HAND PREFERENCE AND THE INCIDENCE OF ACCIDENTAL UNILATERAL HAND INJURY

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Abstract—Four hundred and eighty-six individuals gave detailed descriptions of an accidental unilateral hand injury and answered questions about their hand preference. Their handedness data were compared to 402 respondents (matched for sex and age) with no experience of hand injury. The risk of hand injury was similar for right- and left-handers. Individuals with consistent hand preference, regardless of side, were more likely to injure their preferred hand when compared to mixed preference types. The present data argue for a use explanation of hand injury risk (one is more likely to injure the hand that is used most frequently) rather than an explanation based on inherent risk factors present for left- but not for right-handers.

INTRODUCTION

Controversy has arisen over the recent, rather startling, suggestion that left-handedness may be a marker for decreased survival fitness. Based on archival data, Coren and Halpern argued that right-handers live as much as 9 years longer, on average, than left-handers [5, 10, 11, 12]. Other investigators, using longitudinal paradigms and prospective data, have not confirmed this suggested survival difference between right- and left-handers [16, 17, 24]. COREN [2, 4] argued further that left-handers are at an increased risk of suffering accidental injury. He suggested that the elevation of accident risk for left-handers contributes to their possible survival disadvantage relative to right-handers.

Coren and his associates have offered two explanations for an association between left-handedness and increased accident potential [2, 4-6, 10, 11]. The first hypothesis derives from the notion that pathological factors intervene either before, during or after birth to cause deviations from right-handedness [1, 9]. If left-handers have minor neurological impairments not apparent in right-handers, these neurological differences could contribute to an increased tendency to be clumsy and awkward and, therefore, accident prone. The second theory emphasizes the difficulties left-handers experience in a world arranged for the right-handed majority. COREN [2] provided detailed speculation on the way in which the right-biased design of common household tools and implements causes increased difficulty of use for the left-hander, regardless of whether the left-hander uses the preferred or non-preferred hand. He argued that these right biases, encountered on a daily basis, raise the accident risk for left-handers far above that of right-handers.

The empirical evidence supporting an association between left-handedness and accident risk is sparse and has produced mixed results. COREN [4] collected retrospective self-reports of accidents requiring medical attention and showed an elevated accident incidence in left-handers; however, the significance of this pattern was evident only for some categories of
accidental injury. HALPERN and COREN [10] reported an increased incidence of traffic accident deaths among left-handers, using data from either the posthumous reports of relatives or from death certificates. Recently, however, PETERS and PERRY [18] found no relationship between left-handedness and an elevated incidence of self-reports of traffic accidents.

The present study explored the relationship between the side of hand preference and a specific type of accidental injury, namely, accidental hand injury. COREN'S [2] elaborated accident hypothesis, concerning the risk to left-handers of manipulating tools biased toward right hand use, predicts that left-handers are at a higher risk than right-handers of suffering an accident-related hand injury. Therefore, the incidence of hand injuries should show significant variation as a function of the side of hand preference.

**METHOD**

**Subjects**

The Hand Injury sample was composed of a maximum N of 486 respondents (266 males and 220 females) ranging in age from 13 to 83 years (Mean = 43.4 years), who reported having experienced a unilateral hand injury. Two hundred and two of the respondents (45.7% of the total sample) were contacted by mail from the client lists of two physiotherapy clinics in Victoria, British Columbia, Canada. The remaining 264 respondents (54.3% of the total sample) were either contacted by mail after answering advertisements placed in newspapers throughout British Columbia, Canada, or they were interviewed personally at research stations established in shopping malls in Victoria, British Columbia, Canada. None of the respondents from the clinic sources overlapped with those contacted by other methods.

The No Hand Injury sample was composed of a maximum N of 402 individuals (219 males and 183 females) with an age range of 10–85 years (Mean = 45.0 years). These individuals were chosen from a sample of 654 individuals, who reported no experience with hand injury. The selection of respondents for the No Hand Injury sample was conducted so that the age and sex composition of the control group matched that of the Hand Injury respondents, because both age and sex are variables that can affect the differential incidence of right- and left-handedness [7, 13, 19, 20, 22]. Data from the No Hand Injury respondents were collected in a manner similar to that used for the Hand Injury sample. Individuals were either contacted by mail from the University of Victoria employee lists or they were interviewed individually at research stations established in shopping malls in Victoria, British Columbia, Canada.

**Procedure**

Data collection took place between 1986 and 1989. The Hand Injury respondents gave detailed descriptions of a unilateral hand injury suffered at any time during the 5 years prior to the date of data collection. These descriptions included the nature of the hand impairment (fracture, nerve damage, tendon or ligament problems and so forth), the cause of the accident that led to the injury, and the length of the injury recovery period. The injury questions were designed in consultation with physiotherapists and were based on assessment inventories used in hand rehabilitation clinical settings.

The Hand Injury respondents described their hand preference prior to the occurrence of their hand injury using a 5-point rating scale, where a response of 1 indicated complete use of the right hand, 5, complete use of the left hand, and responses of 2, 3 and 4, signified primarily right hand use with occasional use of the left hand (2), use of either hand (3), and primarily left hand use with occasional use of the right hand (4). The 5-point scale was used to answer five questions about preferred hand use. These questions were: Which hand did you use to (1) eat with a fork (without a knife); (2) throw a ball; (3) cut with scissors; (4) write a letter; (5) hold a match while striking it.* These items are associated with the dimension of skilled hand preference identified by STEENHUIS and BRYDEN [23] and the measurement technique has been used previously to assess both the side and the strength of hand preference [14, 22].

The hand preference of the No Hand Injury respondents was assessed in an identical fashion. To control for the fact that the Hand Injury respondents reported on hand preference patterns from past memory (prior to the hand injury), the No Hand Injury respondents also completed the five hand preference items in terms of their current, post-injury, behaviour. However, analyses indicated that individuals, especially those classified as left-handed, showed shifts in preferred hand use as a result of the hand injury. Therefore, the pre-injury hand preference data were used to assess handedness incidence in this sample.
RESULTS

Respondent characteristics and data analysis

Chi-square analyses comparing the age, sex and socio-economic groupings (measured with numerical ratings of occupational status) of the Hand Injury and No Hand Injury samples produced no significant differences in sample composition. In addition, the mean and variance of the age variable for each sex and age grouping was compared statistically; there were no significant differences between the Hand Injury and the No Hand Injury samples for either sex or for any of the four age categories used to divide the two samples (Age group 1: < 31 years; Age group 2: 31–45 years; Age group 3: 46–60 years; Age group 4: > 60 years).

The hand preference of all respondents was scored by assigning each individual the mean score achieved across the responses to the five items. Individuals in both groups were placed into one of four hand preference categories. These were: (1) All Right, respondents with a mean score of 1, indicating consistent use of the right hand for all items; (2) Mixed Right, individuals with a mean score greater than 1 and less than 3, indicating mostly right hand use with occasional left hand use; (3) Mixed Left, respondents with mean scores greater than or equal to 3 but less than 5, indicating predominantly left hand use with occasional right hand use; and (4) All Left, respondents with a mean score of 5, or consistent use of the left hand for all items. This classification method attempts to incorporate both the side and the strength aspect of unilateral hand use [7, 23]. The distributions of the remembered and current hand preference responses for the No Hand Injury respondents were virtually identical; therefore, the control group data were analysed using the current hand preference scores.

Table 1 contains the incidence of the four hand preference types in the two samples and the incidence of right and left hand injury found in the Hand Injury sample. If one uses the more common dichotomous classification scheme (by combining the All and Mixed Right and the All and Mixed Left categories of Table 1), the incidence of left-handedness in the Hand Injury sample was 8.7%, while that in the No Hand Injury sample was 8.8%. These rates of left-handedness are similar to those reported in numerous samples of North American adults [21].

All of the Hand Injury respondents described relatively severe hand injuries requiring medical and/or prolonged therapeutic intervention. The modal injury duration until complete recovery (reported by 60.6% of the Hand Injury respondents) was 1–6 months. The remaining portion of the respondents reported longer periods of injury recovery including some (6%) of over 12 months. Thirty per cent of the injured respondents described multiple injuries (for example, both the fingers and the wrist were impaired) with tendon lacerations (10.4%) and finger fractures (9.1%) being the second and third most frequently reported injuries.

Two statistical methods were used to analyse the hand preference and injury relationship. The first employed the standard \( \chi^2 \) analyses. The second method followed the procedures introduced by Coren and his associates [2–4, 6] in their presentation of data related to handedness and risk. These procedures, which involve the interpretation of relative risk (RR) or odds ratios (OR), are used by medical epidemiologists to measure the strength of
Table 1. Hand preference comparison of hand injury and no hand injury samples*

<table>
<thead>
<tr>
<th>Hand preference</th>
<th>Hand injury</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right Hand</td>
<td>Left Hand</td>
<td>Total</td>
<td>No hand injury</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>All Right</td>
<td>188</td>
<td>96</td>
<td>284</td>
<td>241</td>
<td>525</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(60.3%)</td>
<td></td>
<td></td>
<td>(60.3%)</td>
<td>(60.3%)</td>
<td></td>
</tr>
<tr>
<td>Mixed Right</td>
<td>69</td>
<td>77</td>
<td>146</td>
<td>124</td>
<td>270</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(31.0%)</td>
<td></td>
<td></td>
<td>(31.0%)</td>
<td>(31.0%)</td>
<td></td>
</tr>
<tr>
<td>Mixed Left</td>
<td>11</td>
<td>14</td>
<td>25</td>
<td>17</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(5.3%)</td>
<td></td>
<td></td>
<td>(4.3%)</td>
<td>(4.8%)</td>
<td></td>
</tr>
<tr>
<td>All Left</td>
<td>6</td>
<td>10</td>
<td>16</td>
<td>18</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.4%)</td>
<td></td>
<td></td>
<td>(4.5%)</td>
<td>(3.9%)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>274</td>
<td>197</td>
<td>471</td>
<td>400</td>
<td>871</td>
<td></td>
</tr>
</tbody>
</table>

*Table entries are the N in each category. Total N varies from the maximum N because some respondents did not answer all questions. Values in parentheses are the percentages of the Hand Injury, the No Hand Injury and the combined samples in each hand preference category.

The association between exposure to a risk factor (RF) and the positive or negative incidence of a disease [15]. The risk of a disease is estimated by forming a ratio of incidence rates (or risks):

\[ RR(OR) = \frac{N \text{ exposed with disease} / N \text{ exposed without disease (RF +)}}{N \text{ unexposed with disease} / N \text{ unexposed without disease (RF -)}} \] (1)

In applying this approach to handedness, it is assumed that left-handedness means exposure to a risk factor (RF +), while right-handedness does not (RF -); accidental injury is the outcome or disease variable. The variant of this ratio used by COREN and his associates [2, 4, 6] was:

\[ RR(OR) = \frac{N \text{ injured left-handers} / N \text{ uninjured left-handers (RF +)}}{N \text{ injured right-handers} / N \text{ uninjured right-handers (RF -)}} \] (2)

If the value of the ratio exceeds 1, then the risk of a disease (accident) is greater when exposed to the risk factor (left-handedness); if the ratio is less than 1, then there is a reduced risk of a disease (accident) with exposure to the risk factor (left-handedness) [15]. Odds ratios greater than 1 are interpreted as a per cent of greater risk for left-handers, less than 1 as a per cent of greater risk for right-handers, and ratios of 1 indicate no association between handedness and accidental injury, or a 0 \% risk. Thus, a computed odds ratio of 1.2 is interpreted as a 20 \% greater risk favouring the occurrence of an injury in a left-hander, while one of 0.8 indicates a 20 \% greater risk for a right-hander [2, 4].

**Do left-handers have an elevated risk of accidental hand injury?**

Chi-square analyses were performed on the frequency data presented in Table 1 (combining the side of the injured hand). There was no significant difference in the occurrence of the four handedness categories in the Hand Injury and No Hand Injury groups. Because an odds ratio analysis demands dichotomous classification [15], two different dichotomizations, similar to those reported by COREN and associates [2, 4, 10], were also used to explore the hand preference and injury risk relationship. First right- vs left-handers were compared by combining the frequencies in the All and Mixed Right and the All and Mixed Left categories of Table 1. The \( \chi^2 \) comparison of the incidence of right- and left-handedness in the Hand Injury as compared to the control group was not significant. The
computed odds ratio (using Formula 2) for this dichotomous classification of hand preference was 0.99 [95% CI = 0.62, 1.60]*, indicating a non-significant increased risk of hand injury for right-handers of 1%.

The second dichotomization compared the incidence of consistent right-handedness (the All Right category) in the two groups to the incidence of all other forms of mixed- and left-handedness. This classification procedure was used by Halpern and Coren [10] in their study of handedness and mortality risk. It is consistent with the theory of anomalous dominance proposed by Geschwind and Galaburda [9], which contends that all deviations from strong right-handedness indicate the presence of a pathological risk factor. Once again, \( \chi^2 \) comparison of the frequency of consistent right-handedness vs inconsistent and left-handedness in the two groups was not significant, and the computed odds ratio based on these categories was 1.00 [95% CI = 0.76, 1.32] or 0% risk. Left-handers, regardless of the criterion used to define the side of hand preference, were not more likely than right-handers to have experienced an accidental unilateral hand injury.

The cause of the accidental hand injury was identified and categorized for 453 of the Hand Injury respondents. The incidence of the four hand preference types separated by the cause of the accidental injury is shown in Table 2. Hand injuries related to an accident during participation in a team sport or other leisure activity (for example, tennis or cycling), those related to work activities and home-related accidents accounted for 92.7% of the responses. Chi-square analysis of the association between hand preference and accident cause categories did not reveal a significant pattern. Additional \( \chi^2 \) tests using the dichotomous preference classifications of right-handers vs left-handers and consistent right-handers (All Right) vs mixed and left-handers also failed to reveal a significant association between hand preference and injury cause.

Table 3 contains the odds ratios and 95% confidence intervals computed for each category.

* Ninety-five per cent confidence intervals were computed for each odds ratio reported. Because the null hypothesis is that \( OR = 1 \), representing a 0% risk factor, odds ratios are not regarded as significant if the span of the confidence interval includes the null hypothesis value [8].
of accident cause, with the relative per cent risk favouring hand injury shown in the last two columns. Table 3 also contains the odds ratios and relative risk estimates reported by Coren [2, 4] for similar accident cause categories. The odds ratios, based on the relative incidence of accidental hand injuries in the present sample, were substantially lower than those computed by Coren [2, 4] based on self-report data. In fact, a higher risk was found for right-handers under one category of accident cause. Over the four accident cause categories, Coren’s [2, 4] risk estimates averaged 44.8% in favour of greater accident risk for left-handers. None of the odds ratios computed for the present sample were statistically significant. They averaged to be a 4.3% risk factor for left-handers (an approximate tenfold reduction relative to Coren’s values) and represent estimates close to 0% risk (OR = 1.00) or no association between the risk factor and the outcome variable.

Hand preference and the side of hand injury

When the side of the injury was classified into preferred hand vs non-preferred hand (regardless of the hand preference type), the data indicated that 59.7% of the sample reported a preferred hand injury. Chi-square analysis revealed a significant association between the four categories of hand preference and preferred vs non-preferred hand injury [χ² (3, 471) = 14.56, P < 0.01]. This overall χ² was decomposed into two additional comparisons. The first compared the incidence of preferred and non-preferred hand injury as a function of hand preference strength (All Right and All Left combined vs Mixed Right and Mixed Left combined) while the second made the same comparison as a function of the side of hand preference (All Right and Mixed Right combined vs All Left and Mixed Left combined). The strength comparison reached statistical significance, [χ² (1, 471) = 13.80, P < 0.01]; 66% of the respondents with consistent handedness injured their preferred hand as opposed to 48.5% of those with mixed hand preference patterns. Sixty per cent of the right-handers injured the preferred hand as compared to 58.5% of the left-handers; this comparison was not statistically significant.

The relationship between side of hand injury and handedness side and strength was explored for each of the separate accident cause categories shown in Table 2. Only one hand preference strength comparison reached statistical significance. Individuals with consistent handedness were more likely to injure their preferred hand (70.3%) in a work-related accident when compared to those with mixed handedness (43.4%) [χ² (1, 144) = 10.16, P < 0.01]. None of the comparisons between right- and left-handers revealed a significant pattern.
Further statistical exploration of the separate handedness categories (All Right, Mixed Right, Mixed Left and All Left) was conducted using $\chi^2$ goodness of fit tests with expected values of 0.5, or an equal expected probability of a preferred and a non-preferred hand injury. Only the frequency of preferred hand injury among the All Right respondents (66.2%) deviated from the equal probability expectation [$\chi^2 (1, 284) = 29.81$, $P < 0.01$]. The frequency of occurrence of preferred hand injury among the Mixed Right (47.3%), Mixed Left (56.0%) and the All Left (62.5%) respondents did not show a significant deviation from the chance value of 0.5. The trend toward an increased likelihood of preferred hand injury was evident among the All Left individuals, but the small sample size of 16 may have contributed to the failure to find statistically significant departures from chance values.

DISCUSSION

The present data failed to reveal any relationship between the side of hand preference and the risk of accidental hand injury. The distribution of hand preference types was the same in the Hand Injury sample when compared to the matched control group without hand injuries. Traditional $\chi^2$ analyses did not find any association between these variables, either taken as a group, or when analysed by separate category of accident cause. The odds ratio analyses, on average, showed a non-significant risk relationship between hand injury incidence and the side of hand preference; in addition, the risk estimates were 10 times lower than those reported by COREN [2]. When the incidence of hand preference types was analysed for separate categories of accident cause, risk estimates also emerged showing an elevated injury risk for right-handers. This latter finding partially replicates the report of PETERS and PERRY [18], who found a higher incidence of female right-handers reporting the experience of a traffic accident.

The major result was a significant tendency for individuals with consistent handedness, and respondents with consistent handedness who hurt their hand in a work-related accident, to injure their preferred hand. There was no relationship between the side of hand preference and the incidence of preferred and non-preferred hand injury. Both right- and left-handers showed an approx. 60% incidence of preferred hand injury. The finding of a relationship between hand preference strength and preferred hand injury favours a use rather than an inherent risk factor explanation of the association between hand preference patterns and the risk of hand injury. Rather than individuals of specific handedness types having a higher risk of accidental hand injury, either because of environmental sidedness discordance or pathological propensities, it seems that one has a greater risk of injuring the hand that is used most frequently. Mixed-handers, who report some facility of use with both hands, are less likely to experience a preferred hand injury when compared to those with consistent handedness patterns.

The present study highlights the need to investigate specific types of accidental injury before formulating general statements associating hand preference with accident risk. Also, investigators should validate the severity and specific nature of the accidental injuries and include measures of hand preference strength as well as side. These differences in data collection between the present study and that of COREN [4] could account for the large disparities in risk estimates. Perhaps, as mentioned in his original report, COREN's [4] risk estimates reflect, not an association between left-handedness and elevated accidental injury risk, but an association between the elevated tendency to remember and report more accidents, or to interpret more injuries as accidental, among left-handers when compared to...
right-handers. Emphasizing the “hazardous life of the southpaw” [2], based on ambiguous data, will only exacerbate the problems that left-handers are hypothesized to experience.

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