
Personal Protective Equipment Use by In-Line Roller Skaters

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Background. In-line roller skating is a growing recreational fitness activity, but little is known about the use of personal protective equipment, such as helmets, wrist guards, elbow and knee pads, by participants.

Methods. An unobtrusive observational study was performed on a stratified random sample of adult and child in-line skaters in Oakland County, Michigan. A follow-up observational study was performed on locations identified as having high rates of in-line skating activity.

Results. The prevalence of personal protective equipment use varied greatly with the type of equipment. Helmet use was less than 10% in both phases of the

study; wrist guard use ranged from 46% to 65%; and intermediate values were noted for the use of elbow and knee pads.

Conclusions. Recreational in-line skating is concentrated in paved public areas and is largely a young adult activity. The use of some items of personal protective equipment is common, although few skaters wear all recommended items. Efforts to prevent or reduce accidental injury should include consideration of all these factors.

Key words. Skating; accident prevention; protective devices; equipment safety. (*J Fam Pract* 1994; 38:486-488)

Although in-line roller skating is gaining public attention as a sporting and recreational fitness activity,^{1,2} a MEDLINE survey revealed that little research has been done on reporting the incidence of associated trauma or methods of injury prevention. It is reasonable to suspect that parallels exist between the patterns of in-line skating injuries and those of bicycling and skateboarding, both of which have been extensively studied.

A retrospective analysis of eight injured in-line skaters demonstrated that the greatest frequency of injury was to the dominant upper extremity.³ In this group, four skaters wore helmets, knee pads, and elbow pads. None wore wrist guards. If the use of protective equipment by in-line roller skaters mirrors the low rates among bicyclists and skateboarders, family physicians should expect to encounter an increasing number of injured

patients.⁴⁻¹⁴ The present study was undertaken to prospectively describe current levels of personal protective equipment use by in-line skaters in a suburban Michigan county.

Methods

A stratified random sampling of the 50 1990 US Bureau of the Census divisions in Oakland County, Michigan, was performed (population 1,083,592; median household income \$43,407).¹⁵ Affluent Oakland County was chosen because in-line skating is a high-cost recreational activity.¹ Residential divisions were stratified to those above the median household income (27 divisions) or below the median household income (23 divisions). Five divisions were randomly selected from each group, for a total of 10 divisions. Within each of the 10 divisions, three observation sites were selected, including public parks and residential areas adjacent to schools. There was no publicity about the study.

At each of these 30 total observation sites, all in-line

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Table 1. Characteristics of a Sample of 89 In-Line Roller Skaters (Phase 2)

	No. (%)	Subjects Using Items			
		Helmet No. (%)	Wrist Guards No. (%)	Elbow Pads No. (%)	Knee Pads No. (%)
Sex					
Male	50 (56)	7 (14)	35 (70)	14 (28)	20 (40)
Female	39 (44)	1 (3)	23 (59)	10 (26)	17 (44)
Age					
Adult	83 (93)	7 (8)	57 (69)	24 (29)	37 (44)
Child	6 (7)	1 (17)	1 (17)	0	0

skaters in the observer's line of sight were counted and categorized according to sex, estimation of age,⁴ and the use of a helmet, wrist guards, elbow pads, and knee pads. The duration of observation was 40 minutes at each site. Skaters who had been previously observed were not included in subsequent counts. Observations were made by the authors and by one volunteer with experience from prior studies.

As a follow-up, in-line skaters in all three Metro-parks in Oakland County were studied because the initial survey showed that more than 90% of subjects were found on paved paths in public park areas. The Metro-parks are part of a regional recreational park system. All contain paved pathways, and their geographic locations are within the county but remote from each other. For this part of the study, each park was observed for a total of 2 hours, with skaters counted and categorized using criteria identical to those of the initial survey. All observations for both parts of the study occurred on weekend days in August during which weather conditions were warm and sunny. As all data were categorical, results were analyzed using chi-square techniques.

Results

In the first (random) phase of this study, a total of 26 skaters were observed at 4 of the 30 sites, while no skaters were found at the remaining 26 sites. Ninety-two percent of the subjects were found in public park areas,

54% were male, and 85% were adult. Wrist guards were worn by 46% of skaters. Only two skaters, both of whom were male adults, wore helmets. Elbow pads and knee pads were used by 12% and 15% of skaters, respectively. The small sample size limited in-depth analysis of sub-groups.

During the second phase of the study, a total of 89 skaters were observed. Fifty-six percent were male, and 93% were adult. The breakdown of personal protective equipment use by sex and age is summarized in Table 1.

Although helmet use by male skaters greatly exceeded that of female skaters (14% vs 3%), chi-square analysis showed no significant prediction of personal protective equipment use by sex ($P < .05$) (Table 2). For both sexes, wrist guards were the most commonly used items, followed by knee pads, elbow pads, and helmets. Small numbers precluded a separate analysis of children.

Discussion

In-line skating activity appears to be most concentrated in paved public recreational areas. In contrast to bicycle riders and skateboarders, in-line skaters seem to be older, though there is considerable overlap in age. The design of educational interventions for participants should include consideration of these factors.

The results demonstrate considerable variability in the use of different types of personal protective equipment. Thus, it is difficult to establish a "grade" or index

Table 2. Use of Personal Protective Equipment Among a Group of 89 Child and Adult In-Line Roller Skaters (Phase 2), by Sex

	n	% Using Helmet	% Using Wristguards	% Using Elbow Pads	% Using Knee Pads
Sex					
Male	50	14	70	28	40
Female	39	3	59	26	44
Statistical analyses					
χ^2 (df = 1)		2.224	0.738	0.000	0.015
P value		NS	NS	NS	NS

that succinctly summarizes overall use of these safety devices. Individual perception of risk probably influences individual choice regarding which protective items are worn.

In contrast to a retrospective analysis of injured skaters conducted by Banas and associates,³ wrist guard use was much greater in the present study, elbow and knee pad use was comparable, and helmet use was much lower in the present study. The small number of subjects in the Banas report (eight) limits the value of a more detailed comparison between the groups.

The observers noted approximately five times more bicyclists than in-line skaters during the course of the observations, suggesting that the basic sampling strategy provided a reasonable chance of finding recreational athletes. The small number of children counted makes it impossible to draw significant conclusions about the use of personal protective equipment by children.

The difference in helmet use between male and female skaters approached but did not achieve statistical significance. The sample size of the second phase was adequate to provide an 80% power to uncover an approximate 25% absolute difference (at $P < .05$ significance) in the use of personal protective equipment between male and female skaters.¹⁶ The likelihood of a type II error (inappropriate failure to reject a null hypothesis) would be diminished with a larger sample size. If in-line skaters have essentially similar rates of personal protective equipment use across sex lines, as has been noted among adult bicyclists, a sample size approximating 1000 subjects would be needed to reliably exclude a small difference.^{10,14} A larger absolute difference in helmet use could be confirmed by a follow-up study with approximately 300 subjects.

The stratification strategy was adopted to reduce the likelihood of biasing the sample by income. The overall affluence of Oakland County residents may bias the results toward greater use of personal protective equipment by an affluent population, if income correlates with the ownership and use of such equipment by in-line skaters.

Unobtrusive observational studies are limited by the sampling strategy used and by the possibility of double counting.¹⁷ It is certainly possible that some of the skaters counted in the first phase of this study may also have been included in the second phase. However, because the initial and follow-up samples were analyzed separately,

this is not a serious deficit. Characteristics of subjects and personal protective equipment use were similar between the groups in the first and second phases of the study.

In contrast to bicycling and skateboarding, there is no database on the overall incidence of in-line skating injuries and the use of protective devices by participants at the present time. If in-line skating injuries prove to be a significant public health concern, further research should be directed toward the prevention of associated trauma.

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A Short Survey for Assessing Health and Social Problems of Adolescents

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Background. Many significant problems of adolescents are undetected and untreated. To aid in the discovery of these problems, we have developed and tested picture-and-word charts for use in the classroom or the physician's office. This report presents the results of these tests and describes how the charts may be used.

Methods. We assessed test-retest reliability of the picture-and-word charts. We also compared picture-and-word chart scores with corresponding multi-item questionnaires. Six charts were determined to be the most effective in measuring mutually exclusive dimensions of health and social problems. We used these six charts to examine factors that might affect the distribution of chart scores.

Results. We administered the picture-and-word charts to a diverse population of 658 adolescents whose me-

dian age was 15 years. Compared with multi-item questionnaires, respondents found the charts easier to understand and less likely to induce dishonest replies. Girls scored significantly worse ($P < .001$) than boys on the Physical Fitness and Emotional Feelings charts but better on the (at-risk) Health Habits chart ($P < .001$). The scores of teenagers known to have behavioral problems were worse on the Health Habits chart than were those of other adolescents ($P < .001$).

Conclusions. The charts are an efficient and acceptable method for detecting health and social problems of adolescents.

Key words. Adolescence; health status indicators; risk factors; adolescent behavior.

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The high prevalence of morbidity and risk to adolescent health is well documented. Such problems include pregnancy, drug use, emotional difficulties, school failure, and antisocial behavior.¹⁻⁵ However, when adolescents are seen by physicians and nurses in an office practice or a school clinic, health and social problems are often undetected and untreated.⁶⁻¹⁰

Detection is a critical prerequisite for successful

management of adolescent problems. One approach to improve detection is the use of multi-item screening instruments.¹¹⁻¹⁵ Often these instruments are not easy to use, however, because they require a long time to administer and score. For example, the Child Behavior Checklist¹¹ has 130 items, the Adolescent Health Survey¹² includes 190 items, and the Youth Risk Behavior Survey¹³ has 84 items. A variety of scales focus only on specific psychiatric problems such as depression.^{14,15} Although one of these scales, the Child Depression Inventory,¹⁵ has been incorporated in some clinical settings, it has 27 questions.

Single-item screening instruments offer a practical, valid, and reliable alternative to multi-item questionnaires.¹⁶⁻¹⁸ Single-item instruments can also be easily linked to management information because they do not

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require complicated scoring algorithms.¹⁹ This study is a report on the development, testing, and use of single-item picture-and-word charts for the assessment of adolescent health and social problems.

Methods

Development of Picture-and-Word Charts

Several steps were taken to design a set of picture-and-word charts that would possess face validity and capture important problems of adolescents. First, we reviewed available measures of child and adolescent problems including 15 instruments used for the development of the Child Health and Illness Profile.¹⁰⁻¹⁵ From these measures, we defined 17 potential categories and designed 17 corresponding picture-and-word charts. Second, using focus groups, we asked 51 primary care physicians and 31 adolescents to rate the importance of these 17 categories and to suggest revisions in the words and pictures used in the charts. As a result of these interviews, we reduced the number of picture-and-word charts to 14: Physical Fitness, Emotional Feelings, School Work, Social Support, Family Communication, "At-Risk" Health Habits, Stress, Self-Esteem, Overall Health, "Good" Health Habits, Behavior, Energy, Pain, and Getting Along with Others.

Administration of 14 charts would be impractical and unnecessary if several measured similar dimensions of health. Therefore, we field-tested the 14 charts to determine which were most effective in registering mutually exclusive and important dimensions of adolescent health.

Results

We used two methods to test the picture-and-word charts in the field: test-retest reliability and correlations with questionnaire measures of the same dimensions of health.

If a measure is well designed and the subject has not changed, the measure should give the same result on retest. To evaluate test-retest reliability of the charts, we used the responses of 199 adolescents who completed identical charts on consecutive days (ie, after a 24-hour delay). The charts were administered as part of a battery of questions to minimize the chance that recall of previous answers would bias retest responses. The average test-retest correlation of the six charts (shown in the Figure) was .77; correlations ranged from .71 to .80 for the Family Communication, Emotional Feelings, and

Social Support charts to over .80 for the remaining three charts. In terms of the actual 5-point scale used for each chart, agreement ± 1 scale point averaged 96%, ie, an adolescent who scores a 2 today is unlikely to score a 4 tomorrow, and vice versa. All six picture-and-word charts met the minimum reliability recommended for group comparisons ($r = .50$).²⁰

Next, we examined how well the charts correlated with groups of questions that measured the same dimensions of health. A chart should correlate strongly with questions about the same dimension and have less correlation with noncorresponding measures. For example, the average correlations of similar adult charts with corresponding questionnaires was .64; with noncorresponding measures, the correlation was much lower ($r = .32$).¹⁶

We could find no validated questionnaires with scales that were similar to the dimensions of the adolescent charts. Therefore, four members of our staff read through the available questionnaires, independently identified items corresponding to the adolescent chart dimensions, and compared their respective grouping of questions. After discussion of disagreements regarding grouping, a question remained in a group only if all staff members agreed with its placement. For example, 29 questions, such as "At times I feel I am no good at all" and "I am unhappy, sad or depressed," were grouped to measure emotional health. Since the total number of questions was large ($n = 113$), teenage respondents completed all the charts but only answered grouped questions relating to two to four charts. The number of respondents for each comparison ranged from 58 to 70.

The six picture-and-word charts recommended for clinical use are shown in the Figure. A review of their content shows that the Physical Fitness and Emotional Feelings charts measure key dimensions of physical function and mental health. The School Work and Family Communication charts reflect academic performance and communication with family members. The Health Habits chart is an indicator of risky health-related behaviors. The Social Support chart reveals whether the adolescent perceives that someone is available to help him or her.

We found that the average correlation of the six charts shown in the Figure with corresponding questionnaire measures was .62; for noncorresponding correlations, the average was .32. These data support the validity of this approach.²¹ Table 1 provides more detailed information about each of the six charts. Discussion of the remaining eight is not included because they had lower average test-retest reliability (.69) and correlations with corresponding questionnaires (.53).

PHYSICAL FITNESS

During the past month, what was the hardest physical activity you could do for 15 minutes?

1		
2		
3		
4		
5		

EMOTIONAL FEELINGS

During the past month, how often did you feel nervous, depressed, irritable, sad or downhearted and blue?

1		None of the time
2		A little of the time
3		Some of the time
4		Most of the time
5		All of the time

SCHOOL WORK

During the last month you were in school, how did you do.

1		I did very well
2		I did as well as I could
3		I could have done a little better
4		I could have done much better
5		I did poorly

SOCIAL SUPPORT

During the past month, if you needed someone to listen or in help you, was someone there for you?

1		Yes, as much as I wanted
2		Yes, quite a bit
3		Yes, some
4		Yes, a little
5		No, not at all

FAMILY COMMUNICATIONS

During the past month, how often did you talk about your problems, feelings or opinions with someone in your family?

1		All of the time
2		Most of the time
3		Some of the time
4		A little of the time
5		None of the time

HEALTH HABITS

During the past month, how often did you do things that are harmful to your health such as:

- smoke cigarettes or chew tobacco
- have unprotected sex
- use alcohol including beer or wine?

1		None of the time
2		A little of the time
3		Some of the time
4		Most of the time
5		All of the time

Figure. Picture-and-word COOP charts for assessing adolescent health. Figure reprinted with permission of the Trustees of Dartmouth College, COOP Project.

Table 1. Correlation of Picture-and-Word Charts with Multi-Item Questionnaire on Six Dimensions of Adolescent Health and Social Problems

Picture-and-Word Chart Dimensions	Multi-Item (n) Questionnaire Dimensions					
	Physical (9)	Emotional (29)	School Work (23)	Social Support (17)	Family Communication (19)	Health Habits (16)
Physical	.52	.34	.35	.04	.22	.36
Emotional	.50	.74	.06	.45	.40	.43
School Work	.25	.16	.66	.17	.31	.38
Social Support	.35	.65	.27	.68	.67	.44
Family Communication	.23	.45	.50	.43	.72	.28
Health Habits	.31	.31	.49	.25	.16	.71

NOTE: The number of questions for each dimension is in parentheses. The number of respondents for each dimension ranged from 58 to 70. Cronbach's alpha, a test of internal consistency-reliability, for the physical dimension was .60; for the other five dimensions, alpha ranged from .87 to .94.

Adolescent Opinion of the Charts

We asked 188 teenagers who completed both the charts and validation questionnaire items to compare the relative ease of answering and the honesty of their responses for the two approaches. Twenty-seven percent considered the charts easier to understand, and 7% claimed that the questions were easier (66% either had no opinion or offered no opinion). We also asked the respondents whether the charts or multi-item questions would make them "want to keep a secret about how you feel." Twenty-one percent felt that the questions might promote this reaction; less than 7% of the respondents felt that the charts might induce dishonest responses (72% either had no opinion or offered no opinion).

Factors Affecting the Distribution of Chart Scores

To examine factors that might affect the distribution of chart scores, we tested them in a diverse group of adolescents. The test sample of adolescents was selected from 18 private physicians' offices located in northern New England ($n = 168$) and four schools ($n = 490$), one of which was in Vermont, the other three in New Mexico. The purpose of the study was explained both orally and in writing to all subjects. Consent forms were not required by our institutional review board because respondents' names were not recorded. The median age of the 658 respondents was 15 years, with a range of 12 to 21 years. A majority were girls (54%) and non-Hispanic whites (60%). Twenty-nine percent were Hispanic, 6% black, and 5% other race or ethnicity. Thirty-six of the Hispanic respondents who were in classes designated for Spanish-speaking students used only Spanish translations of the charts and evaluation forms.

Each chart offered five response options on a Likert-

type scale ranging from 1 to 5, with a score of 5 interpreted as the worst. Chart scores of 1 or 2 were reported for the majority of the 658 respondents on the Physical Fitness (76%), Health Habits (69%), Social Support (68%) and Emotional Feelings charts (51%). Lower percentages of similar "good" scores were reported for the School Work (49%) and Family Communications (34%) charts.

In the 658 adolescents sampled, the distribution of scores was influenced by sex and age. Girls scored significantly worse ($P < .001$) than boys on the Physical Fitness and Emotional Feelings charts but better in Health Habits ($P < .001$). Age was most positively correlated with *reduced* Physical Fitness ($r = .24$) and Health Habits chart scores ($r = .34$). We found in our New England subsample of 360 teenagers that those who completed charts in physicians' offices generally had better scores than did their peers in the schools.

Detecting "At-Risk" Adolescents

We examined how the Health Habits chart could have identified 138 adolescents who exhibited significant problems during the academic year, such as drug abuse or antisocial behavior. Using multiple regression, a Health Habits chart score was strongly associated with recognized "at-risk" behavior ($P < .001$) and remained strongly associated with a student's "at-risk" status ($P < .001$) after adjusting for age, sex, and race or ethnicity.

Table 2 illustrates how the Health Habits chart might be used in practice by showing two categories of adolescents and their responses to the chart. One category includes adolescents designated "at risk" in the schools, ie, whose classroom behavior their teachers have characterized as disruptive. The other category describes

Table 2. Relation Between Health Habit Chart Responses and Other Adolescent At-Risk Behaviors

Health Habit Chart Response*	Other At-Risk Adolescent Behavior					
	Was Disruptive During Past Year†			Has Used Illicit Drugs‡		
	Yes (n)	No (n)	Yield (%)	Yes (n)	No (n)	Yield (%)
None of the time	41	178	19	0	42	0
A little of the time	26	55	32	0	7	0
Some of the time	16	44	27	2	3	40
Most of the time	20	19	51	3	1	75
All of the time	30	21	59	3	1	75

*Health Habit chart question:

"During the past month, how often did you do things that are harmful to your health such as:

- Smoke cigarettes or chew tobacco?
- Have unprotected sex?
- Use alcohol including beer or wine?"

†As designated by teachers in Vermont and New Mexico.

‡Responses to anonymous questionnaire administered to adolescents in the school or office setting: "Did you ever use marijuana, cocaine or crack, PSP, LSD, or street drugs with needles?"

a subgroup of adolescents who completed anonymously a four-question survey about illicit drug use. In practice, an efficient threshold for further inquiry is usually a score on the picture-and-word chart of 3, 4, or 5.¹⁹ Table 2 indicates how higher chart scores correspond with a higher yield of detected problems and a decrease in the number of respondents.

Discussion

We designed these picture-and-word charts to assess health and social problems of adolescents. Our study participants found the charts easier to understand and more likely to elicit honest responses than the standard questions of multi-item scales.

In this report, we demonstrated the use of these charts as survey instruments and a tool for the detection of important problems. This study showed that when used to survey populations, respondent age, sex, and administration site will influence the distribution of chart scores. Whenever the charts are used for epidemiological studies, these factors should be described. For the individual patient, these charts can identify areas where further physician inquiry should be valuable. A variety of studies has documented the high frequency of emotional and social problems during adolescence and late childhood. Deaths from risk-taking behaviors and from suicide are the leading causes of mortality in teenagers.^{1,2,22} Since pediatricians, family physicians, internists, general practitioners, and other practitioners care for adolescents,²³ this method of standard assessment should offer

adolescents the opportunity of receiving similar attention regardless of provider type.

There is room for improvement in the connection between effective management and standard assessment.¹⁹ The availability of these charts may stimulate the development of management approaches. For example, adolescents could be educated about interpreting their own chart scores and seeking additional resources when self-management is ineffective.

The charts could also be used to measure the impact of various interventions. Based on our experience with similar picture-and-word charts for adults, brief measures usually are not as precise as more extensive instruments.²⁴ Therefore, the charts would be most appropriate for comparing treatment outcomes in a large number of subjects. These charts should not be used to monitor small changes in individuals.

Our findings are subject to the following cautions. First, our advisors and focus groups suggested charts that made sense to them. Based on test-retest reliability and correlations with corresponding questionnaire measures, we recommend the six picture-and-word charts (Figure) that best register mutually exclusive dimensions of particular relevance to teenagers. However, we do not claim that these six charts should be the only ones used to measure adolescent health and social problems. Eight additional charts, which we found less valid and reliable, as well as other approaches we did not test, may be useful in different circumstances.

Second, our students and school systems were selected to allow us to examine the charts in diverse situations. In these settings, we have shown that the charts are

acceptable, reliable, and reasonable substitutes for multi-item questionnaires. Although we cannot be certain that these findings would be similar in other regions or populations, we believe that they are useful benchmarks for further testing and modification of this approach.

Third, our results should be replicated. Replication raises the important, unresolved question, "Which measure should serve as criterion ('gold') standards for the charts?" Because chart dimensions did not correspond with those of preexisting, validated measures, we examined the correlations of the charts with questions grouped into similar categories—a "silver standard" comparison. The tests of internal consistency for our "silver standards" were generally good, suggesting that they formed meaningful comparison measures.²⁵

We conclude that the adolescent picture-and-word charts represent a useful and standard method for overcoming obstacles in the detection of adolescent health and social problems. However, if a teenager is to benefit, detection must be linked to appropriate management. Therefore, we hope that our results will stimulate the development of programs and approaches that build on these charts by improving rather than just measuring problems.

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