people were injured.

The cost of individual falls to pedestrians and cyclists are thus of roughly the same order of magnitude as road accidents in general. The cost of accidents involving falls could be reduced by improving route planning and by winter maintenance.

In accidents involving falls, a small increase in maintenance investments could lead to greater cost benefits than would possibly otherwise now be possible by preventing other kinds of road accidents.

3.11 The risk of having an accident involving a fall

The amount of risk associated with an accident involving a fall can be assessed on the basis of the probability of such an accident and the consequences in accordance with the guidelines drafted by the Ministry of Social Affairs and Health's occupational safety department shown in Table 1 (Risk assessment, occupational safety guides and guidelines 14, Tampere 1999).

Table 1 : Determining the risk of an accident

Probability	Consequences: Slight Absence <3 days. Temporary slight effects: sprains, bruises	Detrimental Absence 3-30 days. Long term serious effects, permanent slight detriment: fractures, burns	Serious Absence > 30 days. Permanent disability in regard to work, death
Improbable Random dangerous situation, occurring rarely	**1 Insignificant risk**	**2 Slight risk**	**3 Moderate risk**
Possible Daily dangerous situation, there have been some "close shaves"	**2 Slight risk**	**3 Moderate risk**	**4 Significant risk**
Probable Dangerous situations occur frequently and regularly; accidents have occured	**3 Moderate risk**	**4 Significant risk**	**5 Intolerable risk**

According to the results of the present study, several falls occur on a single day and the risk is then probable. Typical injuries sustained as a result of falls were bruises and sprains, as well as bone fractures. Recovering from a fall requires on average 29 days of sick leave, i.e. the consequences were detrimental. Based on the features characteristic of such falls, the risk of a fall can be considered moderate or even significant.

A considerable reduction in the risk of falls is essential and procedures should be set in motion without delay. The freedom to move about is one of our basic national rights, so that the elimination of accidents involving falls must be something more than just avoiding local travel or not going anywhere at all.

3.12 Reducing the risk of a fall

Some sort of picture of the trends in the number of accidents involving falls can be obtained even with a period of monitoring of short duration, since the number of such accidents follows seasonal variations in the amount of pedestrian and bicycle traffic. When determining cases of falls with the aid of a questionnaire, short and representative times of the year should be chosen, enabling effective concentration on monitoring arrangements to be achieved.

When examining the amount of pedestrian and bicycle traffic in the future, in addition to the mode of travel one should also study the gender of the people involved in order to determine the actual risk of injury to women and men. The amount of pedestrian and bicycle traffic should be calculated separately for the summer and winter periods to determine seasonal variations in the mode of travel.

In the cities studied approximately 10% of the amount of the costs caused to the community by accidents involving falls were used for route maintenance. In Finland the effects of an improvement or prioritisation of winter maintenance on the number and cost of accidents involving falls have not been studied. Falls to pedestrians are generally caused by slippery conditions in winter and most of the injuries are the consequence of a few peak days, particularly during the period when the temperature fluctuates on either side of zero (so-called zero conditions). To prevent pedestrians suffering falls, high level winter maintenance is essential, even though cases of slipping cannot be completely avoided. On icy and ungritted pedestrian and bicycle routes more injuries are sustained by pedestrians due to slipping than on icy and gritted routes. Maintenance at times when weather and road conditions are changing must continue to be improved.

The winter maintenance classification for pedestrian and bicycle routes favours routes running through the main streets. As a consequence of this, routes lower down the street hierarchy may remain in bad condition for long periods, despite their not failing to meet the set quality objectives. The present maintenance practice does not take into account the requirements associated with different areas and population groups as, for instance, steep terrain or residential areas popular with senior citizens. In order to standardise the maintenance quality and/or make the division of work clearer, the municipalities have the right to demand to the owner of a property that they take over one or more maintenance tasks and to charge the owner for the work done. Among others, the city of Espoo has taken over winter maintenance tasks belonging to property owners and hopefully this practice will spread to other towns and cities in Finland.

No clear relationship exists between the condition and evenness of an unfrozen road surface and the number of cases of falls. Pedestrians move about within the constraints set by the conditions and walk more carefully on a surface that is in poor condition. With cyclists the number of falls, on the other hand, is correlated with the condition of the road surface; an even surface in good condition reduces the number of falls.

The chances of people nowadays to prepare themselves better for poor road conditions should be locally improved by developing public announcements and keeping people informed. Motorists are warned on local radio on the basis of information supplied by Finnra's road weather service. In addition to motorists, warnings could also be given to pedestrians and cyclists. At times when slippery conditions are at their worst, these could be recommended to postpone their journey to a time when it has been possible to improve the condition of the routes.

The precise recording of single cases of falls by pedestrians and cyclists, together with GIS data, would provide an opportunity to keep longer term records, and especially to monitor the most serious accidents. In Sweden, traffic accidents, as also single accidents involving pedestrians and/or cyclists, are already recorded in some towns and cities and this practice is spreading to cover the entire country.

Through cooperation with, and product development among, shoe and boot manufacturers and importers adequate friction characteristics should be standardised for footwear and the latter marked with an appropriate label.