

PHYSIOTHERAPISTS' ROLE IN INCREASING AWARENESS AND KNOWLEDGE ABOUT TRAUMATIC BRAIN INJURY IN CONTACT SPORTS ATHLETES: A QUALITATIVE RESEARCH.

Practical Research



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Date: 08/06/2021



Preface

In November 2020, I was introduced to the care of neurological pathologies at the Hôpital de Kirchberg in Luxembourg in my second internship. Thanks to Lena Schmitt, who guided me throughout my internship, I knew that working with neurological patients would become a job that I would feel lucky and passionate about doing. Moreover, I have grown a passion for combat sports since my teenage years, which was primarily the reason for studying physiotherapy. The topic of this thesis came from a combination of both my passions. Furthermore, my thesis supervisor, Paul Hodselmans guided and helped me throughout the thesis process. Therefore, I would like to thank them for all the inspiration and professional guidance for the thesis.

Abstract

Background: In the past two decades, awareness about traumatic brain injury has been increasing in the public health. Informative and educational programs such as the Concussion Management program from the University of Kansas Health System have been reaching out to education, health and sports facilities. Practical guidelines about how to identify, treat and manage traumatic brain injury has been created since and helped increase awareness in the general as well as the athletic population. Hence, the problem of lack of knowledge has been gaining in importance in the past decades. Nonetheless, there is little research and guidelines about how physiotherapists can help preventing traumatic brain injury.

Objective: The aim of the study is to explore the physiotherapist's role in widening athlete's knowledge about traumatic brain injury with the goal of decreasing head trauma occurrences in contact sports. Creating awareness and sharing knowledge about traumatic brain injury may help prevent unnecessary head injuries and reduce possible limitations in the long run.

Methods: Data was extracted from semi-structured in-depth interviews, which were recorded and verbatim transcribed. Eight physiotherapists and graduating physiotherapy students were recruited via personal and internet network. Atlas.ti was used for coding and analysis of data. The following main topics were covered: concussion knowledge, pathophysiology of traumatic brain injury, diagnosis of traumatic brain injury and patient education.

Results: Findings stated that there was a general lack of traumatic brain injury knowledge present among contact sports athletes, leading to insufficient capabilities to identify traumatic brain injury and to the continuous unreported incidences. Multiple tools and methods were suggested for increasing traumatic brain injury knowledge and awareness, such as informing by example/role model, conversations with athletes, involving athlete's environment, general patient education and social media.

Conclusion: Physiotherapists can help increase the awareness and knowledge about traumatic brain injury in contact sports athletes by means of informing by example/role model, conversations with athletes, involving athlete's environment, general patient education and social media. Physiotherapists' role could contribute to the educating and spreading awareness about risks, consequences and the condition itself, helping the athletes make more informed decisions about their health. This conclusion was drawn from the qualitative study with experts. Further research needs to be done with a quantitative study to reconfirm this theory. It is recommended to do a quantitative research at hand of surveys to pursue the applicability of these methods in this population.

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Introduction

“[...] [A] traumatic brain injury (TBI) [is defined] as a disruption in the normal function of the brain that can be caused by a bump, blow, or jolt to the head, or penetrating head injury [according to Centers for Disease Control (CDC)]” (Traumatic Brain Injury & Concussion, 2020). There are different types of TBI, where concussion is one of the mildest TBI forms on the brain injury spectrum (Harmon et al., 2013). In the past two decades, the awareness about traumatic brain injury has been increasing in the public health. Since then, practical guidelines have been developed that inform about concussion mechanism, prevention and management. For example, in 2012, the University of Kansas Health System (TUKH) created an interdisciplinary Center for Concussion Management (CCM) program which managed to reach out to exterior communities, such as schools, parent organisations, health care providers and student athletes. These partnerships have aided in increasing concussion awareness and knowledge in this population. (Chen et al., 2020)

For combat sports, a consensus statement from the Association of Ringside Physicians was established upon lack of a common universal guideline on how to manage and identify mild TBI. In this consensus statement, it was recommended that all athletes and coaches/trainers receive education on identifying signs and symptoms of mild TBI's, in both practice and competition situations. Decisions on removing athletes from the sporting activity and sending them to get an evaluation and check up with a health care professional should be made accordingly. (Neidecker et al., 2019)

Despite the increase of guidelines about evaluating, diagnosing and treating head trauma and the increase of TBI knowledge in both sports and public in the last decades via the media and internet, there still seems to be a lack of prevention guidelines and preventative measures in sports. Especially in contact sports, such as American football, rugby and martial arts for example, the risk and reported incidences of TBI is high and frequent. Head traumas happen not only during games, matches or fights but also during practice, despite the available protection gear, including helmets, head gear and mouth gears. In addition to this, it is believed that a percentage of TBI incidences goes unreported (Galgano et al., 2017). Lack of knowledge about TBI, including concussion and contusion in contact sports could contribute to this. The severity of acute, chronic head traumas and repetitive brain injury and the possible physical as well as mental consequences are not known by every athlete in contact sports.

Physiotherapists have a role of rehabilitating patients, to help them regain function in their activities of daily life (ADL) and to help them return to and participate in their social environment. In the sports context, the physiotherapists help athletes return to play (RTP), so they can return to their sport level prior injury. As mentioned in Chen et al., 2020, physiotherapists rehabilitate patients with physical limitations after suffering a TBI. There is much research and physiotherapy guidelines for evaluation and treatment of TBI symptoms such as the clinical practice guideline ‘Physical Therapy Evaluation and Treatment After Concussion/Mild Traumatic Brain Injury’ from (Quatman-Yates et al., 2020). However, there is little literature and thus a clear knowledge gap about how physiotherapists can help prevent TBI occurrences in sports.

The aim of this qualitative research is to find out how physiotherapists can increase awareness and spread knowledge about TBI so athletes can make informed decisions about their physical and mental health during their sport activities. Giving athletes all the information at hand might help them analysing the risk situations differently, resulting in decrease of unnecessary TBI.

Methods

Study Design

The study design of this research paper was a descriptive research design. The aim of this qualitative research was to gain more insight as to how physiotherapists and graduating physiotherapy students could increase awareness and knowledge about TBI in contact sports at hand of in-depth semi-structured interviews. This descriptive study design allowed to identify the personal experiences from experts in the field and to explore their expertise regarding the relevant topic. The in-depth semi-structured interview allowed the researcher to guide and develop the conversation. An interview guide (Appendix 3) which helped to structure and define the main thematic aspects, was set up prior to the interviews.

Concerning the ethical approval, no ethical approval was needed for conducting this qualitative research study. This study was approved by the Hanzehogeschool Groningen. Moreover, a written informed consent form (Appendix 1) was needed from all study participant prior to the interview, which stated that they agreed to the terms of the study.

Setting

Ideally, the in-depth semi-structured interviews with the participant and researcher would have been done in physical form. However, due to the current situation with the pandemic, this physical setting was not favourable and not advised. Thus, the interviews were conducted online via a social platform such as Teams, Zooms or Facebook, dependent on the available resources of the study participants.

Participants (Sample and Recruitment)

The participants were eligible for the study if they had a bachelor's degree in Physiotherapy or were in their graduating year, have worked or played with contact sports athletes, such as soccer, rugby, (field and ice) hockey or martial arts in the last year, were able to provide a written consent form. Other inclusion criteria were that they were able to conduct the interviews via an online platform or via telephone and able to conduct the interview in English. All experts in the field who did not meet the above-mentioned criteria were excluded from the study.

Procedure

In the beginning, the aim was to recruit sports physiotherapists that were experienced in contact sports, but to do time limit and unresponsiveness, the inclusion criteria needed to be adapted. It was decided to include graduated physiotherapists and graduating physiotherapy students next to the sports physiotherapists, which were all recruited by personal connections, social network and internet research via email. An information letter (Appendix 2) where the purpose

of the study, the procedure of the in-depth interview was described in detail in order to be as transparent as possible with the potential participants. After receiving a positive response from the candidates, the time and date of the meeting was planned, the communication method (telephone or online) was agreed on and the written informed consent form was sent via email to the participants. The study participants were required to send the signed consent form back to the researcher prior to the interview. An interview guide (Appendix 3) was used to partially guide the interview and was formed by the following main topics: concussion knowledge, diagnosis of TBI, pathophysiology of TBI and patient education. This semi-structured lay-out allowed an open, interactive and flowing conversation between the two parties. Each topic comprised three to six related questions, all of which did not necessarily need to be included in the conversations. The sub-questions were only used if the researcher had a feeling that the conversations needed more input from the participants to get saturation. Having selected topics helped making the experiences, opinions and suggestions of the participants clearer. The researcher was allowed to record the interview with each participant from start to finish and transcribe the voice recordings. The voice recordings, transcriptions and all other data of the participants were stored on the OneDrive Hanzehogeschool Groningen and were only accessible to the researcher and the responsible thesis supervisor (Paul HODSELMANS) until the end of the study. Moreover, the participants' anonymity was guaranteed during the whole study.

The interviews were conducted in the month of April and May 2021. The current pandemic facilitated interview planning and conduction. At the end, three sports physiotherapists, one graduated physiotherapist and four graduating physiotherapy students took part in this qualitative study.

Data collection & analysis

Data was collected from the interviews by recording and transcribed by the researcher. To each participant, a code was attributed to ensure the participants' anonymity. Data analysis was done at hand of the Miles & Huberman approach (Miles & Huberman, 1994). A coding system was established with the use of Atlas.ti. First, every transcript was read in their entirety to give the researcher an overall impression of the content. Then, the transcripts were analysed line by line and participants' meaningful responses were attributed to initial codes. These initial codes that had certain similar characteristics were connected to compose initial loose themes. At the end of the coding, the initial loose themes were subsequently divided selectively into main categories. A codebook was created on Word and used for the assembling the results (Appendix 4).

Results

Participants

Eight participants, out of which four were graduating physiotherapy students (PT4; PT5; PT6; PT7), one a graduated physiotherapist (PT1) and three sports physiotherapists (PT2; PT3; PT8), took part in this study. There were seven male and one female participants. The age of the study participants ranged from 22 to 57 years. All participants have had experience with contact

sports athletes as a therapist and/or as an athlete themselves. The participants were involved in the following contact sports: rugby, kickboxing, Gaelic football and soccer. See Table 1. to see the characteristics about each participant.

Table 1. Characteristics of participants

Participant	Age	Sex	Specialization	Contact sport
PT1	38	Male	Graduated PT	Kickboxing.
PT2	31	Male	Sports PT	Soccer; Rugby
PT3	57	Male	Sports PT	
PT4	22	Male	Graduating PT student	Soccer
PT5	24	Male	Graduating PT student	Gaelic football
PT6	22	Male	Graduating PT student	Kickboxing
PT7	24	Male	Graduating PT student	Soccer
PT8	32	Female	Sports PT	Rugby

PT=Physiotherapist

The main four topics of the interviews were: concussion knowledge, pathophysiology of traumatic brain injury (TBI), diagnosis of TBI and patient education.

Concussion knowledge

Participants were asked what the concussion knowledge in athletes was. Every participant (n=8) recognized that there was a lack of knowledge about TBI in the sports world.

‘I think it's very low.’ [PT1].

‘Nowadays they might be a bit more knowledgeable uhm but I think yeah there is a big lack of knowledge in sports with concussions.’ [PT5].

Two participants (n=2) mentioned that awareness and knowledge about TBI have been increasing slowly in the last decades.

‘I think the knowledge is getting slowly better... slowly.’ [PT7].

‘I think people are becoming more aware of it now. Before, there was almost no real evidence and research done.’ [PT5]

When asking about the knowledge difference between sports levels, the majority of participants (n=6) acknowledged that there is a difference in concussion knowledge between the different sports levels. They claimed that professionals knew more about TBI than amateur athletes, due to their different surrounding team and staff.

‘...professional athletes there is more knowledge, but that's basically with every injury in soccer. There is more knowledge once the level gets up.’ [PT2].

‘The professionals are more educated than the amateurs because they have people around them. Their surrounding is a lot different.’ [PT4].

Five participants (n=5) have stated a knowledge difference between the different contact sports when asked about TBI knowledge among the different contact sports. Rugby was mentioned to have more TBI knowledge compared to soccer, kickboxing and Gaelic football (n=4).

‘I have worked with rugby players and concussions happen there way more often than in soccer. And they were way more serious about it. They knew what could happen and what needed to be done.’ [PT8].

Pathophysiology of TBI

Participants were asked what signs and symptoms of TBI athletes would know. More than half of the participants (n=5) reported that contact sports athletes had little knowledge about signs and symptoms of TBI. The other three (n=3) claimed that they did not know much about concussions in general.

‘I think the memory part or the balance symptoms. If they cannot stand up properly, or wobbling.’ [PT2].

‘...very little. If you are dizzy or kind of nauseous. Or kind of physically vomiting or something. Those would be the symptoms I would say. From an athlete perspective.’ [PT5].

Participants were asked what aspects of TBI are necessary for athletes to know. According to them, it was important to educate athletes about the mechanism of injury (n=3), signs and symptoms (n=8) and the consequences (short-term and long-term) of TBI (n=7).

‘... for example, the signs and symptoms, the consequences...’ [PT4].

‘The condition and also how it happens.’ [PT7].

Diagnosis of TBI

Participants were asked why many TBI incidences go unreported. The reasons according to them are lack of knowledge (n=5), invisibility (n=2) and misdiagnosing TBI (n=3).

‘Probably lack of knowledge from players, from physios and doctors.’ [PT5].

‘It is not visual. Not like a knee injury or a cut to the temple. But with the brain you cannot see it...’ [PT1].

‘Everyone underestimates it and maybe a lot of people don’t know how to diagnose TBI correctly.’ [PT2].

Patient education

Participants were asked what methods and tools physiotherapists could use to share information and increase knowledge in contact sports. The following tools and methods were mentioned at least by three participants:

Informing by example/role model (n=5);

‘...make it as close as possible to their sports, use examples, maybe if u could have a role model who has suffered incident like that. You could show it and maybe they will become more aware.’ [PT3].

‘...give them a real-life example, make it very visual.’ [PT6].

Conversations with athletes (n=5);

‘...physical talks with them...’ [PT5].

‘So talking about it, they will take it very seriously.’ [PT8].

Involving athlete’s environment (n=4);

‘So just educate trainers... educate parents...’ [PT8].

‘If they are younger than 18, I always call their parents’ [PT2].

Patient education (n=4);

‘..., to sit down and inform the individual athlete.’ [PT3].

‘So patient education. Kinda like pain education but more like the motor control and stuff. Then I would talk about what TBI can do, or what repetitive TBI can do to these symptoms.’ [PT6].

Social media (n=3)

‘...social media...’ [PT1].

‘If you have an Instagram channel as a physio, put some information about that, post about it.’ [PT5].

Discussion

The aim of this study was to find out how physiotherapists could help in increasing awareness and knowledge about TBI in contact sports athletes. The results from the interviews gave good insight into what type of methods and tools could be of use to help increase this knowledge in this population.

The tools and methods that have been mentioned to ideally increase TBI knowledge and awareness were informing by example/role model, conversations with athletes, involving athlete’s environment, general patient education and social media. They said that showing examples and role models that have suffered TBI, makes it more personal to the athletes and could increase their openness to this topic. Interaction between athletes and physiotherapists through conversations and talks, could be another tool to wake their interest and awareness about TBI. When involving the athletes’ environment by informing and educating families, teammates, coaches, trainers and/or friends, athletes will be able to fall back on an educated environment for help or when in doubt. General patient education could be effective in increasing information about the different TBI aspects, such as risks, mechanism of injury, short-term and long-term consequences and signs and symptoms. Another great way that was mentioned was to reach out to this population is social media work, where physiotherapists may use their social platforms to spread awareness and information about TBI. Athletes that are active on social media, could encounter feeds, posts or stories of physiotherapists warning

them about the risks of TBI or teaching them about how to self-diagnose for example. According to a study from 2020, being exposed to variable alternatives of concussion education may contribute positively to athlete's decision-making about TBI in first-year service academy cadets (Register-Mihalik et al., 2020). Based on the results, optimally physiotherapists can at hand of the above-mentioned tools contribute to educating athletes about the TBI condition. However, there is a selection bias due to the varying answers from the different participants. Not all of them were specialized sports physiotherapists and some of them have only played among contact sports athletes, thus reliability of these outcomes could be questionable.

According to the participants, knowledge about traumatic brain injury (TBI) is still poor in contact sports athletes. However, knowledge about TBI has been slowly increasing over the past two decades and more and more people involved in the contact world have been informed about the risks and consequences of TBI. In addition to this, some participants said that research about the consequences, especially the long-term ones, has been increasing as well. This is in line with a study from O'Connell & Molloy (O'Connell & Molloy, 2016) that states that there is still a lack of concussion knowledge among rugby (and hockey) players but that awareness in the rugby world is increasing about repetitive concussions and its possible neurological consequences in the long run. This same study also claims that in the recent years, research about TBI has been increasing in the healthcare and sports sector. These findings indicate that there is still much work to be done for the knowledge insufficiency, considering the slow increase of TBI knowledge in this community.

Most of the participants claimed that professionals have more TBI knowledge than amateur athletes. The most common reason mentioned for this intra-sports knowledge difference was that professionals have more medical staff and people around them that are more knowledgeable about this topic, leading to a more informed and educated environment. A few participants said that amateur athletes have a coach at every training and match and at best a physiotherapist occasionally. The participants said that is important to have an educated environment for the athletes. This is in line with the review of Harmon et al. (Harmon et al., 2013) that emphasises the necessity of educating athlete's familial, educational, sports and healthcare environment about TBI in order to identify, manage and prevent TBI effectively. Based on the results, it seems like educating athlete's environments and making concussion knowledge accessible to athletes, can help athletes in making better informed decisions for their own health and considering their teammates' health. Thus, the coach that usually is present at every team gathering, should make it a responsibility for himself and his athletes to educate himself appropriately about TBI to be able to pass this knowledge on.

Likewise, the participants said there are inter-sports knowledge differences between the contact sports. More specifically, in rugby there is more knowledge compared to kickboxing, soccer and Gaelic football. Some participants also mentioned that there has been increasing research in rugby, upon noticing that rugby players displayed some long-term consequences from repetitive TBI over the years. Based on these results, it is suggested to increase knowledge about the TBI condition in every contact sport where there is a risk of head injury during practice and competition.

Participants reported that due to the still present lack of knowledge in this general population, athletes do not possess sufficient knowledge about pathophysiology and hence are not able to self-diagnose properly among themselves, resulting in continuous unreported TBI incidences. A study with football players found out that the lack of knowledge was not the only reason for unreported TBI cases, but that the fear of being exempted from playing, being excluded from the teammates and the fear of affecting the team, played a role in this as well (Delaney et al., 2018).

According to most of the participants, the signs and symptoms that seem to be known by athletes are the more severe and obvious physical signs, such as vomiting, loss of balance and coordination. They say that the non-visual and more cognitive signs are not perceived as a threat to many of the athletes. Based on the answers of the participants, educating athletes adequately about signs and symptoms, mechanisms of injury, risks and consequences about TBI will give athletes sufficient information to recognize signs of TBI and report suspected head injuries. This is in line with Harmon et al.'s study which supports the need of educating the athlete's about long-term consequences and risks of recurrent concussions (Harmon et al., 2013).

Limitations and strengths of the study

On the one hand, the small sample size and the sample characteristics question the reliability of the outcomes. Ideally, the sample size should be bigger, and the participants of the study should have adequate experience and direct contact with contact sports athletes. It would be recommended to have a bigger sample size and (sports) physiotherapists that actively participate in contact sports athletes' performance and physical health, to get more reliable results.

Another limitation is change of inclusion criteria throughout the study. Initially, only sports physiotherapists were recruited for the study. Eventually, due to time limit and unresponsiveness (from the sports physiotherapists), the inclusion criteria for the participants needed to be adjusted during the course of the study, enabling a wider audience. As a result, next to the sports physiotherapists, graduated physiotherapists and graduating physiotherapy students were included at the end of the recruiting.

In addition to this, the graduating physiotherapy students, the graduated physiotherapist and one sports physiotherapist, who took part in this study, have played with contact sports athletes or treated them on rare occasions. They did not have much experience compared to the other two sports physiotherapists. Only the latter were able to provide more reliable information compared to the other participants. Hence, reliability of the other participants' answers might be questionable.

Furthermore, the topics of the interview were interesting and informative for both research and participant. However, some of the sub-questions of the interview guide were not consistently used throughout the interviews. At the end of the data analysis, these questions were dismissed and only the results from the questions that were asked in every interview were displayed. This did not influence the saturation of the research content.

On the other hand, a strength of the study is that the descriptive study design chosen allowed the researcher to gain more insight into the participants' experience in the contact sports world. The qualitative approach to this subject was more appropriate than the quantitative one, because there was more of an in-depth exchange of information than would have been possible with the quantitative approach. Moreover, the semi-structured aspect of interviewing allowed the conversation to be more flexible and consequently to get more input from the participants.

The contacting of participants and the scheduling of the interviews was facilitated by the electronic exchange of messages. The online possibilities allowed a flexible ground for reaching out, conducting the interviews and keeping in touch.

Finally, this qualitative study provides good in-depth information about TBI knowledge in contact sports athletes and about possibilities to increase the latter at hand of physiotherapists. To pursue the applicability of these methods in this population, a quantitative study with a bigger sample size is recommended.

Conclusion

Physiotherapists can help increase the awareness and knowledge about TBI in contact sports athletes by means of informing by example/role model, conversations with athletes, involving athlete's environment, general patient education and social media. Making them more aware of risks and consequences could help athletes making informed decisions about their own health. Physiotherapists' role in the contact sports world could contribute to the informing, educating and spreading awareness and knowledge about risks, consequences and the condition itself. This conclusion was drawn from the qualitative study with experts. Further research needs to be done with a quantitative study to reconfirm this theory. It is recommended to do a quantitative research at hand of surveys to pursue the applicability of these methods in this population.

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Appendix 1 - Consent form

Consent form: Qualitative research

Dear Sir/Madam,

Various research studies are carried out in the Physiotherapy Programme at Hanze University of Applied Sciences Groningen. You have been asked to participate in a qualitative research study.

What is the study about?

In this qualitative research study, the researcher would like to investigate how physiotherapists and graduating physiotherapy students can effectively increase awareness and knowledge about Traumatic Brain Injury (TBI) in contact sports athletes and therefore contribute to the decrease of TBI incidences and the protection of athletes' health. Moreover, the role of a physiotherapist is not only to treat patients but to provide patient education as well. Thus, by carrying out in-depth semi-structured interviews, different methods will be collected on how to transmit knowledge adequately so it can be used in patient education in a practical setting.

The aim of the study is to find effective methods based on professional's perspectives and suggestions. This study will involve questions mainly about effective tools and methods for increasing knowledge about TBI among contact sports, but also about general knowledge in that population.

What does this mean for you?

During the interview, which will be recorded, you will be asked several questions about your professional opinion, suggestions and ideas you might have on patient education, tools to facilitate increase of knowledge among contact sports athletes. You are expected to use your professional knowledge and answer all the questions truthfully. In this way, we can ensure to provide the best possible result in the best interest of athletes as well as physiotherapists. The interview will approximately take 20-25 minutes and will include 4 main questions.

Is there any benefits or risks of participation?

The benefit of participating in this current study include that you can contribute to finding methods and tools that could facilitate the increase of awareness and patient education in contact sports regarding TBI.

This study poses no risk for you.

Can you withdraw from the study?

Even after signing this form, you reserve the right to withdraw from participating in the study at any given time. There is no need to give a reason for withdrawing. Moreover, if you decide that you do not want your information to be used, you can let the researcher know and it will be deleted.

Where and how long will your data be stored?

The recordings will be deleted from the recording device, after the transcription of the whole interview. They will only be accessible for the researcher. The transcription of the interview will be anonymously stored on the researcher's OneDrive Hanzehogeschool Groningen. The data will then only be retrievable and re-useable by the researcher until the end of the study.

Would you like to participate?

By signing this form, you indicate that you agree to share your professional knowledge and help the researcher in the best possible way to find tools/methods to transmit knowledge and increase awareness about TBI in contact sports athletes and consequently contribute to the decrease of TBI incidences and the protection of athletes' health. You state that you are aware of the fact that the information you provide is, and will remain, confidential.

Your participation in the study is limited to giving consent for the use and application of the information you provide with regards to the product.

Do you have any questions?

If you have any further questions about the study, feel free to contact the researcher. You can find their information below:

Minh Hieu Bui: m.h.bui@st.hanze.nl

Hoping for your cooperation in this study,

Minh Hieu Bui

By signing this form, I indicate that I have been sufficiently informed about the research and agree to voluntarily participate in the study.

Name

Date

Signature

Appendix 2 - Information letter

Information letter: Qualitative research

I am a fourth-year physiotherapy student (International Program of Physiotherapy) at the Hanzehogeschool Groningen (Netherlands). For my bachelor thesis/graduation assignment, I am carrying out a qualitative research involving physiotherapists and graduating physiotherapy students. I would like to investigate how physiotherapists or graduating physiotherapists can effectively increase awareness and knowledge about Traumatic Brain Injury (TBI) in contact sports athletes and consequently contribute to the decrease of TBI incidences and the protection of athletes' health.

At hand of an in-depth semi-structured interview, I would like to gather more insight about the role of a physiotherapist in transmitting valuable knowledge to their patients in the sports world. The interview entails several questions about your professional opinion, suggestions and ideas you might have on patient education, tools to facilitate increase of knowledge among contact sports athletes.

Your participation in this research study is entirely voluntary. If you decide not to take part in this study or decide along the study that you wish to stop the participation, you may withdraw at any time without having to give a reason.

The interview will take about 20-25 minutes. It is anonymous and your responses will be confidential. All the data collected will be stored on the Onedrive Hanzehogeschool Groningen. The data will then only be accessible to me (Minh Hieu BUI) and the responsible thesis supervisor (Paul HODSELMANS) until the end of the study.

If you are interested in participating in this qualitative study, please let me know by getting back to me. Do not hesitate to contact me if you have any questions.

Appendix 3 - Interview guide

Categories/Topics: Concussion knowledge; pathophysiology of TBI; diagnosis of TBI; patient education.

Concussion knowledge

According to physiotherapists in the fields of contact sports, what is the concussion knowledge in athletes?

- What is the athletes' attitude towards risk of TBI during practice and games/matches/fights?
- How do athletes react when one approaches them with the TBI topic?
- What age group is the most affected by TBI?
- What kind of differences are there between amateur and professional athletes in TBI knowledge?
- What kind of differences are there between the different contact sports in TBI knowledge?
- What do athletes do once they are diagnosed with TBI, regarding return to play and training?

Pathophysiology of TBI

What do athletes know about the pathophysiology of TBI?

- What do athletes know about the signs and symptoms of TBI?
- What do athletes know about physical limitations due to TBI?
- What do athletes know about mental and cognitive limitations due to TBI?
- What do athletes know about the risks of repetitive TBI?
- What do athletes know about short- and long-term consequences of TBI?
- What are the most important aspects of TBI that athletes need to know?

Diagnosis of TBI

What is known about identification of TBI among contact sports?

- Who is capable of identifying TBI?
- How do you as a physiotherapist identify TBI?
- Why do/ How come many TBI incidences go unreported?
- What can be done so that TBI can be diagnosed properly?

Patient education

What are the methods and tools that physiotherapists can use to share information and increase knowledge?

- How do athletes absorb information best?
- How open are athletes in receiving information about risk of head injuries?
- How open are athletes to changing their attitude towards risk of head injuries?

- What are the differences in reaching out to amateur and professional athletes about TBI?
- What methods have you used for patient education in athletes?
- What are other suggestions on how to increase concussion knowledge?

Appendix 4 - Codebook

[PT1](#)

[PT2](#)

[PT8](#)

[PT3](#)

[PT4](#)

[PT5](#)

[PT6](#)

[PT7](#)

Question	Test/ quote	Code	inductive / deductive	supercode/concept
What are the methods and tools that physiotherapists can use to share information and increase knowledge?	<p>‘Self-determination theory. Stimulating motivation – intrinsic motivation. For the rest... normal school education with like PP. Self-education.’</p> <p>‘If someone has a brain injury, he is going to research it and he is also going to talk to his other sports mates, and warn them. This is also a great method to spread the knowledge.’</p> <p>‘First training, if you show them about brain injury there is no way to run. They are confronted with it.’</p> <p>‘TV, social media, flyer, via adults (teaching them first), school. The basic stuff.’</p> <p>‘Individual and group education during off-season or during a training.’</p>	Tools/Methods for increasing concussion knowledge (CK)	Inductive	<p>Informing by example/role model</p> <p>Social media</p> <p>Involving environment</p> <p>Patient education</p> <p>Conversations</p>

	<p>‘...in terms on my work at the football clubs, I would say for example presentation for the whole club about to deal with it, how to diagnose it, how to be sure.. what the consequences might be if you underestimate it’</p> <p>‘If they are younger than 18, I always call their parents’</p> <p>‘If it is an older guy, I always try to inform them from evidence-based things as possible. Just like I would inform them about ankle and hamstring injuries. How long recovery takes and what you should do.’</p> <p>‘...a return to play concussion model.’</p> <p>‘The best way to do it is to for example invite someone who had trauma during a soccer match and let them tell their personal story.’</p> <p>‘We would have like a baseline of how they would interact, asking them standard questions that they would know.’</p> <p>‘So talking about it, they will take it very seriously.’</p> <p>‘They had little flyers in the dugout rooms just to... with steps like ‘If you got hit in the head, how can you determine for yourself if you had it or not’, like a concussion protocol.’</p> <p>‘I think you need to start educating at a young age.’</p> <p>‘So just educate trainers... educate parents...’</p> <p>‘...there was a movie about a player and the consequences of concussion after concussion... that could lead to dementia... I think related to Parkinson’s disease. I think that movie woke up a lot of people and made them more aware of the risks of having concussion after concussion and not really taking care of it.’</p>		
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	<p>‘Having a protocol with all the steps you need to take if you suspect anything.’</p> <p>‘...having a baseline for the players and having a list of questions.’</p> <p>‘In my case seeing people going through it, really helped getting through my boys...’</p> <p>‘My club has an information site where stories about things that happen around the club and I think it would be helpful if concussion protocol would be put up there once in a while.’</p> <p>‘I think every staff has like, a kick-off with a team. They will see each other on an occasional basis.’</p> <p>‘So, by just taking an example, maybe it catches their attention and they are more open to observing.’</p> <p>‘how you can inform and educate them, give them examples because that will open their minds.’</p> <p>‘...to sit down and inform the individual athlete.’</p> <p>‘...you want to make them aware as young as possible right.’</p> <p>‘... make it as close as possible to their sports, use examples, maybe if u could have a role model who has suffered incident like that. You could show it and maybe they will become more aware.’</p> <p>‘Sit them down and explain it. But the thing is athletes often won’t listen.’</p> <p>‘If you do it once a month for example, have a 10 minute talk. It will help because it will stick a bit. Even if it is a sentence or two, that is more than zero.’</p> <p>‘It has to be personal. But you can’t get it personal... Only they have to have it or somebody close to them. A friend. A family... otherwise they won’t care. That is why, if it is virtual it might</p>		
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	<p>work. I mean, they make those call of duty games so realistic you know. If they find a way to make that realistic, maybe but... I don't see it happening like that.'</p> <p>'...for example the signs and symptoms, the consequences...'</p> <p>'I suppose not at every training they would have a physio or a doctor, so you kind of have to have your own self-knowledge too.'</p> <p>'...just objective measures to know if they are at risk of potential concussion or TBI. Just to keep them safe. Maybe with information evenings with players. I mean maybe a Webinar.'</p> <p>'...information evenings, really player generated, so it's not too complicated for them. Make sure that they are aware of. Or even a webinar. Everyone loves webinars. Maybe some clinical guidelines in lectures.'</p> <p>'...physical talks with them or PP presentations with the team, with the players.'</p> <p>'If you have an Instagram channel as a physio, put some information about that, post about it.'</p> <p>'Doing kind of a fake case or so. And show them what a physio would do.'</p> <p>'...showing videos, that could also make them remember. You could even join a training session and just practice with them.'</p> <p>'I would come in at a training session, at the beginning is better.'</p> <p>'...and workshops should be organized by health care bodies of the government or maybe health institutes that goes around, you know, sending emails to maybe these institutes.'</p>		
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	<p>'If I was an athlete and I had to go out of my way to learn... what would draw me to that would be if it was a local athlete, someone famous that I really admire and they would do a workshop.'</p> <p>'Just basic anatomy... uhm physiology lessons. Really quick... So patient education. Kinda like pain education but more like the motor control and stuff. Then I would talk about what TBI can do, or what repetitive TBI can do to these symptoms.'</p> <p>'...with motivational interviewing.'</p> <p>'...a physical example.'</p> <p>'...give them a real life example, make it very visual.'</p> <p>'Making it bigger than it is, exaggerating.'</p> <p>'...real life statistics about how often, how severe the trauma is to their head and how it can impact their life.'</p> <p>'Just general patient education...'</p> <p>'I mean educating teams, having sessions where a team has to sit down and go through this.'</p> <p>'advertisements, media things'</p> <p>'a lecture'</p> <p>'You really need to inform them about the condition and the consequences of returning too early. That has to be enough, because the patient knows what could happen and the rest would be up to them. It is their health.'</p> <p>'If you would do all that, the lecture and reinforce as soon as it happens, and they still don't do anything, then it is on them.'</p> <p>'I supposed you could inform their families as well. That might help... the family might be worried about them and try to reinforce it as well.'</p>		
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	<p>‘You need seminars and lectures to educate both players and coaches.’</p> <p>‘...you have to adapt to a person’s personality and you have to realize what their thinking pattern is. And you have to adapt to it. You can do it as a physio... but if you trying to inform a bigger stage, like globally, well then you cannot adapt to single people. You need to just send out a general message about TBI.’</p> <p>‘You can adapt to people and see what motivates them and go on from that.’</p> <p>‘...if you are trying to get a bigger message out there, sports as a whole and around the world, you need to be doing like media work.’</p> <p>‘...inform them on a global level with advertisements.’</p>			
What are the most important aspects of TBI that athletes need to know?	<p>‘Screening. So teach them how to screen. Teach them about the signs and symptoms. Making the right call and send them to the doctor.’</p> <p>‘Ways to prevent. How to react when having symptoms or seeing someone else having symptoms.’</p> <p>‘...a nice powerpoint with the listed long-term and short-term consequences.’</p> <p>‘...prevention and why it is so important.’</p> <p>‘...but the emphasis should be on how severe it can be when it happens. That should be the main point of educating athletes.’</p> <p>‘The long-term consequences, the inability on the long-term to not be able to compete, 100% the factors surrounding work, study, stuff like that and concentration issues could be a long term effect</p>	Aspects of TBI needed to be known	inductive	Mechanism of injury Short-term and long-term consequences Signs and symptoms

	<p>of it. If you wait too long for the healing, some things can be reversible and some thing can be on the background for a really long time.'</p> <p>'...if you don't take care of it, it could give you long-term problems. And that there is a risk of with every injury you get, every injury is dangerous for head, and body and functioning as a human being.'</p> <p>'...it starts with education, especially for trainer coaches and medical staff.'</p> <p>'...if something like this occurs, try to think about those different steps to take. And if you suspect anything, don't take the risk and refer to a GP.'</p> <p>'...not to only do curative treatment but preventive. So, inform them about risks, warn them about... not only about risk for head injuries but also other risks.'</p> <p>'They would have to know the consequences, the symptoms as in what would you see. like... concussions... there are different types of concussions'</p> <p>'... for example the signs and symptoms, the consequences...'</p> <p>'... maybe some talks and guidance about concussions could be helpful. When you have a concussion, what symptoms should I be looking out for.'</p> <p>'But I think it would be good for them to know as well, the signs and symptoms., kind of objective tests about memory loss, sensory loss or something.'</p>		
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	<p>‘...taste and smell changes, just physical symptoms like nausea or physical vomiting, physically feeling unwell. Maybe I suppose speech problems maybe.’</p> <p>‘...self-diagnose.’</p> <p>‘Well, I think that it can seriously impair your quality of life, deteriorate your wellness, your health to the point where you cannot sustain relationships and life the way that you want to... having speech problems, having difficulties in daily life, physically and mentally... and that is not fun, not worth sacrificing for short-term gains in sports.’</p> <p>‘So sharing knowledge about what causes, the effects... is what needs to be done.’</p> <p>‘The condition and also how it happens.’</p> <p>‘....you really shouldn’t be going to sleep after getting hit in the head. I think that needs to be informed.’</p> <p>‘...consequences of you don’t follow that.’</p>			
According to physiotherapists, what is the concussion knowledge in athletes?	<p>I think it's very low.</p> <p>I think the knowledge of my athletes regarding concussion is very poor. Most of the athletes themselves don't recognize concussion as a concussion, for example like headache uhm... they start getting worried once they get nauseous and stuff like that'</p> <p>'I have worked with rugby players and concussions happen there way more often than in soccer. And they were way more serious about it. They knew what could happen and what needed to be done.'</p> <p>'So to be fair they already know a lot.'</p>	Concussion knowledge (CK) in athletes	inductive	Inter-sports difference Intra-sports difference Uneducation Lack of knowledge Slow increase in

	<p>‘I don’t think a lot of soccer players realize that there is a big risk...’</p> <p>‘I think they not aware of the facts and risks of - lets say - head to head impact. I think, they have low knowledge.’</p> <p>‘I think if you start playing rugby you are aware of the fact that you have to be careful and protect yourself. So, it’s not for nothing that they wear these things on their head. In American football they wear helmets, so they are aware of the fact that these things can occur. An average soccer player here isn’t aware of the fact that when bumping their head can have serious brain injury in the long-term.’</p> <p>‘They don’t know.’</p> <p>‘In football you are taught more about knees or stretching – those kind of injuries. In American football, they even wanted to cancel to rule that you can go head to head against each other. Also, MMA, they wanted to do that you cannot hit above the shoulders.’</p> <p>‘I don’t think it is very high at the moment, to be honest... uhm I know that the last few years have been a bit more like talk about athlete’s knowledge of concussions and TBI. Because they probably see the effects a bit.’</p> <p>‘...nowadays they might be a bit more knowledgeable uhm but I think yeah there is a big lack of knowledge in sports with concussions’</p> <p>‘in like rugby or American football, there is a lot of money so they are going to make people aware, they are going to take part in studies I think. Uhm research studies. Definitely American football teams to big at the moment. People are maybe becoming aware of</p>		TBI knowledge
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	<p>the CTE as well. So yeah, I think rugby would have more definitely knowledge because they have an actual concussion protocol for rugby players.'</p> <p>'I think people are becoming more aware of it now. Before, there was almost no real evidence and research done.'</p> <p>'I don't think fighters are very much aware of how much damage it can actually happen.'</p> <p>'Especially the youth, the young people think they are invincible, a lot of people do anyway. They think they are the more courageous and strong than they are. Being aware of it but not knowing to what extent is the danger of it.'</p> <p>'I think a lot of these people they go into the sports knowing there is a danger of getting kicked or punched in the head. And the people that are training you also expect you to be aware of that. You know what you are getting yourself into. But what you don't know is how easy it can happen.'</p> <p>'I think the knowledge is getting slowly better... slowly.'</p>			
What kind of differences are there between amateur and professional athletes in TBI knowledge?	<p>'An amateur might have less knowledge about TBI than a pro. So you have to educate them more. Make them more aware of it.'</p> <p>'...professional athletes there is more knowledge, but that's basically with every injury in soccer. There is more knowledge once the level gets up.'</p> <p>'...the risk where you are out for a long time, is way bigger financially for the club as well, the responsibility.'</p>	CK in amateurs and professionals	inductive	<p>Available personnel difference</p> <p>Financial risk difference</p> <p>Knowledge difference</p> <p>Different motivations</p>

	<p>‘When you are playing for AJAX you have like 15 doctors and physiotherapists, and if 15 people say you should be worried, the message is always clearer than when I say it.’</p> <p>‘In Pro they will be informed effectively by some.. sports GP, related to that team or sports physiotherapists. To be aware of the risks that occur when you bump into somebody else with their head. I think in amateur sports, there is not a lot of focus on that.’</p> <p>‘I don’t think that there will that much staff around the recreational sports team. Also to inform them with preventative means.’</p> <p>‘The professionals are more educated than the amateurs because they have people around them. Their surrounding is a lot different. Amateurs just go there for fun, they don’t really… they just do it to stay healthy.’</p> <p>‘it is easier to approach a professional actually, in my opinion. They hear it more and more and more – like I said – from five different people, whereas in amateurs you will have one coach that tells you. They will not listen to only him.’</p> <p>‘I suppose where the money is, there is going to be more knowledge.’</p> <p>‘Professional – it is their job, also their career…could be on line.’ ‘Amateurs I would say… they wouldn’t care as much. Because it is not their job.’ (when reaching out to them)</p> <p>‘…so it is their career and in this case a risk worth taking. So I don’t think a lot of people would change their attitudes’</p> <p>‘Maybe if you make a rly good point. You will changing their whole career and their whole path. If it is their life, they wouldn’t</p>		
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	<p>change it because you said it was dangerous. They would keep going.'</p> <p>'... amateur players would... they don't see it as a career, they can stop whenever they want. It is more recreational for them, whereas athletes... it is their life. That is their income. They probably are going to do this for most of their life. So I think professional athletes will take it more seriously.'</p>			
What do athletes know about the pathophysiology of TBI?	<p>'Possibly some neck pain.'</p> <p>'contusion of the brain.'</p> <p>'I think the memory part or the balance symptoms. If they cannot stand up properly, or wobbling.'</p> <p>'if they have a headache or they are feeling sick.'</p> <p>'maybe if they fall and were unconscious.'</p> <p>'vomiting, so that was a clear giveaway.'</p> <p>'Nothing. I just think that they uh... concussion. They will just think that it's been shaken there and that it will come back to normal, that no serious damage has been going on.'</p> <p>'They really would not get that.'</p> <p>'Nothing. I really don't think they know. At least not under the age of 18.'</p> <p>'...very little. If you are dizzy or kind of nauseous. Or kinda of physically vomiting or something. Those would be the symptoms I would say. From an athlete perspective.'</p> <p>'I don't think they would know much about it.'</p> <p>'I don't think they would be able to give you signs and symptoms like this.'</p>	Known TBI symptoms	inductive	<p>Serious physical symptoms</p> <p>Visible signs</p> <p>Lack of knowledge</p>

	<p>'No, I don't think so. Maybe for like dizziness and loss of balance, they will realize... they got hit in the head and will put two and two together.'</p>			
Why do/ How come many TBI incidences go unreported?	<p>'It is not visual. Not like a knee injuries or a cut to the temple. But with the brain you cannot see it, there are symptoms but it's more difficult to diagnose.'</p> <p>'Everyone underestimates it and maybe a lot of people don't know how to diagnose TBI correctly.'</p> <p>'Maybe the practitioners underestimate it as well.'</p> <p>'...because I think mostly because they are not diagnosed properly.'</p> <p>'They are dismissing it for something else.'</p> <p>'I don't think they take it serious. Uhm... so they think 'Okay I just fell and...' I don't think they even would uhm.. recognize the symptoms as it being a contusion... ehm concussion sorry. So, they probably are not going to report it.'</p> <p>'...because they don't know it.'</p> <p>'Probably lack of knowledge from players, from physios and doctors.'</p> <p>'Because people don't know what triggers, or how a TBI feels like.'</p> <p>'I think it is un-education. So people not knowing. Like they get hit in the head but then they brush it off and keep on going. And not really realizing the damage that has been done to their brain. And subsequently not taking rest when they should be. This might not</p>	Reasons for unreported TBI incidences	Nonvisible Lack of knowledge Uneducation Differential diagnosis	

	be too severe in the short-term but if this happens a few times after, then it rly is a big problem after.'			
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