A Retrospective Analysis of Major and Significant Injuries and their Consequences Reported by Retired Australian Baseball Players

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Abstract: The purpose of this study was to establish if injuries sustained during a player's career in baseball had consequences later in life following retirement from participation. Seventy-five retired Australian baseball players (mean age 55.8 ±11.4 years) completed a survey to establish the long-term consequences of major (i.e. those resulting in five or more consecutive weeks of training or playing being missed) and serious (i.e. those resulting in more than one week, but less than five weeks of training or playing being missed) injuries sustained during their playing careers. Players typically retire from participation in competitive baseball because of either age (33%), a combination of age and injury (25.3%) or injury (14.7%). The average overall injury rate during a playing career was 5.6 ±7.1. Respondents reported a total of 98 (26.4% of all injuries) "major" injuries (1.5 ±2.2 per respondent/playing career) and 273 (73.6%) "significant" injuries (4.1 ±6.5 per respondent/playing career). The highest number of injuries related to the upper body (n = 145) representing 59.9% of all injuries reported and 40.1% (n = 97) of injuries occurred to the lower body. Some respondents (29.3%) incurred additional medical costs and significant loss of income (12%) associated with their injuries. 5.3% of all respondents indicated their injuries had impacted on their ability to perform work for which they had been previously trained. A further 26.7% reported experiencing limitations in their ability to carry out normal leisure activities later in life. Further research is needed into the mechanisms and management of common injuries and their consequences after retirement with a view to developing strategies that may reduce their incidence/severity and possible negative impact later in life.

Keywords: Baseball, major and significant injury consequences.

INTRODUCTION

There has been limited investigation into the impact of sporting injuries on participants later in life. However, some research suggests injuries sustained while participating in sporting past-times can impact on the athlete in varying ways to differing extents later in life [1-3]. One possible approach to establishing these impacts may be to ask retired athletes to recall those major and significant injuries that they have experienced across their career. In addition a range of questions could also be asked that provide details of the individual's current health status and quality of life, as well as providing information about possible perceived costs (e.g. in terms of loss of income, ongoing medical costs, etc.) over time that are associated with these injuries. Such an investigation might provide important information about the impact of sporting injuries on the retired athlete's employment status and their ability to maintain their chosen employment following withdrawal from regular sport participation.

Very little published data on injury rates in baseball exist, which is surprising given the levels of participation in this sport globally. The United States of America is the birthplace of baseball and the sport is second in popularity in that country only to basketball [4]. It is played in over 100 countries around the world and is a popular Australian team sport played in every state of Australia with some 59,000 registered junior and senior participants [5]. It is a complex game involving 2 teams of 9 players and requires both physical and mental fitness, with the ability to concentrate for long periods of time being a prime requisite. Games may take several hours to play and are intermittent in nature with physical involvement placing high demands on quick, explosive and reactionary movements. These typically involve multiplanar rotations, particularly of the shoulder, hip and torso [6, 7]. Baseball is generally considered a non-contact sport in character but collisions can occur with other participants and objects (e.g. ball, ground, fencing and signage) that may result in injury.

Various types of injuries have been linked to baseball participation and these include injury to the wrist and hand, sprains, fractures, dislocations, tendon ruptures, lacerations and contusions [8]. According to Nicholls *et al.* [9], baseball has one of the highest impact injury rates of all sports with these injuries primarily attributed to impact by a ball after it has been hit, pitched or thrown; some impact injuries also result from hitting another player or objects [8]. Notwithstanding this, research has shown that it is possible to prevent some sport injuries [10] and a well designed prehabilitation programme that considers the more common injuries associated with a particular sport may serve a preventive role in this context [11].

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Injury associated with sport and physical activity can potentially result in significant health care costs and consequent disabilities and reduced mobility may result in inactivity. This in turn may increase the risk of cardiovascular disease and other health problems [12]. Participation in sport comes with many potential health benefits but it can also result in personal injury, yet little research has focused on the long-term impact that major injuries may have on participants. A preliminary analysis, using the responses of respondents in this current study, has been published in the literature [13]. However, an in-depth analysis with further findings is presented here with the aim to better understand the impact of (major and significant) injuries sustained during participation in competitive baseball on players' lives post participation. This analysis also determined if retired players experience negative economic and lifestyle consequences that have carried over into their post retirement period from competitive participation.

MATERIALS AND METHODOLOGY

Subjects

A sample of 204 retired players were invited to participate in the study by direct mail package. The mailing list of potential participants was generated from the membership databases of the Australian Baseball Federation (ABF) and the Far North Coast (FNC) Baseball Association. The ABF and FNC Baseball were both responsible for identifying retired players in their databases to whom the survey package could be sent. At no time did the researchers have any knowledge of the name and mailing addresses of possible participants identified on the two mailing lists.

Survey Design

The survey tool used a combination of "yes/no", checklist and short open-ended response questions. The survey was developed specifically for this study but was adapted from a survey utilised in similar research involving retired rugby league players [3, 14]. The survey was 13 pages long with a total of 27 items; some items had sub-sections. The survey essentially had six sections relating to the following: i) personal details; ii) playing history; iii) employment history; iv) injury/medical history; v) impact of injuries; and vi) training and game preparation. Participants in the survey were only asked to identify major and/or significant injuries as defined by the descriptors provided in the survey (these are described below). Each potential participant received a package containing the survey, an explanatory cover letter and a reply paid addressed envelope in which to return the completed survey. Survey participants had the freedom to choose whether to participate or not and were advised that their completion and submission of the survey constituted consent. No respondent was able to be personally identified and neither was there any need for such identification. This research was granted ethics approval by the Southern Cross University Human Research Ethics Committee (ECN-04-184). After the initial development of the survey form it was distributed to relevant experts in the sport/sports injuries field for input and feedback regarding face validity and relevance of items. This group consisted of one physiotherapist with experience at an international level within the sport of baseball, one sports medicine physician, two sports scientists and a senior member of New South Wales Baseball with experience in player development. A pilot study was also conducted using four subjects from the target population. This process resulted in a number of small changes being made to the survey tool.

Definitions of Major and Significant Injury

For the purposes of this investigation, a **major** injury was defined as an injury that resulted in five or more consecutive weeks of training or playing being missed. A **significant** injury was an injury that resulted in more than one week, but less than five weeks of training or playing being missed. These definitions were developed after consultation with two of the invited experts who had extensive knowledge and experience of this sport.

Statistical Analysis

SPSS was used for all statistical analysis. As the number of major, significant and total (significant + major) injuries were significantly positively skewed, a natural logarithmic transformation was applied to the counts of injuries in each category [ln(number of injuries+1)]. A hierarchical analysis of variance was performed on each of the transformed variables; number of major, significant and total injuries, with the covariate of years spent playing baseball and factors, level of competition played (4 levels – local, state, semi-professional/professional, national), and playing position (4 levels – pitcher, outfield-hitter, infield-hitter, catcher). A hierarchical analysis of variance gives the significance of each factor after adjusting for the previous variables included separately in the model. An alpha level of $p \leq 0.05$ was used for all statistical comparisons. Borderline effects were also indicated at the $p \leq 0.10$ level. All data were summarised using descriptive statistics (mean [±SD]) and percentages.

Limitations

This research was conducted using a relatively small sample of retired players from one country and therefore caution should be taken when interpreting these findings and applying them to all retired players. No attempt was made to get respondents to quantify their total exposure in terms of games played and training sessions participated in. Respondents were only asked to identify major and significant injuries and not all injuries (e.g. minor ones that may have stopped a player from playing/training for 0-7 days). This research also relied upon the recollection and honesty of respondents in completing the questionnaire. In some cases respondents were reporting details of injuries that may have occurred 50 years or more previously. Further, given the response rate it is possible that participation bias has influenced the nature of reported data since those recipients who chose not to respond to the survey may have had no record of significant or major injury during their playing career.

RESULTS

A total of six survey packages were returned because the postal address was either incorrect or the sender was no longer at the stated address, therefore 198 of 204 packages distributed were actually delivered. A total of 75 completed

surveys were returned for analysis representing a 37.8% return rate.

The average age of respondents at the time of completing the survey was 55.8 ±14.7 years (range 16-81 years). The average age respondents started playing as a registered player was 13.8 ±5.7 years (range 5-45 years) and the average age at which they stopped playing in an organised competition was 41.3 ±11.4 years (range 15-79 years). Respondents spent an average of 27.2 ±10.9 years playing (range 5-57 years). Eleven (14.7%) respondents had represented their local association, 18 (24%) had played at a state level, 2 (2.7%) had been professional players in North America, 35 (46.6%) had represented Australia and 9 (12%) had played at local association level only. The highest level of representative play was used in this investigation as an expression of skill level i.e. presumably the higher the level of representative play attained the more skilful the player.

Respondents were asked to identify the playing position that they mainly played during their career (Table **1**). Table **2** summarises the reasons why respondents retired from participation in competitive baseball. In addition to those reasons provided in Table **2** a range of "other" reasons were provided from six of the respondents including becoming involved in coaching/administration, taking up another sport, and moving overseas to work.

Table 1. Playing Position of Respondents (N = 75)

Position	n	%
Pitcher	20	26.7
Hitter – Outfielder	10	13.3
Hitter – Infielder	24	32.0
Catcher	20	26.7
Total*	74	98.7

N.B.: Not all respondents responded to this question.

A total of 89.3% of respondents were employed full-time during their playing careers. The remaining 10.7% were either employed part-time, unemployed or full-time students. The majority of respondents were employed in office work with the next most popular employment category being in some form of trade (e.g. building and construction, etc). These two categories of employment accounted for 54.7% of all responses. Similarly, after retirement from the game, 52.0% of respondents continued to work in these two areas of employment.

Table **3** shows that a total of 242 injuries were reported by 66 (88%) respondents during their playing careers representing 47 different types of injury. However, 9 (12%) respondents reported no incidence of major or significant injury during their playing career. Respondents may have experienced more than one occurrence of the same type of injury during their playing career. Of the 371 separate incidents of injury reported by respondents, 98 (26.4%) were considered major while 273 (73.6%) were considered significant. This reflects an average injury rate per player/playing career of 5.6 (±7.1). With respect to major and significant injuries this represents an average injury rate per player/playing career of 1.5 ± 2.2 and 4.1 ± 6.5 respectively. As can be seen from Table **3**, a total of 59.9% of all injuries reported occurred to the upper body and 40.1% occurred to the lower body. The most common site of injury to the upper body involved the shoulder (17.8%), followed by the elbow and forearm (9.9%). With respect to the lower body the most common site of injury occurred at the ankle (14.9%), followed by the knee (11.6%).

Table 2. Reason for Retiring from Participation in Competitive Baseball

Reason for Retiring	n	%
Age	25	33.3
Combination of age and injury	19	25.3
Injury	11	14.7
Work/Family commitments	8	10.7
Lack of interest/motivation	4	5.3
Time constraints	2	2.7
Other	6	8.0
Total	75	100

Statistical analysis found no significant interaction between level of competition (reflecting skill level) and playing position with any of the transformed severity of injury variables i.e. number of major, significant and total injuries ($p = 0.411$, $p = 0.284$, $p = 0.501$ respectively). Table **4** presents the estimated marginal means and standard errors for the ln transformed data and back transformed to original count measurements using the log normal distribution properties outlined by Lindsay [15].

This analysis was conducted on a total of 59 respondents providing complete information on all factors included in the models. Results of significant posthoc tests (non adjusted) are also indicated in Table **4**. The position of catcher (mean = 1.06, SE = 0.27), had significantly ($p = 0.027$) lower numbers of major injuries than any other position; pitcher (mean = 2.65, SE = 0.41), hitter-outfielder (mean = 2.58, SE = 0.57), hitter-infielder (mean = 3.28, SE = 0.42). There was also a non-significant trend toward a higher number (total injuries $p = 0.069$) and severity of injuries (major injury $p = 0.087$) being experienced by semi-professional/professional players.

Table **5** provides details of the total incidence of injuries, their severity and when (i.e. during play or training) they occurred. With respect to frequency and severity of injury, 43 (65.1%) respondents (n = 66) experienced no more than one major injury during their career while 17 (25.8%) experienced 2-3 and 6 (9.1%) experienced 4 or more. With respect to significant injuries, 24 (36.4%) respondents experienced no more than one during their playing career while 21 (31.8%) experienced 2-3 and 21 (31.8%) experienced 4 or more.

A total of 41 (62.1%) injured respondents (n = 66) required hospitalisation on 66 separate occasions as a result

Table 3. Site and Type of Injury Reported by Retired Baseball Players During their Playing Career (n = 66)

Site of Body	Type of Injury	Total	%
Head and facial (n = 21) 8.7%	Concussion	8	3.3
	Fractured (broken) nose	8	3.3
	Fractured (broken) jaw	1	0.4
	Eye Injury	4	1.7
Neck (n = 10) 4.1%	Muscular injuries	6	2.5
	Ligament damage	4	1.7
Back (n = 14) 5.8%	Fractured (broken) vertebra	2	0.8
	Muscular injuries (upper back)	2	0.8
	Muscular injuries (lower back)	6	2.5
	Disc injury of the lumbar or thoracic spine	1	0.4
	Tendon or ligament damage	3	1.2
Shoulder (n = 43) 17.8%	Shoulder dislocation	3	1.2
	Acromioclavicular (AC) joint dislocation or subluxation	1	0.4
	Clavicle fracture	2	0.8
	Rotator cuff injury	15	6.2
	Muscular injury (shoulder or upper back)	4	1.7
	Tendon or ligament damage	11	4.5
	Nerve injury to shoulder or upper arm	3	1.2
	Reconstructive surgery	4	1.7
Elbow and Forearm (n = 24) 9.9%	Fractured (broken) forearm	3	1.2
	Fractured (broken) wrist	4	1.7
	Nerve injury or entrapment	2	0.8
	Tendon or ligament damage	15	6.2
Hand (n = 22) 9.1%	Finger dislocation	8	3.3
	Fractured (broken) finger	10	4.1
	Tendon or ligament damage	4	1.7
Chest/Abdomen (n = 11) 4.5%	Fractured (broken) ribs	3	1.2
	Fractured (broken) sternum	1	0.4
	Cartilage injury of ribs	3	1.2
	Abdominal strain injuries	4	1.7
Groin (n = 10) 4.1%	Muscular injuries	9	3.7
	Tendon injury	1	0.4
Hip and Thigh (n = 23) 9.5%	Quadriceps strain	1	0.4
	Hamstring strain	16	6.6
	Other muscular injuries	5	2.1
	Tendon or ligament damage	1	0.4
Knee (n = 28) 11.6%	Cartilage tears that required surgery	12	5.0
	Anterior Cruciate Ligament (ACL) injury	5	2.1
	Posterior Cruciate Ligament (PCL) injury	2	0.8
	Medial Collateral Ligament (MCL) injury	6	2.5
	Patella tendon injury	2	0.8
	Reconstructive surgery	1	0.4
Ankle (n = 36) 14.9%	Sprained ankle (ligament damage)	22	9.1
	Fractured (broken) ankle / shin bone	5	2.1
	Tendon or ligament damage	3	1.2
	Muscular injuries	4	1.7
	Fractured (broken) bones of the foot	2	0.8
	Total	242	100.0

Table 4. Estimated Means and Standard Errors for Transformed Data and Back Transformed to Original Counts by Level of Injury, Representative Level/Skill and Position Played for Respondents (n = 59)

Injury Level	Factor	Levels	n	Transformed ln(x+1)		Original Scale (Back Transformed)	
				Mean	SE	Mean	SE
Major*	Representative level	Local	10	0.77	0.20	1.65	0.41
		State	14	0.50	0.16	0.99	0.27
		Semi-professional/Professional	2	1.68	0.43	5.42	1.65
		Aust rep	32	0.76	0.11	1.61	0.22
	Position played	Pitcher	16	1.03	0.18	2.65	0.41
		Hitter-Outfielder	8	1.05	0.24	2.58	0.57
		Hitter-Infielder	19	1.15	0.18	3.28	0.42
		Catcher*	15	0.49	0.18	1.06	0.27
Significant	Representative level	Local	10	1.28	0.29	4.45	1.61
		State	14	1.28	0.23	4.26	1.20
		Semi-professional/Professional	2	2.53	0.61	17.14	12.68
		Aust rep	32	1.25	0.16	4.20	0.82
	Position played	Pitcher	16	1.47	0.26	6.41	2.22
		Hitter-Outfielder	8	1.73	0.34	7.92	3.44
		Hitter-Infielder	19	1.71	0.26	9.25	3.33
		Catcher	15	1.44	0.25	5.73	1.84
Total	Representative level	Local	10	1.78	0.23	6.73	1.79
		State	14	1.48	0.19	4.58	0.96
		Semi-professional/Professional	2	2.88	0.49	21.56	11.86
		Aust rep	32	1.62	0.13	5.50	0.79
	Position played	Pitcher	16	1.93	0.21	8.71	0.74
		Hitter-Outfielder	8	2.03	0.27	9.21	1.07
		Hitter-Infielder	19	2.16	0.20	11.93	0.79
		Catcher	15	1.63	0.20	5.90	0.63

*Denotes significant (at the $p \leq 0.05$ level) post hoc comparison (non-adjusted) for level of injury (major) and position played: catcher *vs* pitcher ($p = 0.022$); catcher *vs* hitter-outfielder ($p = 0.042$) and catcher *vs* hitter-infielder ($p = 0.004$).

N.B.: Estimated means use the covariate of years spent playing being held constant at 28.02. This was the mean calculated from respondents (n = 59) who indicated injury, level of play and position.

of an injury sustained during their career. This represented an average for this group of 3.5 ±9.3 days in hospital with a range of 0-72 days. Injuries requiring a hospital visit ranged from out patient visits to monitor concussion, set fractured bones, receive treatment for lacerations to extended stays in hospital for a range of surgical procedures (e.g. cartilage tears requiring surgery, joint reconstruction surgery, etc).

62.1% (n = 41) of respondents had an injury that required them to spend one day or less in hospital receiving treatment. A further 19.7% (n = 13) had an injury that required them to spend between 2-3 days in hospital receiving treatment, while 4.6% (n = 3) spent 4-5 days in hospital and 13.6% (n = 9) spent 6 days or more in hospital receiving treatment for injuries sustained during their career. The respondent requiring a 72 day stay in hospital received major surgery to the knee in 1951. A total of 14 respondents indicated that they had undergone a total of 16 surgical procedures relating specifically to either joint replacement or joint reconstruction. However, only 3 cases of joint replacement and 7 of joint reconstruction were deemed to have a medical link with the respondents' involvement in baseball.

Respondents were asked to indicate if they were experiencing any of a number of listed medical conditions at the time of completing the survey and also if medical examination had established if any of these conditions were directly related to their involvement in baseball. 18.7% (n = 14) and 24.0% (n = 18) of all respondents indicated that they were currently experiencing arthritis and restricted joint mobility that medical examination had indicated was associated with their participation in baseball. Of those respondents suffering from arthritis the most common site of the disease was the knee followed by the fingers. However, only 4 (5.3%) respondents whose arthritis was linked to their participation in baseball were taking medication for this condition. Ten (13.3%) respondents indicated that the injuries sustained from their participation in baseball had

Table 5. Total Incidence of Injury and Severity During Play and Training as Recalled by Retired Baseball Players (n = 66)

Severity of Injury	Sustained During a Game	Sustained During Practice	Category Total
Major	89 (90.8)	9 (9.2)	98 [26.4]
Significant	219 (80.2)	54 (19.8)	273 [73.6]
Total	308 (83.0)	63 (17.0)	371 [100.0]

N.B.: Figures in () are % of sub category total. Figures in [] are % of total injuries.

been compounded by their work. Twenty (26.7%) respondents indicated that other sport activities had exacerbated their injuries from baseball and 8 (10.7%) had suffered some form of accident which had made their injury worse.

Respondents were asked to indicate if, in their opinion, the injuries sustained during their playing career had impacted negatively on them in some way either during or after their retirement from baseball; they were asked to select from a list of 5 "consequences". Twenty-two (29.3%) respondents indicated that they believed they had incurred additional medical costs associated with their injuries that were not covered by their health insurance or club cover. Twenty-one (28%) had retired early from baseball as a result of their injuries and 20 (26.7%) felt that they were currently experiencing limitations in their ability to carry out normal leisure activities. However, only 9 (12%) perceived that they had significant loss of income due to extended periods of recovery and/or rehabilitation from their injuries and just 4 (5.3%) perceived that their injuries had impacted on their ability to perform work for which they had previously been trained.

DISCUSSION

Within the limitations of this study it can be concluded that the prevalence of major and significant injury, as defined in this research, per player/playing career reported here is substantially lower than that reported previously for baseball players [9]. Further, the data reported here does not appear to confirm claims of baseball having high rates of injury [4, 9, 16]. However, the types of injuries found within the current sample of retired Australian baseball players are similar to those reported previously in the literature [8, 17-19].

While injury rate is often calculated based on total hours played and involved in training it was not considered appropriate to ask respondents to try and recall these details in this present study. It would be hard to imagine that a respondent could recall accurately their total hours of involvement over time and from several years ago. Further, it was not considered appropriate to ask retired players to recall all injuries sustained in a playing career. As with most sports, minor injuries are common place but may not be so debilitating enough that a player has to withdraw from training and play for an extended period of time. It also seems reasonable to assume that players will have much greater difficulty accurately recalling minor injuries compared with more significant and major injuries.

The evidence from this study shows that catchers were significantly less likely to sustain a major injury during their playing careers than all other playing positions. This may reflect the catcher's position during play behind the batter and their protective clothing, which functions to protect the player from impacts by the ball and presumably from other players. This position on the team also requires the player to produce fewer repeat dynamic high power movements, such as sprinting, throwing, changes of direction, etc., which are a characteristic of all other positions on the team. Therefore, with respect to baseball, it appears that intensity of effort is a major contributor of injury severity and rate.

Just 14.7% of respondents indicated that injury alone was the primary reason for them retiring from participation in the sport with a further 25.3% indicating that a combination of age and injury was responsible for their retirement. With respect to the latter it appears likely that the wear and tear that participants experience, from what might be described as a highly repetitive activity, in combination with the length of time actively involved within this sport, combine to ultimately force a player into retirement. Given the average length of participation (27.2 ± 10.9 years) and the average total frequency of injury (5.6 ± 7.1) per player/playing career, the rate of injury in baseball could not be considered excessive. Notwithstanding this, the findings of this current study suggest that prevalence and severity of injury is not linked to years played or level of participation. However, there was a trend toward higher rates of injury overall and incidence of major injury associated with participation in representative level play. It is speculated that this may reflect the typically higher total number of games played and total volume and intensity of training undertaken as players progressed to higher levels of representative play.

The overall prevalence of major and significant injuries, as defined within this study, would appear to also be relatively low within this group. However, it was noted by some respondents that their participation in other sport activities (26.7%), work (13.3%) or some form of accident (10.7%) may have made these injuries worse. While some injuries required hospitalisation most of these were relatively minor and required only an out patient visit lasting less than 1 day. Notwithstanding this, some respondents sustained an injury severe enough to ultimately require an extended stay in hospital e.g. 7 reported cases of joint reconstruction. Injury to the shoulder, elbow and forearm accounted for 27.7% of all injuries reported. This is not surprising given the high demand placed on throwing and pitching skills within this sport, which may result in injury to these areas of the arm and shoulder [14].

It is possible that the injuries identified within this study may all be reduced with appropriate sport specific conditioning and prehabilitation exercises. Any such prehabilitation program should aim to address any imbalances that may exist and that typically occur as a result

of repetitive movements, and aim to achieve muscular balance to aid in protection of joints and connective tissue. For example, functional balance training on unstable surfaces may not only improve proprioception but also reduce the likelihood of injury to the ankle, knee and lower back [7, 20, 21], which are all areas of the body identified in this investigation associated with injury. As a result, a systematic programme of sport specific conditioning that works to reduce the incidence of the more common injuries identified in this study would appear to have merit. It is worth noting that athletes who suffer ankle sprains are also more likely to reinjure the same ankle [21]. In this current research ankle injuries were the second highest after the those linked to the shoulder and on this basis any strategies that work to strengthen and stabilise this joint in baseball players would appear to be beneficial.

It is reasonable to assume that the debilitating consequences of major injuries will worsen without appropriate medical care, potentially deteriorating with the number of years post retirement. Joint injuries may result in potentially debilitating side effects, such as osteoarthritis, restricted joint movement and ultimately the possibility of joint replacement or reconstruction [22-24]. The most common site of arthritis reported by respondents in this study was the knee followed by the fingers, possibly reflecting the stresses placed on these joints of the body from participation in this sport. However, only a small number (n = 4) of respondents were taking medication for this condition.

The survey found that of the respondents suffering long-term complications, 12.0% (n = 9) indicated that they had lost income during their career due to injury. While the majority of respondents were covered by private medical insurance throughout their career it is not clear whether they had any form of income protection or were paid sick leave in their normal employment when absent from work due to injury sustained while playing. Notwithstanding this, 9.3% of respondents indicated that they either "agreed" or "strongly agreed" that in their opinion the injuries identified as occurring during their playing career had affected their ability to work in their chosen career or generate income. Further, 5.3% (n = 4) of respondents indicated that, in their opinion, they had suffered a reduced ability to work in their chosen occupation because of the consequences of old injuries.

Injuries sustained from sport and recreation activities can place significant costs on the health systems of countries [25]. For the injured participant there is also the potential for ongoing medical costs. In this study 29.3% (n = 22) of respondents reported that they had to cover additional medical costs associated with these long-term injury complications that were not covered by their health insurance or club cover. In addition, 26.7% (n = 20) perceived that their injuries had placed limitations on their ability to carry out normal recreation activities such as walking, gardening, etc. However, it may also be argued that because of their involvement in this sport their ability to participate in a range of physical activities later in life has been enhanced.

CONCLUSION

No research to date has examined the long-term consequences of injuries sustained by baseball players during their playing careers. Consistent with the original aims and objectives of this research this study has attempted to shed some light on this issue by asking retired Australian players to report the impact of major and significant injuries on them after retiring from the game. Given the lack of research into long-term consequences of injury generally and the unique nature of each sport, not only in terms of skill but also playing and training demands, no attempt has been made to compare the results found here with those reported previously in other sports [e.g. 14, 26]. Given that all sports have inherent risks associated with them that may result in injury the issue of how the more severe injuries impact on sport participants later in their life, once their sporting involvement ceases, is an area worthy of more detailed investigation [25]. Of particular interest to governments and health agencies will be the additional cost such injuries place on the public health system.

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CONFLICT OF INTEREST STATEMENT

There are no conflicts of interest linked to this research.

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