Anti-slip devices to prevent pedestrians from slipping and falling during wintertime
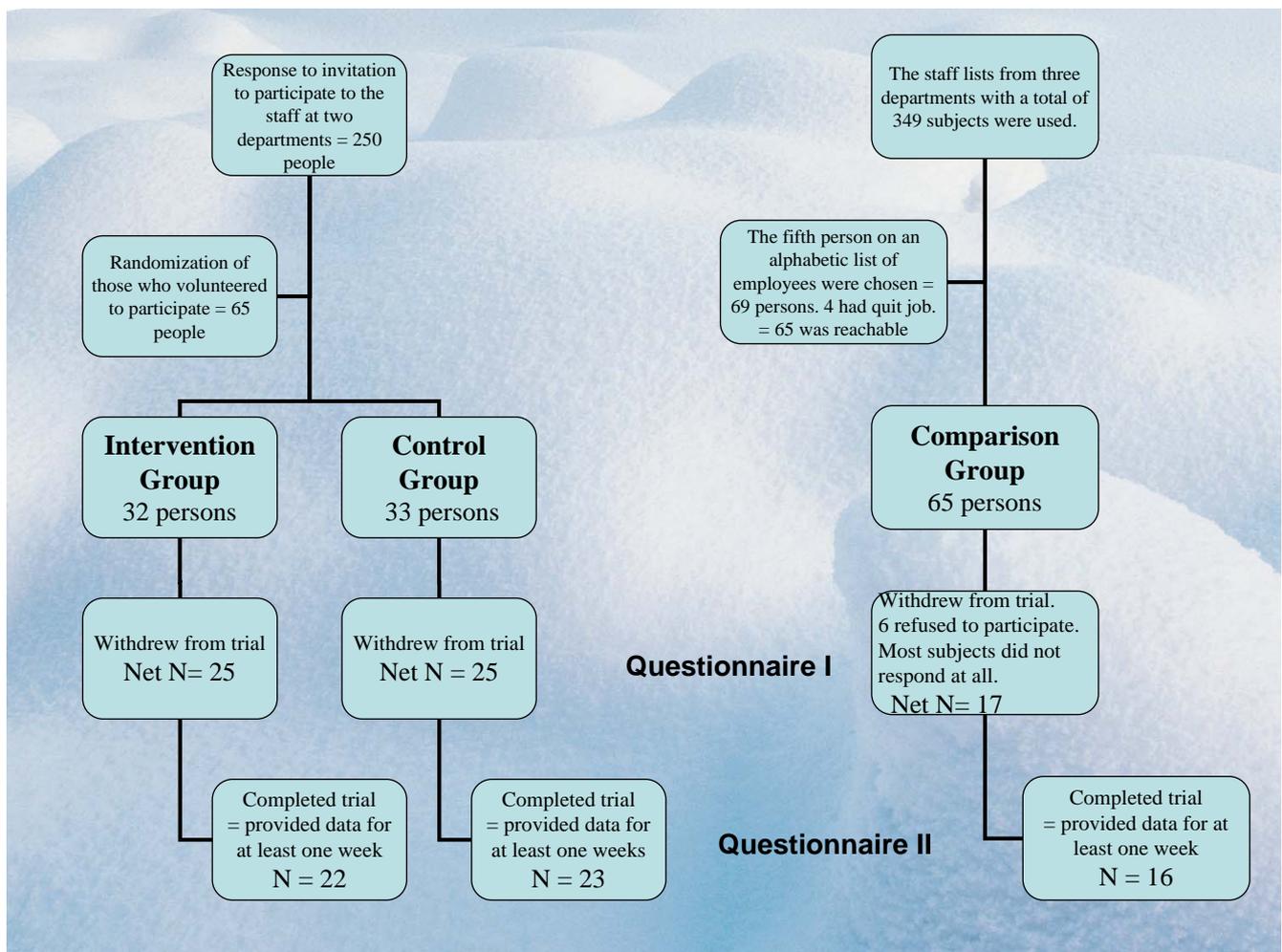
Glenn Berggård
Department of Civil, Mining and Environmental Engineering,
Luleå University of Technology,
Sweden

Aim

- Pedestrian exposure during wintertime
- Occurence of slips or falls
- Preventive gains of anti-slip devices

Slide 1 (flowchart):

Response to invitation to participate to the staff at two departments = 250 people

The staff lists from three departments with a total of 349 subjects were used.

Randomization of those who volunteered to participate = 65 people

The fifth person on an alphabetic list of employees were chosen = 69 persons. 4 had quit job. = 65 was reachable

Intervention Group
32 persons

Control Group
33 persons

Comparison Group
65 persons

Withdrew from trial
Net N= 25

Withdrew from trial
Net N = 25

Withdrew from trial. 6 refused to participate. Most subjects did not respond at all.
Net N= 17

Questionnaire I

Completed trial = provided data for at least one week
N = 22

Completed trial = provided data for at least one weeks
N = 23

Completed trial = provided data for at least one week
N = 16

Questionnaire II

Forms used

- I, **Background**, health, attitudes and previous experiences in the beginning of the trial period
- II, **Daily diary** of walked distance, walking conditions, walking aids and occurrence of incidences or falls reported weekly
- III, **Detailed incident or fall report** used after each occurrence of incident or fall.
- IV, **Experiences of the use of anti-slip devices** to those who used anti-slip devices during the trial period.

A fall was defined to the subject as an occurrence when another part of the body than the feet was in contact with the ground.

All forms were available on paper, in digital format for printing out or submitting by e-mail, both in Word and PDF-format

Baseline characteristics of the net subjects

Characteristics	Group			
	Intervention	Control	Comparison	Total
N	25	25	17	67
Ages, yr	30-67	27-64	30-63	27-67
Female, %	60	60	60	60

Previous experiences of falls

Characteristics	Group			
	Intervention	Control	Comparison	Total
Total no. of falls previous during the winter	10	8	6	24
No. of falls previous during the winter by female	5	5	1	11
% falls by female	50	63	17	46

Total walking distance and time

Characteristics	Groups; no. (and %) of study subjects			
	Intervention	Control	Comparison	Total
Mean daily total walking distance, km	2.95 (N=919)	2.85 (N=1,093)	2.77 (N=451)	2.87 (N=2,463)
Mean daily total walking time, minutes	32 (N=919)	33 (N=1,094)	37 (N=446)	33 (N=2,459)
Total walking distance, km	2714	3099	1247	7061
The groups share of the total distance, % of 7061 km	38	44	18	100

Walking conditions

Characteristics	Intervention	Control	Comparison	Total
Mean daily walking distance in darkness, km	1,76 (N=255)	0,92 (N=314)	1,83 (N=105)	1,38 (N=674)
Mean daily walking distance with reflex, km	2,28 (N=132)	2,02 (N=59)	2,93 (N=33)	2,31 (N=224)
Mean daily walking distance in street lightning, km	1,75 (N=266)	1,22 (N=238)	1,77 (N=113)	1,55 (N=617)
Mean daily walking distance with walking sticks, km	5,00 (N=4)	5,00 (N=16)	4,69 (N=20)	4,85 (N=40)
Mean daily walking distance with anti-slip devices, km	3,36 (N=284)	5,88 (N=52)	3,15 (N=20)	3,71 (N=356)

The exposure for users and *non users* of anti-slip devices

Characteristics	Group			
	Intervent	Control	Comparison	Total
Mean daily total walking distance for subjects when using anti-slip devices, km	3.68	6.51	3.55	4.08
No of days with walk trips for subjects with anti-slip devices	284	52	20	356
Mean daily walking distance when using anti-slip devices, km	3.36	5.88	3.15	3.71
The groups shares of days with walk trips with anti-slip devices, %	80	15	5	100
Total walking distance during days using anti-slip devices, km	953	305	63	1,321
Share of total walking distance with anti-slip devices, %	72	23	5	
Mean daily walking distance for subjects NOT using anti-slip devices, km	*2.63*	*2.65*	*2.73*	*2.66*
No of days with walk trips for subjects NOT using anti-slip	*635*	*1,041*	*431*	*2,107*
The groups shares of days with walk trips NOT using anti-slip devices, %	*30*	*49*	*21*	*100*
Total walking distance during days when NOT using anti-slip devices, km	*1,670*	*2,761*	*1,177*	*5,608*
The share of days with walk trips with anti-slip devices compared to all days with walk trips within each group, %	31	5	4	14

Walking distance in different age groups

Characteristics	Age group		
	-44	45-	Total
Total walking distance, km	2.48 (N=1,075)	3.21 (N=1,357)	2.89
Distance with anti-slip devices, km	1.73 (N=69)	4.19 (N=287)	3.71

Incidents or falls

Characteristics	Group			
	Intervention	Control	Comparison	Total
Subjects using walking diaries	22	23	16	61
Total no of reported walking days	1,028	1,138	492	2,658
Subjects reporting incidents or falls	9	13	6	28
% subjects reporting incidents or falls	41	57	38	46
Subjects using anti-slip devices	19	8	5	32
% subjects anti-slip users	86	35	31	52
Number of incidents or falls	29	23	12	64
Incidents or falls per day	0.0282	0.0202	0.0244	0.0241
Incidents or falls per subject	1.3182	1.0000	0.7500	1.0491

Incident or falls and actual falls

Characteristics	Intervention	Control	Comparison	Total
Total number of incidents or falls	29	23	12	64
Number of incidents or falls when walking <u>with</u> anti-slip devices	8	1	0	9
Number of incidents or falls when walking <u>without</u> anti-slip devices	21	22	12	55
Number of subjects reporting => 1 incidents or fall	9	13	6	28
Number of subjects reporting => 3 incidents or fall	5	3	0	8
No. of actual falls with anti-slip devices	1	0	0	1
No. of actual falls without anti-slip devices	1	5	0	6
Stated prevented no. of falls by using anti-slip devices (* and walking sticks)	5	1*	0	6

Number of incidents or falls and the usage of anti-slip devices

Incidents or falls	Number of days		Total
	With anti-slip devices	Without anti-slip devices	
No	347 (14%)	2,050 (86%)	2,397
Yes	9 (14%)	55 (86%)	64
Total	356	2,105	2,461

Mean daily total walking distance compared with experiences of incidences or falls

Variable	Group			
	Intervention	Control	Comparison	Total
Mean daily total walking distance with incidence or fall, km	2.58 (N=29)	2.95 (N=23)	2.95 (N=12)	2.78 (N=64)
Mean daily total walking distance without incidence or fall, km	2.97 (N=919)	2.84 (N=1091)	2.76 (N=451)	2.87 (N=2397)
Incidence or fall per km	0.0106	0.0074	0.0096	0.0091

Relative incidence or falls and actual fall rate for anti-slip users and non users.

	Anti-slip		
	Users	Non users	Total
No of days	356	2,107	2,463
Mean daily walking distance, km	4.08	2.66	2.87
Total walking distance, km	1,453	5,607	7,061
No of incidences or falls	9	55	64
Incidence or fall per km	6.2×10^{-3}	9.2×10^{-3}	9.0×10^{-3}
Actual falls	1	6	7
Fall per km	0.69×10^{-3}	1.07×10^{-3}	0.99×10^{-3}

Mean daily walking distance with anti-slip devices compared with experiences of incidences or falls

| Variable	Group			
	Intervention	Control	Comparison	Total
Mean daily walking distance on anti-slip devices with incidence or fall, km	1.78 (N=8)	4.80 (N=1)	- (N=0)	2.12 (N=9)
Mean daily walking distance on anti-slip devices without incidence or fall, km	3.40 (N=276)	5.90 (N=51)	3.15 (N=20)	3.75 (N=347)

Experiences from reported incidents or falls

75% in daylight

19%

Winter shoes were used
in 56 slip/fall cases

Ordinary shoes were
used in 5 cases
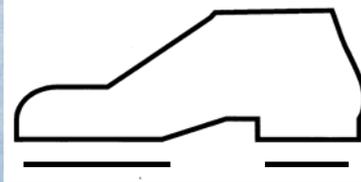
Foot blade device in 2 cases

Heel device in 4 cases

Snow covered 37%

Sand 1 case/
Gravel 3 cases

Uncovered ice 45%

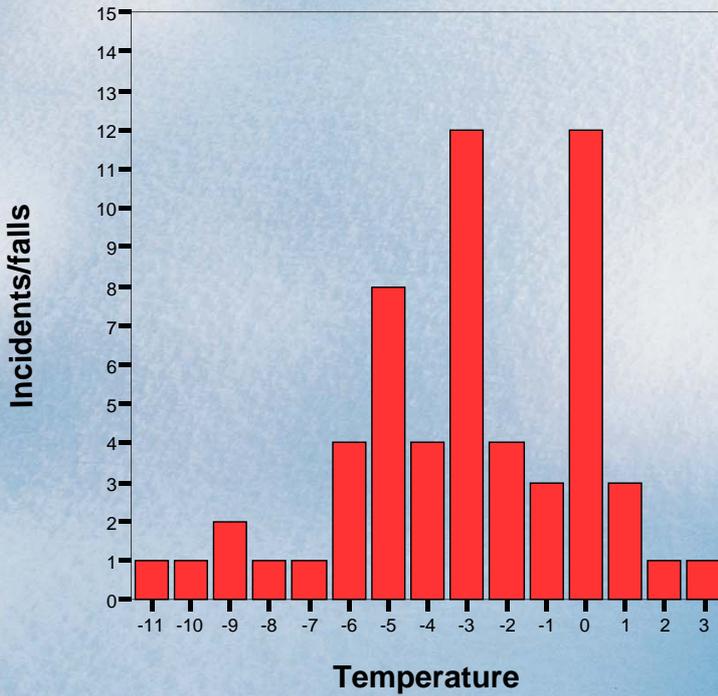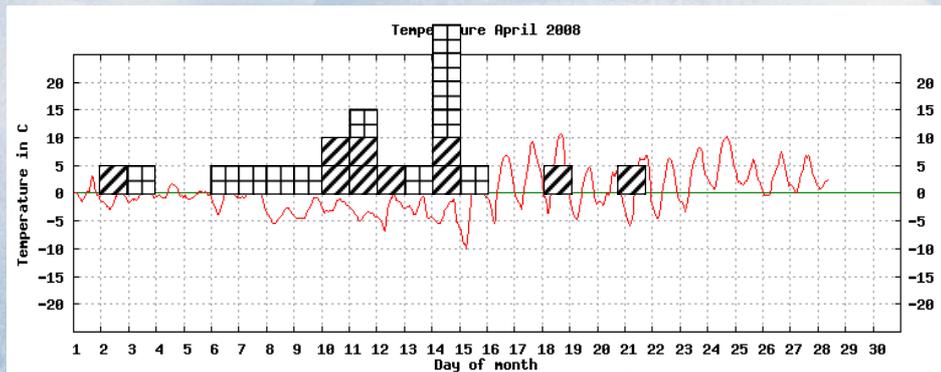| Loos snow/slush 20%	Packed snow 26%	Thick ice 35%	Thin ice 15%

Slush

Ice

Temperature and incidence or falls

~80% from -6 ^{0}C and 0 ^{0}C

Incident or fall occurrence and temperature
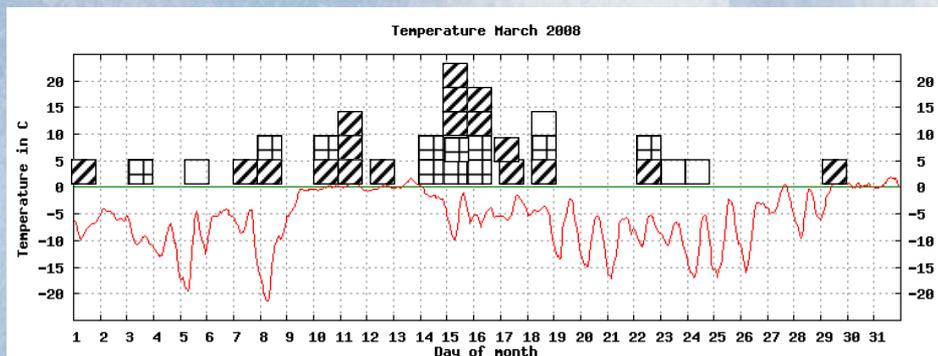
Conclusions

- The anti-slip users walked longer compared to non users
- An incident or fall wearing anti-slip devices reduced the walking distance that day
- Anti-slip devices prevents from falling
- The users of anti-slip devices will continue to do so and they will also recomend others to do so.

The most favourable forms were in PDF-format submitted by e-mail