INJURIES AND USE OF PROTECTIVE EQUIPMENT AMONG COLLEGE IN-LINE SKATERS

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(Received 12 September 1995; in revised form 20 April 1996)

Abstract—In-line skating injuries and protective gear use were explored in a sample of college students (n = 217). A minority of respondents wore protective gear. One third of skaters had experienced at least one minor injury, and a smaller percentage had experienced fractures or head injuries. Most minor injuries occurred during the first 1-2 times skating, while more serious injuries tended to occur after at least 50 times on in-line skates. Psychosocial predictors of protective gear use were explored. Four major Health Belief Model constructs (perceived barriers to wearing gear, perceived susceptibility to injury, perceived severity of injury, and perceived benefits of wearing gear) were significant predictors of protective gear use. The Health Belief Model, tested using regression and structural equation modelling, predicted gear typically worn, frequency of gear use, and injuries received while in-line skating. Implications for increasing protective gear use are described. Copyright © 1996 Elsevier Science Ltd

Keywords—In-line skating, Protective gear, Health Belief Model

INTRODUCTION

In-line skating is currently the fastest growing sport in the U.S.A. At least 2.5 million people skate 25 times per year or more. Thirty-five percent of in-line skaters are over the age of 18, and 46% of all in-line skaters are women. There were 9.4 million skaters in 1992, an increase of 51% over the previous year (American Sports Analysis Report 1993).

Unlike ice skates, which have metal blades on the bottom, or roller skates, which have a pair of rubber wheels at each end of the foot, in-line skates have a single row of polyurethane wheels under a hard plastic boot. These wheels provide an almost frictionless ride on pavement, permitting high speeds and virtually unlimited movements (Strauss 1990).

There are three main hazards associated with in-line skating. First, the nature of the sport involves endurance, balance, strength, high speed, and possibly acrobatic stunts. Beginners, who often underestimate the velocity and force that can be generated while skating (Banas et al. 1992), and expert skaters performing stunts (Hoffman et al. 1992), may be at particular risk. Second, in-line skaters use paved public areas, increasing the likelihood of collisions with automobiles, bicycles, and pedestrians. Third, environmental hazards such as hills, gravel, and obstacles increase the potential for accidents. The United States Consumer Product Safety Commission (1994) projected an "alarming" increase to 83,000 in-line skating injuries treated in U.S.A. emergency rooms in 1994, compared to 37,000 in 1993.

A fall while standing still on in-line skates can have major neurological and musculoskeletal consequences, without adding the elements of speed, height, or other objects (Powell and Svensson 1993; Strauss 1990). Safety equipment is recommended to prevent or minimize injuries. The most common fractures associated with in-line skating are navicular or radial wrist fractures, caused by skaters putting out their hands to break a fall (United States Consumer Product Safety Commission 1994; Schieber et al. 1994). Splint-type wrist guards are recommended to prevent this type of injury. Other common in-line skating injuries include lacerations, contusions, and abrasions, which may be avoided or minimized by wearing elbow and knee pads. Most importantly, wearing a helmet is suggested to protect against head injuries incurred by collisions with the pavement or other objects. The United States Consumer Product Safety Commission (1994) reported 5 in-line skating deaths and 8648 head injuries between August 1992 and May 1994. Of the accidents studied in depth, helmets were not worn in any of the head injury cases or deaths resulting from head injury, and wrist guards were worn in only 1 of 44 wrist injuries.

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There is considerable evidence that social and psychological factors play a role in the use of protective equipment and accident reduction in other sports and activities (e.g. Chesham et al. 1993; Lehto and Foley 1991). Because gear use is an entirely volitional behavior, understanding the underlying psychosocial mechanisms will have implications for the development of gear-increasing interventions. The Health Belief Model (HBM) (Janz and Becker 1984; Rosenstock 1974) provides a framework for studying how psychological factors may affect protective gear use. The HBM considers the following components: perceived severity of possible injury associated with not engaging in the protective behavior, perceived susceptibility to injury, perceived barriers to the protective behavior, and perceived benefits of engaging in the protective behavior. In a review of 46 studies of the HBM, the most consistent predictor of protective behavior was perceived barriers to taking the protective behavior (Janz and Becker 1984).

RESULTS

Of the 217 students who had in-line skated, 56 (25.9%) had tried it once, 62 (28.7%) had tried it 2-5 times, and 98 (45.4%) had done it 6 times or more. Of this sample, 34% of the men and 20% of the women had in-line skated at least 21 times. Thirty-nine women (32.5%) and 17 (18.3%) men had skated only once.

Protective gear use

Most (49.3%) respondents used their in-line skates for recreation and fitness. Seventy (33%) in-line skaters reported that they generally wore no protective gear at all when in-line skating, and only 3 (1.4%) ever wore full protective gear (helmet, wrist guards, knee and elbow pads). The majority of the sample did not own any protective equipment (57.5%) and only 8.8% wanted to own all protective equipment items.

The most common single item worn was pads (knee or elbow), and the majority of respondents (30%) said that they did or would wear at least two of the following items of protective gear: helmet, wrist guards, knee or elbow pads, gloves, eye protection. The most common reason given for not wearing gear was that it was perceived unnecessary (14.4%), and 32.6% of the sample reported that a combination of the following reasons prevented them from wearing gear: uncomfortable, looks foolish, unnecessary, inconvenient, peers do not approve. Only 14 skaters (6.5%) reported that they consistently wore their protective equipment.

In-line skaters who had skated at least 6 times were less likely to wear gear regularly than their less experienced counterparts. As the number of times on in-line skates increased, the percentage of skaters who never wore gear increased steadily from 9.9% to 50%. Similarly, as the number of times in-line skating increased, the percentage of skaters who always wore protective gear decreased steadily from 10.9% to 0%.

A larger proportion of women than men reported wearing protective gear consistently. While 9.8% of the men reported wearing equipment most of the time and 5.4% reported wearing equipment all of the time, 23.5% and 9.2% of women reported wearing equipment most or all of the time, respectively. The variability of equipment use was considerably greater among women than men.

Almost 74% of the sample had seen promotions to encourage the use of protective gear ("cue to
Injuries and use of protective equipment among college in-line skaters

Specific cross-tabulations are shown in Table 1. Most respondents (64.4%) had never been injured, 71 (32.9%) had received cuts and scrapes in-line skating, and 6 (2.8%) had received either a fracture or head injury, as well as cuts and scrapes. Of those in-line skaters who had suffered a fracture or head injury while in-line skating, 5 had in-line skated at least 51 times and 1 was injured the first time on in-line skates. Over 85% of the sample believed that if they had a serious in-line skating accident they would want to wear more protective gear regularly.

As the frequency of gear use increased, the incidence of minor injuries decreased. The frequency of more serious injuries (fractures and head injuries) was highest among those who wore protective gear approximately half of the time. The causal direction of these relationships cannot be established. None of the in-line skaters who reported consistently wearing their protective gear had received a serious injury while in-line skating.

Female in-line skaters accounted for 65% of the minor injuries received, and males accounted for 80% of the serious injuries received. Fifty-eight percent of females and 66% of males had never been injured on in-line skates. Owners of in-line skates accounted for 83% of the serious injuries, while non-owners (in-line skates were rented or borrowed) accounted for 56% of minor injuries.

About 1 out of 9 (12.2%) in-line skaters thought it was acceptable to in-line skate after consuming 3 or more alcoholic drinks and 5.5% of in-line skaters had done so. It was not asked whether or not injuries were received while intoxicated.

Predicting gear use with the HBM

As shown in Table 2, each major construct in the HBM was correlated with protective gear use

<table>
<thead>
<tr>
<th>Variables</th>
<th>Minor injury*</th>
<th>Major injury†</th>
<th>No injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>45 (21.1)</td>
<td>1 (0.5)</td>
<td>74 (34.9)</td>
</tr>
<tr>
<td>Male</td>
<td>24 (11.3)</td>
<td>4 (1.9)</td>
<td>65 (30.5)</td>
</tr>
<tr>
<td>Number times in-line skated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>13 (6.0)</td>
<td>1 (0.5)</td>
<td>42 (19.5)</td>
</tr>
<tr>
<td>2-5</td>
<td>19 (8.8)</td>
<td>0 (0.0)</td>
<td>43 (19.9)</td>
</tr>
<tr>
<td>6-20</td>
<td>12 (5.6)</td>
<td>0 (0.0)</td>
<td>29 (13.4)</td>
</tr>
<tr>
<td>21-50</td>
<td>9 (4.2)</td>
<td>0 (0.0)</td>
<td>15 (6.9)</td>
</tr>
<tr>
<td>50+</td>
<td>18 (8.3)</td>
<td>5 (2.3)</td>
<td>10 (4.6)</td>
</tr>
<tr>
<td>Protective gear typically worn while in-line skating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helmet</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>4 (1.9)</td>
</tr>
<tr>
<td>Wrist guards</td>
<td>7 (3.3)</td>
<td>1 (0.5)</td>
<td>2 (0.9)</td>
</tr>
<tr>
<td>Knee and/or elbow pads</td>
<td>2 (0.9)</td>
<td>0 (0.0)</td>
<td>12 (5.6)</td>
</tr>
<tr>
<td>Gloves</td>
<td>2 (0.9)</td>
<td>0 (0.0)</td>
<td>7 (3.3)</td>
</tr>
<tr>
<td>Glasses/Eye gear</td>
<td>6 (2.8)</td>
<td>0 (0.0)</td>
<td>12 (5.7)</td>
</tr>
<tr>
<td>Two of the above</td>
<td>20 (9.4)</td>
<td>2 (0.9)</td>
<td>36 (17.0)</td>
</tr>
<tr>
<td>Three of the above</td>
<td>6 (2.8)</td>
<td>1 (0.5)</td>
<td>19 (9.0)</td>
</tr>
<tr>
<td>All of the above</td>
<td>1 (0.5)</td>
<td>0 (0.0)</td>
<td>2 (0.9)</td>
</tr>
<tr>
<td>None of the above</td>
<td>26 (12.3)</td>
<td>2 (0.9)</td>
<td>42 (19.8)</td>
</tr>
<tr>
<td>Frequency gear worn while in-line skating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>20 (9.4)</td>
<td>1 (0.5)</td>
<td>36 (17.0)</td>
</tr>
<tr>
<td>Rarely</td>
<td>19 (8.9)</td>
<td>1 (0.5)</td>
<td>38 (17.8)</td>
</tr>
<tr>
<td>About 1/2 time</td>
<td>12 (5.6)</td>
<td>3 (1.4)</td>
<td>30 (14.0)</td>
</tr>
<tr>
<td>Mostly</td>
<td>11 (5.1)</td>
<td>1 (0.5)</td>
<td>26 (12.2)</td>
</tr>
<tr>
<td>Always</td>
<td>8 (3.7)</td>
<td>0 (0.0)</td>
<td>8 (3.7)</td>
</tr>
</tbody>
</table>

Percentages shown reflect percentage of 217 minus missing data. For "gender", n = 213, for "number times in-line skated", n = 216, for "protective gear" and "frequency gear worn" n = 212. Percentages may not add exactly to 100 due to rounding. The "no injury" category includes data from 9 subjects who selected the response option "never in-line skated" on the injury history question, but indicated that they had in-line skated earlier on the questionnaire.

*Minor injury refers to bruises, scrapes, or cuts.
†Major injury refers to fracture or head injury.
The variables BEN, BAR, SEV, SUS, and GHV refer to the scale scores for HBM constructs benefits, barriers, perceived severity, perceived susceptibility, and general health value, respectively. CUE is also a HBM construct, measured by a single indicator. SEX refers to gender, where F = 1, M = 2. EXP refers to in-line skating experience, as measured by number of times in-line skated. INJ refers to injuries received while in-line skating, where 0 = none, 1 = minor injuries (cuts, bruises, scrapes) and 2 = major injuries (head injury or broken bone). GF refers to the frequency or rate of gear use, and GW refers to the actual items of gear worn (higher numbers mean more items of protective equipment typically worn).

The purpose of this study was to collect descriptive data regarding injuries and the use of protective equipment among college students. We also explored the applicability of the HBM (Rosenstock 1990) constructs in predicting equipment use.

Structural equation modelling was used to test the relation between HBM constructs and gear use in a model that included measurement models for the HBM constructs. In these models, the latent HBM constructs were error free. In addition, measures of in-line skating experience, cues to action, and gender were included. Maximum likelihood estimates corroborated the findings of the regression models.

**DISCUSSION**

The purpose of this study was to collect descriptive data regarding injuries and the use of protective equipment among college students. We also explored the applicability of the HBM (Rosenstock 1990) constructs in predicting equipment use.

Consistent with the growth of in-line skating reported nationally (American Sports Analysis Report 1993), over half of the students in the Fall 1993 introductory psychology class in a large U.S.A. university had in-line skated. Approximately one third of these skaters had experienced a minor injury such as an abrasion and 2% had experienced more serious injuries. More experienced skaters accounted for 80% of all serious injuries. It is not clear from the data whether more experienced in-line skaters accounted for more injuries because of greater exposure, or because they were less likely to wear protective gear. Further, the small number of serious injuries obtained (n = 5) limits the strength of the conclusions that can be drawn from this finding.

One third of skaters do not typically wear any protective gear and only 1.4% typically wear all protective gear when skating. Elbow and knee pads, which protect against minor injuries, are the most common single pieces of equipment worn. Equipment use as measured in this study may be overestimated.
because eye protection (one of the response options) is commonly worn in Arizona. More than half of the skaters did not own any protective equipment and less than 10% indicated interest in owning protective gear. Reasons for not wearing gear were that it was unnecessary, uncomfortable, foolish looking or inconvenient. Gear was less likely to be used as the number of times in-line skating increased.

The cross-sectional nature of the study makes it difficult to explain why the frequency of serious injuries was highest among those in-line skaters who wore gear approximately half the time. One explanation is that individuals who were injured then decided to wear protective gear. Evidence for this possibility is the significant correlation between injuries and perceived susceptibility and that 85% of the sample reported they would increase equipment use following a serious injury. A third variable, such as general clumsiness or lack of confidence, may explain the association. Those individuals who are least able and confident (and therefore likely to be injured) may be more likely to wear gear. Last, it is possible that when protective equipment is not worn, skaters are more cautious and therefore less likely to be injured. These findings highlight the need to understand the psychological change process as skaters become more proficient. The impact of injury on the learning process and subsequent gear use should be incorporated into prevention strategies.

Given the seriousness and prevalence of in-line skating injuries, the lack of protective gear use is problematic. The United States Consumer Product Safety Commission (1994) reported that almost all in-line skaters treated in emergency rooms were not wearing any protective equipment at the time of injury. Although associations such as the International In-Line Skating Association have emerged to begin to provide standardized lesson opportunities, organized competition, and safe skating information, appropriate restrictions and formal guidelines have not been developed. The high risk and lack of regulation create an opportunity to understand individual protective behaviors and a need to develop appropriate prevention strategies.

Several HBM constructs were important predictors of safe skating habits. Perceived barriers to equipment use, susceptibility to injury, and benefits of equipment use were significantly related to gear use, suggesting that these constructs may be important targets for injury prevention strategies (MacKinnon and Dwyer 1993). Specifically, methods to reduce barriers and increase perceived susceptibility to injury are needed. Making the social normative climate more conducive to wearing gear may impact both of these areas.

The college student sample is worthy of study because in-line skating and injuries are prevalent in this age group and because persons in this age group are more likely to make their own decisions regarding equipment use than younger in-line skaters. However, children receive 60% of all in-line skating injuries (Schieber et al. 1994), highlighting the need for future study in this age group. Future research would also be strengthened by observational data to corroborate self-reports, larger sample sizes, and more detailed questions. The results from this study suggest that this is a sport worthy of further study to better understand the motivation to wear protective gear. Gaining a better understanding of human behavior as it relates to in-line skating may pave the way for more safety-conscious social norms, more appropriately targeted safety promotions, and overall decreases in sport-related injuries and fatalities. This may be especially true in sports such as cycling and snowmobiling, which, like in-line skating, require repeated actions to increase safety.

REFERENCES

Schieber R.A.; Branche-Dorsey C.M.; Ryan G.W. Comparison of in-line skating injuries with roller skating...
APPENDIX

List of Questionnaire Items

Perceived Severity
1. The worst thing that could probably happen if I had a crash on my in-line skates is that I would get scraped and bruised.
2. An in-line skating accident may result in broken bones, severe head injuries, and potential life-long damage.
3. *Even a severe in-line skating accident wouldn't result in many injuries.
4. An in-line skating crash could result in some very serious injuries for a skater not wearing protective gear.

Perceived susceptibility
1. If I were to go rollerblading, it is quite likely that I would fall and hurt myself.
2. *I doubt that I would injure myself if I in-line skated around campus.
3. If I commuted to and from school on in-line skates, it is quite probable that at some point I would be involved in a crash, fall, or accident.
4. If I in-line skated on roads or sidewalks I would be afraid of being hit by a car or falling on pavement at high speed.

Perceived barriers
1. People who wear protective gear when biking or in-line skating look ridiculous; I would be embarrassed to wear a helmet and wrist guards or pads around campus.
2. Even though wearing protective gear while in-line skating reduces the severity of potential injuries, it is far too hot and inconvenient to bother.
3. Protective gear is a good idea, but it is too expensive and inconvenient to use regularly.
4. *There is no reason why I do not or would not wear protective gear while in-line skating.

Perceived benefits
1. Wearing basic protective gear could save me from severe injury if I were to crash or be involved in a traffic accident while in-line skating.
2. If I wore a helmet and wrist guards I would really decrease the likelihood of hurting myself while in-line skating, even if I fell.
3. *Wearing protective gear would not help if I were in a traffic accident while in-line skating.
4. In-line skaters who wear protective equipment while skating get fewer and less severe injuries than in-line skaters who do not wear safety equipment.

General health values
1. In general, my physical health is very important to me.
2. *I don't really have to worry about my health until I am older.
3. My health and safety are high priorities for me.

Notes: *Items marked with an asterisk are reverse coded. All items are scored on a 1-8 Likert scale. "Roller blading" is synonymous with in-line skating.