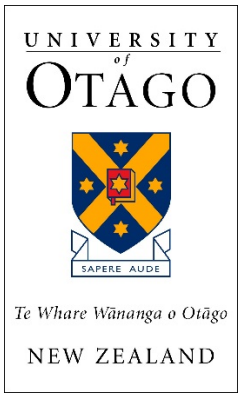

Is Film Misleading Young Adults About Traumatic Brain Injury?

Investigating misconceptions about Traumatic Brain Injury in young adults and the portrayal of head injuries in popular film

A research report by

Thomas Aitken, Michelle Bai, Richard Bell, Liam Christopher, Stefanie Dixon, Gabrielle Farley (Team Leader), Katie Hoeksema, Jaron Huang, Carl Lin Liew, Steve Miller, Jordan O'Neill, Edward Palmer, Barney Rathnayaka, Matthew Russell, Paige Simpson and Neil Van Geest

Fourth Year Medical Students
Department of Public Health, University of Otago, Wellington

September 2016

Under the supervision of
Prof Diana Sarfati and Dr Richard Jaine

Table of Contents

Abstract

AIMS: The aims of this study were 1) to investigate whether misconceptions about Traumatic Brain Injury (TBI) are present in university students in the Wellington region, and 2) conduct a quantitative analysis of the portrayal of TBI symptoms and recovery in popular action films. **BACKGROUND:** TBI is a significant global public health problem and a growing cause of disease burden. Previous literature suggests that misconceptions about TBI are held by the public, and it has been hypothesised that the portrayal of TBI in popular media may underlie misconceptions. No previous research has explored the potential relationship between misconceptions about TBI and portrayal of TBI in popular film.

METHODS: In the first part of the study, investigators visited four university campuses in the Wellington region and surveyed people aged 18 – 24 about their perceptions of TBI and their exposure to a list of 20 action films (selected based on a set inclusion and exclusion criteria). In the second part, the 20 selected action films were analysed for frequency of head injuries, TBI symptoms, recovery time, and outcome.

RESULTS: 359 completed surveys were analysed. The results showed that misconceptions about TBI were present in the sample population. Males provided more correct answers than females, although the difference was small. Respondents with previous personal exposure to TBI were more likely to provide the correct answer to a question about time of recovery following a TBI. Analysis of 20 action films identified 930 head injury events. In 81% of head injury events, symptoms of TBI were not portrayed. 39.7% of significant characters showed an immediate recovery after exhibiting TBI symptoms; if the mechanism of injury was assault or a car crash, this proportion increased to 72.7% and 80%, respectively.

CONCLUSION: This study confirmed that misconceptions about TBI are present 18 to 24 year old university students, and that popular action films present an inaccurate portrayal of TBI, particularly with respect to recovery time following a head injury. Proposed

interventions focus on primary prevention of TBI, and include social media and advertising campaigns to provide countermeasures to the portrayal of TBI in popular media and aim to improve misconceptions about TBI.

Introduction

Traumatic brain injury (TBI) is a serious global public health problem (1, 2). Internationally, at least 10 million TBIs that are serious enough to result in hospitalisation or death occur every year (2). It is estimated that 57 million people have been hospitalised with one or more TBIs worldwide (2). According to the World Health Organization (WHO), TBI will surpass a significant number of diseases to become the third largest cause of global disease burden by the year 2020, both because of the frequency of TBI and the potential for long-standing consequences (1, 3). Therefore, public health research exploring the determinants of TBI is imperative. This will enable issues concerning prevention and management to be addressed, and for strategies to be formulated to manage this growing health problem.

Defining Traumatic Brain Injury

To start addressing this growing public health problem, it is important to firstly define TBI. In New Zealand, the Accident Compensation Corporation (ACC) guidelines define TBI as, "an acute brain injury resulting from mechanical energy to the head from external physical forces" (4). The current criteria for the clinical identification of TBI includes one or more of the following: confusion or disorientation, loss of consciousness, post-traumatic amnesia, and other neurological abnormalities, such as focal neurological signs, seizure and/or intracranial lesions (4). To assess the severity of TBI, the Glasgow Coma Scale (GCS) score and duration of post-traumatic amnesia are used to categorise TBI into either mild, moderate or severe (4). These categories are as follows: a GCS score of 13 to 15 and a post-traumatic amnesia period of less than 24 hours is a mild TBI, a GCS score of 9 to 12 and a post traumatic amnesia period lasting 1 - 6 days is a moderate TBI, and a GCS score of 3 to 8 and a post-traumatic amnesia period lasting 7 days or more is a severe TBI (4).

Consequences of Traumatic Brain Injury

Unsurprisingly, the consequences of TBI vary based on the severity of the injury. The majority of adults with a mild TBI achieved a full recovery somewhere between three and 12 months following the injury (4). However, a minority of both children and adults will have longer lasting effects (greater than 12 months) due to a mild TBI. Evidence also suggests that adults who sustained a TBI in childhood or adolescence may show psychological impairments in adulthood (4). Moderate and severe TBI can result in a complex set of neurological and psychological impairments, together with medical problems and physical disabilities. This affects not only the person who has suffered the TBI, but also their family/whānau, carers and the wider community. Consequences of severe TBI persist in varying forms for the rest of a person's life, and new problems resulting from the injury may emerge as a result of the aging process or new demands on the individual (4). Studies have also demonstrated that survivors of severe TBI often suffer from loss of friendship and social support, experience limited opportunities to develop new social contacts and friends, have fewer leisure activities, and show higher levels of anxiety and depression for prolonged periods of time (4).

Symptoms associated with TBI, such as memory loss and fatigue, are often invisible and have no physical manifestations, thus it is sometimes referred to as the 'silent epidemic' (1). The silent nature of TBI is one factor that makes it difficult to quantify the magnitude and extent of TBI, on both a global and local scale. Another factor that makes it difficult is the problem of capturing minor TBI, which makes up the majority of brain injury, as few people present to medical services and receive treatment (1). Furthermore, in multi-trauma situations, such as during military conflict, TBI is often under-reported or incorporated with other disability and death statistics (1).

Economic Burden of Traumatic Brain Injury

A study conducted in New Zealand in 2010 looked at the economic costs of a TBI. When looking at a detailed breakdown of a 12-month follow-up and the resources used for a patient in the first year following a TBI, the average cost per patient was US$3,783 (5). This cost changes depending on the severity of TBI. Furthermore, it only accounts for healthcare costs and not for income lost as a result of sustaining a TBI (5). In addition, the study looked at lifetime costs for all TBI survivors, which was estimated to be US $146.5 million for the year 2010 (5). This is expected to increase to US $177.1 million in 2020 (5).

Figures calculated by the New Zealand ACC Injury Statistics Tool indicate that during the July 2015 - June 2016 period, the total cost (including all new and active claims) for 'Concussion/Brain Injury' was approximately $84.2 million (NZD) (6). Of note, this total has been increasing with every financial year. Compared to the July 2011- June 2012 period, in which the total cost was approximately $66 million (NZD), the cost has greatly increased, with the number of active claims and new claims increasing every year (6). These figures indicate that not only is there is a significant burden of disease associated with TBI in New Zealand, but also a large associated economic burden.

Traumatic Brain Injury - International Epidemiology

Globally the burden of TBI is a significant problem, with the global incidence rate of TBI estimated to be 106 per 100,000 people (1). However, it is important to note that there are limitations when estimating the global burden of TBI (1). It is difficult to compare epidemiological rates of TBI between different countries due to variations in defining TBI, patient inclusion criteria, and assessment methods (7). Presently there is no internationally accepted definition of TBI (1).

Available data concerning the causes of TBI worldwide estimates that 60% of all cases are caused by road traffic accidents, 20 - 30% are caused by falls, 10% are due to violence, and 10% are due to workplace or sporting injuries (1). Low and middle income countries have a greater burden of TBI, due to both the high risk environment and healthcare systems that are unable to fully support the consequences (1). Latin America and Sub-Saharan Africa have a rate of TBI varying from 150 - 170 per 100,000 people, which is higher than the global incidence rate (1). Tagliaferri *et al.* (2005) reported that TBI incidence was greater in developing countries compared to developed countries (8). The rapid progression of urbanisation in developing countries, such as India and other Asian countries, has resulted in an increase in traffic accidents, with an associated increase in related TBI (7). Traffic accidents resulting in TBI have the highest rates in Latin America, Sub-Saharan Africa and Caribbean (1). Violence also accounts for a high proportion of TBI in these regions (1).

Traumatic Brain Injury - New Zealand Epidemiology

TBI and the associated negative impacts are not only a global public health problem; epidemiological research in New Zealand clearly shows the heavy burden of TBI in our own society. In 2010, the prevalence of TBI was 527,000 people and the incidence of first time TBI was 11,300 people (4,9). A New Zealand study conducted by Feigin *et al.* reported a total TBI incidence of 790 per 100,000 person-years, with approximately 749 mild cases and 41 moderate to severe cases (9). These findings suggest that the incidence of TBI in New Zealand is much greater than the estimates of comparable high-income countries (9). Of note, the incidence of TBI in the USA is estimated to be lower than in New Zealand. Furthermore, the incidence and prevalence of TBI within the New Zealand population is expected to increase over time, reflecting the global trend and further worsening the local burden of disease (5).

Age

When considering the societal impact of TBI, it is important to identify the high risk groups. In New Zealand, the younger population is disproportionately affected with 70 - 75% of TBI occurring in children and young adults (9,10). Accordingly, TBI is a major cause of long-term disability in this age group (9). The highest rates of TBI are reported in the 0 - 4 and 15 - 34 year age brackets; 1300 per 100,000 person years and 1033 per 100,000 person-years, respectively (9). Incidence of mild TBI is significantly higher in the 0 - 4 year age bracket, with 1262 per 100,000 person-years. The incidence of moderate to severe TBI is highest in the 15 - 34 year age bracket for males, with 110 per 100,000 person-years. However for females, the highest incidence is in the over 65 year age bracket, with 81 per 100,000 person-years (9). Of note, there is a bimodal peak of incidence of mild TBI with respect to age, with the second peak occurring in the over 65 year age bracket (9). In New Zealand, the average age at which a TBI is first diagnosed is 23 years old (10). These epidemiological findings provide strong evidence for targeting the younger population, namely young adults, when investigating TBI, as they are disproportionately represented with respect to TBI.

Sex

Males are twice as likely to sustain a mild TBI compared with females; males also have a greater risk of a more severe injury (9,10). Furthermore, events that result in a TBI occur at a younger age for males and the associated mortality is twice as high (10). Loss of health due to TBI, as measured by disability-adjusted life years (DALYs), further shows the burden of disease falling largely on males, peaking at 20 - 24 years of age (10).

Ethnicity

Ethnicity is also a risk factor for sustaining a TBI; a disparity exists between ethnicities within society. International research indicates that minority groups have a greater incidence of TBI and associated poorer outcomes (11). With respect to New Zealand, the Pacific population has a greater risk of mortality following TBI compared with other ethnic groups (11). A study conducted by Lagolago *et al.* (2015) reported that one quarter of the Pacific population living in New Zealand have suffered a TBI at some point in their lifetime (11). Furthermore, evidence has demonstrated that Māori have a greater risk of suffering a mild TBI compared with New Zealand Europeans (4,9). Of note, males are consistently at a greater risk of acquiring TBI, regardless of which ethnic group they identify with (9).

Geography

Traffic accidents are twice as likely to occur in the rural setting compared to the urban setting (4). Accordingly, living in a rural environment places a person at 2.5 times greater risk of suffering a moderate to severe TBI compared with a person living in an urban setting (9).

Causes of Traumatic Brain Injury

There are various mechanisms of injury which can result in a TBI, namely motor vehicle accidents (MVAs), falls, and assault (4). Epidemiological studies have shown that different mechanisms of injury disproportionately affect different high risk groups. With respect to age, falls are largely responsible for TBI in the very young and older adult populations, as is shown in Figure 1 (4,9). Traffic accidents and assaults each account for a fifth of all TBI and are a significant mechanism of injury in the young adult age group (9). Of note, ACC reports that half of those who have suffered a severe TBI were involved in a traffic accident (4). With

respect to high risk ethnic groups, assault is ethnically patterned; Māori have a three to four times greater risk of assault-related TBI compared with New Zealand Europeans, as shown in Figure 2 (9). In the New Zealand Pacific population, assault also accounted for a large proportion of TBI, particularly in the 15 - 24 year old age group (11). Sporting injury was also a common mechanism of injury, contributing to a third of all TBI in the Pacific population (11). With respect to sex differences, mechanisms of TBI likely reflect the differing behaviours and exposures for males and females. Males are more likely to be involved in high-risk activity, have greater exposure to hazards in the work environment, and sustain injuries resulting to violence (9).

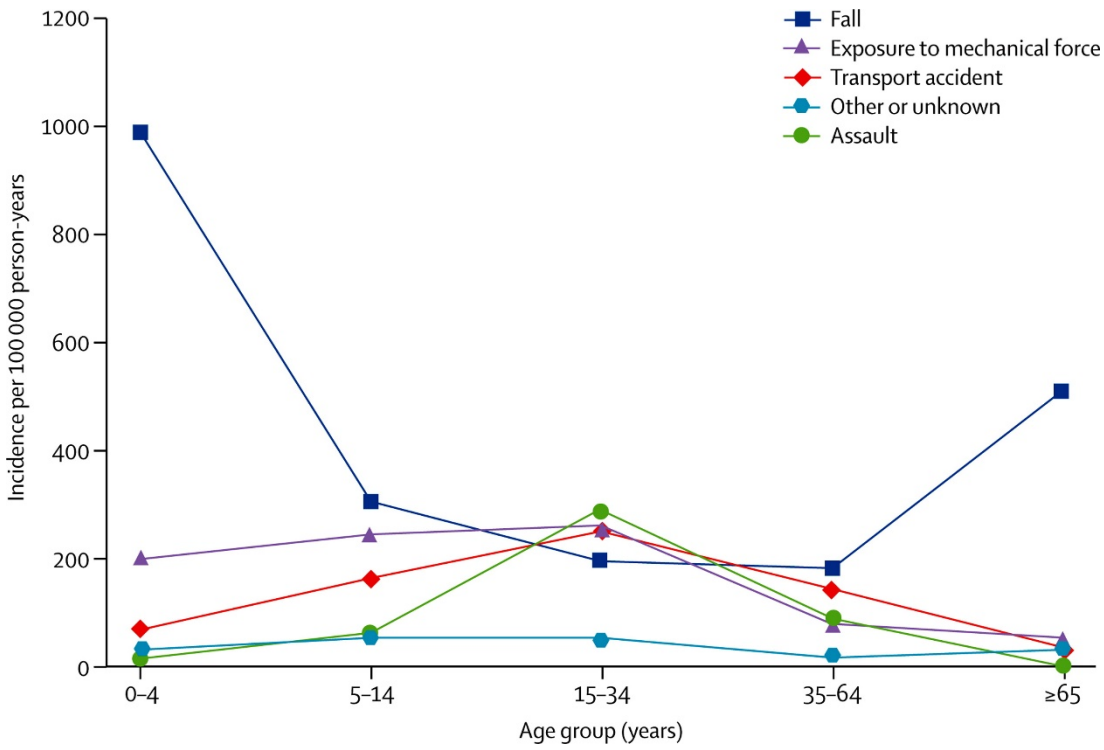

Figure 1: Age-specific incidence of Traumatic Brain Injury by cause of injury (9).

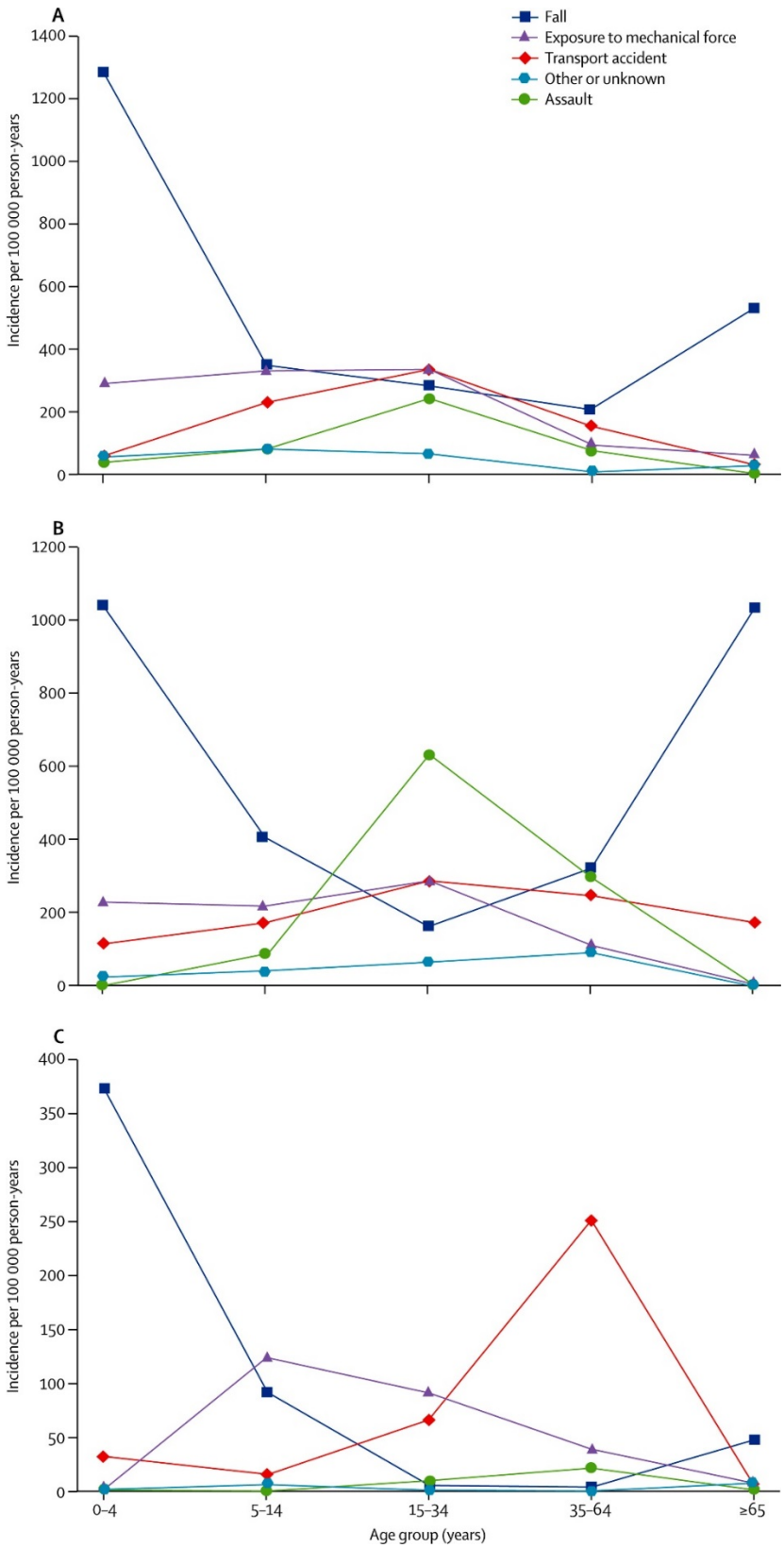

Figure 2: Age specific incidence of Traumatic Brain Injury in European (A), Māori (B) and other ethnic origin (C) populations, by cause of brain injury (9)

Knowledge and Awareness of Traumatic Brain Injury

It is evident that there are multiple factors at play with regard to TBI incidence, prevalence and differential patterning across groups of individuals. However, it has been suggested in the literature that an important factor may well be the general public's perception and understanding of TBI as a whole (12). Knowledge and awareness within a population can heavily influence health behaviours and outcomes; this may be particularly important with respect to an injury mediated by external forces.

The literature suggests that misconceptions are held by the public regarding TBI. Gouvier, Prestholdt, and Warner (1988) conducted a survey in Louisiana, USA, investigating misconceptions held by the general public with respect to TBI (13). Participants were recruited in the largest shopping mall in the region and the population sample represented a number of age groups. The findings of this study suggested a substantial level of misconception regarding TBI, particularly in areas concerning the nature of unconsciousness, amnesia and recovery (13).

The Gouvier *et al.* (1988) study was replicated by Willer, Johnson, Rempel, and Linn in 1993, employing similar methodology but recruiting participants from different geographical areas in the USA (14). Willer *et al.* (1993) surveyed adults living in Western New York who attended a healthcare pavilion at the Erie County Fair, as well as adults from two shopping malls in Southern Ontario, Canada. Overall, the study reported that the level of misconception about TBI was comparable across the different geographical locations, and similar to the findings of the original study (14). The findings of the Gouvier *et al.* (1988) study and Willer *et al.* (1993) study suggest that the pattern of responses across the three sample populations indicates that misconceptions surrounding TBI are potentially universal (13,14). Furthermore, it was suggested by the authors that these misconceptions may arise

from the portrayal of TBI in media, particularly in film and television shows (14). The Willer *et al.* (1993) study made reference to the finding that an overwhelming number of respondents believed that a second blow to the head can help restore memory, and hypothesised that this misunderstanding was likely perpetuated by comedy routines and cartoons (14). Furthermore, the study speculated that individuals affected by TBI may themselves be affected by the misconceptions that exist in society (14). This could present problems for affected individuals with respect to successful integration into society; there could also be issues with negative labelling or stereotyping of individuals affected by TBI, leading to inadequate support structures (14).

Guilmette and Paglia (2004) also conducted a replication study investigating misconceptions about TBI, and recruited participants in Providence, Rhode Island, USA (15). The study recruited participants at a Department of Motor Vehicles office. In general, the study reported similar findings to previous studies with regard to misconceptions about TBI (15). Although some changes were made to the structure of the survey questionnaire, the key findings would appear to support the suggestion that misconceptions about TBI may be universal (at least within the American population) (15). However, the authors did note that in the 8 to13 years since the previous studies were conducted, knowledge about mild TBI appeared to have improved; this did not extend to improved understanding of moderate to severe TBI (15). This difference was attributed to increased media exposure about the potential adverse effects of sports-related concussion (15).

Ten years ago, Hux, Schram, and Goeken (2006) replicated the original Gouvier *et al.* (1988) study, with the survey questionnaire including 17 of the original 25 questions (12). The selection criteria for questions included in the survey was based on the findings of the Gouvier *et al.* (1988) study and the Willer *et al.* (1993) study (12–14). Survey questions were

retained for the Hux *et al.* (2006) study if more than 25% of participants, in either of the previous two studies, answered the question incorrectly (12). The study recruited participants from a regional shopping mall in Nebraska, USA. The findings of this study in keeping with previous findings but it was noted that the respondents did recognise the fallacy of certain misconceptions (12). The authors interpreted this to represent a reduction in the general misconceptions concerning TBI in their sample population, as compared with the original Gouvier *et al.* (1988) study (12,13). This was attributed to a potential increase in public awareness campaigns regarding TBI. However, Hux *et al.* (2006) did note that the apparent increase in understanding did not apply to the questions concerning coma, loss of consciousness, memory deficits and recovery from TBI (12). The authors suggested that misconceptions may, at least in part, be associated with the misrepresentation of TBI in popular media (12).

More recently, Pretorius and Broodryk (2013) conducted a further investigation into misconceptions about TBI (16). However, in contrast with previous studies, the sample population in this study consisted exclusively of university students (16). The questionnaire used in the study was based on the original survey used in the Gouvier *et al.* (1988) study. The results were in keeping with the previously reported findings; misconceptions about TBI are present in adult and university student populations (16).

Potential Consequences of Misconceptions of Traumatic Brain Injury

A number of concerns arise when addressing the possible widespread misconceptions regarding TBI. One concern is the potential behaviour individuals are engaging in that may result in an increased risk of TBI, due to a lack of understanding of the consequences of their actions. An example of a high-risk behaviour is the ‘king hit’. These are characterised by a single assault to the head, causing the victim to lose consciousness (17). Another potential

concern is whether people are seeking medical attention in relation to sustaining a TBI, especially as it has been reported that there is a tendency to downplay the severity of TBI (18,19).

Evidence suggests that individuals involved in TBI treatment and rehabilitation may not have accurate expectations around TBI and recovery, which in turn can affect the manner in which the treatment or rehabilitation process is perceived and administered (20). In addition, individuals involved in the day to day life of those affected by TBI, for example teachers or educators, may also struggle to effectively manage their relationships with the affected individual, again due to commonly held misconceptions about the condition (21). Lastly, misconceptions regarding TBI may also increase the risk that affected individuals are victims of discrimination or stigmatisation (19).

The Role of Popular Media in Traumatic Brain Injury Knowledge and Awareness

Previous studies have provided solid evidence to support the notion that misconceptions about TBI exist in the public, however it is important to also address what may be underlying and driving these misconceptions. It has been proposed that one possible source of misconception is the portrayal of TBI in popular media. This is not a novel idea as it has been demonstrated, in relation to other health issues, that exposure to media can affect the public's perception and understanding, and thus consequently impact health behaviours (22,23). One key example is the portrayal of cigarette smoking in film and the associated rates of smoking in the adolescent and young adult population (22,23). Studies conducted state that the portrayal of smoking in film is a major public health issue, as it has been shown to increase the uptake of smoking in the younger population (22,23). Titus-Ernstoff *et al.* (2008) conducted a longitudinal study investigating the relationship between viewing people smoking in film and the initiation of smoking by children (24). The investigators reported

that at least one third of children who initiated smoking were influenced, at least in part, by their viewing of films that portrayed people smoking (24).

Smoking is not the only health behaviour which can be affected by its portrayal in popular film. The same effect can be seen for other types of unhealthy behaviours, such as promoting consumption of unhealthy foods to children via advertising. Lioutas and Tzimitra-Kalogianni (2014) investigated the effects of advertising on children's food preferences and found that exposure to advertising can influence children's preferences for food products, and hence persuade children to consume unhealthy food items (25). Another study conducted by Hardman *et al.* (2015) looked specifically at the relationship between exposing adults to the idea that food addiction is 'real' and eating behaviours (26). The findings indicated that the simple exposure to this message encourages individuals to self-diagnose as food addicts, although there was limited influence on indulgent food intake (26). However, this study demonstrates that the endorsement of a particular message can affect a person's self-perception and hence behaviour (26).

It has been suggested in the literature that popular forms of media may contribute to an individual's knowledge of TBI, however no published literature has specifically looked at this potential association. Thus, there is a dearth of data concerning the portrayal of TBI in popular media and how it may be perceived by, and impact upon, an individual. At is stands, no qualitative research has been conducted investigating the portrayal of TBI in popular media, and it is unknown whether this portrayal plays a role in the high rates of TBI in society.

New Zealand-Specific Research

Limited research has been conducted in New Zealand to assess the relationship between popular film and individual knowledge/behaviour. One study by Gendall, Hoek, Edwards,

and Glantz (2016) looked at the effect of smoking in film on New Zealanders aged between 18 and 25 years (27). An association was observed between exposure to smoking occurrences in films and the current smoking status of the individuals (27). Taking into account other influences on smoking behaviour, the attributable fraction of current smoking due to smoking in movies was estimated to be 54% (27). This finding is consistent with international findings from comparable studies, however the New Zealand results were relatively higher than international levels (27,28). Potentially, this could be attributed to the restricted marketing of tobacco in New Zealand society. Media and film are the last remaining channels of tobacco marketing to adolescents and young adults, therefore may have a more influential effect on this group (27).

No research has been conducted in a New Zealand population investigating the portrayal of in popular film and media. The evidence from the Gendall *et al.* (2015) study indicates that the 18 - 25 year old age group are influenced by popular film with regard to smoking behaviours, thus film may also influence this population with respect to other health understanding and behaviours (27). Accordingly, it would be interesting to investigate the potential relationship between portrayal of TBI in film and associated health behaviours and knowledge in young adults.

Summary

TBI is a serious public health problem, not only on the global scale but also for New Zealand society. The growing burden of disease associated with TBI, and its preventable nature, makes it a worthy and important topic of public health research. As discussed, there are certain groups in New Zealand who are at a higher risk of acquiring a TBI, namely young people, Māori or Pacific people, males and those living in a rural area. Evidence suggests that that there are a number of misconceptions held by the public concerning TBI, and it is

reasonable to assume that the portrayal of TBI in film may play an influential role in supporting these misconceptions. Poor and inadequate public knowledge may be driving the high rates of TBI in the population, and thus this is a specific area of interest that warrants further public health research.

Aims

The aims of this study were 1) to investigate whether misconceptions about TBI are present in university students in the Wellington region, and 2) conduct a quantitative analysis of the portrayal of TBI symptoms and recovery in popular action films.

Method

Survey

Participants

The first arm of this study included a survey replication study with the purpose of discerning public awareness, knowledge and perception(s) of TBI. Approximately 350 participants, aged between 18 and 24 years, namely on tertiary campuses throughout the Wellington region (Whitireia Polytechnic, Massey University and Victoria University) was the intended sample size for this analysis. The survey respondents verbally consented to complete a short survey approximately 5 minutes in length; providing information on their age, sex, ethnicity and subject of study, alongside completing the brief questionnaire. The study protocol received ethics approval from the University of Otago Human Ethics Committee 2016 (D16/293) (refer to *Appendix A*).

Questionnaire Design

Demographic data, including age, sex, ethnicity and subject of study from each respondent was collected in Section A of the survey. The questionnaire aspect of the survey (Section B), consisted of 14 true/false questions and a single multiple-choice question. 13 of the 15 questions were previously developed by Gouvier *et al.* (1988) and Hux *et al.* (2006) and replicated here (12,13). Permission was gained from the authors of Hux *et al.* (2006) to replicate these questions in the survey. Two additional questions were designed, including a true/false question ("Fatigue is an uncommon complication of head injury"), and the single multi-choice question ("After being knocked out, the expected recovery time would be: seconds, minutes, hours, weeks, months"), to assess the understanding of the consequences and recovery related to TBI within the study population. These particular questions were

designed following discussions with experts in the field (a neurosurgeon and a clinical psychologist) who identified key areas of misconception and misunderstanding within their patient populations. Two brief questions in respect to previous TBI exposure (personal or otherwise), and the response following a head injury, were included in Section C, with the aim of identifying if there was any association between previous TBI exposure and a greater understanding of the burden of the disease, therefore less misconception, compared to those who have had no previous exposure. In Section D of the survey, quantitative data on film exposure within the sample population were collected to identify the rate of exposure to popular film. A sample of 20 films released between 2006 and 2016 was sourced from the top 250 grossing films of all time and listed on the survey for each participant to select if they had viewed previously. A copy of the survey is appended at the end of this report (refer to *Appendix B*).

Procedure and Data Analysis

Individuals at each of the regional tertiary campuses were approached at random to ensure diversity and generalisability. Informed consent was gained verbally and voluntarily, provided that the participant fit the specific age criterion of 18 - 24 years. Those who did not meet this criterion were excluded. An information sheet was made available to all eligible participants, to briefly explain the context and purpose of the study and supplement their informed consent. Participants were asked to read and anonymously complete the self-report survey. Eligible participants were to choose the correct answer in the questionnaire aspect and select those films which they had viewed prior to the survey.

Analysis of the survey data was predominantly descriptive. The data collected from the completed surveys were collated and analysed to explore and compare demographic data trends, the number of correct answers provided, and the effect of previous exposure to TBI.

This analysis was predominantly completed using Microsoft Excel. However, where applicable, statistical analysis was performed using GraphPad™ Prism 7 using a Student's unpaired t-test. All values are expressed as mean +/- SEM. A p-value of <0.05 was considered statistically significant.

Film

Inclusion and Exclusion Criteria

The second arm of the study focused on film analysis in order to explore depictions of head injury and TBI in popular film. The medium of film was selected due to its large viewership and potential role in misinforming viewer's perceptions of TBI (12,14). A sample of 20 films released between 2006 and 2016 was sourced from the top 250 grossing films of all time from (29). This criterion was chosen given the age of the target survey demographic. Films within this time period are likely to represent commonly viewed material, and as a result may have a large effect on public perception of TBI.

Sampled films included the rating of "violence" as designated by 'film and video labelling body of NZ' (30), for the likelihood of TBI portrayal. Animated and documentary films were excluded. All films chosen were set in a modern contemporary setting defined as; set within 10 years of the film's release, not within a fantastical setting where the physics are unknown or do not apply to our regular everyday environments (e.g. no films set predominantly in space, fantasy settings, post-apocalyptic worlds, etc.) Films including abnormal or supernatural elements (e.g. mutant creatures, superheroes, etc.) were also excluded. Modern contemporary settings were chosen as portrayal of TBI within a realistic and familiar environment was more likely to have an influence over the viewer.

Table 1. The 20 action films included for analysis	
American Sniper	James Bond - Spectre
Angels and Demons	Kingsman: The Secret Service
Bourne Ultimatum	Live Free or Die Hard
Casino Royale	Mission: Impossible III
Da Vinci Code	Mission: Impossible - Ghost Protocol
Fast and Furious 5	Mission: Impossible - Rogue Nation
Fast and Furious 6	National Treasure
Fast and Furious 7	Slumdog Millionaire
James Bond - Quantum of Solace	The Hangover
James Bond - Skyfall	The Hangover Part II

Coded Variables

Films were reviewed by 15 independent assessors, with each assessor watching 1 - 2 films, and who noted any head injury depicted in each film. 'Head injury' was defined as any incident where a character receives an external force to the head. These injuries were considered for all depictions, with character roles being defined as significant or extra. Significant characters were defined as having greater than two spoken lines of dialogue. All other characters were defined as extra. Mechanisms of how the head injury occurred were noted, e.g. motor vehicle accident (MVA), assault, projectile, falls, explosions or 'other'. In instances where there were an unknown number of victims, i.e. MVA, at least one victim was assumed. Motor vehicle accidents were included if it involved any visible character, with visible impact and damage to vehicle due to a rapid change in velocity.

For significant characters, the assessors recorded any head injuries and the follow-up separately from head injuries occurring to different characters, significant or otherwise. For head injuries occurring to multiple extras, the assessors would collate and record the data together for feasibility of analysis if there was no change in mechanism of injury, TBI symptoms or outcome between head injuries. Any injuries perpetrated by background characters deemed in an extra role, or inflicted on one another, was excluded due to the

exaggerated frequency of head injuries recorded in scenes involving mass violence, that may not be relevant to other data collection. It was assumed that the public's focus during these films would be on significant characters, thereby the depiction of head injury with major characters would likely be more influential. If there were preventive or risk factors involved preceding the injury, this was noted (i.e. seat belt use prior to MVA, or alcohol/drug use).

If TBI symptoms were depicted subsequent to the head injury, this was also noted if they could be attributed to the head injury only. Symptoms that were observed included: loss of consciousness, alterations to memory, confusion/disorientation, other neurological symptoms i.e. focal neurological signs, seizure and/or intracranial lesion (4).

If TBI symptoms were shown, the length of recovery from onset of symptoms was estimated from the following options: immediate full recovery (back to normal within a few minutes of head injury), full recovery within a day of head injury, full recovery greater than a day of head injury, unknown (if recovery not shown). These parameters were chosen owing to the subjective measurement of the relative time difference during screen time.

Overall, the outcome of the head injury was noted as: full recovery/no TBI symptoms from injury, partial recovery (TBI symptoms may still be present), death or permanent damage or unknown (refer to *Appendix C* for the film analysis tool).

Intervariability Assessment

The films were reviewed by 15 independent assessors, therefore due to potential large assessor intervariability, all assessors were trained to employ the film analysis criteria correctly. Analysis criteria was determined for objectivity by all 15 viewers assessing the same scenes to ensure comparable results. Furthermore, any depictions that were held in contention were reviewed twice to ensure the consistency of this analysis tool. Lastly, after

the initial viewing of all 20 films, four assessors were selected to watch a different film each (chosen from the list of 20 films without any criteria), and the two independent analysis were compared for differences.

Data Analysis

Data were collated using Microsoft Excel and analysed using descriptive statistical methods. 95% confidence intervals were not calculated.

Results

Survey Analysis

The results of 359 students between 18 and 24 years of age from three different university campuses (there were zero survey respondents from the Toi Whakaare campus) were included in the analysis. Twice as many females were surveyed compared with males (64.6% and 35.4%, respectively). One quarter of participants were 19 years of age (25.63%), with over two thirds of participants between 18 and 20 years of age (69.64%). Most participants identified 'NZ European' as their ethnicity (64.07%). The demographic data shows that participants represented students studying a range of different subjects, with 'Arts' and 'Health Sciences' identified as the two most common subjects (22.56% and 17.83%, respectively).

Table 2. Demographic information of the 359 participants surveyed and analysed

Sex	**Number**	**Percentage of total**
Male	232	(64.6%)
Female	127	(35.4%)
	359	(100.00%)
Institution		
Massey	164	(45.68%)
Victoria University	156	(43.46%)
Whitirea	39	(10.86%)
Toi Whakaari	0	(0.00%)
	359	(100.00%)
Age		
18	68	(18.94%)
19	92	(25.63%)
20	90	(25.07%)
21	46	(12.81%)
22	34	(9.47%)
23	13	(3.62%)
24	16	(4.46%)
	359	(100.00%)
Ethnicity		
Asian	43	(11.98%)

Māori	25	(6.96%)
NZ European	230	(64.07%)
Pacific	29	(8.08%)
Other	32	(8.91%)
	359	(100.00%)
Subject studied		
Arts	81	(22.56%)
Commerce	35	(9.75%)
Communications	34	(9.47%)
Design related	43	(11.98%)
Education	6	(1.67%)
Health Sciences	64	(17.83%)
Law	16	(4.46%)
Science	42	(11.70%)
No Response	32	(8.91%)
Other	6	(1.67%)
	359	(100.00%)

The number of participants who answered each question correctly was quantified. Question 1, which states 'A head injury can cause brain damage even if the person is not knocked out' was answered most accurately, with 96.94% of all participants answering 'true' correctly. Question 6, which states 'After a head injury, people can forget who they are and not recognise others, but be normal in every other way' was answered least accurately, with only 12.81% of all participants correctly answering 'false'.

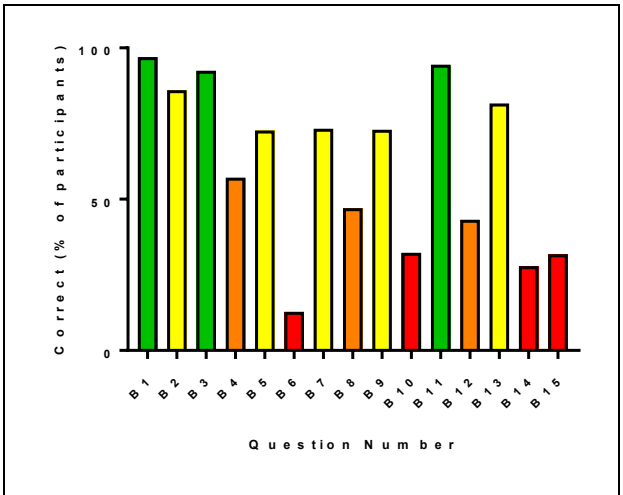

Figure 3. Total number of participants who answered each survey question correctly

Sex

Data from our study showed that males provided a higher number of correct answers (9.6 ± 0.15) than females (9.02 ± 0.19) (Figure 4 a). When analysed by each question, there was little difference in correct responses between males and females with the exception of Question 10, which states "People who have had one head injury are more likely to have a second head injury". More males (46%) answered Question 10 correctly than females (24%) (Figure 4 b).

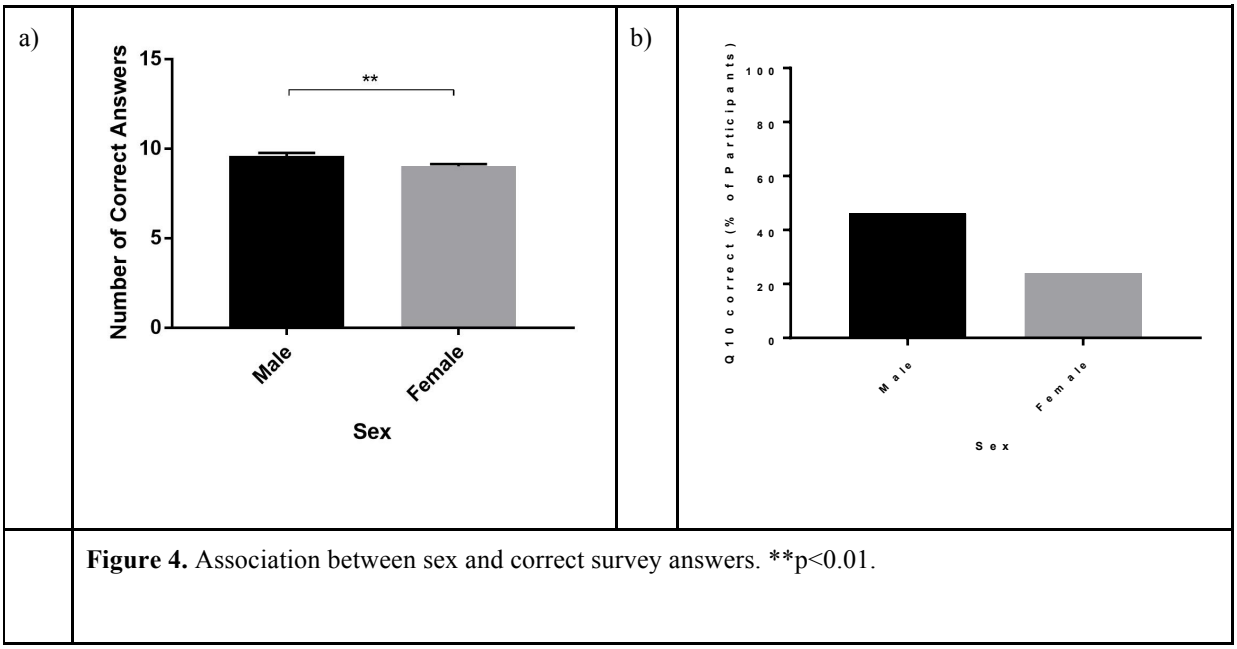

Figure 4. Association between sex and correct survey answers. **p<0.01.

Personal Experience with Traumatic Brain Injury

There was no difference in the number of correct answers between participants who had previously been exposed to TBI and those who had no previous exposure to a TBI (Figure 5 a). Further analysis was conducted to examine each survey question individually. Question 15, which asks "After being knocked unconscious, the expected time to make a full recovery would be (seconds, minutes, hours, weeks or months)" showed the biggest difference (9%) between the exposed and unexposed groups (Figure 5 b).

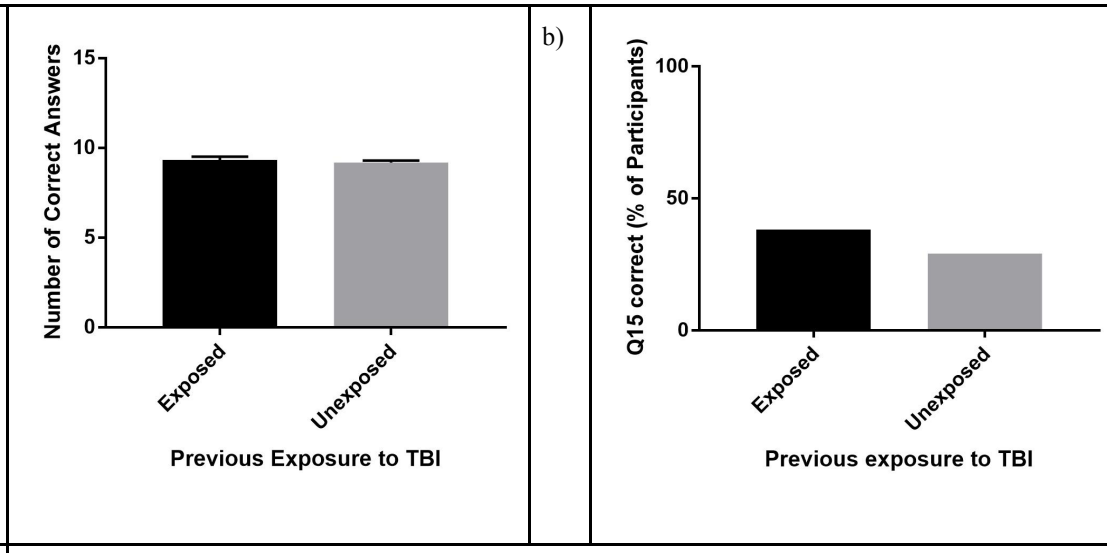

Figure 5. Association between previous personal experience of TBI and correct answers

Film Exposure

The total number of correct answers for the survey questions did not differ between categories of film exposure; the low (0-6 films), medium (7-13 films) and high (14-20 films) groups all had an average of 9/15 correct answers (Figure 6).

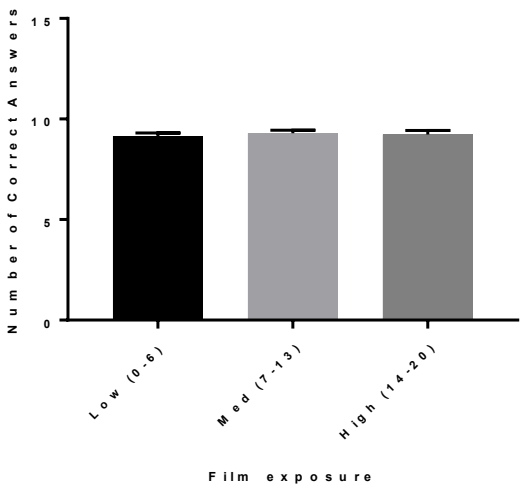

Figure 6. Number of correct answers per category of film exposure

Field of Study

There was no difference in number of correct answers between participants who study 'Health Sciences' (9.28 ± 0.229) compared with students studying all other subjects (9.21 ± 0.104) (no figure shown).

Seeking Medical Attention

321 (90%) of the survey participants said they would seek medical help if they were to experience a head injury, compared with 37 (10%) people who said they would not seek help (no figure shown).

Film Analysis

In this analysis, 20 films were viewed and the data were collated and analysed. In the films viewed, there were a total of 930 incidences of head injury, with 46.3% of these involving injury to a significant character. Over half of the head injuries were due to assault, with 16.1% and 12.6% caused by car collisions and falls/collisions with stationary objects respectively. In 81% of the head injuries observed, the character did not exhibit any symptoms of TBI or the post-injury sequence was not shown on screen. When symptoms of TBI were shown, loss of consciousness was portrayed 87% of the time. Time to recovery following a TBI was also recorded, with 16.9% of characters showing an immediate recovery and 50.8% not recovering at all. Death was the most common final outcome following head injury. However, it is important to note that recovery time and final outcome differed greatly between significant characters and extras, as described in more detail below.

Table 3. Summary of analysis of 20 action films

	Number	Percentage
Movies analysed	20	
Incidence of head injury		
Significant characters	431	(46.3%)
Extras	499	(53.7%)
Total	930	(100%)
Mechanism of Injury		
Assault	500	(53.8%)
Car crash	150	(16.1%)
Explosion	54	(5.8%)
Falls or collision with stationary objects	117	(12.6%)
Projectile	92	(9.9%)
Other	17	(1.8%)
Total	930	(100%)
Head injuries		
Show TBI symptoms	177	(19.0%)
Do not show TBI symptoms	753	(81.0%)
Total	930	(100%)
TBI symptoms portrayed		
Loss of consciousness	154	(87.0%)
Alteration to memory	1	(0.6%)
Confusion/disorientation	18	(10.2%)
Other neuro signs	4	(2.3%)
Total	177	(100.0%)
Recovery time following TBI symptom		
Immediate	30	(16.9%)
Within a day	9	(5.1%)
Greater than a day	1	(0.6%)
No recovery	90	(50.8%)
Unknown	47	(26.6%)
Total	177	(100%)
Final outcome following TBI symptom		
Full recovery	45	(25.4%)
Partial recovery	1	(0.6%)
Death	89	(50.3%)
Unknown	42	(23.7%)
Total	177	(100.0%)

Proportion of Head Injuries with Traumatic Brain Injury Symptoms

As shown in Table 3, the proportion of head injuries that resulted in the presentation of TBI symptoms for all characters was 19.0%. When dividing the role of the character into significant and extra, the proportion of head injuries that resulted in the presentation of TBI symptoms was 13.5% and 23.85%, respectively.

The proportion of head injuries and associated TBI symptoms was then analysed based on the specific mechanism of injury. The proportion of head injuries following *assault* that resulted in the presentation of TBI symptoms for all characters was 11.6%. Figure 7 shows the difference between significant and extra characters with respect to the proportion of head injuries following assault that resulted in the presentation of TBI symptoms, which was 4.4% and 18.9%, respectively.

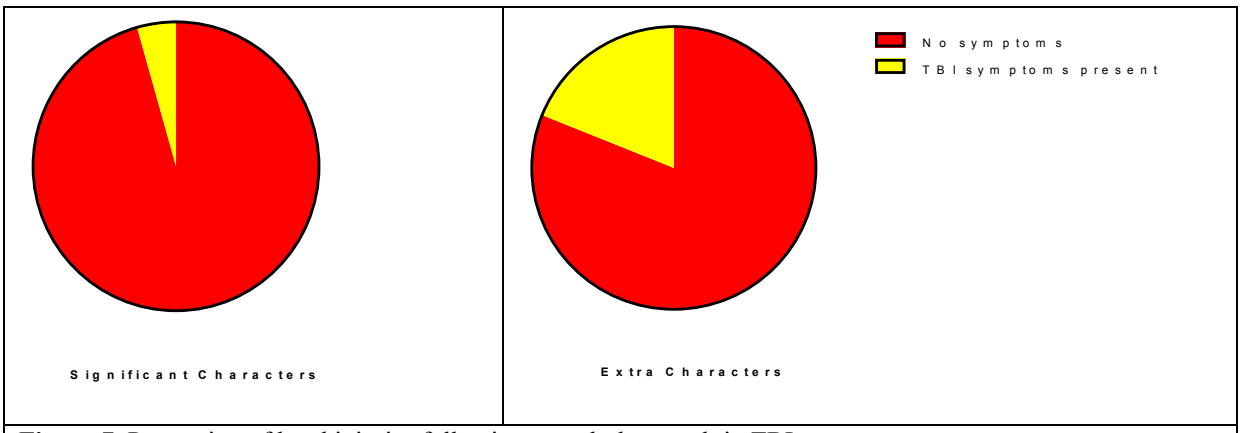

Figure 7. Proportion of head injuries following assault that result in TBI symptoms

The proportion of head injuries following a *car crash* that resulted in the presentation of TBI symptoms for all characters was 16.7%. Figure 8 shows the difference between significant and extra characters with respect to the proportion of head injuries following a car crash that resulted in the presentation of TBI symptoms, which was 14.7% and 18.3%, respectively.

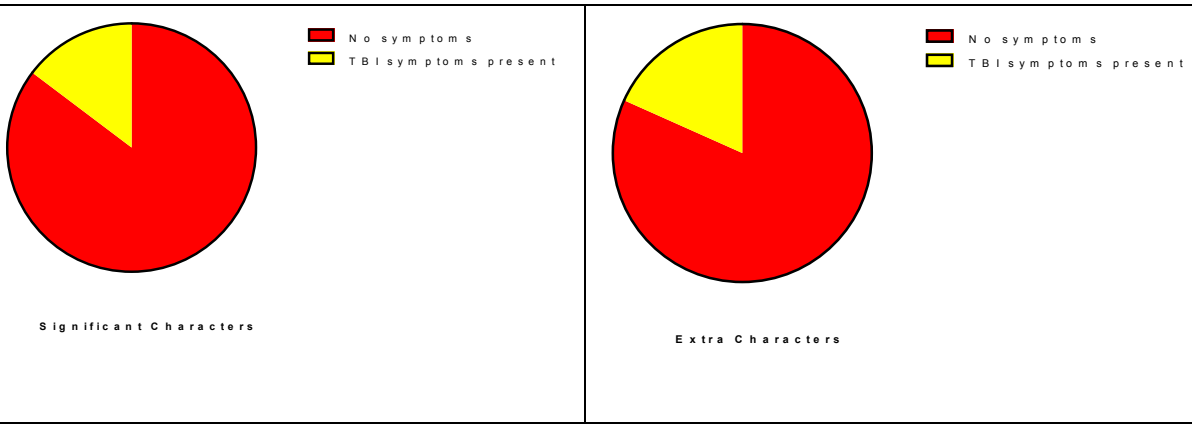

Figure 8. Proportion of head injuries following car crash that result in TBI symptoms

Traumatic Brain Injury Symptoms with an Immediate Recovery

As shown in Table 3, the proportion of all characters exhibiting TBI symptoms that were shown to have an immediate recovery (defined as a recovery period lasting less than several minute0 was 17.0%. When dividing the role of the character into significant and extra, the proportion of characters exhibiting TBI symptoms that were shown to have an immediate recovery was 39.7% and 5.9% respectively.

The proportion of characters exhibiting TBI symptoms that had a full recovery was then analysed based on the specific mechanism of injury. The proportion of characters exhibiting TBI symptoms following *assault* that were shown to have an immediate recovery for all characters was 22.4%. Figure 9 shows the difference between significant and extra characters with respect to the proportion of characters exhibiting TBI symptoms following *assault* that were shown to have an immediate recovery, which was 72.7% and 10.6%, respectively.

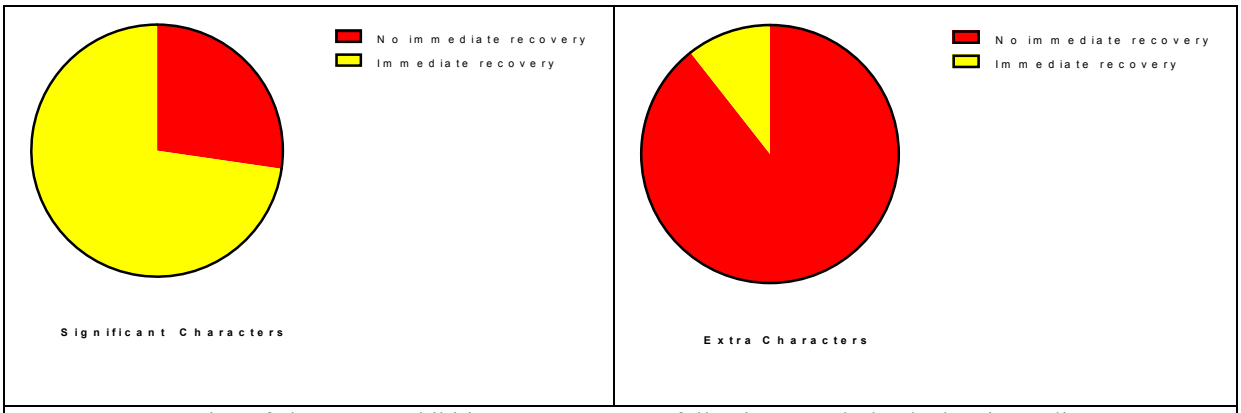

Figure 9. Proportion of characters exhibiting TBI symptoms following assault that had an immediate recovery

The proportion of characters exhibiting TBI symptoms following a *car crash* that were shown to have an immediate recovery for all characters was 36.0%. Figure 10 shows the difference between significant and extra characters with respect to the proportion of characters exhibiting TBI symptoms following a car crash that were shown to have an immediate recovery, which was 80.0% and 6.7%, respectively.

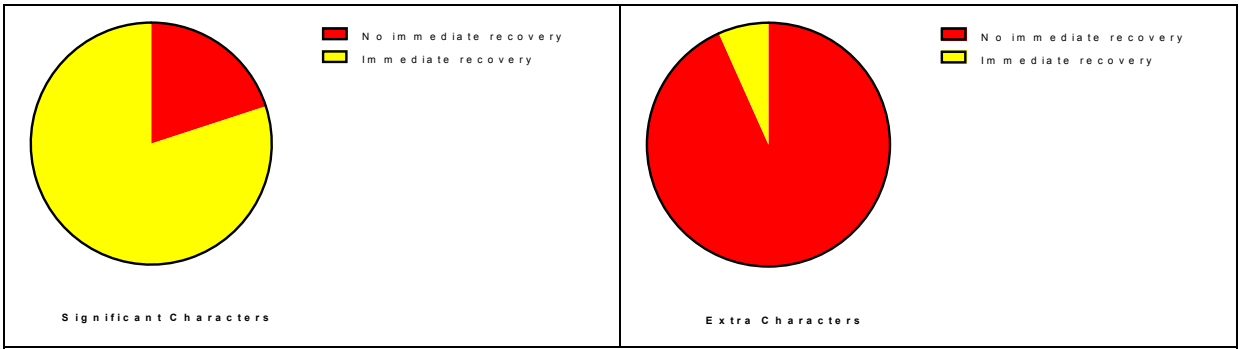

Figure 10. Proportion of characters exhibiting TBI symptoms following car crash that had an immediate recovery

Loss of Consciousness Following a Single Head Injury

The proportion of all characters that sustained a single head injury following assault that exhibited loss of consciousness (a specific TBI symptom) was 25.5%. Figure 11 shows the

difference between significant and extra characters with respect to the proportion of characters that sustained a single head injury following assault that exhibited loss consciousness, which was 9.1% and 32.0%, respectively.

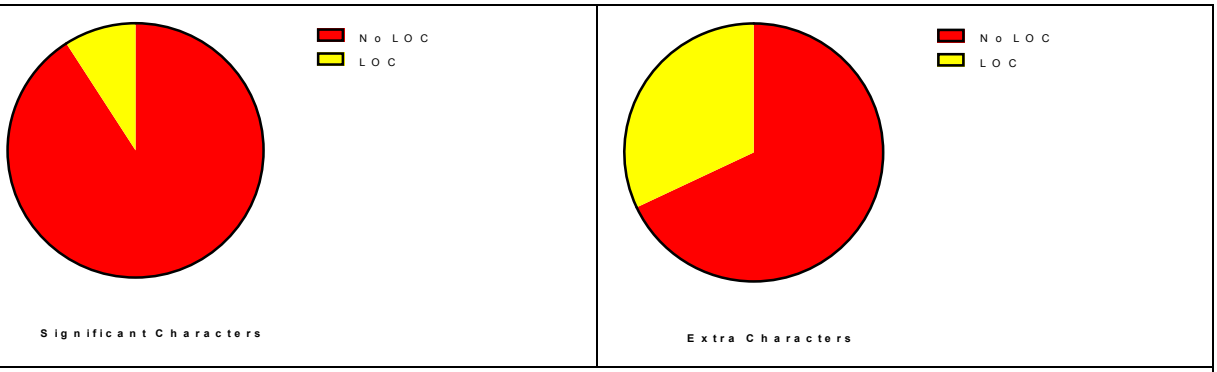

Figure 11. Proportion of characters that sustain a single head injury following assault that exhibit loss of consciousness.

Discussion

There are two main arms to the current study. The first arm involves the surveying of 359 young adults about their understanding and potential misconceptions concerning TBI. The second arm involves the quantitative analysis of 20 action films with respect to the portrayal of head injuries, TBI symptoms and the recovery period. The main findings and implications of the survey analysis, and associated strengths and weaknesses, will be discussed first. Next, a discussion of the main findings and implications, and the strengths and weaknesses, of the film analysis will be presented. Lastly, potential intervention strategies will be discussed in the light of the survey and film analysis findings.

Survey Analysis

Main Findings

The key finding from the analysis of the survey data was that general misconceptions concerning TBI symptoms and recovery were present in our surveyed population of young adults. However, not all misconceptions presented in the survey questions were endorsed as such; the fallacy of certain misconceptions was recognised by a large proportion of the respondents. This suggests that, while general misconceptions are held by young adults, there are pockets of understanding regarding TBI symptoms and recovery.

With regard to sex differences, males provided more correct answers than females, although this difference was very small. Further analysis revealed that one question in particular showed the greatest difference with respect to sex; the question stated, “People who have had one head injury are more likely to have a second head injury” (with more males providing the correct answer ‘true’).

Previous personal exposure to TBI, on the whole, did not show any difference with respect to the number of correct answers provided. However, further analysis revealed that one question, which stated, "After being knocked unconscious, the expected time to make a full recovery would be" (with "seconds, minutes, hours, weeks, months" provided as the answer options), showed that individuals with previous personal exposure to TBI were more likely to give the correct answer ('months').

The results of the survey were also analysed with respect to the respondent's listed field of study, i.e. what degree they were enrolled in. The area of study was broadly divided into 'Health Sciences' and 'Non-Health Sciences'. These two categories were used to analyse the number of correct answers provided in the survey, however no differences were found between the two groups.

Lastly, respondents were asked to identify which films they had seen from a list of 20 action films. Each of the respondents indicated that they had seen at least one of the films.

Relation to Previous Studies

As discussed previously, a number of studies have investigated the misconceptions held within society regarding TBI. The survey used in the present study was derived from a similar survey conducted by Hux *et al.* (2006) (12). Two additional questions were designed to elucidate whether the sample population were aware that fatigue is a common feature of TBI, and whether the participants had an appreciation for the length of recovery time following a TBI.

This current study did not find a significant difference in the types of misconceptions held by the sample population compared to the population studied by Hux *et al.* 2006 and Hux, Bush, Evans, and Simanek (2013) (12,31). An interesting finding is that Question 6, which states

"After a head injury, people can forget who they are and not recognise others, but be normal in every other way", had the lowest number of correct answers in this current study, mirroring the results from the Hux *et al.* (2006) study (12). Question 10 on the survey, which states "People who have had one head injury are more likely to have a second head injury", and Question 14, "Complete recovery from a severe head injury is not possible, no matter how hard the person tries to recover" were both answered poorly in this current study, again echoing the findings by Hux *et al.* (2006) (12).

The comparison between these studies demonstrates that misconceptions about TBI in a New Zealand population of young adults are similar to misconceptions held by overseas populations, and that the specific types of misconceptions are consistent with previous findings. The study by Hux *et al.* (2006) was in part derived from a study originally implemented by Gouvier *et al.* (1988) (12,13). The Gouvier *et al.* (1988) study was further modified and reproduced by Willer *et al.* (1993), Guilmette *et al.* (2004), and more recently by Hux *et al.* (2006) and Pretorius *et al.* (2013) (12–16). The studies differed by geographical area and focused on different age groups. Despite these differences, the findings regarding the types of misconceptions were comparable, with minor improvements in understanding about mild TBI apparent in more recent studies (15). This suggests that there is a common source perpetuating the misconceptions. One example of a widely disseminated source is popular media, specifically film portrayal. It is reasonable to consider that there are specific misconceptions around TBI propagated in popular media that have not been addressed appropriately or adequately.

Participant responses were analysed by field of study in university, which was further divided into 'Health Sciences' and 'Non-Health Sciences'. It was found in the present study that there was no difference in the number of correct answers between the two groups. This could be a

reflection of TBI being a specialist topic, as opposed to a core topic included in Health Science-related studies. Using similar survey questions as the previous study, Hux *et al.* (2013) surveyed students studying to be Special Education professionals, and demonstrated that students in this field did not appear to have different levels of misconception in comparison to the public (31). Hux *et al.* (2006) performed their analysis differently to the current study; the investigators looked at the level of education held by the participants (12). It was concluded that participants with higher education did significantly better with regard to the number of correct answers (12). Hux *et al.* (2013) examined the education level of the participants, this time specifically focusing on the subject of Special Education (31). It was found that there was no significant difference between students who held a Bachelor's degree compared to Master's degree students (31). This was difficult to compare to the current study as the participants were only asked their field of study; the level of education was presumed to be similar due to the narrow age range of the sample population.

Implications

The survey shows there are key misconceptions about TBI held by young adults in New Zealand, especially with regard to presentation of amnesia, secondary head injuries, the role of an individual's personal effort during recovery, and the average time required for recovery. Although certain questions were answered poorly, the fallacy of other misconceptions were recognised by most of the respondents. Questions relating to whether brain damage can occur even if a person is not knocked unconscious (true), if most people with brain damage look and act disabled (false) and 'feeling normal' indicates the completion of recovery (false), were answered correctly by the vast majority of respondents. Therefore, it is important to note that misconceptions held by young adults in the sample population relate to specific

areas within the topic of TBI. However, with regard to the public health implications of the survey findings, it is important to further explore the questions that were answered poorly.

As previously discussed, the survey question with the lowest number of correct answers provided by all respondents was Question 6, which states “After a head injury, people can forget who they are and not recognise others, but be normal in every other way”. Most people answered ‘true’ which is the incorrect answer. These responses suggest that the majority of respondents do not recognise the potential ramifications of head injuries, instead believing that memory alterations can occur in isolation. This misconception may lead people to believe that those who have suffered from a TBI will be entirely normal beyond their memory issues. The wide-ranging effects of TBI are misunderstood in the current sample population, which may reflect the lack of knowledge in the general population. Therefore, many members of society may not appreciate and understand the burden of such a condition. In turn, this may lead to people minimising the significance of TBI and the potentially debilitating effects on an individual.

Another survey question that was poorly answered was Question 14, which stated “Complete recovery from a severe head injury is not possible, no matter how hard the person tries to recover”. The majority of respondents answered ‘false’ which is incorrect, suggesting that many people in the sample population believe that severe TBI can be entirely reversed based on effort alone. The belief that it is dependent upon the patient to recover through effort and determination alone, may have serious impacts on the affected individual's sense of worth during recovery. If this idea is perpetuated in the public, a person with a severe TBI may be perceived as lazy or lacking the motivation to fully recover. This potential stigmatisation may further frustrate the individual affected by TBI, as the blame for the lack of recovery is centred on the individual themselves. In addition, those supporting an individual with a TBI

may unfairly judge the affected person for factors outside of their control, believing that the burden of recovery lies with the individual. Ultimately, people with severe TBI may lose crucial support systems.

Question 10, which states “If you have one head injury, you're more likely to have a second head injury”, was also answered poorly. Furthermore, this was the only question which showed a significant difference in the number of correct answers between males and females, with more males answering correctly (‘true’). One potential explanation for this sex-related difference is the relative exposure to contact sport. Most contact sports are predominantly played by males, such as rugby, and tend to have an increased risk of head injury. Recently, there has been an increase in awareness and safety practices regarding TBI in sports. Therefore, this finding could reflect a greater awareness of head injuries in the contact sports community. Knowledge that males acquire through exposure to contact sports may subsequently reduce misconceptions about repeat head injuries. This suggests that similar community-orientated platforms for disseminating key information may also be effective. However, it must be noted that this survey question was still answered poorly overall; there were a substantial number of male respondents who answered incorrectly.

When comparing participants who identified as having previous exposure to TBI with those who did not, only Question 15 showed a significant difference in correct responses. Question 15 stated “After being knocked unconscious, the expected time to make a full recovery would be” and gave the options of ‘seconds, minutes, hours, weeks and months’ to choose from. Participants who had previous personal experience of TBI were more likely to select ‘months’ (the correct answer) than those who had no experience with TBI. From this it may be implied that those with personal experience of TBI have a better understanding of the recovery time following a TBI. However, it is noteworthy that there was no difference in the

number of correct answers provided for the remaining 14 survey questions between those with previous experience of TBI and those with no experience. This could reflect the construction and validity of the survey itself; Question 15 was the only non-binary question and the correct answer was not easily inferred. Binary questions can result in participants selecting one answer based on the wording of the question, as opposed to providing a response representative of their actual knowledge. This may be exacerbated when surveying university students, who are a population well-versed in exam technique and inferring the correct answers. Therefore, it is proposed that Question 15 may have provided a more accurate representation of the true knowledge base of participants.

Strengths of Study

The study undertaken has provided an insight into the understanding of TBI within the 18 – 24 year old age group, as well as the exposure to a select list of films amongst this population. The majority of the current survey questions were sourced from the Hux *et al.* (2006) study, therefore, comparability of results in each study population was possible (12). An additional question was added to the current survey regarding the expected recovery times following loss of consciousness; this question may have more accurately identified misconceptions about TBI as it was less clear what the correct answer was meant to be. Furthermore, this specific question provided multiple answer choices, thus a respondent could not make a 50/50 guess about the correct answer, i.e. it was non-binary, and thus potentially provided a better measure of understanding of TBI recovery. 500 survey responses were initially targeted, with a response rate of 60% - 70%, and this goal was met within the current study (359 completed surveys were included and analysed). Compared with the previous studies using a similar survey, this sample size is comparable. The survey was relatively cheap, quick and easy to conduct.

Limitations of Study

Firstly, there is a limitation in the generalisability of the results from the survey due to the sampling method. University students aged between 18 – 24 years were the target population for the survey. Therefore, the results of the survey analysis may not be applicable to individuals outside of this age range. Furthermore, as surveying was conducted at university campuses, this excluded young adults not enrolled at university, and thus potentially excluded individuals with a lower level of education or from a lower socioeconomic status background. Furthermore, due to how the survey was conducted (i.e. multiple people conducting the survey at the same time on different campuses) there was a skew in the sex and ethnicity of the survey respondents. The majority of respondents identified as New Zealand European and twice as many females than males completed the survey. Thus, ethnicities other than NZ European and males were underrepresented in the obtained sample. This could be a significant weakness of the study, as the underrepresented individuals (i.e. Māori, Pacific people, and males) represent the populations that are the most at risk of sustaining a TBI within the 18 - 24 year old age group. Individuals under the age of 18, who also have a high risk of sustaining a TBI, were excluded from completing the survey, as this required a different level of ethical approval which was not possible due to time restrictions.

Another potential limitation of the survey design is the lack of context provided for some of the survey questions. This could be a cause of variability in the answers provided, particularly as a local clinical psychologist, with extensive experience working with individuals with TBI, provided answers that were different to the answers identified as correct (based on the study from which the survey questions came from).

There was also a design weakness in one particular question of the survey. Question 15 states, ‘After being knocked unconscious, the expected time to make a full recovery would

be', and the following potential answers were given – 'seconds, minutes, hours, weeks, months'. Unfortunately, the option of 'days' was not included as a potential answer. This is potentially problematic as some respondents provided the informal feedback that they would have chosen 'days' as the correct answer. However, this answer is still incorrect and thus does not influence the finding that the majority of respondents held misconceptions around the expected recovery time following a loss of consciousness event.

Lastly, the definition of 'Health Sciences' with respect to the demographic data may have affected the findings. Participants studying health-related subjects, such as Nursing and Physiotherapy, were grouped as 'Health Sciences', and participants studying all other subjects, including Science and Psychology, were grouped as 'Non-Health Sciences'. This is a fairly arbitrary grouping; being in the 'Health Sciences' group does not necessarily mean that an individual has received formalised teaching about TBI, and vice versa. Therefore, this may have impacted on the finding that there was no difference in the number of correct answers between 'Health Sciences' and 'Non-Health Sciences'.

Film Analysis

Main Findings

Head injuries were portrayed at least once in each of the 20 films analysed for this study. However, correct portrayal of the likely sequelae of a head injury was observed in only one of the 930 instances of head injuries that occurred across all 20 films. Assault was the most frequently portrayed mechanism of head injury, contributing nearly 54% of the head injuries observed. However, for head injuries following assault, significant characters only displayed symptoms of TBI 4.4% of the time.

Analysis of the films strongly suggests that the type of character, either a significant character or an extra, is an important determinant of the likely sequelae of a head injury, with respect to the likelihood of symptoms occurring and the recovery from those symptoms. Symptoms of TBI are rarely displayed by significant characters, particularly following an assault and car crash. This contrasts markedly with those of extras, who are drastically more likely to show symptoms of TBI than a significant character. Across all mechanisms of injury, significant characters had a higher likelihood of showing immediate recovery compared with extras. This difference is more marked when the injuries are caused by assault or car crashes (which together make up nearly 70% of the head injuries).

Following head injuries as a result of assault, significant characters showed an immediate recovery in 73% of instances, versus only 11% for extra. Furthermore, following head injuries as a result of a car crash, significant characters made an immediate recovery 80% of the time, versus only 7% for extras.

Implications

The misrepresentation of TBI in film may have significant implications for public health, largely due to the fact that film has such a global exposure. This is illustrated in the survey findings, with all respondents indicating that they had seen at least one of the films analysed in the current study. Film is a highly effective means of communicating a message to a large group of people, as indicated by the popularity of the medium in the advertising industry and in public health campaigns. The widespread exposure of film, combined with the effectiveness of this form of media in communicating a message, means that large groups in society are potentially influenced by the content of a film. As such, even if the misrepresentations about TBI in film have only a small effect at the individual level, it will have a large impact at a population level. Accordingly, misportrayal of TBI in film is a

potentially a significant public health issue. This is exacerbated by the finding that potential head injuries were a common occurrence in the popular films analysed in the current study; head injuries occurred, on average, approximately 47 times per film. This high rate of occurrence of head injuries in film highlights the potential for any inaccurate depictions to be rapidly propagated within a population, which has the potential to impact on the behaviour of large groups of individuals.

Based on the film analysis conducted in the current study, the proportion of potential head injuries from all mechanisms of injury that resulted in the portrayal of TBI symptoms was just under 20%. There has the potential to influence public perception concerning the likelihood of suffering a TBI following a head injury. It is difficult to accurately comment on the true likelihood of sustaining a TBI following a head injury similar to those shown in film, as this information is not readily available and it is difficult to gauge the severity of an impact shown in a film with respect to a real life situation. However, the high rate of head injuries and low frequency of TBI symptoms depicted in the analysed films implies that TBIs occur infrequently, which is likely to contrast with reality. This misrepresentation is likely to influence an individual's perceptions and behaviours in regard to the perceived likelihood of sustaining a TBI. Another factor that may exacerbate this is the dramatic portrayal of events, such as assault and car crashes, in film. For example, it is not uncommon for films to show a car rolling several times following a high speed car crash or an individual receiving multiple punches to the head, with characters exhibiting no symptoms of TBI. It is reasonable to assume that this could lead to a misconception about the severity of an incident or force required to sustain a TBI. Accordingly, this could increase the probability that an individual may underestimate the likelihood of sustaining a TBI when involved in a similar, but less dramatic, incident. This may result in a delay in seeking appropriate medical treatment and poorer health outcomes for the individual.

Assault was the most common mechanism of injury in the films analysed. Of the recorded head injuries, TBI symptoms were only exhibited in just over 10% of the cases and an immediate recovery from these symptoms occurred just over 20% of the time. This is potentially significant as the portrayal of TBI could impact on an individual's perceptions about the outcomes of violence and violence-related head injuries. These misconceptions could increase the frequency that individuals engage in high-risk behaviour, potentially leading to poorer health outcomes for the individuals involved. As previously stated, even if a film's portrayal of TBI has only has a small influence on an individual's perceptions and behaviour, at a population level it is significant due to movies being a universal exposure.

By definition, significant characters have greater screen time and tend to be a focal point in the film. Furthermore, these characters are more likely to command a viewer's attention and have a greater impact due to the celebrity status of the actor. The current study shows that significant characters are also more likely have an immediate recovery following a head injury, especially when assault is the mechanism of injury. The greater attention given to a significant character coupled with the misrepresentation of recovery following a TBI is a potent combination, and could have a significant impact on public perception of TBI.

Currently there are no alternative sources of information about TBI being communicated to the public, thus film is unchallenged in its inaccurate portrayal of TBI and the associated sequelae. Certain public health initiatives have targeted specific high-risk populations, such as professional rugby players, however this only addresses a small subset of the general population. In contrast, popular film has the potential to rapidly reach (and impact upon) significant portions of the general population. At present, the lay person may be unaware of the degree to which film is implicitly impacting on their knowledge (or lack thereof) about TBI. If film is the only reference point for a person regarding TBI, it is unreasonable to

assume that an individual will be aware of the dangers of a ‘king hit’ or understand the length of time required to recover from a TBI.

In society, misinformation is pervasive and communicated to the public on any number of topics, with the potential to negatively impact upon a person’s wellbeing. The privately funded film industry has an incentive to make a film that is appealing to audiences in order to make a profit, and often this involves the inclusion of violence and dramatic action scenes. However, the results of the study show that the action scenes are in fact pivotal in conveying misconceptions about TBI. It is difficult to actively counter this information, particularly when it is dispersed amongst a large number of films produced each year and distributed via a number of different broadcasting mediums that are difficult to monitor. Furthermore, the government of an individual country unfortunately has little influence over large international film production companies, and attempting to exert influence could result in a public outcry against the paternalistic attitude of a ‘nanny state’. In addition, an effective counterargument from the film industry might be that each film produced is rated by the film censorship agency of each individual country, and that viewers are advised in advance of the potentially subversive content. However, these censorship measures are not specific enough to effectively counter any misinformation that is contained in the upcoming film. In summary, it would be naïve and unproductive to hope that the film industry would alter their portrayal of head injuries and TBI. However, given the growing significance of TBI with respect to a global health burden, it would seem prudent that counter measures are implemented. Allowing a private industry to run unchecked in society negates the role of the health authorities and subsequently may place the public at risk. It would therefore seem that public health interventions in this area would be worthwhile, in an attempt to counter the

misrepresentation of TBI in film and the potential associated misconceptions held by the public.

Strengths of Study

This research is novel as it is the first study undertaken with the aim of quantitatively analysing the portrayal of TBI in film. With regards to the film analysis tool, the selection of films followed a strict inclusion and exclusion criteria, in order to choose the most appropriate films for the context of this study. Despite having 15 independent film assessors, the potential observer bias and intervariability between assessors was mitigated by the implementation of a 'quality control check', i.e. four assessors (of the total 15) independently analysed a film for a second time following the initial analysis of all 20 films, and the results were compared for any differences (of which only minor differences were present). A training session was also conducted prior to commencing the analysis, so that all 15 assessors were appropriately trained to utilize the criterion. This criterion contained a logical and clearly defined set of coding instructions for assessment of film, in an attempt to capture a broad range of data while minimizing observer subjectivity. Another strength is that findings from this study may allow for hypothesis generation and promote further research into this area.

Limitations of Study

A limitation of analysing film in regards to the portrayal of TBI is the subjective nature of the content. It is difficult to determine in film what actually should cause a TBI in real life, for example trying to determine if a TBI would have been sustained by a particular car crash in reality. This makes it difficult to obtain accurate data and make subsequent comments on film contributing to public misconceptions about the chance of sustaining a TBI, as true values are not known or the data are difficult to find/access.

Another limitation that may have impacted on the accuracy of the data was intervariability as a result of 15 independent assessors analysing 20 films. This potential limitation was recognised early on and a subsequent effort was made to mitigate the problem (as previously discussed). When the data were collated it was apparent that there was some deviations from the standardised template for coding events, however this was not the majority. The subjective nature of the analysis could also have exacerbated these differences in coding.

The data obtained in that scenes where there may have potentially been a head injury but the outcome was not shown were coded as events not showing TBI symptoms. This could cause an over representation of head injuries that didn't result in TBI, and therefore a lower reported proportion of head injuries that showed TBI symptoms.

Only a sample of 20 films were analysed and due to the strict inclusion/exclusion criteria, there may have been potential selection bias, thus this is also a potential weakness of the study. The inclusion/exclusion criteria were chosen to give the highest chance of obtaining meaningful data from each of the analysed films.

Lastly, as individual characters were not identified in each film, i.e. characters were coded as either significant or 'extra, as opposed to 'Tom Cruise', character storylines involving multiple head injuries cannot be commented upon. Thus, the potential cumulative effect of head injuries and possible TBI could not be assessed based on the current film analysis tool.

Interventions and Future Recommendations

Two main findings are evident in this current study. Firstly, misconceptions about TBI are present in the sample population of young adults. Secondly, misportrayal of TBI, largely with respect to recovery time, has been quantitatively demonstrated in the 20 selected action films. Accordingly, proposed interventions need to be targeted in response to the findings of the

current study. Interventions must aim to improve public understanding of TBI, namely in young adults, and to counter the pervasive and unchallenged misportrayal of TBI in film. In order to achieve these objectives, primary preventative strategies need to be developed and implemented. Although not demonstrated by the current findings, high risk groups such as Māori and males, also require targeted interventions. The consequences of TBI can have a long-lasting personal, societal and economic impact, therefore it is imperative that interventions concerning TBI are developed and implemented to address the growing burden of disease.

The Ottawa Charter for Health Promotion

The following interventions have been formulated using the Ottawa Charter for Health Promotion (32). These interventions aim to improve the understanding and medical treatment of TBI within New Zealand communities. The five areas for health promotion outlined in the Ottawa Charter are building healthy public policy, creating supportive environments, strengthening community action, developing personal skills, and re-orienting health services (33). Each of these areas of action aim to achieve equity in health outcomes and enable people to lead healthy lives.

Public Policy

The first area of action outlined in the Ottawa Charter revolves around building healthy public policy to reduce the incidence of TBI. Health policy is either proposed or undertaken by a government to achieve specific health care goals (33). In the example of TBI prevention, health policy may involve compulsory head gear use in all contact sports for both amateur and professional sportsmen. This could have the dual benefit of reducing the incidence of

TBI in individuals playing contact sport, while simultaneously encouraging the use of head protection to the community. Furthermore, head gear use by professional sportsmen could further promote understanding around TBI. Professional sportsmen can be seen as positive role models for normalising the usage of safety equipment by children and young adults, which are a high-risk group for TBI in New Zealand.

Supportive Environments

The second area of action involves creating supportive environments. A supportive environment is one in which individuals feel equipped and comfortable dealing with TBI and seeking appropriate medical treatment. Furthermore, it would be an environment which protects individuals against sustaining a TBI. Creating a supportive environment can partly be achieved by implementing appropriate healthy public policy. Using the aforementioned example of compulsory head gear in sport, the implementation of this policy could lead to the normalisation of protective equipment in all levels of sport. Thus, the effects of public policy have the potential to be highly effective in creating supportive environments and influencing members of New Zealand society.

Social Media

Social media can also play a key role in creating supportive environments, as it provides an alternative avenue for advertising and promoting a message to a targeted audience. The high prevalence of young adults within social media networks means that social media is likely to be highly effective in informing the high-risk demographic of children and young adults about TBI symptoms and consequences. Social media websites, such as Twitter, provide a promising pathway in targeting a wide range of age groups. Individuals with large social influence and presence on Twitter have the power to stimulate the growth of a campaign. This idea is not novel; campaigns relating to TBI have already been launched in other

countries. In Australia, the hashtag #nobrainnogame was set up by the Queensland Brain Institute to raise awareness and provide funding for research. Similarly, the hashtag #ConcussionAware was launched in the United Kingdom for similar purposes. The Brain Injury Association used this campaign to raise awareness in sports, particularly those at grassroots levels. New Zealand currently has no comparable social media campaign, therefore an initiative in conjunction with relevant groups, such as the Brain Injury Support group (34), could be launched to raise awareness of TBI in the New Zealand public.

Social media campaigns can be highly cost-effective as individuals willingly share information amongst their contacts. Costs include the initial design and development of the campaign, but once established a successful social media campaign can be self-perpetuating with no ongoing costs. Paid advertisements could be used in conjunction with a social media launch to promote rapid initial growth and to reach a more diverse audience. While the benefits of social media campaigning are difficult to assess, this has the potential to be a cost-effective intervention, especially when compared with advertising based solely on traditional media, such as billboards, television advertisements, and pre-movie advertisements.

Community Action

Another vital aspect of the Ottawa Charter is strengthening community action. Initiatives in this area could involve contacting local regional councils in order to promote awareness of TBI. Dissemination of pamphlets containing infographics amongst high-risk populations could also prove to be an effective targeted strategy. Infographics provide a visual form of media which is more accessible to less educated populations and young children. Pamphlets are particularly helpful for patients suffering from TBI, as non-verbal information allows patients and their families to refer back to the information at a later time.

The Centre of Disease Control (CDC) have developed infographics relating to TBI, which has created a platform to inform patients rapidly and effectively (Figure 12). CDC infographics have already been designed and are readily available, therefore the cost of further dissemination is reduced to the printing and distribution costs of pamphlets. The benefit provided by pamphlets is difficult to quantify; one barrier is that infographics are already highly prevalent in healthcare settings and thus may go unnoticed. Involving primary health physicians would be a more effective way to distribute pamphlets, as they are in a position to identify and disseminate information to high-risk patients. A beneficial flow-on effect from raised awareness is a larger proportion of the community having an accurate understanding of TBI, which may lead to more rapid identification and treatment of head injuries in the future.

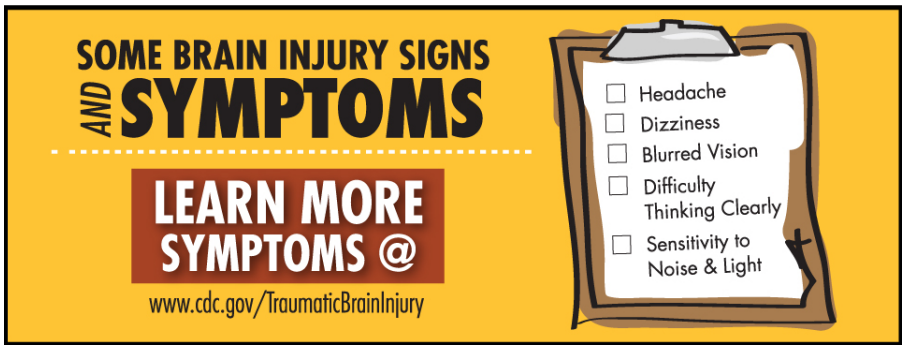

Figure 12. An example of a TBI infographic available through the CDC (35).

Developing Personal Skills

The fourth area of the Ottawa Charter, developing personal skills, links to strengthening the community. An increase in understanding of TBI amongst individuals can create a supportive community, leading to better outcomes for TBI sufferers. One opportunity to develop personal skills is through adult community classes to learn about TBI. To address the knowledge deficit in younger populations, a TBI-based topic could be included in the health

curriculum at primary or secondary schools to explain how to confidently seek and provide help.

Although it may be an expensive option, educational advertisements about TBI could be utilised to develop personal skills. Advertising through a variety of print, audio and visual forms would be an effective medium to passively provide correct information about TBI to a large sector of the population. This multimedia approach may help attenuate the inaccurate messages portrayed through film and television. Additionally, advertisements could empower viewers to take charge of their own safety through the encouragement of helmets and head gear where appropriate.

Reorienting Health Services

Reorienting health services is the final health promotion action addressed by the Ottawa Charter. A local clinical neuropsychologist in Wellington indicated that inadequate education regarding TBI is currently provided to healthcare professionals (although this is only anecdotal evidence). It was reported through personal correspondence that it is a common occurrence for patients with symptoms of TBI to be discharged without receiving proper treatment in emergency departments throughout New Zealand. Inadequate recognition and treatment of head injuries was attributed to a lack of understanding amongst healthcare professionals who are not regularly exposed to TBI. Addressing this deficit would require a system-wide intervention through district health boards to provide a TBI module as part of continuing clinical education. A limitation on this intensive intervention is the financial and time strain it would put on an already burdened healthcare system. However, if delivered effectively, it could greatly increase the prompt identification and treatment of TBI patients, and thus potentially reduce costs associated with poorly managed TBI down the track.

In Wellington Regional Hospital, a fast track system has been implemented to allow rapid identification and treatment of stroke in the Emergency Department (ED). A fast track system guides clinicians through an eligibility criteria for thrombolytic treatment and details each step that should be undertaken within a limited timeframe. An equivalent fast track tool could be developed for head injuries presenting to ED to reduce waiting time and enable rapid and potentially life-saving treatment.

In contrast to the other interventions proposed in this document which focus on TBI prevention, this intervention aims at improving outcomes for patients after an injury has occurred. Establishing a TBI fast track system nationwide would be difficult as it places a high demand on staff and resources. However, fast track has proven effective at delivering prompt treatment for stroke in some hospitals and thus is a viable option to consider (36).

Summary

Overall, the aim of the proposed interventions is to provide a greater understanding of the circumstances that can cause TBI, recognition of the symptoms of TBI, and the importance of seeking prompt medical treatment. It is evident from this study that misconceptions are prevalent, even amongst individuals with previous exposure to TBI. Therefore, some interventions are specifically aimed at high-risk communities, while other proposed interventions aim to address misconceptions throughout the New Zealand population. Exposure to film is thought to be one source of inaccurate knowledge of TBI. Film is a medium capable of influencing a wide-range of populations, therefore it is imperative that

interventions to counteract inaccurate messages are implemented in a way that can induce systemic change.

Māori and Pacific Implications and Interventions

The literature outlines a high prevalence and incidence of TBI amongst both Māori and Pacific populations in New Zealand. It would be beneficial to ascertain whether greater misconceptions about TBI are held by these ethnic groups compared with the general population, as this could contribute to the observed disparity. However, due to methodological limitations of surveying in the current study, there were insufficient Māori and Pacific participants to allow an analysis of the association between ethnicity and survey responses. The findings indicate that general misconceptions about TBI are largely unrelated to individual information, such as sex or previous exposure to TBI. Thus, although it is unknown whether greater misconceptions are present in Māori and Pacific populations, the findings indicate that misconceptions about TBI are likely to be widespread.

Greater education around the possible repercussions of head injuries may reduce the incidence of TBI. For example, promoting the message that a single blow to the head can result in months of recovery, permanent cognitive impairment, or even death, could reduce the rates of assault-related head injuries. As previously discussed, Māori have three-to-four times the risk of assault-related TBI compared to New Zealand Europeans. Similarly, in Pacific populations' assault is an over-represented cause of TBI. Furthermore, assault is a common mechanism of injury in the young adult population; Māori and Pacific populations have a younger population distribution compared with the general New Zealand population. Therefore, interventions aiming to reduce assault-related TBI in youth will likely have a significant benefit on Māori and Pacific populations.

A nationwide TBI education programme could be incorporated in the secondary school curriculum; the purpose would be to address misconceptions about causes, symptoms and sequelae of TBI. This programme could be piloted in communities in which young Māori and Pacific people comprise a significant proportion of the student roll to ensure the needs of high-risk groups are being addressed.

One approach could be to develop the equivalent of a 'Harold the Giraffe' character, which involves a mobile classroom and is organised through the Life Education Trust. This initiative involves travelling around schools to educate children on healthcare in a fun and interactive manner, and could be adapted to specifically address TBI.

The Treaty of Waitangi plays a critical role when addressing public health issues based on inequity between Māori and non-Māori people. TBI rates have ethnic disparity and therefore the health needs of Māori must be adequately addressed in a culturally competent and holistic manner. Accordingly, any public health strategy developed in New Zealand must incorporate and specifically address the needs of Māori. It is imperative that Māori communities are actively involved and included in the process to ensure any interventions have a meaningful and long-lasting impact. Local iwi, hapu and marae should be involved in the development and implementation of educational sessions and programmes. In addition to school-based programmes, television advertising targeting the Māori demographic could be an effective means of addressing misconceptions about TBI. This could include broadcasting advertisements in Te Reo Māori or utilising the Māori Television channel.

Ethical Considerations

In terms of the ethical considerations underlying the aims of this current research, equity, non-maleficence and justice are likely the most important issues to address. In regards to equity, disparities in rates of TBI have been identified in young Māori and Pacific males

compared to the general population. Furthermore, equity is an important consideration at a global level in respect to the burden of disease associated with TBI. A major public health issue, at an individual, community and global level, demands that health outcomes be improved for all people, and areas of inequity identified and duly addressed.

Non-maleficence is another key ethical principle to consider in relation to the current study. In terms of the research methodology, no psychological stress on key informants or survey participants was anticipated or reported. Participants or researchers were not put at any risk, as data collection involved only a verbal exchange. No minors were surveyed or interviewed. Moreover, no forms of deception which may have threatened any individual's emotional or psychological well-being was anticipated or reported.

With regard to the ethical concepts of public health, particularly in the context of addressing TBI and subsequently undertaking this research, the concepts of justice, autonomy, equity and utilitarianism are deemed important. Any recommendations or possible interventions based on the results of this research must aim to address the inequity of the burden of TBI in vulnerable populations, with subsequent distributive justice, in alignment with the needs of these populations. Interventions must be implemented fairly, be feasible, and made accessible to these populations. Distributive consequences must be considered, particularly with respect to potential benefits or burdens of any intervention.

Conclusion

This study confirmed that misconceptions about TBI are present in 18 to 24 year old university students. In addition, this study showed that popular action films present an inaccurate portrayal of TBI, particularly with respect to recovery time following a head injury. Previous international research has indicated that there are particular misconceptions about TBI held by adult populations; the results of this study indicate that young adults in New Zealand appear to have similar types of misconceptions about TBI. Furthermore, it had been suggested that popular media may play an important role in creating and supporting misconceptions about TBI, however portrayal of TBI in film had not been quantitatively analysed prior to this study. Although it was difficult to conclude whether a head injury depicted in a film would result in a TBI in the real world, it was clear that the length of recovery following a TBI was inaccurately portrayed. TBI is a significant global public health issue with a rising incidence, therefore it is imperative to identify underlying factors that may be contributing to the problem and adding to the overall burden of disease. In light of our findings, this report has discussed potential interventions using the Ottawa Charter for Health Promotion to improve general understanding about TBI and provide countermeasures to the portrayal of TBI in popular media. These proposed interventions include education programmes in schools and local communities, normalising protective head gear through public health policy, social media campaigns, and a strong TBI advertising campaign on television. The aim of increasing a society's understanding about TBI and countering misinformation presented in popular media is to reduce the incidence of TBI and improve health outcomes. Future research recommendations include further analysis of the potential relationship between misconceptions about TBI and exposure to misportrayal of head injuries in popular media, and investigating if greater misconceptions are present in high-risk populations, such as Māori and Pacific people.

Acknowledgements

We would like to gratefully acknowledge the support and guidance of our two supervisors, Prof Diana Sarfati and Dr Richard Jaine. In addition, we would like to thank Mr Andrew Parker, Dr Paul Quigley, and Kay Cunningham for sharing their expertise with the group. Lastly, a big thank you to the Public Health Department and Kerry Hurley for your support and kind encouragement.

References

1. Hyder AA, Wunderlich CA, Puvanachandra P, Gururaj G, Kobusingye OC. The impact of traumatic brain injuries: A global perspective. NeuroRehabilitation. IOS Press; 2007;22:341–53.

2. Langlois JA, Rutland-Brown W, Wald MM. The epidemiology and impact of traumatic brain injury: A brief overview. The Journal of Head Trauma Rehabilitation. 2006;21(5):375–8.

3. World Health Organization. 3.6 Neurological disorders associated with malnutrition 111 [Internet]. Available from: http://www.who.int/mental_health/neurology/neurodiso/en/

4. NZ Guidelines Group ACC. ACC guidelines on TBI: Diagnosis, acute management and rehabilitation [Internet]. 2006. Available from: https://www.mendeley.com/viewer/?fileId=5a44681e-a09f-813f-0d39-de6ae691d558&documentId=97658a5a-9eae-38d8-b83c-b1f3e28a3a7f

5. Te Ao B, Brown P, Tobias M, Ameratunga S, Barker-Collo S, Theadom A, et al. Cost of traumatic brain injury in New Zealand: evidence from a population-based study. Neurology. 2014;83:1645–52.

6. ACC. ACC Injury Statisitics Tool [Internet]. Available from: http://www.acc.co.nz/about-acc/statistics/injury-statistics-tool/index.htm#results

7. Faul M, Coronado V. Epidemiology of traumatic brain injury. Handbook of Clinical Neurology. 2014 Dec; 127:3–13.

8. Tagliaferri F, Compagnone C, Korsic M, Servadei F, Kraus J. A systematic review of brain injury epidemiology in Europe. The European Journal of Neurosurgery.

2006;148:255–68.

9. Feigin VL, Theadom A, Barker-Collo S, Starkey NJ, McPherson K, Kahan M, et al. Incidence of traumatic brain injury in New Zealand: A population-based study. The Lancet Neurology. 2013;12:53–64.

10. Te Ao B, Tobias M, Ameratunga S, McPherson K, Theadom A, Dowell A, et al. Burden of traumatic brain injury in New Zealand: Incidence, prevalence and disability-adjusted life years. Neuroepidemiology. 2015;44:255–61.

11. Lagolago W, Theadom A, Fairbairn-Dunlop P, Ameratunga S, Dowell A, Mcpherson KM, et al. Traumatic brain injury within Pacific people of New Zealand. New Zealand Medical Journal [Internet]. 2015;17(128):1175–8716. Available from: http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2015/vol-128-no-1412/6497

12. Hux K, Schram CD, Goeken T. Misconceptions about brain injury: A survey replication study. Brain Injury. 2006;20(5):547–53.

13. Gouvier WD, Prestholdt PH, Warner MS. A survey of common misconceptions about head injury and recovery. Archives of Clinical Neuropsychology. 1988;3:331–43.

14. Willer B, Johnson WE, Rempel RC, Linn R. A note concerning misconceptions of the general public about brain injury. Archives of Clinical Neuropsychology. 1993;(8):46–465.

15. Guilmette TJ, Paglia MF. The public's misconceptions about traumatic brain injury: A follow up survey. Archives of Clinical Neuropsychology. 2004;19:183–9.

16. Pretorius C, Broodryk M. Misconceptions about traumatic brain injuries among South African university students. South African Journal of Psychology. 2013;19(3):75–9.

17. Pilgrim JL, Gerostamoulos D, Drummer OH. “King hit” fatalities in Australia, 2000-2012: The role of alcohol and other drugs. Drug and Alcohol Dependence. 2014;135:119–32.

18. Ono M, Ownsworth T, Walters B. Preliminary investigation of misconceptions and expectations of the effects of traumatic brain injury and symptom reporting. Brain Injury. 2011;25(2):237–49.

19. Block CK, West SE, Goldin Y. Misconceptions and misattributions about traumatic brain injury: an integrated conceptual framework. Physical Medicine and Rehabilitation. 2016;8:58–68.

20. Ernst WJ, Trice AD, Gilbert JL, Potts H. Misconceptions about traumatic brain injury and recovery among nursing students. Journal of Head Trauma Rehabilitation. 2009;24(3):213–20.

21. Farmer JE, Johnson-Gerard M. Misconceptions about traumatic brain injury among educators and rehabilitation staff: a comparative study. Rehabilitation Psychology. 1997;42(4):273–86.

22. Glantz SA. Erratum: Smoking in movies: A major problem and a real solution. The Lancet. 2003;362:258–9.

23. Glantz S. Smoking in movies. CHEST Journal. 2006;129(2):495.

24. Titus-Ernstoff L, Dalton MA, Adachi-Mejia AM, Longacre MR, Beach ML. Longitudinal study of viewing smoking in movies and initiation of smoking by children. Pediatrics. 2008;121(1):15–21.

25. Lioutas ED, Tzimitra-Kalogianni I. “I saw Santa drinking soda!” Advertising and children’s food preferences. Child: Care, Health and Development. 2014;41(3):424–

33.

26. Hardman CA, Rogers PJ, Dallas R, Scott J, Ruddock HK, Robinson E. “Food addiction is real”. The effects of exposure to this message on self-diagnosed food addiction and eating behaviour. Appetite. 2015;91:179–84.

27. Gendall P, Hoek J, Edwards R, Glantz S. Effect of exposure to smoking in movies on young adult smoking in New Zealand. PLoS One. 2016;11(3).

28. Dalton MA, Sargent JD, Beach ML, Titus-Ernstoff L, Gibson JJ, Ahrens MB, et al. Effect of viewing smoking in movies on adolescent smoking initiation: A cohort study. The Lancet. 2003;362:281–5.

29. Box Office Mojo [Internet]. [cited 2016 Aug 16]. Available from: http://www.boxofficemojo.com/alltime/world/

30. Film and video labelling body [Internet]. [cited 2016 Aug 16]. Available from: http://www.fvlb.org.nz/nz

31. Hux K, Bush E, Evans K, Simanek G. Misconceptions about traumatic brain injury among students preparing to be special education professionals. Support for Learning. 2013;28(3):109–14.

32. Fry D, Zask A. Applying the Ottawa Charter to inform health promotion programme design. Health Promotion International. 2016;31(3):1–12.

33. World Health Organization. The Ottawa Charter for Health Promotion [Internet]. 1986. Available from: http://www.who.int/healthpromotion/conferences/previous/ottawa/en/

34. Brain Injury Support [Internet]. Available from: http://brain-injury.org.nz/

35. Centers for Disease Control and Prevention. #CDCHeadsUp [Internet]. 2015. Available from: https://www.cdc.gov/headsup/resources/graphics.html

36. Ratanakorn D, Keandoungchun J, Sittichanbuncha Y, Laothamatas J, Tegeler CH. Stroke fast track reduces time delay to neuroimaging and increases use of thrombolysis in an academic medical center in Thailand. Journal of Neuroimaging. 2012;22(1):53–7.

Appendix A

D16/293

Academic Services
Manager, Academic Committees, Mr Gary Witte

13 September 2016

Dr R Jaine
Department of Public Health (Wgnt)
University of Otago, Wellington
University of Otago Medical School

Dear Dr Jaine,

I am writing to confirm for you the status of your proposal entitled **"Is film misleading young adults about the reality of traumatic brain injury"**, which was originally received on August 19, 2016. The Human Ethics Committee's reference number for this proposal is **D16/293**.

The above application was Category B and had therefore been considered within the Department or School. The outcome was subsequently reviewed by the University of Otago Human Ethics Committee. The outcome of that consideration was that the proposal was approved.

Approval is for up to three years from the date of HOD approval. If this project has not been completed within three years of this date, re-approval must be requested. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing.

Yours sincerely,

Mr Gary Witte
Manager, Academic Committees
Tel: 479 8256
Email: gary.witte@otago.ac.nz

Appendix B

MEDICAL STUDENT RESEARCH
University of Otago, Wellington
Traumatic Brain Injury

SURVEY FORM

Informed consent gained ☐ **Yes** **Indicate age** _____

A. Participant details

Sex ☐ Female ☐ Male

Ethnicity ☐ NZ European ☐ Maori ☐ Pacific ☐ Asian ☐ Other

Subject of study _____

B. Understanding of Traumatic Brain Injury

Please read the following statements and indicate whether TRUE or FALSE

1. A head injury can cause brain damage even if the person is not knocked out — **TRUE / FALSE**
2. Whiplash injuries to the neck can cause brain damage even if there is no direct blow to the head — **TRUE / FALSE**
3. Most people with brain damage look and act disabled — **TRUE / FALSE**
4. When people are knocked unconscious, most wake up shortly after with no lasting effects — **TRUE / FALSE**
5. Even after several weeks in a coma, when people wake up, most of them will be able to recognise and speak to others right away — **TRUE / FALSE**
6. After a head injury, people can forget who they are and not recognise others, but be normal in every other way — **TRUE / FALSE**
7. Sometimes a second blow to the head can help a person remember things that were forgotten after a first blow to the head — **TRUE / FALSE**
8. People with amnesia who cannot remember events before their injury usually have trouble learning new things too — **TRUE / FALSE**
9. How quickly a person recovers depends mainly on how hard they work at recovering — **TRUE / FALSE**

10. People who have had one head injury are more likely to have a second head injury — **TRUE / FALSE**

11. Once a recovering person feels "back to normal", the recovery process is complete — **TRUE / FALSE**

12. It is good advice to rest and remain inactive during recovery — **TRUE / FALSE**

13. Fatigue is an uncommon complication of head injury — **TRUE / FALSE**

14. Complete recovery from a severe head injury is not possible, no matter how hard the person tries to recover — **TRUE / FALSE**

15. After being knocked unconscious, the expected time to make a full recovery would be

Seconds **Minutes** **Hours** **Weeks** **Months**

C. Personal Views on Traumatic Brain Injury

Have you, or anyone close to you, ever suffered from a Traumatic Brain Injury (TBI)?

☐ Yes ☐ No

If you had an accident that involved an injury to the head and were knocked unconscious, would you seek medical help?

☐ Yes ☐ No

D. Film Exposure

Please indicate which of the following films you have seen:

☐James Bond - Casino Royale
☐ James Bond - Quantum of Solace
☐James Bond - Skyfall
☐James Bond - Spectre
☐Fast and Furious 5
☐Fast and Furious 6
☐Fast and Furious 7
☐Da Vinci Code
☐Angels and Demons
☐Mission: Impossible - III
☐Mission: Impossible - Ghost Protocol
☐Mission: Impossible - Rogue Nation
☐The Hangover
☐The Hangover Part II
☐American Sniper
☐National Treasure II
☐Bourne Ultimatum
☐Kingsmen: The Secret Service
☐Live Free or Die Hard
☐Slumdog Millionaire

END OF SURVEY

Title: TBI survey form | Final Version | Version date: August 2016
For office use only: | Survey ID No: | Entered ☐

Appendix C

Instructions for Completing Film Analysis Forms

Defining Head injury

- Include any visible head injuries
- Assume that car crashes and explosions will cause a head injury to those involved
    - E.g. if 3 people are in one car crash or 3 people are caught in an explosion record that as 3 head injuries. Separate as necessary into different rows if symptoms/recovery/outcomes differ between the 3 victims, otherwise may be included on 1 row.

Victim's role in movie

- Defined as one of the following
    - Significant role (>2 lines of dialogue)
    - Extras (<2 lines of dialogue)

Preventative or risk factors (if applicable):

- Applicable if applied prior to head injury occurring. i.e. substance use prior to head injury, use of helmets etc.

Number of similar head injuries per character:

- If multiple impacts to head of similar mechanism with each impact not causing obvious change in symptoms or outcomes following head injury-list the number of times the impact occurred (e.g. character punched 5 times in the head in a fight scene-include it as 5)
- If role is designated as extra, can be grouped together if similar mechanisms of head injury, TBI symptoms and outcomes

Head injuries between extras are excluded. (i.e. Head injury must be related to a significant character-either inflicted on or due to)

Mechanism of head injury:

- Record as one of the following:
    - Falls or collision with stationary objects
    - Assault
    - Projectiles (includes bullets, objects falling on heads etc.)
    - Explosions
    - Car crash/hit by car -
        - If unknown number of passengers, assume 1
    - Other (please specify)

Any TBI symptoms shown:

- Yes or No (must be linked to head injury e.g. if someone falls because they lost consciousness and then hits the head on the ground-cannot attribute loss of consciousness to head injury)
- If no proceed to outcomes
- If yes proceed to what TBI symptoms then Recovery then Outcome

What TBI symptoms

- Any of the following (note must be attributed to head injury, not other causes such as drug use):
    - Loss of consciousness
    - Alterations to memory
    - Confusion/disorientation
    - Other neurological signs (e.g. seizure, focal neurological signs, SOL)

Recovery

- Immediate full recovery (back to normal within a few minutes of head injury)
- Full recovery within a day of head injury
- Full recovery greater than a day of head injury
- Unknown/indeterminate

Outcome

- Full recovery/no TBI symptoms from injury
- Partial recovery (TBI symptoms may still be present)
- Death
- Unknown