HETA 98-0308-2785
International Union of Bricklayers and Allied Craftworkers (IUBAC)
Washington, D.C.

Shiro Tanaka, MD, MS

PREFACE

The Hazard Evaluations and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (NIOSH) conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, technical and consultative assistance to Federal, State, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Shiro Tanaka of the Surveillance Branch, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Data analysis was performed by Martin Petersen, PhD, and Kathleen L.Watkins, DSHEFS. Administrative assistance with the mailing of the questionnaire was provided by the International Union of Bricklayers and Allied Craftworkers (IUBAC), Washington, DC. Desktop publishing was performed by Nichole Herbert. Review and preparation for printing was performed by Penny Arthur.

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Health Hazard Evaluation Report 98-0308-2785
International Union of Bricklayers and Allied Craftworkers (IUBAC)
Washington, DC
April 2000

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SUMMARY

On August 10, 1998, the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation (HHE) request from the International Union of Bricklayers and Allied Craftworkers (IUBAC) of Washington, DC. The requester was concerned that many of their members must kneel to perform their work (such as laying tiles on the floor) at a variety of construction sites, but was not sure whether or not the workers were provided with adequate knee protection to perform their tasks safely. If such were provided, the requester was also concerned about the usage of the knee pad among workers and the protective quality thereof.

A self-administered questionnaire survey was conducted among the members who were systematically selected, inquiring about their work history, history of knee problems, use of knee pads, and evaluation of the knee pad. The results indicated, among other things, that the amount of work time kneeling is closely associated with the use of knee pads; the median percentage of kneeling time at work was 50% for knee pad users and 8% for non-pad users. The knee pad users wore the pad 5 days per week, 6 hours per day (both medians). About 18% of the respondents reported that they had experienced a work-related knee problem. Among those who had a knee disorder, 33% lost one or more days of work due to that disorder. The average number of workdays lost for job-related knee disorder (22 days) was significantly more than those for non-job related knee disorders (3.5 days). (However, whether or not the disorder was due to chronic kneeling or acute injury was not determined.)

When various attributes of currently used knee pads were rated on a scale of 1 (worst) to 4 (best), 'ease of putting on/off' and 'protection against sharp objects' received median rating of 4; and 'durability' and 'comfort of padding' were rated 3, while 'comfort of support' and 'resistance to moisture' were rated 2, suggesting the need for improvement in these attributes. The median useful life of the padding was 16 weeks and a pair was replaced at a median interval of 7 months. The median cost of a pair was $20. Only 8% of the knee pad users reported that their pads were provided by their employer; 91% bought them on their own. Two-thirds of the pad users felt that the employer had a responsibility for providing them. Possible consequences of working without the knee pads were reported to be knee pain and/or inflammation, or slowing down of the work to avoid such pain and inflammation, suggesting that this PPE is good for productivity. Currently, Occupational Safety and Health Administration (OSHA) regulations on personal protective equipment (PPE) do not include a specific requirement for knee protection.

Members of IUBAC who must work kneeling mostly wear the knee pads for protection of their knees and to avoid knee pain. While it is very difficult to perform kneeling tasks without the knee protection, currently most of survey respondents who use knee pads must purchase this protection on their own. Survey respondents also indicated that improvements are needed in various components of knee pads, for example, the straps need to be made more supporting and comfortable, or the pads made more resistant to moisture.

Keywords: SIC 15 (Building construction - general contractors and operative builders), SIC 17 (Construction - special trade contractors), also SIC 12 (Coal mining, if low seam mines are encountered), kneeling work, knee protection, knee pads, personal protective equipment (PPE); bricklayers, cement workers, marble masons, stone masons, terrazzo workers, tile layers.

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INTRODUCTION

On August 10, 1998, the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation (HHE) request from the International Union of Bricklayers and Allied Craftworkers (IUBAC), Washington, DC. The requester was concerned that many of their members must kneel to perform their work (such as laying tiles on the floor) at a variety of construction sites, but was not sure whether or not the workers were provided with adequate knee protection to perform their tasks safely without incurring injuries and/or inflammation to the knee. The requester was also interested in the workers' usage of knee pads and, if they were used, their protective quality. In response to this request, the project officer visited three IUBAC locals (Dayton, Ohio; Indianapolis, Indiana; and Oakland, California) to learn about the members' work practices, and to pretest a questionnaire on several volunteer workers. In October 1998, NIOSH mailed the questionnaire to the sampled members, and again in February 1999, to those who did not respond to the first mailing. The survey was closed on April 30, 1999. (See Methods Section for the detail.) On June 9, 1999, preliminary results were presented to the requester and also at the 1999 U. S. Public Health Service (PHS) Commissioned Officers Association Professional Conference held in Washington, DC.

BACKGROUND

General

Since construction work involves many types of job tasks that are performed close to the ground or floor, kneeling posture is unavoidable for many construction trade workers. For example, the floor must be prepared by cement masons, floor layers, and tile setters, often in kneeled positions. Carpenters, plumbers, and roofers also have to work frequently in kneeled positions. Outside of construction, coal miners who work in low seam mines spend much of their working hours on their knees. Local pain, discomfort, and resultant health consequence of kneeling directly on hard surface could be readily experienced by any person who attempted such an act and would hardly require scientific proofs for their cause-effect relationship. A good example would be the need for kneeling cushions used in places of worship. Surveillance data also indicate that workers in construction trades which tend to require kneeling posture show higher incidence rates of knee disorders.[1,2] A recent Swedish study has also shown that the relative risk of incurring knee disorders is closely related to the proportion of time spent in kneeled posture by workers.[3] A previous NIOSH study indicated that tile setters were at an increased risk of incurring knee disorders, and carpet layers were at an added risk, since they used the knee kicker to stretch carpet wall to wall.[4] Since it has long been established that kneeling work is hazardous to the knee, this HHE does not involve medical examinations of the knees to document this known fact.

If it is not feasible to "engineer out" or replace kneeling tasks, the next line of defense is in the realm of personal protective equipment (PPE), in this case, the knee pad. This is the concern raised by the requester of this HHE. Descriptions of, or testings about the knee pad have been published from France, Germany, and Sweden.[5,6,7,8,9] U.S. scientific literature on knee pads is very limited; only three internal reports were uncovered.[10,11,12] In 1985, NIOSH reported on the effects of kneeling on the skin of the knee,[13] and in 1990 NIOSH published a Hazard Alert on carpet layer's knee problem, in which the knee pad was discussed.[14] Currently, Occupational Safety and Health Administration's (OSHA) regulations on PPE do not include any type of knee protection,[15,16] nor is there any applicable American National Standard Institute (ANSI) standard on the knee pad.

METHODS

A questionnaire was developed, pre-tested, and mailed to a stratified systematic sample of 3,462 members from the various trade categories of the IUBAC roster. (For example, after picking the first person randomly, every N^{th} person in the roster was sampled [N = 2, 3, 4, . . . etc.] depending on the size of the group and sample.) This was done solely for convenience in an attempt to get enough data in each occupational stratum. The data within each stratum were assumed to be in random order with respect to variables of interest, and all data were analyzed as a simple random sample. The questionnaire was self-administered by each recipient and returned to NIOSH in a self-addressed post-paid government envelope. The first mailing took place in October 1998 with a cover letter from the president of IUBAC. The questionnaire was mailed a second time in February 1999 to those sampled members who had not responded to the first mailing. Returned questionnaires were keypunched and edited, and a SAS dataset was created for statistical analysis.[17]

Items in the questionnaire included demographic information, present and past trade/occupation, percent of work time kneeling, past medical history of the knees, use of the knee pad and its composition materials (outer shell, padding, and support), evaluation of the pad's attributes (comfort, support, durability, price, etc.), and possible personal consequences of not wearing the knee pad. Space was provided for additional comments.

The initial intent of the sampling was to obtain representative samples with regard to the amount of kneeling. For each occupation/trade category, we calculated the sample size using factors such as the estimated percent of work time spent on kneeling and the size of membership. Based on casual observation (not by an actual ergonomic time study) and in consultation with union local officials, we categorized these trade groups into 'occasional' kneelers such as bricklayers, 'intermediate' kneelers such as marble masons, and 'frequent' kneelers such as tile layers. For example, we sampled 50% of 901 stone masons who would kneel 10% of the time to obtain 450 samples, which would have given us the confidence interval of $\pm$10%, assuming a participation rate of 75%.

RESULTS

The questionnaire was mailed to 3,462 sampled members, of which 42 were returned by the Postal Service as "no forwarding address." After two mailings, a total of 736 members responded to the questionnaire (response rate: 21.5%), of which 10 were excluded because of their retirement status. The remaining 726 were used in further analysis (referred to as respondents). The respondents included 717 males and 9 (1.2%) females. Since the number of females was small, they were combined with the males in the data analysis. No race/ethnicity information was obtained from the questionnaire. Respondents were further categorized by whether or not they used the knee pad in the current or previous job. There were 515 (71%) knee pad users and 211 non-pad users (including 2 unknowns).

Not all respondents answered all questions, resulting in missing values. Respondents with missing values were excluded from statistical analyses that required those values. Since the response rate was not high, statistical significance tests were not performed routinely to compare two or more means.

Geographic distribution of respondents - Table 1 shows that the respondents came from as many as 40 states. However, no statistical test by state or region was conducted, since the respondents were not considered representative of the state or region.

Occupation/trade categories of the respondents, their sample size, response rate, percentage of

work hours spent kneeling, and prevalence of knee pad use are shown in Table 2. It is arranged in descending order of kneeling time at work (the second to the last column). Our initial statistical plan of calculating response rates and confidence intervals for the percentages had to be abandoned for two reasons. First, the response rate was not high; and second, many respondents indicated that they were involved with more than one trade category. Although many respondents indicated multiple occupation/trade categories (on average, 1.9 trades were checked per respondent), their principal occupation or trade is used for calculating the third column of Table 2.

Nonetheless, Table 2 seems to suggest that, based on the responses received, the frequency of kneeling is closely associated with the use of the knee pad. The last two columns of Table 2 show a general parallel relationship. Typically, a very high percentage of tile layers used knee pads, compared to bricklayers or plasterers, who reported kneeling less than 50% of their work time. Trades requiring more kneeling time generally had a higher participation rate. Tile layers and cement masons responded to the survey with the highest and second highest rate, respectively (fourth column), whereas other trade groups showed a generally low response rate.

Age - As shown in Table 3, the median age of the respondents was in the early 40s. The knee pad users were slightly younger than the non-pad users.

Years in BAC membership - Table 4 shows that the median of union membership years of the respondents was 12.5 (range: less than one year to 43.7 years). The knee pad users had slightly shorter years of union membership than the non-users.

Table 5 shows estimated **percent of time kneeling per workday**. It is also a general summary of Table 2. Clearly, the knee pad users worked kneeling several times longer in a workday than the non-pad users (median 50% vs 8%).

History of knee morbidity (Table 6) was elicited by asking, "Have you ever had a knee problem which was treated by a doctor?" Those responding positively (27%) were asked whether or not they thought (or their doctor told them) that it was job-related, and 69% said "Yes." People responding positively to the latter question were asked whether or not they filed a workers' compensation claim for the knee problem, and 39% said they did. Since no time frame was specified, these prevalence may be considered for their (working) life time.

Table 7 shows **workdays lost due to knee problem** in the past 12 months among respondents who reported a history of a knee problem. While 67% of those respondents with history of a knee problem did not lose any workdays, the remaining 33% lost from one day to 365 days of work. (In the latter case, the respondents probably included weekends and holidays as workdays.) The average number of workdays lost was 3.5 ($\pm$ 13.6) for non job-related knee problems, while the job-related knee problems caused on average 22.1 ($\pm$ 66.1) lost workdays.

Reasons for not wearing the knee pad were given by those who indicated that they did not wear the knee pad in their current or most recent job. Multiple responses were allowed. Table 8 indicates that about one-half (49%) of the reasons for not wearing the knee pad are related to lack of perceived need (rarely kneel or knees do not hurt). However, the remaining 51% of the responses suggest that these workers may be in need of knee pads and would wear them if the design and functioning of the knee pad were improved, or if the pads were provided by the employer.

The remainder of the analysis was limited only to those respondents who used the knee pad.

The number of days per week wearing knee pads was 3.8 days (mean) and 5 days (median).

The number of hours per day wearing knee pads was 5.5 hours (mean) and 6 hours (median) per day.

These results indicate that knee pads are worn by these workers on most work days in a week and during most of the working hours.

Rating of attributes of the knee pad is shown in Table 9 by using a scale of 1 (poorest or least desirable), 2, 3, and 4 (best or most desirable). The majority of pad users gave the most favorable rating to "ease of putting on/off" and "protection against sharp objects." "Durability" and "comfort of padding" received a favorable, but not the best, rating. In contrast, "comfort of support" and "resistance to moisture" received a somewhat unfavorable rating, suggesting the need for improvement.

Type and material of the knee pad as reported by the respondents are shown in Table 10. For the padding material, foam or sponge rubber was most common, although their chemical compositions or physical characteristics are not known. For the outer shell, the materials most commonly reported were rubber, hard plastic, and leather. A variety of types of support were also reported. Because of the lack of standard nomenclature for these items, it is possible that some misclassification might have occurred.

Durability of the knee pad was further examined by additional questions. The respondents indicated that the padding was one of the components that tended to wear out most easily (43%), followed by the strap (32%), and the outer shell (25%). The median useful life of the padding was 16 weeks (mean: 27 weeks; range <1 ~ 416).

Replacement of the knee pad: When asked what they would do with the worn out padding material, 535 responses were obtained from 498 knee pad wearers, since multiple responses were allowed. Of these responses, 53% indicated replacement with a new pair, 27% would add their own padding, and 20% would get by with worn padding until the next replacement. These results suggest that many workers are not getting optimum protection from use of the knee pad. The respondents reported that they replaced the worn knee pads with a new pair every 7 months (median; mean was 12.8 months with a range of 1 ~ 204). In this case, the median is more useful, since the large mean results from a few extremely large values.

Acquisition of the knee pad: The majority (91%) of the respondents reported that they paid for the knee pad themselves, while 8% reported that their pads were provided by their employer, contractor, or supervisor, and 1% said that they were a gift from their family or a friend. Those respondents who paid for their own knee pads reported that a pair cost an average of $22 (median $20; range $7 ~ $150). When asked whether or not the employer should provide the knee pad, 67% said "Yes" and 33% said "No."

Possible consequences of working without the knee pad: As shown in Table 11, the majority of the respondents reported that, if they worked without the knee pad, they suffered knee pain or inflammation, or they "had to slow down" their kneeling work to prevent such pain or inflammation. This finding seems to suggest that the use of knee pads is not only for comfort but also for safety and productivity of kneeling workers.

Additional comments: Finally, respondents were asked to make any comments with regard to the knee pad they have used. Altogether 415 respondents wrote some comments, which were categorized and summarized as follows (one person could make more than one comment): 57% of the comments concerned the quality of the padding material; these respondents stated that the padding was not comfortable or durable enough, and that replacement padding was not readily

available. Thirty-five percent (35%) of the comments concerned the strap of the knee pad; many respondents wrote that the straps tended to cut off the circulation (in their leg) or did not provide enough support (the knee pad tended to slip down).

Several people commented that the Velcro[R] fastening device tended to rip out or get clogged when the pad was covered with material such as cement. About 5% reported that they were satisfied with the knee pad they were using.

Several respondents stated that they made their own knee pads. One person stated that he would work squatting instead of kneeling when he worked on the floor. Some of the respondents who said that workers should provide their own knee pads stated that the knee pad provided by the employer would tend to be of inferior quality.

DISCUSSION

According to the Bureau of Labor Statistics (BLS) report for the year 1997,[18] there were 169,000 brick and stone masons, 65,000 tile setters, 89,000 concrete and terrazzo finishers, 1,134,000 carpenters, and 196,000 roofers. A large percentage of these trade workers are known to work kneeling at least part of their working hours. It has been documented that kneeling on hard surface, or repeated pressure on the knee, is damaging to this joint.[4] The BLS' Annual Survey also reports that the contractors for "masonry, stonework, and plastering" and "roofing, siding, and sheet metal work" reported more than 2 times the incidence of occupational injuries and illnesses of the knee involving days away from work as the total private sector working population.[2] Although not all of these knee disorders can be attributed to the kneeling, and the magnitude of the attribution is not known, the existence of a strong association between kneeling and knee disorder is undeniable.[3] The results of this survey, while limited in its scope and suffering from the low participation rate, nonetheless corroborate with this notion. There was an association between the frequency of kneeling at work and the use of knee pads, indicating that kneeling workers are practicing self-protection despite the absence of an OSHA PPE regulation requiring knee protection. There was a clear difference in the median percentage of kneeling time between the knee pad users and non-users. In other words, workers who must kneel on the job must wear the knee pad to work safely and without pain, discomfort, or inflammation to the knee.

With regard to the attributes of knee pads, evaluation by the users clearly indicated areas of need for improvements. While the users were mostly satisfied with their pads for the ease of putting them on and off, and for protection against sharp objects, they were dissatisfied with regard to their pads' uncomfortable support and inadequate resistance to moisture. The durability and comfort of padding were also the items that need improvement. Presented below are some considerations for development of "ideal" knee pads.

Support mechanism - Any PPE must be attached to the body of the worker by some support mechanism against the gravity and motion of the body parts. The knee joint, due to its unique anatomical configuration (wider above with the thigh and narrower below with the calf), seems to pose a special challenge in this respect. Additionally, the knee joints are always flexed and extended whenever the worker kneels down and stands up. Comments made by respondents indicated that the straps tended to cut off the circulation (to the lower leg) if worn too tight or did not provide enough support (the knee pad tended to slip down) if worn comfortably. This type of challenge is not encountered with other types of PPE such as the hard hat or safety shoes.

A few alternatives have been developed and marketed. One approach is to do away with straps by inserting a sheet of padding material into a knee pocket attached to the work trouser.[5] This

system has not been studied systematically but appears to be acceptable to infrequent kneelers such as carpenters and plumbers. However, if the worker kneels frequently, the knee pocket may wear down rather quickly, particularly if the floor is rough and abrasive. Also, regular fabrics are not resistant to water and thus make this method unsuitable to working conditions where moisture or an abrasive surface (such as concrete flooring) is encountered. To overcome these problems, the knee pocket must be made of materials resistant to moisture and abrasion.

It is also conceivable that a knee pad with clasps or fasteners to attach it to the work trouser may be developed. Unlike the straps, this method will not constrict the legs. However, to the extent of the author's knowledge, no such device has been tested or marketed, nor can we predict its effectiveness or acceptance by the workers.

Currently rubber straps are the type most commonly found, according to the IUBAC survey respondents. Some workers reported that the tightening mechanism should be improved. Also, some complained that the Velcro^{R} fasteners tended to be ripped out or clogged up if used in a work environment where gritty materials are present. If the rubber straps are provided with numerous protrusions on the inner surface that faces the trouser, they may provide additional friction for the support.

Knee pads are also sold at sporting good stores for cyclists or rollerbladers. Typically, their supporting part is made of a wide elastic material such as Spandex ^{R} and worn directly over the body part (not over the work wear). Although they are very flexible and well-fitting, they are for protection against injury from a fall and may not necessarily be suitable for kneeling work in wet or rough surfaced areas.

Padding material - Padding in the knee pad should provide comfort and protection to the knee against the work surface, which is usually hard and/or rough. When the worker kneels, the weight of the body is concentrated at the small area of the knee as a downward pressure. Padding reduces this pressure by distributing the weight over a wider area of the knee. For this purpose, the padding should be resilient, comfortably firm, and long lasting. Typically, the padding is made of sponge rubber or plastic foam. An example of the latter is closed cell ethylene vinyl acetate. However, at the present time, there seems to be no standard methods to compare quantitatively the characteristics (such as elasticity and resiliency) of these padding materials. To the extent of this author's search of the literature, which included multiple websites, there seems to be no standard by either the ANSI or the American Society for Testing and Materials (ASTM) to describe or test the characteristics of the padding material. (For example, how well do they withstand the pressure of 100 pounds per square inch for 10 minutes repeated over a 3-day period? How much thickness do they lose under pressure and recover when the pressure is removed?)

The reason behind the lack of such a standard may be that there is not much industrial need for the testing. While these plastic foams are widely used for packaging or insulation, which must withstand certain degree of shocks to protect the contents during the shipment, such impact stress may not be similar to the one for the knee pad. Bicycle helmets have the stylofoam cushioning but, again, their use characteristics may not be applicable to those of the knee pad.

Based on this questionnaire survey, direct observations, and review of knee pad catalogues, it can be said that a variety of knee pads are sold and used. Each worker seems to have his own preference based on the working conditions, availability at the store, fit, and cost. Also, the type of occupation seems to be an important factor in the selection of knee PPE. For example, knee pads used by tile setters must be resistant to the moisture, while carpenters would seldom work on wet surfaces, and roofers probably should not wear knee pads with a slippery outer shell.

It can therefore be concluded that one style or type of knee PPE would not fit all needs. In contrast to the established standard testing methods for the hard hat, safety goggles or ear muffs, standard testing methods for the knee pad need be developed in consideration of the varied components and requirements for the knee pad for a variety of work situations. Further research efforts are sorely needed.

As practiced by one respondent, squatting posture may be an alternative to kneeling. This posture is commonly seen in some Asian countries but not in European or North American countries, with the exception of the baseball catchers. No research reports are available to determine whether or not this working posture is an acceptable or a safe alternative to the kneeling.

Regulations pertaining to knee protection Section 1910.132 General requirements of OSHA's regulation on Personal Protective Equipment[15] and Section 1926.95 Criteria for personal protective equipment (Safety and Health Regulations for Construction)[16] states, in part (**Emphasis** added):

(a) *Application*. Protective equipment, including personal protective equipment for eyes, face, head, and **extremities**, protective clothing, respiratory devices, and **protective shields and barriers**, **shall be provided**, used, and maintained in a sanitary and reliable condition wherever it is necessary **by reason of hazards of processes or environment**, chemical hazards, radiological hazards, or **mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body** through absorption, inhalation, or **physical contact**.

In the Subsections that follow, these regulations specifically list PPEs for the eye, respiratory system, head, etc. However, the knee is not specifically mentioned, although working on the knees on hard surface or over sharp objects meet the conditions described in *Application*.

RECOMMENDATIONS

1. Employers should provide employees who must kneel on the job with knee PPE such as knee pads which will reduce the pressure on the knee and enable them to work without pain, discomfort, or inflammation to the knee.

2. In the absence of an OSHA regulation for the knee PPE, trade unions of construction workers and other labor unions, which include workers who must kneel on the job, can play an active role by:

a. Surveying its membership for the need for knee protection, and the type favored or used by the members.

b. Negotiating with employers to include in the contract a provision for the knee protection.

3. Manufacturers of PPE should survey their customers and make an effort to develop and market knee PPEs which meet the users' need.

4. Manufacturers of knee PPE hould also make available for purchase replacement padding for the knee pad, so that the users do not have to buy the whole new pair when only the padding wears out.

5. Workers who must kneel to work should always wear knee protection as necessary.

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Table 1
Geographic Distribution of Respondents by Knee Pad Use
International Union of Bricklayers and Allied Craftworkers (IUBAC)
Washington, D.C.
October 1998 - April 1999
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Region and States *	Knee Pad User	Non Pad User	Total
Hawaii & Western States	**116**	**37**	**153**
HI	45	21	66
ID, OR, WA	15	5	20
CA	38	7	45
AZ, CO, NM, NV, UT	18	4	22
Central & Southern States	**135**	**80**	**215**
MN, WI	55	37	92
IA, IL, NE	47	25	72
AR, KS, MO, OK, TX	21	9	30
AL, FL, GA, NC	12	9	21
Midwest & Eastern (part)	**145**	**48**	**193**
IN, KY, OH	51	12	63
MI	29	11	40
DE, MD, PA, VA, WV	65	25	90
Northeastern	**118**	**44**	**162**
CT, NJ, NY	99	34	133
MA, ME, NH, RI	19	10	29
State unknown	1	0	1
Grand Total	**515**	**209**	**724**

* States are grouped arbitrarily by proximity.

Table 2

Sample Size, Response Rate, and Knee Pad Use by Occupation/Trade Category [a]
International Union of Bricklayers and Allied Craftworkers (IUBAC)
Washington, D.C.
October 1998 - April 1999
HETA 98-0308-2785

Occupation and/or Trade Category	Members Sampled[b]	Members Responded[c]	Response Rate (%)[d]	Kneeling Time at Work (%)	Use Knee Pad (%)
Tile layers and/or Tile finishers	168	119	70.8	65.2	95.8
Terrazzo and/or Mosaic workers	146	39	26.7	61.8	100.0
Marble masons and/or Marble finishers	379	84	22.2	53.8	86.9
Cement masons and/or Cement finishers	212	104	49.1	40.5	83.5
Stone masons	450	66	14.7	38.3	77.3
Other	340	29	8.5	29.6	55.2
Pointer/Cleaner/ Caulkers	431	63	14.6	19.5	55.6
Plasterers	383	41	10.7	16.3	43.9
Bricklayers and/or Cement block layers	953	181	19.0	16.1	46.1
Total	3,462	726	21.0	37.2	71.1

[a] This table is arranged in descending order of Kneeling Time at Work (second last column).
[b] Questionnaires mailed; 42 were returned as "No forwarding address" and 2,684 were not returned.
[c] Number in principal occupation.
[d] The rates are approximate because the numerator is for principal occupation and the denominator is for current occupation.

Table 3*

Age of Respondents by Knee Pad Use
International Union of Bricklayers and Allied Craftworkers (IUBAC)
Washington, D.C.
October 1998 - April 1999
HETA 98-0308-2785

All Respondents (724)	Mean 43.7 years	Median 42 years	Range 20 ~ 72 years
Knee Pad Users (515)	43.2	41	20 ~ 69
Non Pad Users (209)	44.8	44	20 ~ 72

* Missing values are not included in this and all following tables.

Table 4

Respondents' Years in the IUBAC Membership by Knee Pad Use
International Union of Bricklayers and Allied Craftworkers (IUBAC)
Washington, D.C.
October 1998 - April 1999
HETA 98-0308-2785

All Respondents	Mean 14.8 years	Median 12.5 years	Range <1 ~ 43.7 years
Knee Pad Users	14.3	12.2	<1 ~ 41
Non Pad Users	15.9	13.4	<1 ~ 43.7

Table 5

Estimated Percent of Time Kneeling per Workday by Knee Pad Use
International Union of Bricklayers and Allied Craftworkers (IUBAC)
Washington, D.C.
October 1998 - April 1999
HETA 98-0308-2785

All Respondents	Mean 37 %	Median 30 %	Range 0 ~ 100 %
Knee Pad Users	46 %	50 %	1 ~ 100 %
Non Pad Users	15 %	8 %	0 ~ 90 %

Table 6
History of Knee Problem among Respondents
International Union of Bricklayers and Allied Craftworkers (IUBAC)
Washington, D.C.
October 1998 - April 1999
HETA 98-0308-2785

Ever had a knee problem treated by a doctor	Thought (or doctor said) it was job-related	Filed a workers' compensation claim for this knee problem
Yes 195 (27%)	Yes 130 (69%)	Yes 50 (39%)
No 519 (73%)	No 58 (31%)	No 79 (61%)

Table 7
Workdays Lost due to the Knee Problem in the Past 12 Months
International Union of Bricklayers and Allied Craftworkers (IUBAC)
Washington, D.C.
October 1998 - April 1999
HETA 98-0308-2785

Lost Work Days *	Respondents (Column Percent)
None	126 (67%)
1 ~ 5	15 (8%)
6 ~ 15	20 (11%)
16 ~ 60	14 (7%)
61 ~ 365	12 (6%)
Total	187

* These categories are arbitrary.

Table 8
Reasons for Not Wearing the Knee Pad
International Union of Bricklayers and Allied Craftworkers (IUBAC)
Washington, D.C.
October 1998 - April 1999
HETA 98-0308-2785

Percent *	Reason
33	I rarely kneel in my job.
16	Even if I kneel in my job, my knees do not hurt.
13	Knee pads tend to slip down or do not stay up on my knees.
10	Straps pinch my calf or they are too tight on my legs.
10	My employer or contractor does not provide them to me.
7	Knee pads are not easy to put on or take off.
3	Knee pads are too expensive for me to buy.
8	Other

* Percentage of 347 reasons given by 195 non-wearers. More than one response was allowed (average 1.6 responses per respondent).

Table 9
Rating of the Attributes of Knee Pad by Users
International Union of Bricklayers and Allied Craftworkers (IUBAC)
Washington, D.C.
October 1998 - April 1999
HETA 98-0308-2785

Scale: 1 (worst or most unsatisfactory), 2, 3, 4 (best or most satisfactory)

Attribute of Knee Pads	Mean	Median
Ease of putting on/off	3.6	4.0
Protection against sharp objects	3.3	4.0
Durability	3.2	3.0
Comfort of padding	2.8	3.0
Comfort of support (strap)	2.4	2.0
Resistance to moisture	2.4	2.0

Table 10

Type and Material of the Knee Pad as Reported by the Respondents
International Union of Bricklayers and Allied Craftworkers (IUBAC)
Washington, D.C.
October 1998 - April 1999
HETA 98-0308-2785

Component	Percent	Material
Padding [a]	80	Foam or sponge rubber
	1	Some liquid material in a pouch
	19	Other (felt, some fabric, carpet padding, horse hair?)
Outer shell [b]	37	Rubber
	31	Hard plastic
	29	Leather
	2	Cloth
	1	Other
Type of Support [c]	38	Elastic strap with Velcro(R)
	34	Strap with a buckle
	20	Rubber strap
	3	Non-elastic strap with Velcro(R)
	3	Elastic band such as Spandex(R)
	1	Padding sheet inserted into a pocket of the trouser
	1	Other

[a] Percentages are based on 513 responses from 490 wearers.
[b] Percentages are based on 571 responses from 505 wearers.
[c] Percentages are based on 571 responses from 504 wearers.

Table 11
Consequences of Working without the Knee Pad
International Union of Bricklayers and Allied Craftworkers (IUBAC)
Washington, D.C.
October 1998 - April 1999
HETA 98-0308-2785

Percent *	**Consequences of not wearing the knee pad****
43	I could do my job, but my knees would hurt or become inflamed.
28	I could not do my job because of knee pain or inflammation.
19	I could do my job, but would have to slow down to rest my knees.
5	My knees would be okay (no pain or inflammation).
6	Other

* Percentage of 618 responses from 510 knee pad wearers.

** Responses to the question "If you tried to do your job WITHOUT wearing knee pads, what would happen?"

For Information on Other
Occupational Safety and Health Concerns

Call NIOSH at:
1–800–35–NIOSH (356–4674)
or visit the NIOSH Homepage at:
http://www.cdc.gov/niosh/homepage.html

National Institute for Occupational Safety and Health
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