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Musculoskeletal and skin disorders in a population of floor-layers

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In a case report Robertson et al.[1] have drawn attention on occupational bursitis in floor-layers and in a preliminary report Tanaka et al.[2] have suggested that knee-joint inflammation was much more frequent in this occupational group. The epidemiological study by Thun et al.[3] has shown an increased prevalence of bursitis, knee effusion and skin infection of the knee in floor-layers. These findings have been related to several sources of knee trauma, such as frequent kneeling. Their data suggest that there is a substantial knee morbidity in this occupational group.

Bursitis is recognized by the Swiss legislation as an occupational disease provided that the causal relationship with a particular job is established with a probability higher than fifty percents. Between 1983 and 1987, 1544 cases of chronic bursitis have been registered by the Swiss occupational insurance[4], but the location is not specified and it is not possible to give the prevalence of the disorder from these statistics.

In the frame of a study the main purposes of which were an assessment of hydrocarbon-induced toxic effects on the kidney[5], the pancreas[6] or the nervous system[7] we had the opportunity to study this issue in a group of floor-layers.

A history of knee morbidity was looked for and the prevalence of some complaints affecting the musculoskeletal system or the skin was assessed as well.

As the literature in this field is rather scarce the purpose of this work was to see whether the findings of Thun et al.[3] were also valid in a group of Swiss floor-layers, whether other parts of the musculoskeletal system were affected as well, and whether further preventive steps should be undertaken.

Subjects and methods

Subjects

The study group was selected according to the main purpose of this work, i.e. the assessment of the toxic effects of hydrocarbons. A detailed description of the study group and of the selection rationale has been published elsewhere[5]. Briefly summarized, the participating workers were invited to a general health examination or had to undergo a periodic or preplacement medical examination. All participants were examined in the same way by the physicians of the Institute of Occupational Health where the examinations took place. The main advantage of this selection procedure is that all workers were «apparently» healthy men who were working at the time of the examination and did not have any special reason to consult a physician about possible work-related symptoms. To avoid a recall bias no subject did know that we were interested in the musculoskeletal or skin morbidity and the medical examination was always presented either as a periodic or as a preplacement medical examination or as a general evaluation of the possible occupational risks. Patients referred to us for a possible occupational disease were not eligible.

279 workers were eligible for study. The floor-layers (n=111; mean age 36.2 years, range 16–66) came from 20 plants with 2 to 18 workers. A representative sample could not be drawn because there is no occupational register which would allow it but we tried to have a sample of different working conditions. This group comprises 104 presently active floor-layers and 7 ex-floor-layers.

The comparison group (n=144; mean age 42.1 years, range 16-73) is constituted of workers from several plants with a fairly broad spectrum of occupational physical work. It includes 25 printers, 23 laboratory workers, 36 workers from a cable producing and installing plant, 43 roadmen and 17 people employed in miscellaneous jobs. A detailed description of these subgroups has been published elsewhere[5].

15 eligible workers did not participate (10 refusals, 5 because of organizational problems) and 9 people were not considered because of missing data in the occupational (n=5) or previous clinical history (n=4). The total loss is then 24 (8.6%), 13 and 11 workers in the floor-layer and the comparison group respectively.

Methods

Knee morbidity means any previous medical history related to the knee joint located in the nonarticular surrounding tissues, such as persistent knee pain, knee effusion, knee tap, bursitis, infection or operation. We did not try to collect an accurate medical diagnosis because we felt that it is very difficult to distinguish between articular and nonarticular damage on the ground of anamnestic data[3]. Doubtful cases were coded as positive in the comparison group and as negative in the floor-layer group to minimize a possible interpretation bias.

Arthralgias at any site (other than gonalgias), knee pain, bursitis of the prepatellar or infrapatellar bursa, myalgias and bone pain (both at any site) at the present clinical history were also recorded. A complaint was considered of occupational origin only if this seemed probable, that is, if it has an obviously work-related pattern. Doubtful cases were classified as of nonoccupational origin.

It should be stressed that a previous medical history should be considered as a «lifetime prevalence». On the contrary, a prevalence was calculated for current arthralgias, knee pain, bursitis, myalgias and bone pain. Present clinical history means «at the time of the examination or during the 1 to 2 months before it».

A hyperkeratosis was defined according to Lachapelle[8].

A clinical examination of the knee joint was made but this proved difficult because an exact standardization of the examining methods and of the coding of the findings was not easy to achieve. This precludes a meaningful statistical analysis. In their small validation study Thun et al.[3] did also notice that the predictive value of the physical examination of the knee joint is not satisfactory.

Written instructions were given to the examining doctors and the coding of the answers were reviewed by the same occupational health practitioner.

Social class was defined according to the Swiss Federal Office for Industry and Labor[9].

Statistics

Comparisons between groups used the chi-square test unless otherwise mentioned. All calculations were done with the statistical package for social sciences[10].

Results

A «floor-layer» could have two different activities : floor-laying and/or floor-impregnating. In the study group all workers (n=111) have carried on both activities. There were only 12 workers who impregnated floors most of the time, the others being only floor-layers, so that the job duration for both activities taken together was very similar to the job duration for floor-laying only (Table 1). Therefore, we felt that making two different subgroups would not be very meaningful and all subjects will subsequently be referred to as «floor-layers».

Tab. 1. Duration of employment (in years).

Percentile	10	50	90	minimum	maximum
Floor-laying and/or floor impregnating (n = 111)	1.5	9.8	27.1	0.1	47.3
Flor-laying only (n = 111)	0.1	7.2	27.1	0	47.3

A past history of knee morbidity was found in 52 (46.8%) floor-layers and in 26 (18.1%) workers from the comparison group, this difference being highly significant (p <0.00001; Table 2). The knee morbidity increases with the job duration, the proportion of affected people being as high as 70 % in the floor-layers having worked in this job for more than 20 years (Table 3).

Tab. 2. Previous history of knee morbidity.

	Previous history		
	positive n(%)	negative n(%)	
floor-layers	52 (46.8)	59 (53.2)	111 (100)
comparison group	26 (18.1)	118 (81.9)	144 (100)

Chi square : $p < 0.00001$

Presently impregnating floors or having impregnated floors was not related to the knee morbidity (p=0.13). The knee morbidity was similar in the subgroups which constitute the comparison group (p=0.92). It was not related to the social class (p=0.51).

The prevalence of current arthralgias, gonalgias and myalgias was distinctly higher in the floor-layer than in the comparison group (Table 4) and a similar but weaker trend was observed for the present history of bursitis (p=0.07). There was no complaint of bone pain in either group.

Lee et al.[11] have described a dose-related increase in the joint pain prevalence of toluene-exposed workers. As our printer group is moderately exposed to toluene[12] and as toluene is the mean air contaminant in the floor-laying work[7], a more detailed analysis of the prevalence of arthralgias was done by comparing the floor-layers, the printers and a group of workers without any occupational history of hydrocarbon exposure according to a previously described questionnaire[5]. However, although the printers' exposure to toluene was around the biological threshold value (1.58 mol hippuric acid/mol creatinine or 2.5 g/g)[12] their prevalence of work-related arthralgias and myalgias was not at all increased compared to never hydrocarbon-exposed workers.

Obesity (body mass index above 27.1 kg/m2) was somewhat more often encountered in people complaining about arthralgias (p=0.04), but was associated neither with myalgias nor with knee pain (p=0.45). Its prevalence was not significantly different in the floor-layer and the comparison group (p=0.36). Then, this possible confounding factor cannot explain the difference between groups.

Tab. 3. Knee morbidity and job duration.

			job duration (in years)						
			0-1	>1-3	>3-5	>5-10	>10-15	>15-20	>20
Previous history	negative	n=	14	11	10	7	8	3	6
		%	77.8	73.3	66.7	50.0	40.0	33.3	30.0
	positive	n=	4	4	5	7	12	6	14
		%	22.2	26.7	33.3	50.0	60.0	66.7	70.0

Chi square : $p < 0.02$

Tab. 4. Prevalence of musculoskeletal disorders.

		knee pain[a]			arthralgias[b]			myalgias[c]		
		no	NWR	WR	no	NWR	WR	no	NWR	WR
floor layers	n	92	5	13	66	16	29	97	4	10
	%	83.6	4.5	11.8	59.5	14.4	26.1	87.4	3.6	9
comparison group	n	129	12	3	98	33	11	141	3	0
	%	89.6	8.3	2.1	69.0	23.2	7.7	97.9	2.1	0

NWR : not work-related
WR : work-related; cases with a mixed origin (NWR and WR) taken together as WR in this table for simplification.
a) $p = 0.009$ *b*) $p = 0.00003$ *c*) $p = 0.0008$

Five floor-layers but no worker from the comparison group complained about nonallergic skin disturbances at the present clinical history ($p=0.05$).
An occupationally induced skin anomaly was observed at the clinical examination in 94 (85.5%) floor-layers and 26 (18.2%) workers in the comparison group. In the floor-layers this anomaly was in most cases ($n=72$) only a hyperkeratosis at the knee joint and/or at another site, that is a benign condition. The 24 other cases constituted a heterogeneous group with combinations of occupational and/or non occupational skin anomalies and/or hyperkeratosis at one or several sites. There was no relationship between a previous history of knee morbidity and the presence of a knee skin anomaly ($p=0.33$).

Discussion

The interest of the study is twofold. Firstly, it confirms that the knee morbidity in floor-layers is not negligible since about 47% floor-layers and only 18.1% workers in the comparison group have a positive previous history. This estimate should be viewed as rather conservative, as the condition set for coding a history as positive has probably rather underestimated the magnitude of the problem in the floor-layer group.

This lifetime prevalence of knee morbidity is of the same order of magnitude as that reported by Thun et al.[3] who found that 47% of their floor-layers reported having had at least one episode of either knee aspiration or bursitis compared with only 11% of the comparison group.
The higher prevalence of knee pain in the floor-layer group is in accordance with this observation as is the trend toward more bursitis in the floor-layer group. One could object that psychosocial factors could also play a role[13] but it is unlikely that it explains the whole difference between groups owing to the obvious relationship between occupational knee stress and knee morbidity.
Age is another potential confounding factor but as the floor-layers were younger than the workers from the comparison group it could hardly explain our results. Sport could also bias the results. However, it is often hardly possible to distinguish between a work- and a sport-induced knee damage. We do not think that this has been an important bias because our results agree very well with those of Thun et al.[3] who excluded all workers with a history of sport injuries.
Secondly, the higher prevalence of occupational arthralgias and myalgias is interesting. Although Lee et al.[11] noted a dose-related increased prevalence of arthralgias in their toluene-exposed groups, we think

that the hypothesis of hydrocarbon-induced arthralgias should be viewed with caution. However, our printers were exposed to toluene concentrations comparable to that measured by Lee et al.[11] but did not complain over more occupationally-induced arthralgias. Furthermore, this symptom is generally not ascribed to the hydrocarbon exposure and, thirdly there are several potential confounding factors such as the physical demand at work or the psychosocial stress which should be considered as well. Finally, there is no physiopathological rationale which would explain hydrocarbon-induced arthralgias.

The same reasoning could apply to the work-related myalgias but as Pedersen et al.[14] described a hydrocarbon-induced myopathy even after considering several confounding factors, a toxic effect seems at least possible.

In any case, we think that both findings should be interpreted with caution and that it would be premature to ascribe the work-related arthralgias or myalgias of the floor-layers solely to a toxic effect without having done a careful ergonomical analysis.

The skin morbidity was much more heterogeneous than expected so that it was not possible to code meaningfully for every particular disease or disease-combinations encountered. Nevertheless, this result suggests that it was in most cases a benign condition.

As the proportion of workers who could not be included in the final analysis was rather small (8.6%) this should not have heavily distorted the results of the study. Of more concern is the nonrandom selection of the floor-layers and of the comparison group. Better data on the knee morbidity of floor-layers could however be gained in a prospective study which would have the advantage that the medical diagnosis would be more accurate than the broad categories used in the previous history. Whether the selection we made has introduced a bias cannot be definitely answered with the available data, but it should be stressed that the comparison group was a heterogeneous «mixture» of people with very different jobs, what make a bias less likely.

In conclusion, alhough this study has some drawbacks it suggests a distinctly higher musculoskeletal morbidity, first of all of the knee, in floor-layers. The economical burden related to this morbidity is not known, but it is probably not negligible. We then think that it would be worth collecting more accurate information on the muskuloskeletal and skin morbidity of floor-layers. Simultaneously, more efficient preventive measures[15] should be taken to reduce the occupational prevalence of musculoskeletal and cutaneous disturbances in this occupational group on the basis of a careful ergonomical analysis.

Summary

In the frame of a study on hydrocarbon-induced toxic effects, the knee morbidity and the prevalence of work-related arthralgias, gonalgias, myalgias and skin anomalies were investigated in a group a floor-layers. The results show that a previous history of knee morbidity is distinctly higher in floor-layers and that these workers have a higher prevalence of musculoskeletal and cutaneous disturbances than the comparison group. Owing to the fairly high prevalence of these troubles, it seems that this pathology deserves more attention and that more efficient preventive measures are indicated.

Résumé

Troubles locomoteurs et cutanés chez les poseurs de sol

Dans le cadre d'une étude sur les effets toxiques des hydrocarbures, la morbidité due à l'atteinte de la région du genou ainsi que la prévalence d'arthralgies, de myalgies et de lésions cutanées liées au travail ont été examinées dans un groupe de poseurs de sol. Les résultats montrent que l'atteinte de la région du genou est nettement plus fréquente chez les poseurs de sol et que la prévalence de troubles locomoteurs ou cutanés est augmentée dans ce groupe. Compte-tenu de la prévalence assez élevée de ces divers troubles, il paraît que la pathologie de ce corps de métier mériterait davantage d'attention et que des mesures préventives plus efficaces devraient être envisagées.

Zusammenfassung

Bewegungsapparat- und Hautbeschwerden bei Bodenlegern

Die auf Beschwerden des Kniegelenkes oder dessen umliegenden Weichteile zurückzuführende Morbidität ebenso wie die Prävalenz von Arthralgien, Myalgien und Hautkrankheiten wurden im Rahmen einer Feldstudie über die toxischen Wirkungen von Kohlenwasserstoffen in einer Gruppe Bodenleger untersucht. Die Resultate zeigen, dass die Bodenleger ein Knieleiden deutlich häufiger aufweisen, und dass die Prävalenz von Störungen des Bewegungsapparates in dieser beruflichen Gruppe erhöht ist. Es scheint, dass es angezeigt wäre, der Pathologie dieser beruflichen Gruppe mehr Beachtung zu schenken und wirkungsvollere Präventivmassnahmen ins Auge zu fassen.

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