Karate injuries in children and adolescents

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Abstract

Objectives: To identify risk factors for injury and to establish safety guidelines for children in Uechi–Ryu karate. Design: A 1-year retrospective survey of injuries. Setting: A private karate school (Uechi–Ryu style) in Plymouth, MA. Patients: A total of 68 athletes (age 6–16 years; mean age 10 years) who participated in karate during the 1995–1996 season. Interventions: None. Main outcome measures: The presence or absence of injury, with grading of injuries as major, moderate or minor. The types of injuries and body region involved were also analyzed. Results: Twenty eight percent of athletes sustained at least one injury. All injuries were minor, with no time off from training required. The injuries consisted primarily of bruises (11 of 19). Other injuries included mild sprains or strains (5 of 19) and having their ‘wind knocked out’ (3 of 19). Most injuries were localized to the extremities. Logistic regression analysis identified risk factors for injury. Risk of injury increased with number of years of training (odds ratio 2.95; 95% confidence interval 1.81–4.82; \( P < 0.0001 \)), number of hours per week (odds ratio 2.12; CI 1.15–4.21; \( P = 0.016 \)) and rank, specifically brown belt versus lower belts (odds ratio 6.56; CI 2.02–21.26; \( P = 0.006 \)). Conclusions: Karate is a relatively safe sport for children and adolescents when properly taught. Risk of injury increases with experience; therefore, greater supervision is required of higher ranks. Injury increases with weekly training; however, 3 h a week or less appears to be associated with a low risk of significant injury in this age group. © 2000 Elsevier Science Ltd. All rights reserved.

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1. Introduction

Participation in martial arts has increased dramatically since the mid 1980s (Oler et al., 1991; Pieter and Lufting, 1994) with approximately 1.5–2 million Americans involved, according to Oler et al. (1991). Jaffe and Minkoff (1988) estimate that 20% of these participants are children; however, little research has been conducted to assess the risk of injury in this younger population. The goal of this study was to determine the risk of injury to children and adolescents training in one type of martial art, Uechi–Ryu karate. Critchley et al. (1999) states that karate is one of the most popular martial arts. According to Corcoran and Farkus (1993), Uechi–Ryu is a traditional Okinawan karate style which involves the practice of basic techniques, kata (predetermined combinations of techniques), sparring and body toughening exercises. Students (karateka) train in bare feet on a wooden floor. The uniform (gi) consists of a canvas jacket and pants. Uechi–Ryu is considered a non-contact martial art; therefore, no protective gear is worn. Even within Uechi–Ryu there is a variety of training styles.

Many parents see martial arts as a form of physical activity and discipline for their children, as well as a tool for self-defense. Violan et al. (1997) demonstrated that karate improves balance, flexibility and strength among boys aged 8–13 years. It also develops qualities such as respect, discipline, concentration, patience and self-confidence in the young karateka. Research by Daniels and Thornton (1990, 1992) showed that training in martial arts decreases hostility. Layton (1993), who tested reaction time and movement time among black-belts in karate, suggests that karate training may retard the normal deterioration in motor skills that occurs with aging.

McLatchie and Morris (1977) and Oler et al. (1991) have questioned the safety of martial arts, particularly
at the tournament level. In many martial arts, tournaments comprise only a fraction of the total time spent training and frequently students do not participate in tournaments at all. On the other hand, a 5-year national survey by Birrer and Halbrook (1988) concluded that the martial arts are safe, with the majority of injuries involving the extremities and being minor in nature. That study examined all martial arts as a group, including those which use weapons.

No published studies have evaluated and reported on the safety of martial arts for children, even though the number of children and adolescents who participate in these activities continues to grow. The purposes of this study were to identify risk factors for injury, to compare the risk of injury from karate with other children’s sports in this age group and to establish injury reduction strategies.

2. Methods

2.1. Subjects

A comprehensive survey of karate-related injuries was completed on 68 students from the Peter McRae Karate School in Plymouth, MA. The school studied does not stress free-sparring (fighting without predetermined techniques) and does not participate in tournaments. All subjects were taught by one instructor, with each session lasting 1 h. Classes began with a 10 min warm-up, primarily stretching, starting with the feet and progressing upwards to the neck. Fifteen minutes were then spent on basic techniques such as blocks, punches and kicks. This was followed by 15 min of either pre-arranged sparring, where both the attacker and defender know which technique is being employed, or body-toughening exercises. Classes ended with approximately 20 min of kata training. There were 57 males and 11 females, with a mean age of 10 years (range 6–16 years). There were ten beginners (white belts), 47 intermediates (red/purple belts) and 11 advanced karateka (brown belts).

2.2. Survey

Survey responses were obtained from students and parents. The questionnaire consisted of two sections: personal data (age, number of years in karate, number of hours of training per week) and karate-related injuries which had occurred within the past year. The latter portion was a checklist of injuries grouped by body region. For each injury, the student indicated if they needed to take time off and whether casting or surgery was necessary. Each reported injury was graded into major, moderate or minor, according to the following criteria: any injury which required more than 24 h off training was considered significant, as defined by Fetko (1994), as were concussions regardless of whether or not time off was required. Significant injuries were classified as moderate (<7 days off) or major (7 or more days off). Brust et al. (1992) also used 1 week off training as a distinction between injuries of differing severity. Injuries which required either cast or surgery were considered major. All other injuries were classified as minor. A comment section at the end of the survey allowed for any explanations concerning the exact mechanism of injury.

3. Statistical analysis

Multivariate logistic regression analysis was conducted to identify risk factors for the presence or absence of injury, with the likelihood ratio $\chi^2$ test used to assess the significance of each predictor (Hosmer and Lemeshow, 1989). Odds ratios were computed for each risk factor by exponentiating the regression coefficient and 95% confidence intervals (CI) were constructed using the method described by Schlesselman (1982). A two-tailed $P < 0.05$ was considered statistically significant. Data analysis was performed using SPSS for Windows (version 6.1, SPSS Inc., Chicago, IL). A power analysis indicated that 68 students would provide 70% power to detect an odds ratio of at least 2.0 for any of the variables entered into the logistic regression model (nQuery Advisor, version 3.0, Statistical Solutions, Boston, MA).
4. Results

A total of 68 questionnaires were completed, 57 by males (84%) and 11 by females (16%). There were 104 students under 17 years of age registered at the club; however not all of the students were training at the time of the survey. Of the students not training regularly at the time of the study, according to the school’s instructor, none had sustained any injuries which might have precluded participation in karate. Those involved in the study were therefore representative of the total membership of the club regarding injuries. The average age of all participants was 10 years and the average length of training in karate was 2.3 years (range 1 month–5.5 years). Students trained an average of 2.2 h per week (range 1–8 h).

Of the 68 subjects, 19 (28%) reported injuries. When expressed per volume of training, the rate of injury is 3.7/1000 h; however, for comparison with other studies, the rate of significant injury (time off) is 0/1000 h. Most of the injuries were localized to the extremities, with only a few to the trunk and one to the face (Table 1). Seventeen subjects sustained only one injury, one sustained two injuries, and one reported three injuries (22 injuries in 19 athletes). There were no major injuries and none that required any time off from training. The injuries consisted primarily of minor bruises, with only five of the total injuries being mild strains or sprains. In three cases, subjects complained of having had their ‘wind knocked out’. Of the 19 athletes who had sustained injuries, the average number of years in karate was 3.5. The 49 athletes who remained injury-free had trained an average of 1.8 years.

The presence or absence of injury was analyzed with respect to age, sex, number of years of training in Uechi–Ryu (experience), number of hours per week (training) and rank. Experience, training and rank were found to be significant predictors of injury (Table 2). There was no significant relationship between age or sex and injuries. In this survey, no significant (major or moderate) injuries were reported. All injuries were considered minor in severity, a finding that did not change with length of training in this group. The estimated risk of injury increased 2-fold with each additional hour of weekly training (odds ratio = 2.12, \( P = 0.016 \)). Risk of injury increased approximately three times with each additional year of experience in karate (odds ratio = 2.95, \( P < 0.0001 \)). Brown belts were more than six times as likely to sustain an injury compared to lower belt ranks (odds ratio 6.6, \( P = 0.006 \)).

5. Discussion

The most clinically interesting finding of this study is that of the 68 young karateka, none sustained a signifi-
Grana (1994) contends that maximal gains in strength occur during the second decade of life. Violan et al. (1997) found that participation in Uechi–Ryu karate increases muscle strength in children when compared with age-matched controls; therefore, children with greater experience in karate would likely be stronger than less experienced athletes. With greater muscle bulk and strength, the force generated by techniques increases, as does the potential for injury. Children also tend to gain more confidence and speed with experience, which leads to more aggressive training. The greater speed and force of techniques seen in more advanced karateka, combined with more opportunities for sparring, help explain the greater risk of injury in the brown belts. Consistent with the conclusion of Risser (1993), children should be matched by size and rank in karate training.

Of particular interest is the finding that the number of hours of training per week is correlated with risk of injury. Sixty-six (97%) subjects trained 3 h or less per week. Given the absence of significant injuries in this study, 3 h of karate training per week appears to pose a low risk of significant injury for children 16 years and under. A causal relationship between weekly training and injury risk could have been complicated if the presence of injury had affected the amount of time each child spent training per week. This was addressed by recording the average weekly training throughout the entire year. As suggested by O’Neill and Micheli (1988), training exclusively in one sport subjects the child to the repetitive microtrauma particular to that sport, thereby increasing the risk of overuse injury. Many of the athletes in this study were very active in other sports as well, such as baseball, football and soccer. Although this was not addressed specifically in our study, perhaps by limiting the amount of time spent each week in karate, the youngsters benefited from cross-training in these other sports.

To place the rate of significant injuries in karate (0%) within the context of other children’s sports, a comparison can be made with baseball (2–8%) (Committee on Sports Medicine and Fitness, 1994), soccer (7.7%) (Kibler, 1993), gymnastics (30%) (Maffulli and Baxter-Jones, 1995) and ice hockey (33%) (Brust et al., 1992). It is worth mentioning that 24% of the soccer injuries and 18% of the hockey injuries would be classified as major by our criteria, whereas there were no major injuries in karate.

Because the data on weekly training and injuries were collected for the same period, a causal relationship could have been difficult to determine; however, since none of the young karateka required time off from training, the presence of injury did not affect the number of hours of training per week. In addition, if any of the participants had sustained a significant injury requiring time away from training, this would have reduced weekly training. This study detected a significant relationship between weekly training and injury risk, with those training more hours per week being at greater risk of injury; therefore, a causal relationship is likely. Another limitation of this study was the sample size. While the sample size provided moderate power to detect differences in the risk of injury according to belt rank, as well as amount of weekly training and experience, a larger study with greater statistical power would be necessary to identify factors associated with specific type of injuries since the risk of injury is so low in this population.

6. Conclusions

Children may benefit from participating in martial arts. These benefits include discipline, mental concentration, physical conditioning and fun. There is considerable variability among martial arts styles, as well as differences in teaching philosophies within any given style. This study has focused on only one style; therefore, caution must be exercised in extrapolating the findings to all martial arts. Full contact martial arts, such as Taekwondo (Korean karate), may have very different patterns of injury and merit further investigation.

From this study, one can conclude that, when properly taught, Uechi–Ryu karate is safe for children, with all injuries being extremely minor in nature. The vast majority of injuries consist of bruising due to contact. The risk of significant injury in karate appears to be less than that seen in other popular children’s sports. As the child’s experience in karate increases, so does the risk of injury. Consequently, instructors need to exercise greater vigilance in supervising the more experienced karateka. Given that risk of injury increases with greater weekly training, limiting the number of hours spent practicing karate may reduce the risk of future injury. Based on this study, training 3 h per week appears to be relatively safe for children 16 years and under, especially those involved in other sports activities. The amount of karate training per week which results in an increased rate of significant injury is unknown and warrants further study.

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