USE OF A PATIENT-GENERATED OUTCOME MEASURE TO IDENTIFY THOSE SYMTPOMS AND ACTIVITIES OF GREATEST IMPORTANCE TO COLLEGIATE ATHLETES

A Thesis
by
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Abstract

USE OF A PATIENT GENERATED OUTCOME MEASURE TO IDENTIFY THOSE SYMPTOMS AND ACTIVITIES OF GREATEST IMPORTANCE TO COLLEGIATE ATHLETES

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Clinicians strive for positive patient outcomes following injury and rehabilitation. In efforts to improve patient outcomes, Patient-Reported Outcome Measures (PROMs) have recently gained attention as a method to incorporate the patient's perception into treatment. Historically, many PROMs were developed to target the general population, or in the case of orthopedic measures, those most commonly treated in an outpatient physical therapy setting. Therefore, the predominant focus of many PROMs has been on activities of daily living (ADLs), not higher levels of function. Since athletic trainers (ATs) often work with highly active populations with demands surpassing those of ADL's, PROMs and other tools must appropriately represent activities that are of value and relevance to athletes if they are to be beneficial to both patients and clinicians. The objective of this project was to identify those symptoms and activities of primary importance to an athletic population across injury phase and region, and assess the appropriateness of the commonly used PROMs. Utilizing a cross-sectional study design, patient-generated outcome measure (the Measure Your Medical Outcome Profile (MYMOP-2)) and a disability PROM validated in an athletic population (the modified Disablement of the Physically Active Scale) were collected from collegiate athletes experiencing injury. MYMOP-2 responses were linked to International

Classification of Functioning, Disability and Health (ICF) domains and categories to explore response trends and frequencies based on region of injury and phase of injury. The items of the Lower Extremity Functional Scale (LEFS) and the Disabilities of the Arm, Hand, and Shoulder outcome measure (DASH) were also linked using the ICF. Resultant codes from the MYMOP-2 responses and the LEFS and DASH were compared to assess for their degree of commonality. The LEFS showed to have significant content differences with common participant generated ICF codes at all levels of analysis. At the second level of the ICF taxonomy, the DASH did not have significant content differences with patient-generated codes for upper extremity injuries. However, there were significant content differences present between the DASH and patient generated upper extremity codes at the third level. While primary patient concerns were sports participation and pain, the commonly used PROMs did not consistently encompass these or other common patient concerns. Therefore, these content differences validate the perceived barriers held by many athletic trainers regarding the use the widely available PROMs.

Acknowledgements

I would like to thank and acknowledge my wonderful committee, Dr. Kym Fasczewski, Dr. Erin Bouldin, and Laurie Rivera. Additionally, I would like to thank my amazing professors and lab mates for their tireless support and camaraderie.

Dedication

All of the hard work and passion that has led to this final product I owe to my biggest supporters. Dr. Aaron Sciascia, for never letting me sit within the limits of fear or comfort. You are what got me here and allowed me to grow. Thank you for always reminding me of who my creator is and to stop fighting him so hard. To my amazing committee, Dr. Kym Fasczewski, Dr. Erin Bouldin, and Laurie Rivera, thank you all for listening to my countless rants and frustrations. The guidance and mentorship I have received from you all made this possible. I thank you so much for that. Aryn Judd, you keep me grounded as a clinician, push me just as hard as any of my professors, and share all of my frustrations that have led to fighting for our patients and our profession. Thank you for fueling my passion even more. My fiancé, Nick. You have listened intently to every soapbox I have stood on and wiped every tear that I've shed. You are my rock. And lastly, Dr. Jennifer Howard. Without you, I genuinely would not have survived the last two years. You picked up right where Aaron left off and helping me grow into an even more passionate and driven version of myself. I will never be able to fully express the gratitude I have for you for helping me become so much sharper and stronger. You mean more to me than you will ever know.

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Foreword

This thesis will be submitted to the Journal of Athletic Training; a peer-reviewed journal owned by the National Athletic Training Association; it has been formatted according to the authors style guide for that journal.

Review of Literature

Evidence Based Practice, Patient Centered Care, and Patient Reported Outcome Measures

Over the last decade, athletic training has undergone a shift towards the utilization of evidence-based practice (EBP). EBP has been a major focus of both initial and continuing education in Athletic Training. Because of this, there has been more attention placed on identifying factors which influence treatment outcomes.[1,5–8] The dynamic between external factors (coaches, home life, school, etc.), clinician evidence/experience, and patient perception has been recognized as influencing outcome status, resulting in the increased call for patient-centered care. Still, recent literature recognizes that the primary treatment decision making factor is likely clinician experience and clinical findings, rather than a whole-person, or patient-centered, approach.[7,9,10] To remedy this, there has been a push to include Patient-Reported Outcome Measures (PROMs) in athletic training practice.[1,5,6,9–13] PROMs are defined as instruments patients complete that provide information about the effect of their health condition or injury on their overall health status or health-related quality of life (HRQOL) and that highlight the patient perspective. [9]

The acknowledgement of patient-perception as a key component of patient-centered care aligns with the fundamentals of EBP. Patient-centered care recognizes that primary concerns, even within the same diagnosis, can vary from patient-to-patient.[1,6,7,9–11,14–16] The clinician's ability to gain a greater understanding of how their patient is responding, both physically and psychosocially, to their treatment may be improved with the usage of PROMs.[1,5,6,9–13,17] With this improved clarity, the clinician should then be able to ensure that adequate treatment adjustments and progressions are made; therefore, allowing for a greater likelihood for improved outcomes.[1,6,7,9,10,12,13]This approach is thought to result in a more educated and engaged patient, an improved patient-clinician relationship, and, likely, a more successful patient outcome. Despite these constructs supporting PROMS, traditional clinical measures (i.e. strength measures and special tests) and clinician experience are thought to still carry the majority of importance during clinical decision making.[1,7,9,12,13] This uneven distribution of importance between clinician experience, external factors (i.e. coaches, homelife, etc.), and patient perception is thought to disrupt the balance that must exist in order to have a successful outcome.[1,6] To better explain this school of thought, a three-tiered model for rehabilitation has been proposed.[1] (see figure 1)

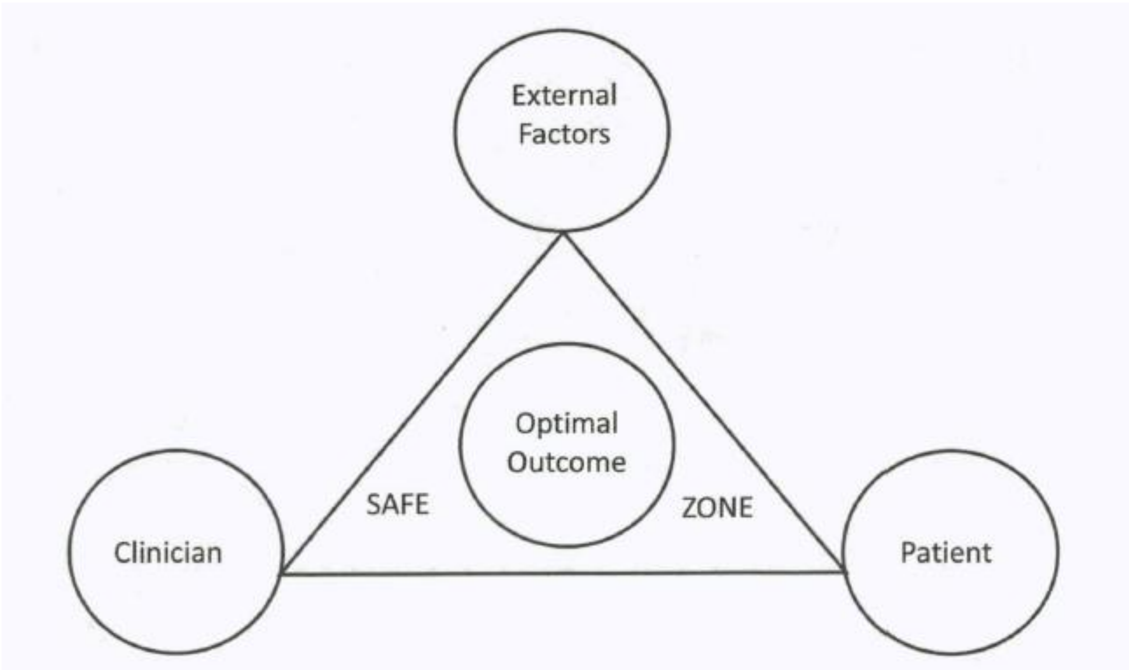

Figure 1: Three-tiered model for rehabilitation[1]

This model provides a visual explaining the proposed "safe zone" associated with optimal or successful rehabilitation outcomes. The proposed safe zone may only be achieved when there is a balance between the inclusion of clinician input/practice-based evidence, patient input/perception, and external factors (i.e. coaches, family, school, work, etc.).[1] When the balance is shifted and excess emphasis is placed in certain categories, others suffer, and the safe zone is no longer achievable. This imbalance is theorized to result in a less optimal patient outcome, likely leaving the patient dissatisfied and at a higher risk of re-injury.[1,6]

Recent literature has explored ways to apply models such as this in clinical practice. Howard et al stated that a critical component of effective patient-centered care is the utilization of PROMs.[1,6] The implementation of PROMs is not a foreign concept in many health-care fields. Professions such as physical therapy often use PROMs primarily for reimbursement purposes[11]; but their usefulness extends far beyond this. The application of PROMs facilitates a balance between external factors, clinician experience/evidence, and patient perspective to exist in treatment and rehabilitation. They provide clinicians with critical information about how a patient's affliction affects them daily, as well as what their psychosocial response to their disability may be. PROMs allow for insight regarding what activity/ADL restrictions, what primary concerns exist, and where dissatisfactions may lie for the patient.[1,6,7,10,18,19] When clinicians are able to reach this level of understanding about how a patient is being affected by their disability or injury, successful treatment outcomes are hypothesized to become more attainable.[1,5–7,9–13,16] The improved clarity regarding dysfunction, psychosocial impacts, disability, and changes to a patient's life should enable a more effective and beneficial clinical decision making process, involving both the clinical expert (the clinician) and the patient-experience expert (the patient).[1,6,9,10,12,13,16] However, the effectiveness of PROMs facilitating patient care is limited by the content each measure addresses. If a PROM fails to assess the impairments, barriers, and/or concerns important to the patient, then its utility may be greatly reduced. The frequently used PROMs in AT, such as the Lower Extremity Functional Scale (LEFS) and Disability of the Arm Shoulder Hand Scale (DASH), are borrowed from other professions and may not be advantageous for use in an athletic population.[20] The goal of this study is to identify the primary concerns of an injured athletic population so we may examine if the commonly used questionnaires are able to track changes in the patient's perception of themselves and their condition in a meaningful way.

Current Utilization of PROMs in AT

While recommendations have been made for why PROMs should be used in AT practice, little is known about how they are, or should be, used in AT practice. Recent studies have attempted to mitigate this by examining how ATs are actually using PROMs and practice, along with why they are or are not. These studies have noted that in addition to possible treatment efficacy improvements, PROMs may also encourage self-reflection in practice and lead to personal growth and improvement of patient care abilities.[9,10] Despite increased examination of the usage of PROMs in clinical practice across multiple health care settings and their widely recognized potential usefulness, practicing Athletic Trainers (ATs) often report a number of barriers in their implementation.[9,10] A study by Coulombe et al examined the perceptions of secondary school athletic trainers about the usage of PROMs. Specifically, they examined practicing ATs perceived barriers on the regular usage of PROMs. 62.9% of all participants believed PROMs are beneficial for determining treatment efficacy, and 57.7% believed them to be useful when examining the changes to a patient's status. However, only 15% of ATs surveyed actually used them in practice.[10] Coulombe et al noted that many of the participants appeared to be "resistant to change", or had hesitations because of time required to score PROMs.[10] Participants also felt that most PROMs are not ideal for acute, quick turn-around cases, which are the vast majority of those seen by ATs. Additionally, several concerns regarding how useful the information provided by PROMs is were reported as hesitations for using PROMs in AT practice.[10] If PROMs are to be advantageous in a traditional AT setting, these very valid challenges cannot be ignored. Some of the first steps to addressing these challenges is building on the work done by others such as Vela et al with the creation of the DPA, a measure designed to be meaningful to an athletic population[12,13], as well the examination of common, or primary, concerns for an athletic population, or identification of applicable measures that may be further refined for the needs of an AT setting.[6,7,9,10]

International Classification of Functioning, Disability, and Health (ICF)

The push for EBP and the utilization of PROMs exists among multiple health-care professions, not just in athletic training.[9,12,12,15,21] For this movement to come to fruition, reliable tools for examining patient-perception and evaluating treatment outcomes must exist.[11,16,22,23] The World Health Organization (WHO) has been instrumental in attempting to accomplish this task with the development of the International Classification of Function, Disability, and Health (ICF) model. The ICF framework provides a unified, standard language that may be used as a reference for describing and/or comparing health information. It aims to improve both communication between medical professionals and the understanding of biological, psychological, sociological, and environmental factors the patient experiences as a result of their disease, disability, injury, etc..[2–4,11,16,22–25]. Rather than placing focus on a patient's diagnosis or condition, the ICF aims to emphasize their resultant experience and changes in functional ability. This allows for an improved inclusion and recognition of the patient's perception and individualized response to their treatment and condition.[2,3,24,26]

The ICF model itself is a flexible, multi-tiered, hierarchical framework split initially into two parts (Figure 2). Part one contains the domains of body functions (b), body structures (s), and activity and participation (d). Part two contains contextual factors divided into environmental factors (e) and personal factors (pf). Identifying the relevant domains is the initial step when using the ICF framework to describe an individual's health, function, and/or experiences.[2,4,24,26]

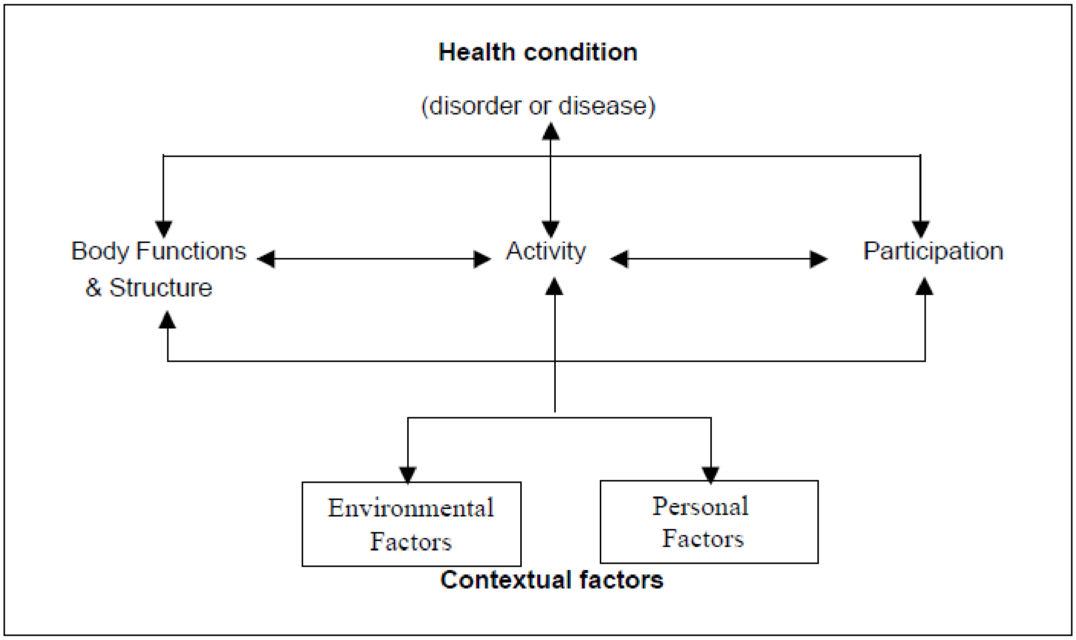

Figure 2: ICF model of Disability[2]

Each domain has a series of up to 4 levels (Figure 3). The first level is referred to as the chapter, and each chapter contains up to three (second-level, third-level, and possibly fourth-level) chapters, each representing a different specificity in description of the examined patient symptom, experience, limitation, restriction, etc.. As you progress deeper into the ICF, description, specificity increases.[2–4,22,23,26] Figure 3 represents a visual of the ICF structure and domain/code distribution.[3]

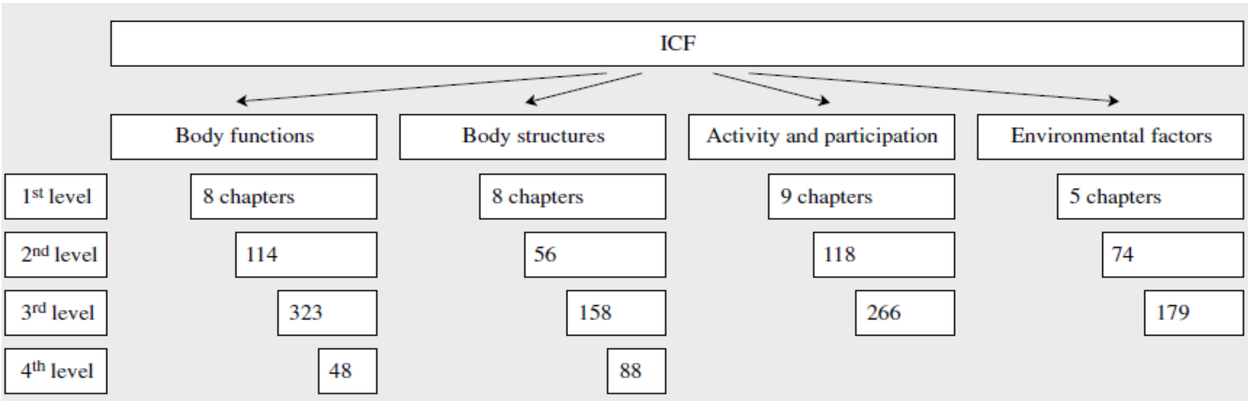

*Figure 3:structure and category distributions*3

As described above, the ICF model has a hierarchical organization; therefore, once the professional has identified a patient complaint, symptom, impairment, etc. that they wish to link, they will first select the appropriate chapter. From this point, the linking rules, developed in 2002 and refined in 2005 and 20016[4,22,23], are followed through the model to determine the appropriate code. The linking rules describe the methodology that is to be followed when attempting to link patient responses, clinical measures, and/or clinical findings to describing ICF codes. Resultant codes are representative of their domains, chapters, and levels; and, as previously described, increase in specificity as the model is followed to its deeper levels (i.e. level four). Figure 4 provides a visual representation of the linking rules and the linking decision tree.[4]

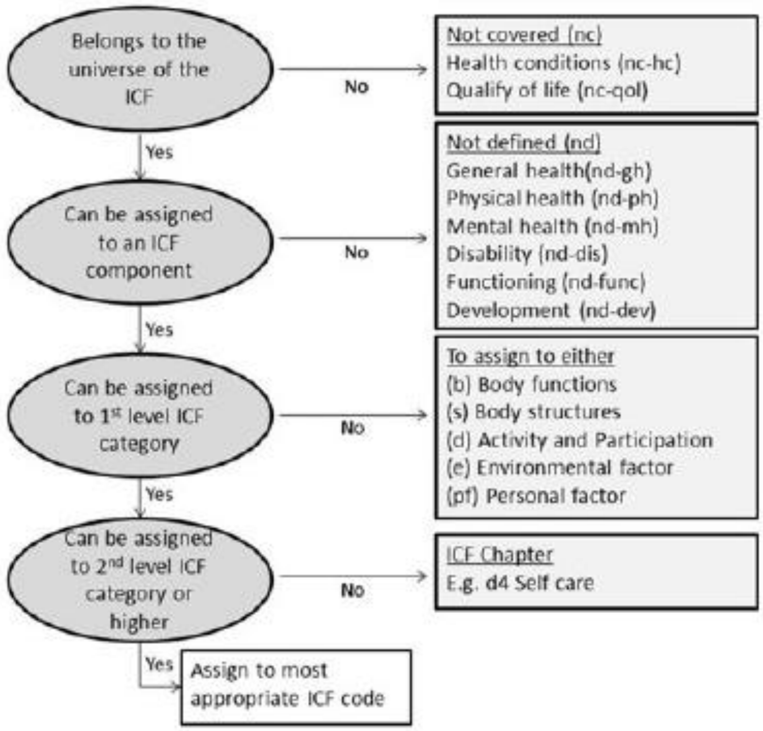

Figure 4: Linking decision tree[4]

For example, if a self-generated response shows limitations with pitching a baseball, it would be coded as d4454 Throwing "Using fingers, hands and arms to lift something and propel it with some force through the air, such as when tossing a ball." We arrive at this code using the WHO's ICF coding browser[27] to follow the following progression:

- d Activities and Participation
    - d4 Mobility
    - d430-d449 Lifting and carrying objects
    - d445 Hand and arm use
    - d4454 Throwing

The ICF framework and its domains and codes create a universal language which enables clinicians, researchers, and other medical share-holders to focus on the patient's perception and experiences in a standardized manner.[4,23,24,26] Therefore, understanding and following the described linking rules is critical when employing the ICF framework.

The Clinical and Research Applicability of the ICF

Recent literature has examined the framework's applicability in research and clinical settings.[11,24,26] For example, Smith-Forbes et al utilized the ICF as a means to identify, categorize, and quantify meaningful concepts extracted from patient responses to a patient-generated PROM.[11] They found that, regardless of the pathology, resultant codes primarily fell into categories associated with the domains of body functions and activity and participation limitations.[11] Meaning, the individuals were mostly concerned with their altered level of function, and its resultant impact on their world.[11] Their work is an example of how the ICF is an applicable tool for identifying the primary concerns of patients. The ICF model provides a resource to link the researcher, the patient, and the clinician. The patient's beliefs and values regarding their own health can be linked back to the domains and categories of the ICF allowing for standardization of priorities and quantification of outcomes across patients and conditions. This allows researchers and clinicians alike to better evaluate the tools they utilize during the treatment process, as well as which interventions they may choose, so they are more directly related to the needs of the patient. Our purposes for using the ICF taxonomy are to identify the primary concerns of an injured athletic population so we may evaluate if commonly used questionnaires (DASH and LEFS) are the appropriate tools for evaluating an athlete's progress throughout treatment.

Measure Yourself Medical Outcome Profile-2 (MYMOP-2) Questionnaire

In order for PROMs to be beneficial to clinical practice, each measure must prove valid and sensitive for its intended population. As the push for implementing PROMs in practice has grown, a variety of questionnaires have been developed, varying from patient-generated to condition-specific to region specific instruments, to assess how a patient progresses through their treatment. Patient-generated PROMs, like the MYMOP-2, are intended to evaluate a small number of symptoms of primary concern to the patient and their change over the course of treatment.[28–31] Initially published in 1996 and revised as the MYMOP-2 in 1999[28,29], the MYMOP-2 has been examined in numerous settings such as chiropractic care for patellar tendinopathy, massage therapy, and other various acute and chronic settings. [31] The MYMOP-2 has been found to detect changes in several populations, including military[28,30,31]; therefore, its application to an athletic population is not unreasonable. Because it is an open-ended tool, it allows for a patient-centered evaluation of symptoms across multiple phases of injury/disease/condition, and across multiple pathologies.[28,30,31] This versatility allows for researchers and clinicians alike to possibly utilize the MYMOP-2 to better understand concerns of primary importance to a variety of populations.[28,31] This could prove especially beneficial when responses are linked with the ICF model for further exploration.

The Modified Disablement in the Physically Active scale (mDPA)

The Disablement in the Physically Active scale (DPA) is a generic PROM that was designed to examine constructs of disability in a physically active population.[12,13] The DPA was designed to give clinicians a practical and applicable tool that allows researchers and clinicians alike to examine a patient's perception of their injuries and measure their resultant disablement.[12–14,17,18,32] The DPA initially was established by Vela and Denegar in 2010 as a 16 question scale assessing the impact injury may have on a physically active/athletic individual's level of impairment, functional ability, disablement, and quality of life as related to both sport and daily living situations. The original measure included physical and psychosocial components.[12,13] Houston et al. further examined the DPA in 2015, dividing it into 2 subcomponents: the DPA Physical Summary Component (DPA-PSC) and the DPA Mental Summary Component (DPA-MSC). This re-examination did not add or subtract elements to the original DPA, it only analyzed the mental wellbeing and physical well-being as separate entities. The two components may be analyzed individually or collectively, resulting in a physical summary score, a mental summary score, or a total score. Because this version, the mDPA, may be analyzed collectively or by its subcomponents, it allows clinicians to better examine both a patient's physical and mental well-being separately as well as collectively.[14,17,18,32] Because the mDPA was not only designed for, but also has been validated for an athletic population with an excellent intra-rater reliability[12,17], it is a reliable (DPA-PSC: alpha= 0.941, r_s = 0.956, $p<0.001$; DPA-MSC: alpha= 0.878, r_s = 0.691, $p<0.001$), not time-intrusive, and effective tool for clinicians and researchers when tracking a patient's changes in impairments, functional limitations, disability, and quality of life over time.[12–14,17,18,32] This lends the mDPA and its variations to be potentially excellent tools to compare or confirm the validity and applicability of tools/PROMs meant to assess disablement or treatment outcomes for an active/athletic population.

Research Manuscript

Introduction:

Over the last decade, athletic training has undergone a shift towards the utilization of evidence-based practice (EBP). EBP has been a major focus of both initial and continuing education in Athletic Training[5,6,8]. Because of this, there has been more attention placed on identifying factors which influence treatment outcomes.[1,5–8] The dynamic between external factors (coaches, home life, school, etc.), clinician evidence/experience, and patient perception has been recognized as influencing outcome status, resulting in an increased call for patient-centered care. Still, recent literature recognizes that the primary treatment decision making factor is likely clinician experience and clinical findings, rather than a whole-person, or patient-centered, approach.[7,9,10] To remedy this, there has been a push to include Patient-Reported Outcome Measures (PROMs) in athletic training practice.[1,5,6,9–13] PROMs are defined as instruments patients complete that provide information about the effect of their health condition or injury on their overall health status or health-related quality of life (HRQOL) and that highlight the patient perspective. [9]

The acknowledgement of patient-perception as a key component of patient-centered care aligns with the fundamentals of EBP. Patient-centered care recognizes that primary concerns, even within the same diagnosis, can vary from patient-to-patient.[1,6,7,9–11,14–16] The clinician's ability to gain a greater understanding of how their patient is responding to their treatment, both physically and psychosocially, may be improved with the usage of PROMs.[1,5,6,9–13,17] This improved clarity is thought to result in a more educated and engaged patient, as well as an improved patient-clinician relationship. Therefore, a shift in this direction may enable the clinician to achieve an improved treatment outcome.[1,6,7,9,10,12,13]

Despite these constructs supporting PROMS, traditional clinical measures (i.e. strength measures and special tests) and clinician experience are still thought to carry the majority of importance during clinical decision making.[1,7,9,12,13] This uneven distribution of importance between clinician experience, external factors (i.e. coaches, homelife, etc.), and patient perception is thought to disrupt the balance that must exist in order to have a successful outcome.[1,6] When the balance is shifted and excess emphasis is placed in certain categories, others suffer. This imbalance is theorized to result in a less optimal patient outcome, likely leaving the patient dissatisfied and at a higher risk of re-injury.[1,6]

PROMs provide clinicians with critical information about how a patient's affliction affects them daily, while also giving insight to psychosocial responses to injury, what primary concerns exist, and where dissatisfactions may lie for the patient.[1,6,7,10,18,19] When clinicians are able to reach this level of understanding about how a patient is being affected by their disability or injury, successful treatment outcomes are hypothesized to become more attainable.[1,5–7,9–13,16] However, the effectiveness of PROMs facilitating patient care is limited by the content each measure addresses. If a PROM fails to assess the impairments, barriers, and/or concerns important to the patient, then its utility may be greatly reduced. Many of the frequently used PROMs, such as the Lower Extremity Functional Scale (LEFS) and Disability of the Arm Shoulder Hand Scale (DASH), are borrowed from other professions and may not be advantageous for use in an athletic population.[20]

If we are to examine the appropriateness of commonly used PROMs for a certain population, we must gain an understanding of what needs to be covered by these measures. The International Classification of Function, Disability, and Health (ICF) framework, developed by the World Health Organization (WHO), intends to provide a unified, standard language that may be used as a reference for describing and/or comparing health states. It aims to improve both communication between medical professionals and the understanding of biological, psychological, sociological, and environmental factors patients experiences as a result of their disease, disability, injury, etc..[2–4,11,16,22–25]. Rather than placing focus on a patient's diagnosis or condition, the ICF aims to emphasize their resultant experience and changes in functional ability. This allows for an improved inclusion and recognition of the patient's perception and individualized response to their treatment and condition.[2,3,24,26] The ICF framework, therefore, in theory provides an ideal framework by which to classify and identify the primary concerns of patients and the content covered within commonly used PROMs.

The primary aims of this study were to utilize the ICF framework to identify if the primary concerns of collegiate athletes experiencing an injury, to determine if these primary concerns vary based on phase of injury or injury region, and to determine if these primary concerns are accurately and concisely represented in commonly used PROMS. We hypothesized that 1.) differences will exist between codes reported by participants in an acute, subacute, or chronic phase of injury and 2.) that less than 70% of the most commonly occurring codes generated from participant responses would be represented in the commonly used PROMs (LEFS and DASH).

Methods

This observational cross-sectional study used the Measure Your Medical Outcome Profile (MYMOP-2)[28] (appendix 1) and the modified Disablement in the Physically Active Scale (mDPAS)[12,13] (appendix 2) to identify those symptoms and activities most relevant to injured collegiate student-athletes and to compare those symptoms and activities to those represented on commonly used PROMs.

Participants

Participants included injured student-athletes at 4 collegiate institutions. Any student-athlete receiving care for any injury who was over the age of 18, fluent in English, and willing to sign a HIPAA release for their athletic trainer to share information regarding their injury with investigators was eligible to participate. The same student-athlete was not enrolled more than once for a given body region (upper extremity, lower extremity, spine/head).

Study Procedures

Data Collection

Participants who consented to participate were asked to complete the MYMOP-2, the mDPA, and a demographics form identifying their treating athletic trainer, age, year in school, sport, date of injury, and location/description of injury. Data collection occurred one time per participant, per region of injury. At the time of enrollment, the treating athletic trainers were asked their assessment of the injury state of each participant (acute, subacute, chronic).

Instrumentation

The MYMOP-2 (Appendix 1) is a patient-generated outcome measure which allows the patient to identify the two symptoms (either physical or mental) and one activity limitation that are of the greatest importance to them and provide a numeric severity rating for each. Responses are listed by the patient who is then asked to rate the severity of each from “as good as it could be” to “as bad as it could be” (rated 1-6) The MYMOP-2 asks patients to then describe how long they have experienced Symptom 1 (the primary complaint) and their medication use as a result of their condition/injury. In total, there are 7 questions listed on the MYMOP-2.[9,14]

The Disablement in the Physically Active Scale is a generic, population specific instrument that was developed for use in a physically active population. This 16 item instrument measures HRQOL across four domains: impairment, functional limitations, disability, and quality of life. The DPAS is a valid and reliable instrument in patients with acute and persistent injuries. The mDPAS is a modified version of the DPAS and has been examined in an athletic population.[14,17,18,32] Because the MYMOP-2 has not been used previously in an athletic population, the mDPAS was collected to assist in quantifying the level of disability among enrolled subjects in a manner that can be compared to previous investigations.

ICF Linking

Each participant's responses to the MYMOP-2 were linked to an ICF code (domain and category) via the established ICF linking rules displayed in table 4.[14,17,18,32] In brief, 3 raters reviewed all MYMOP-2 responses independently and assigned a code in the deepest level of the corresponding domain/chapter. The raters included two licensed athletic trainers and an individual licensed as both an athletic trainer and a physical therapist. Prior to analyzing responses, reviewers underwent training in the ICF Model via recommendations from literature outlining and examining the ICF model, the World Health Organization ICF Manuals, and previously conducted studies with similar methodologies.[3,4,11,16,22–24,26] The ICF model itself is a flexible, multi-tiered, hierarchical framework split initially into two parts (Figure 1). Part one contains the domains of body functions (b), body structures (s), and activity and participation (d). Part two contains contextual factors divided into environmental factors (e) and personal factors (pf). Identifying the relevant domains is the initial step when using the ICF framework to describe an individual's health, function, and/or experiences.[2,4,24,26]

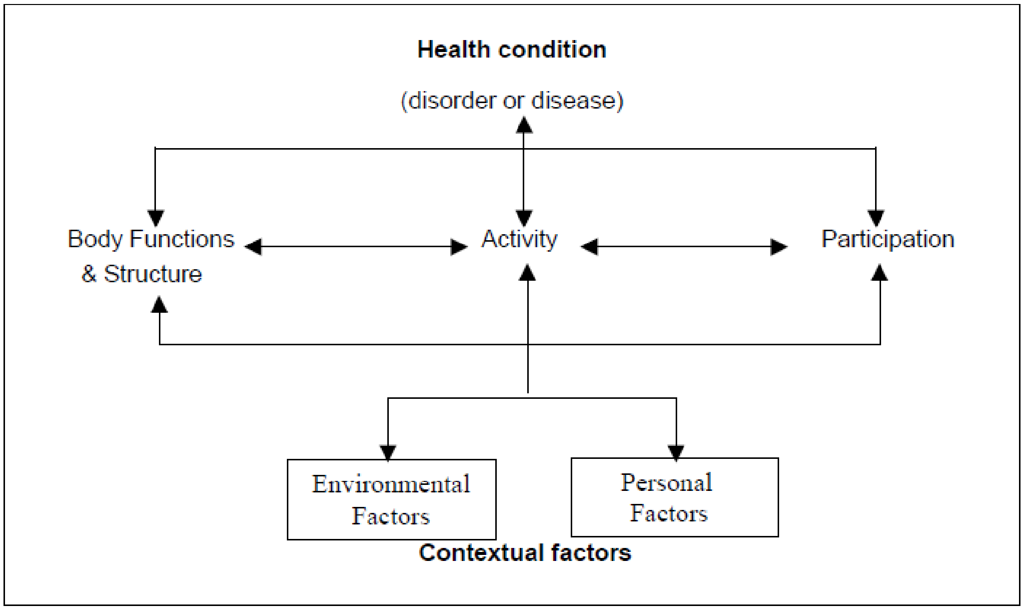

Figure 5: ICF model of disability[2]

Each domain has a series of up to 4 levels (Figure 2). The first level is referred to as the chapter, and each chapter contains up to three (second-level, third-level, and possibly fourth-level) chapters, each representing a different specificity in description of the examined patient symptom, experience, limitation, restriction, etc.. Figure 2 represents a visual of the ICF structure and domain/code distribution.[3]

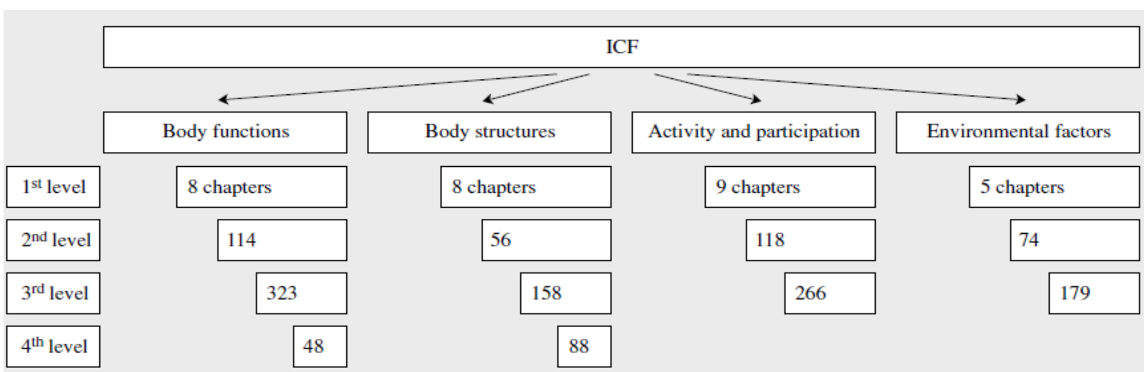

Figure 6: ICF structure and category distributions[3]

In the linking process, the professional first identifies a patient concern that they wish to link and selects the chapter in which it most appropriately fits. The hierarchical structure is then followed, guided by the definitions provided in the taxonomy in the ICF browser[27], to arrive at the specific and appropriate code. Resultant codes are representative of their domains, chapters, and levels; and, as previously described, increase in specificity as the model is followed to its deeper levels (i.e. level four). For example, if a self-generated response states “pitching a baseball”, it would be coded as d4454: Throwing. The definition for what is included in Throwing states: “Using fingers, hands and arms to lift something and propel it with some force through the air, such as when tossing a ball.” The process to arrive at this code is as follows

• d Activities and Participation - *Domain*

- d4 Mobility - *Chapter*
- d430-d449 Lifting and carrying objects – *Component*
- d445 Hand and arm use – *Level 2*
- d4454 Throwing - *Level 3*

Raters were permitted to assign multiple ICF codes to a single MYMOP-2 response if necessary to fully represent the participant’s concern. For example, if a participant listed “pain when I run”, separate codes were assigned to represent pain (b280) and running (d4552). To improve reliability, responses were linked 3 times, once by each rater. Practice linking was conducted prior to analysis via linking the commonly used questionnaires (LEFS, DASH, and mDPAS) to ICF codes following the aforementioned guidelines. Disagreements in resultant codes from all measures were reconciled in meetings held by reviewers, resulting in a final set of agreed upon codes for each participant-generated MYMOP-2 response and each PROM question.

Statistical Analysis

To confirm the degree of disability and the symptom severity rating described on the MYMOP-2, a Pearson’s correlation coefficient was used to examine the relationships between MYMOP-2 severity ratings and total mDPA scores. Because a higher score/rating for each questionnaire indicates a higher severity of limitation/symptom experience, we hypothesized that a positive correlation would exist between the two. Inter-rater reliability was examined via Fleiss’s kappa to assess the agreement between raters assigning ICF codes to participant responses. Frequency distributions were analyzed for ICF codes generated from MYMOP-2 responses overall, at each phase of injury, and for upper and lower extremities. In order to reduce the data to those codes representing the activities and symptoms most important to the vast majority of student-athletes, the most frequently identified ICF codes that cumulatively represented 80% of ICF codes overall, at each phase of injury, and for upper and lower extremities were considered to be the most common concerns/codes and were used for comparisons between injury states and for comparison to existing PROMs. In order to examine various levels of specificity in coding, codes were examined at both the second and third levels of the ICF.

To examine the relevance of the LEFS and DASH, it was determined that a minimum of 70% of the most common participant-generated codes for upper or lower extremity injuries respectively, must be encompassed by the PROM if it was to be considered representative of patient concerns (i.e. were 70% of the top 80% of generated codes addressed by the LEFS or DASH respectively). Additionally, in order to determine the amount of extraneous content present in common PROMs, we examined if 70% of the codes generated from the LEFS and DASH were included in the most common participant-generated codes. Chi-square one-sample goodness of fit tests were performed ($p<0.05$) to test the a priori selected 70% thresholds. If the shared content represented in the LEFS or the DASH was significantly below 70%, the PROM was considered to be non-representative of the primary concerns of the respective patient population. Additionally, if the representation of LEFS or DASH generated codes was significantly less than 70% within participant-generated codes, PROMs were classified as containing a significant amount of extraneous, nonrelevant content.

Results

Outcomes were completed by 149 collegiate athletes (74 females, 75 males) with a mean age of 19.6±1.3. These participants represented 150 injuries. Lower extremity injuries represented 77% (115) of our population and upper extremity injuries represented 15% (23) (Figure 5). Men's and women's soccer contributed the largest portion of our participants (43/150). The distributions of sport representation are presented in Table 1., and the phase of injury distribution is presented in Figure 6. The mean of mDPA total score was 26±14. The mean severity score for reported MYMOP-2 symptoms was 3±1. Correlations between mDPA scores and MYMOP-2 severity ratings were significant ($p<0.001$), but weak to moderate with $r=0.25$ to 0.54. (Table 3)

Agreement levels for the first two full ICF codes assigned to responses were $k = 0.53$ or better, meaning agreement levels on the first two codes reached were always moderate or better. On average, agreement for the first 2 codes in symptom 1, symptom 2, and activity were $k=0.64$ (Good). Agreement decreased as raters moved beyond the initial two codes represented in a response, in part because third or fourth codes were not consistently indicated by participants responses. Agreements for full codes are displayed in tables 3-5. For each response and code, a consensus was reached among all three raters and those agreed upon codes were used in final analyses.

Collected participant responses resulted in 594 ICF codes. The vast majority of these codes were represented in the Body Function (56%) and Activities and Participation (41%) domains (Figure 7). The remainder were represented by the Body Structure domain or were not codable (ns). It is worth noting that there were no final codes falling into the Environmental Factors domain. Code frequency distributions for the most commonly occurring codes overall, and by extremity, at both the second and third levels of the ICF are displayed in tables 6-11. Table 12 summarizes the count of codes included and excluded in the most common codes overall, by injury phase and, by region of injury. The ICF codes generated from the LEFS, DASH, and mDPA content are displayed in Table 13.

Most of our participants were determined to be in the acute phase of injury, per their treating athletic trainers. Injury distributions are displayed in Figure 7. The most commonly occurring codes by injury phase are presented in Tables 14 and 15. These tables show that commonalities in codes exist regardless of the phase of injury. The most common codes generated from responses by individuals in the subacute and chronic phases of injury are included in the most common codes generated from participants in the acute phase. Therefore, we did not identify any differences in most common concerns based on injury phase.

For the LEFS at the second level of the ICF, only 3 out of the 12 most common codes (25%: Chi square single-sample test for 70% $p<0.001$) were represented in the LEFS questions. Similarly, at the third level only 5 of the 21 most common codes (24%; test for 70% $p<0.001$) were represented in LEFS questions. Therefore, we reject the hypothesis that the codes generated from the LEFS represented 70% of the most common participant-generated codes at both the second and third level of the ICF. Additionally, for codes generated from the LEFS questions, only 3 of 13 codes (23%; test for 70% $p<0.001$) at the ICF second level and only 5 of 24 codes (21%; test for 70% $p<0.001$) at the third level were among the most common participant concerns. This shows statistically and clinically significant content differences existed at all levels between the LEFS and the most common concerns of participants with lower extremity injuries.

For the DASH at the second level of the ICF, 7 out of the 8 most common codes (88%: test for 70% $p=0.28$) were represented in the DASH. However, at the third level only 5 of the 12 most common codes (42%; test for 70% $p<0.001$) were represented in DASH questions. These results demonstrate that at the more general second level, the DASH does contain the most common concerns of upper extremity participants. However, analysis at the more specific third level demonstrated that the most common concerns of participants were not well represented in the DASH. Furthermore, in examining ICF codes generated from the DASH, only 7 of 26 codes (27%; test for 70% $p<0.001$) at the ICF second level and only 5 of 33 codes (15%; test for 70% $p<0.001$) at the third level were among the most common participant concerns. Therefore, it can be concluded that the DASH contains significant extraneous content that is not representative of the most common concerns of participants with upper extremity injuries.

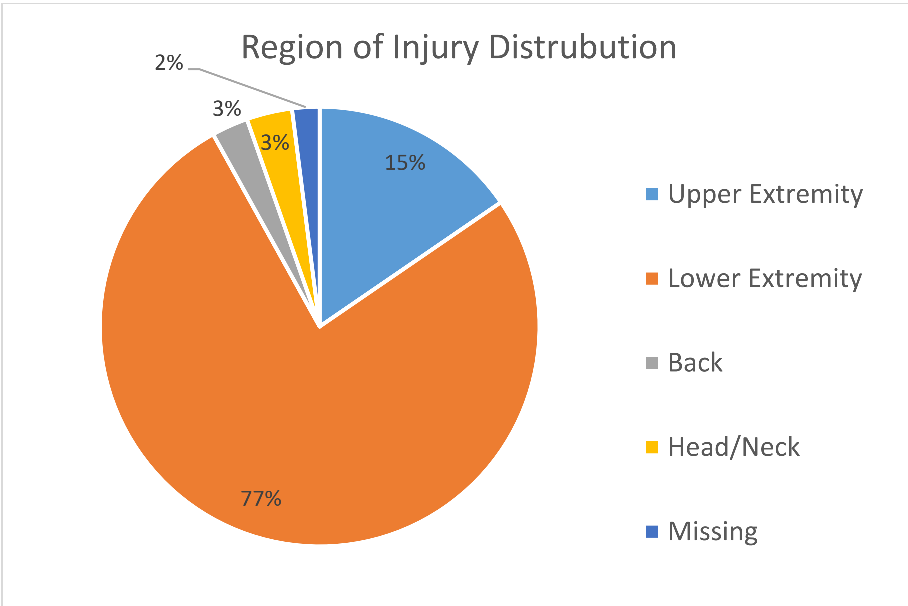

Figure 7: Region of injury distribution

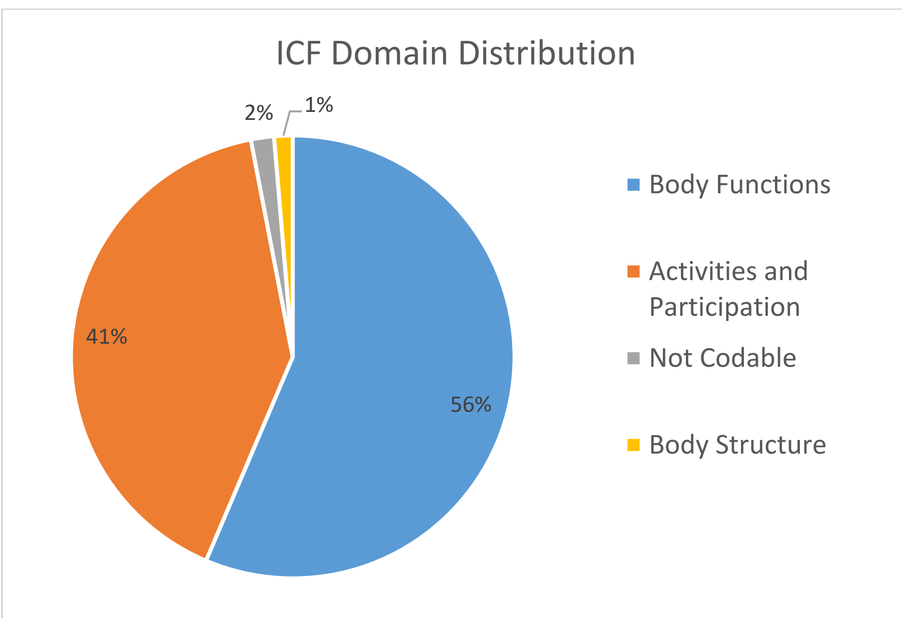

Figure 8: ICF domain distribution

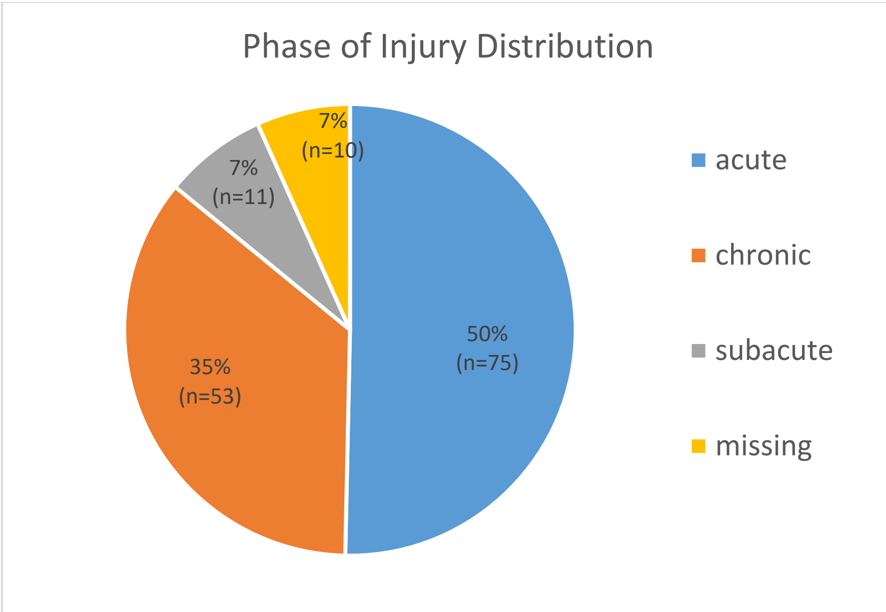

Figure 9: Phase of injury distribution

Sport	Percent (n)	Cumulative Percent
Soccer	30.67% (46)	30.67%
Football	16% (24)	46.67%
Lacrosse	11.33% (17)	58.00%
Track and Field	8.67% (13)	66.67%
Volleyball	6.67% (10)	73.34%
Basketball	6% (9)	79.34%
Softball	5.33% (8)	84.67%
Baseball	3.33% (5)	88.00%
Cheerleading	3.33% (5)	91.33%
Cross Country	2% (3)	93.33%
Cycling	1.33% (2)	94.66%
Field Hockey	1.33% (2)	95.99%
Swimming	1.33% (2)	97.33%
Tennis	1.33% (2)	98.66%
Wrestling	1.33% (2)	100%
Total	100% (150)	100%

Table 1: Sport Distribution

mDPA Total vs. MYMOP Severity Rating		
Correlation	Pearson's r	sig. (2 tailed)
mDPA vs. MYMOP-2 symptom 1 severity	0.321	p<0.001
mDPA vs. MYMOP-2 symptom 2 severity	0.263	p<0.001
mDPA vs. MYMOP-2 activity severity	0.537	p<0.001

Table 2: mDPA vs. MYMOP severity rating correlations

Fleiss Kappa Interrater Reliability: Symptom 1 Full Codes			
Code	Kappa coefficient	Agreement Level	95% Confidence Interval
Symptom 1 Code 1	0.696	Good	0.671-0.722
Symptom 1 Code 2	0.648	Good	0.605-0.691
Symptom 1 Code 3	0.519	Moderate	0.471-0.567
Symptom 1 Code 4	-0.003	Poor	-0.076-0.070

Table 3: Fleiss kappa agreement symptom 1 full code

Fleiss Kappa Interrater Reliability: Symptom 2 Full Codes			
Code	Kappa coefficient	Agreement Level	95% Confidence Interval
Symptom 2 Code 1	0.678	Good	0.651-0.705
Symptom 2 Code 2	0.513	Moderate	0.471-0.556
Symptom 2 Code 3	0.561	Moderate	0.510-0.612
Symptom 2 Code 4	0.12	Poor	0.059-0.181

Table 4: Fleiss kappa agreement symptom 2 full code

Fleiss Kappa Interrater Reliability: Activity Full Codes			
Code	Kappa coefficient	Agreement Level	95% Confidence Interval
Activity Code 1	0.763	Good	0.728-0.798
Activity Code 2	0.566	Moderate	0.520-0.611
Activity Code 3	0.483	Moderate	0.433-0.533
Activity Code 4	0.245	Fair	0.178-0.313

Table 5: Fleiss kappa agreement activity full codes

Agreed ICF Codes Overall: Level 2

Code	Description	Percent (n)	Cumulative Percent
b280	Sensation of pain	22.73% (135)	22.73%
d920	Recreation and leisure	15.63% (93)	38.38%
d455	Moving around	10.23% (61)	48.65%
b780	Sensations related to muscles and movement functions	7.57% (45)	56.23%
b152	Emotional functions	5.38% (32)	61.62%
d450	Walking	4.04% (24)	65.66%
b289	Sensation of pain, other specified and unspecified	3.36% (20)	69.02%
b798	Movement functions, other specified and unspecified	2.52% (15)	71.55%
b710	Mobility of joint functions	2.02% (12)	73.57%
b439	Functions of the hematological and immunological systems, other specified and unspecified	1.85% (11)	75.42%
d445	Hand and arm use	1.68% (10)	77.10%
ns	Not codable	1.68% (10)	78.79%
b199	Mental functions, unspecified	1.51% (9)	80.30%

Table 6: Overall most commonly occurring codes level 2

Agreed ICF Codes Overall: Level 3

Code	Description	Percent (n)	Cumulative Percent
b2801	Pain in body part	15.66% (93)	15.66%
d9201	Sport	13.81% (82)	29.46%
b280	Sensation of pain	6.91% (41)	36.36%
b7808	Sensations related to muscles and movement functions, unspecified	6.23% (37)	42.59%
d4552	Running	5.90% (35)	48.48%
b1528	Emotional functions, other specified	3.87% (23)	52.36%
d4509	Walking, unspecified	3.53% (21)	55.89%
b289	Sensation of pain, other specified and unspecified	3.36% (20)	59.26%
b798	Neuromusculoskeletal and movement-related functions, other specified	2.52% (15)	61.78%
b439	Functions of the hematological and immunological systems, other specified and unspecified	1.85% (11)	63.64%
d4558	Moving around, other specified	1.68% (10)	65.32%
ns	Not codable	1.68% (10)	67.00%
b1522	Range of emotion	1.51% (9)	68.52%
b199	Mental functions, unspecified	1.51% (9)	70.03%
d4553	Jumping	1.51% (9)	71.55%
b7800	Sensation of muscle stiffness	1.34% (8)	72.90%
d4300	Lifting	1.34% (8)	74.24%
b298	Sensory functions and pain, other specified	1.17% (7)	75.42%
b7100	Mobility of a single joint	1.17% (7)	76.60%
b799	Neuromusculoskeletal and movement-related functions, unspecified	1.01% (6)	77.61%
b1349	Sleep functions, unspecified	0.84% (5)	78.45%
b7109	Mobility of joint functions, unspecified	0.84% (5)	79.30%
d4551	Climbing	0.84% (5)	80.13%

Table 7: Overall most commonly occurring codes level 3

Agreed ICF Codes Upper Extremity: Level 2

Code	Description	Percent (n)	Cumulative Percent
b280	Sensation of pain	29.87% (23)	29.87%
d920	Recreation and leisure	18.18% (14)	48.05%
d445	Hand and arm use	10.38% (8)	58.44%
b780	Sensations related to muscles and movement functions	5.19% (4)	63.64%
d430	Lifting and carrying objects	5.19% (4)	68.83%
b289	Sensation of pain, other specified and unspecified	3.89% (3)	72.73%
b710	Mobility of joint functions	3.89% (3)	76.62%
ns	Not Codable	3.89% (3)	80.52%

Table 8: Upper extremity most commonly occurring codes level 2

Agreed ICF Codes Upper Extremity: Level 3

Code	Description	Percent (n)	Cumulative Percent
b2801	Pain in body part	22.08% (17)	22.08%
d9201	Sport	18.18% (14)	40.26%
b280	Sensation of pain	6.49% (5)	46.75%
b7808	Sensations related to muscles and movement functions, other specified	5.19% (4)	51.95%
d4300	Lifting	5.19% (4)	57.14%
d4454	Throwing	5.19% (4)	62.34%
b289	Sensation of pain, other specified and unspecified	3.90% (3)	66.23%
d4458	Hand and arm use, other specified	3.90% (3)	70.13%
ns	Not codable	3.90% (3)	74.03%
b1349	Sleep functions, unspecified	2.60% (2)	76.62%
b7109	Mobility of joint functions, unspecified	2.60% (2)	79.22%
b7300	Power of isolated muscles and muscle groups	2.60% (2)	81.82%

Table 9: Upper extremity most commonly occurring codes level 3

Agreed ICF Codes Lower Extremity: Level 2

Code	Description	Percent (n)	Cumulative Percent
b280	Sensation of pain	21.61% (102)	21.61%
d920	Recreation and leisure	14.61% (69)	36.23%
d455	Moving around	11.86% (56)	48.09%
b780	Sensations related to muscles and movement functions	8.47% (40)	56.57%
b152	Emotional functions	6.14% (29)	62.71%
d450	Walking	4.87% (23)	67.58%
b289	Sensation of pain, other specified and unspecified	3.60% (17)	71.19%
b798	Neuromusculoskeletal and movement-related functions, other specified	2.75% (13)	73.94%
b439	Functions of the hematological and immunological systems, other specified and unspecified	2.11% (10)	76.06%
b199	Mental functions, unspecified	1.90% (9)	77.97%
b710	Mobility of joint functions	1.90% (9)	79.87%
ns	Not codable	1.48% (7)	81.36%

Table 10: Lower extremity most commonly occurring codes level 2

Agreed ICF Codes Lower Extremity: Level 3

Code	Description	Percent (n)	Cumulative Percent
b2801	Pain in body part	14.00% (66)	14.00%
d9201	Sport	12.70% (60)	26.70%
b280	Sensation of pain	7.4% (35)	34.10%
d4552	Running	7.00% (33)	41.10%
b7808	Sensations related to muscles and movement functions, other specified	6.80% (36)	47.90%
b1528	Emotional functions, other specified	4.20% (20)	52.10%
d4509	Walking, unspecified	4.20% (20)	56.40%
b289	Sensation of pain, other specified and unspecified	3.60% (17)	60.00%
b798	Neuromusculoskeletal and movement-related functions, other specified	2.80% (13)	62.70%
b439	Functions of the hematological and immunological systems, other specified and unspecified	2.12% (10)	64.80%
b1522	Range of emotion	1.91% (9)	66.70%
b199	Mental functions, unspecified	1.91% (9)	68.60%
d4553	Jumping	1.91% (9)	70.60%
b7800	Sensation of muscle stiffness	1.69% (8)	72.20%
d4558	Moving around, other specified	1.69% (8)	73.90%
ns	Not codable	1.48% (7)	75.40%
b298	Sensory functions and pain, other specified	1.27% (6)	76.70%
b7100	Mobility of a single joint	1.27% (6)	78.00%
b799	Neuromusculoskeletal and movement-related functions, unspecified	1.06% (5)	79.00%
d4551	Climbing	1.06% (5)	80.10%

Table 11: Lower extremity most commonly occurring codes level 3

Count of Codes Represented and not Represented in Top 80%

Level of Analysis	All (n=59;94)	Upper (n=20;26)	Lower (n=51;73)	Acute (n=48;75)	Subacute (n=14;75)	Chronic (n=36;54)
Top 80% Level 2	13	8	12	6	1	3
Top 80% Level 3	23	12	20	10	1	4
Codes not in top 80% Level 2	46	12	39	42	13	33
Codes not in top 80% Level 3	71	14	53	65	19	50

Table 12: Codes representing/not representing most common participant generated codes

ICF Codes Generated from Questions on Common PROMs

Code	Description	LEFS	DASH	mDPA
b1263	Psychic stability			x
b1266	Confidence		x	x
b1268	Temperament and personality functions, other specified			x
b1300	Energy and drive functions			x
b1349	Sleep functions, other specified		x	
b1522	Range of emotions			x
b2351	Vestibular functions of balance			x
b280	Pain			x
b28014	Pain in lower limb		x	
b28019	Pain in body part, unspecified		x	
b289	Sensations of pain, other specified and unspecified		x	
b298	Sensory functions and pain, other specified and unspecified		x	
b4559	Exercise tolerance functions, unspecified			x
b7101	Mobility of several joints		x	
b7109	Mobility of joint functions, unspecified			x
b7159	Stability of joint functions, unspecified			x
b7301	Power of muscles of one limb		x	
b7309	Muscle power functions, unspecified			x
b7409	Muscle endurance functions, unspecified			x
b749	Muscle functions, other specified and unspecified			x
b7601	Control of voluntary movement functions			x
b7608	Control of voluntary movement functions, other specified		x	
b7800	Sensations of muscle stiffness		x	
b7808	Sensations related to muscles and movement functions, other specified			x
b798	Neuromuscularskeletal and movement-related functions, other specified		x	
d170	Writing		x	
d2100	Undertaking a simple task		x	
d2302	Completing the daily routine			
d2309	Carrying out daily routine, unspecified			x
d2401	Handling stress			x
d2408	Handling stress and other psychological demands, other specified			x
d4101	Squatting	x		x
d4104	Standing			x
d4105	Bending			x
d4107	Rolling over	x		
d4108	Changing basic body position, other specified	x		
d4153	Maintaining a sitting position	x		x
d4154	Maintaining a standing position	x		x
d4158	Maintaining a body position, other specified			x
d4159	Maintaining a body position, unspecified			x

Table 13: ICF codes generated from questions on common PROMs

*****Lower Extremity Functional Scale (LEFS), Disablement of Arm, Shoulder, and Hand (DASH), modified Disablement of the Physically Active Scale (mDPA)***

ICF Codes Generated from Questions on Common PROMs (Continued)

Code	Description	LEFS	DASH	mDPA
d4300	Lifting	x		
d4308	Lifting and carrying, other specified		x	
d4309	Lifting and carrying, unspecified			x
d4351	Kicking			x
d4451	Pushing		x	
d4452	Reaching		x	
d4453	Turning or twisting the hands or arms		x	
d4454	Throwing		x	x
d4455	Catching		x	x
d4459	Hand and arm use, unspecified		x	
d4500	Walking short distances	x		
d4501	Walking long distances	x		
d4502	Walking on different surfaces	x		
d4509	Walking, unspecified			x
d4551	Climbing	x		x
d4552	Running	x		x
d4553	Jumping	x		x
d4558	Moving around, other specified	x		x
d4600	Moving around within the home	x		
d4608	Moving around in different locations, other specified	x		
d469	Walking and moving, other specified and unspecified			x
d489	Moving around using transportation, other specified and unspecified		x	
d5100	Washing body parts		x	
d5202	Caring for hair		x	
d5400	Putting on clothes		x	
d5402	Putting on footwear	x		
d550	Eating		x	
d6309	Preparing meals, unspecified		x	
d6402	Cleaning living area		x	
d6409	Doing housework, unspecified	x	x	
d649	Household tasks, other specified	x		
d6505	Taking care of plants, indoors and outdoors		x	
d7402	Relating with equals			x
d7500	Stretch motor reflex			x
d7509	Informal social relationships, unspecified		x	
d7702	Sexual relationships		x	
d820	School education	x		
d859	Work and employment, either specified and unspecified	x	x	
d9200	Play			x
d9201	Sport	x	x	x
d9204	Hobbies	x		
d9208	Recreation and leisure, other specified		x	x
d9209	Recreation and leisure, other unspecified	x	x	x

Table 13 (continued): ICF Codes Generated from Questions on Common PROMs (Continued)

*****Lower Extremity Functional Scale (LEFS), Disablement of Arm, Shoulder, and Hand (DASH), modified Disablement of the Physically Active Scale (mDPA)***

Phase of Injury Most Common Codes : Level 2

Code	Description	Acute	Subacute	Chronic
b152	Emotional functions	x		
b280	Sensation of pain	x	x	x
b780	Sensations related to muscles and movement functions	x		
d450	Walking	x		
d455	Moving around	x		x
d920	Recreation and leisure	x		x

Table 14: Phase of injury most common code distribution level 2

Phase of Injury Most Common Codes: Level 3

Code	Description	Acute	Subacute	Chronic
b1528	Emotional functions, other specified	x		
b280	Sensation of pain	x		x
b2801	Pain in body part	x	x	x
b289	Sensation of pain, other specified	x		
b439	Functions of the hematological and immunological systems, other specified and unspecified	x		
b7808	Sensations related to muscles and movement functions, other specified	x		
b798	Neuromusculoskeletal and movement-related functions, other specified	x		
d4509	Walking, other specified	x		
d4552	Running	x		x
d9201	Sport	x		x

Table 15: Phase of injury most common code distribution level 3

Discussion

The overarching goal of this study was to identify the primary concerns held by injured collegiate athletes. In order to extract the meaningful concepts from participant responses, a group of 3 clinician raters linked reported symptoms/restrictions to ICF codes. Analysis of codes revealed that sensation of pain (generalized or body part specific) and sport participation were by far the most common concerns of participants, regardless of their region (upper vs lower extremity) of injury. These two concerns combined represented 41.74% of all participant concerns. In addition to this, codes related to running/moving around, emotional functions (stress, confidence, frustration, anxiety, etc.), mobility (range of motion), swelling, and strength/muscle power functions were also among the most common participant concerns. It is also important to note that regardless of level of analysis or region of injury, “not codable” was always present in the most common ICF codes for participant responses. This will be further discussed in our ICF limitations section, but it cannot be ignored that the ICF taxonomy may have notable limitations to its inclusivity for highly active populations. Findings for commonly occurring codes are consistent with those found in previous studies. For example, in a study examining common functional limitations in those experiencing shoulder injuries it was observed that their most common participant generated ICF codes were related to activity limitations and participation restrictions and shared similar content (ex. lifting, emotional functions, recreation and leisure). Additionally, their analysis yielded similar code counts in their reported participant concerns.[11]

When examining commonly occurring ICF codes by phase of injury, differences in the amount of codes represented in each phase were observed. The acute phase presented with 6 codes making up the most common concerns at the second level, and 10 codes for the third level. The chronic phase presented with 3 codes cumulatively representing 80% of generated codes at the second level, and 4 at the third level. The subacute phase presented only 1 code representing 80% of participant-generated codes at both the second and third level of analysis. All of the most common codes within the subacute and chronic phases were represented in the acute phase as well. It should be noted that there were notably fewer participants in the subacute and chronic phases; however, the responses of these participants were consistent with concerns of those classified as being in the acute phase. The concerns represented in each phase are in line with those represented by all participants across phases, as well as when analyzed by region/extremity of injury. Pain, sport, and movement functions are the most common concerns across all three phases. Therefore, our results failed to support our hypothesis of content differences between the three phases.

Concerning participants with lower extremity injuries, regardless of level analyzed, the LEFS did not contain 70% of the most common participant concerns. These results support the hypothesis that significant underlying content differences would exist between the LEFS and self-generated participant concerns. Overall, the LEFS content failed to represent even the global primary concerns of student-athletes, and certainly did not address specific impairments, limitations, and restrictions that were of concern to participants (ex. swelling, anxiety, frustration, feeling like part of the team, etc.). Perhaps most concerning is that pain, the most commonly occurring participant concern, was not represented in LEFS content at all. In addition to this, the majority of LEFS content was not present in the primary concerns of student-athletes. This further suggests that this instrument may not be appropriate for use in active populations as it both contains much extraneous content and does not address patient concerns well.

The hypothesis regarding a lack of shared content between upper-extremity patient concerns and the DASH was rejected at the second level of the ICF but was supported at the third level (ex. d4454). The DASH contained at least 70% of the most common patient concerns for upper extremity injuries when examined at the second level (ex. b280) of the ICF framework, but not at the third level. Based on these results it may be concluded that the DASH is sensitive to the general impairments, limitations, and restrictions experienced by collegiate athletes with upper extremity injuries. However, because the shared content does not remain when a deeper and more specific analysis is done, the DASH may be limited in its ability to focus in on and assess with precision the specific concerns patients most commonly experience. It is important to note that the DASH did encompass the top patient concerns of pain and sport participation ability, as well as one emotional wellness question: confidence. Additionally, the vast majority of codes generated from review of the DASH were not represented in the participant-generated response codes. These results suggest that many of the DASH questions may be superfluous and not particularly meaningful to highly active populations.

Analyses showing notable content differences between the commonly used PROMs and patient concerns is in line with the concerns held by surveyed practitioners.[9,10] These measures do not currently appear to align with the concerns of a traditional athletic population. Not only do they not adequately share content with patient generated concerns, they provide a large amount of extraneous content. For example, while the DASH shares 7/8 of the most common concerns held by participants experiencing upper extremity injuries at the second level of the ICF taxonomy, it possesses content covering an additional 19 codes. The LEFS similarly possesses content covering an additional 10 codes at the second level of analysis. This large amount of extraneous content also confirms hesitations clinicians have regarding the worth of these PROMs.[9,10] The presence of this extraneous content places additional demands on the responding patient and adds unnecessary time for clinicians to score PROMs. Reducing the content to only that of greatest importance to the intended patient population of concern would increase efficiency and clinical relevance. Overall, the current findings validate previously reported clinician concerns regarding the commonly used PROMs. Additionally, our results may show that using a guided patient-generated outcome measure, such as the MYMOP-2, may be more beneficial to collegiate athletes. This is due to the large number of codes represented outside of the top 80% of patient concerns, showing that patient concerns are highly individualistic and may not always follow a trend. (table 9) Conversely, it is worth further exploration to see if patients would respond similarly to a patient-generated measure as they would to a measure built upon the most common codes shown here and in related studies.

ICF Limitations

The largest limitation in this study related to the clinical applicability of the ICF language. As a result, the agreed upon codes often were those listed as "other specified or unspecified" or were not codable. We specifically found the coding language limitations to be at their peak when patients reported emotional experiences, or specific perceived symptoms such as swelling. For any reports of anxiety, frustration, etc. b1528, "Emotional Functions, other specified", best encompassed the emotions our participants reported experiencing. Swelling was a key example of a code set our raters were forced to build in order to accurately describe the presented concerns. The resultant code set was b439, “Neuromusculoskeletal and movement-related functions, other specified,” and b798, “Functions of the hematological and immunological systems, other specified and unspecified.”

Additionally, there is a gross underrepresentation of concerns related to a level of function surpassing ADLs. While there is representation for concerns such as “sport”, “swimming”, “throwing”, and “lifting”, the definitions provided by the ICF do not necessarily encompass the concern of the participant. ‘Lifting’, for example, often was referred to as weightlifting in the strength and conditioning sense by participants. But, the ICF code for lifting defines itself as “Raising up an object in order to move it from a lower to a higher level, such as when lifting a glass from the table”. While the inclusion criteria of lifting an object from a lower to a higher level qualifies lifting weights here, the context is misrepresentative. This misrepresentation potentially contributed to some of the overlap content between PROM generated codes and the most common participant generated codes. Continuing with the lifting example, this code (lifting and carrying, other specified) is generated from questions on the DASH stating: difficulties lifting and carrying a shopping bag, or a heavy item (over 10 lbs). When given context from the questions, we can see that while the lifting and carrying code at the second level (d430) is in both the DASH and upper extremity injury codes, their concerns are very different. Our participants stated being concerned with lifting weights, but never referenced lifting things such as shopping bags. The lack of specificity in the ICF taxonomy may have resulted in an exaggeration of agreement in content between the common PROMs investigated and patient concerns and may create challenges when trying to apply the ICF taxonomy in future clinical practice or research. If the ICF taxonomy was more specific and inclusive to concerns related to a higher level of function and superseded concerns of ADLs, the amount of shared content between the DASH and patient-generated codes at the second level may look differently. Additionally, these limitations involving taxonomy inclusivity and specificity may cause those linking patient concerns to arrive at a more clouded, less specific, and possibly contextually misleading code due to the nature of the taxonomy. This could prove counterproductive to the intention of the ICF, which is to provide a universal, patient-centric language that both improves inter-clinician communication and identifies primary patient concerns. If the resultant code is not inclusive enough for a broad range of patient concerns, it provides more confusion than answers. Further expansion of the taxonomy to represent a wider variety of experience-centered codes, along with the addition of codes reflecting a higher level of functional demand, would help in the resolution of these issues.[33]

These concerns regarding the inclusivity of the ICF taxonomy are not unique. Mitra and Shakespeare noted that because of the increased attention the ICF has gained in many medical and rehabilitation settings (ex. oncology, physical therapy, athletic training, etc.), the taxonomy may benefit growing with our increased understanding of disablement. They state that a revised ICF model would need to consider individual agency and whether an individual is able to act, participate or live on behalf of what matters to them.[33] Our data confirms this need, especially related to functional concerns of physically active individuals and concerns related to psychosocial wellbeing. The previous example of lifting applies to the need for adaptation to the activities and participation domain. For better inclusion of changing psychosocial wellbeing, we turn to the lack of acknowledgement of emotional experiences. While there is a small set of codes related to handling stress, the inclusion criteria do lend themselves towards experiences such as sadness, grief, anxiety, anger, frustration, etc. This led raters to link psychosocial concerns such as not feeling like a part of the team, frustration, anxiety, sadness, etc. to the 'emotional functions' component. The inclusion criteria for this component are as follows: *"Specific mental functions related to the feeling and affective components of the processes of the mind. Inclusions: functions of appropriateness of emotion, regulation and range of emotion; affect, sadness, happiness, love, fear, anger, hate, tension, anxiety, joy, sorrow; lability of emotion; flattening of affect."* This definition is more related to structural dysfunction than it is to patient experience, as indicated from the defining terms "appropriateness" and "functions related to". This lack of patient-centric language again may lead clinicians/researchers to a clouded and potentially misleading result.

Furthermore, because emotional experiences were continuously presented in the most common participant concerns, we cannot ignore the need for improved recognition of patient emotional states throughout their changing HRQOL. This need is demonstrated within the ICF taxonomy and in the commonly used PROMs. If athletic trainers and other clinicians are to continue to grow as evidence-based practitioners, this improved recognition of patient emotional changes as a result of injury/disability is critical. Adding this piece to PROMs, which are intended to improve the inclusion of patient perspective in treatment decision making, would allow for a truly holistic, patient centric approach. Including this recognition in models such as the ICF would encourage this even further. The improved recognition of emotional experiences highlights rehabilitation needs that are not observable to clinicians as other dysfunctions are. If we better acknowledge the psychosocial health of our patients, we are again more equipped to provide a holistic and patient-centric treatment.

While recognizing there is a need to expand the ICF, it is highly beneficial in finding a universal language for practitioners to highlight patient concerns. If clinicians use the ICF as a starting point as it is intended, it may encourage better discussions related to the patient and their perspective, thus improving the recognition of patient experience. However, as previously stated, expanding the taxonomy would likely be very beneficial to practicing clinicians and researchers alike.[33] Including supplemental sets of codes for different populations (i.e. active populations, those with psychiatric conditions, etc.), which could be drawn from the ICD-10 taxonomy, may be a starting point for these improvements.

Study Limitations

Analysis related to injury phase in this study may have been limited by our ability to collect return to play dates from some of our clinicians. This could have influenced the numbers of those represented in each phase of injury as we relied on clinician interpretation alone and were not able to collect clinician interpretation of phase of injury for a few participants. Having return to play dates in addition to date of injury and data collection would have allowed us to calculate more accurately which phase of injury our participants were in. Additionally, the number of participants enrolled who were experiencing upper extremity injuries was disproportionately low. Our samples size restricted our ability to examine the primary concerns for those experiencing back, head, and neck injuries. Future research should consider a more in-depth investigation of these other injury classifications and their adjacent PROMs. Furthermore, we have been limited in the fact we only included the LEFS and DASH for our extremity specific measures. The shared content between patient-generated concerns and PROMs such as the international knee documentation committee questionnaire (IKDC), the knee injury and osteoarthritis outcome score (KOOS), the Kerlan-Jobe Orthopaedic Clinic score (KJOC), etc. may have presented differently. However, we chose to include only the LEFS and DASH as they are the most commonly used and well-known PROMs among most clinicians.[20]

Conclusions

This study confirms some of the concerns held by clinicians regarding the commonly used PROMs investigated, the LEFS and the DASH. For lower extremity injuries, our hypothesis regarding a lack of shared content between patient concerns and items addressed on the commonly used PROMs was confirmed at both superficial and deeper ICF levels of analysis. For upper extremity injuries, this hypothesis was rejected at the second level of ICF coding but was supported for the third level of ICF coding. This shows that the DASH is potentially sensitive to the genre of concerns held by collegiate athletes experiencing upper extremity injuries. But, because the amount of content shared fell below 70% when analyzing at the third, more specific level, the DASH does not appear to be specific to precise patient concerns. A measure based upon the identified primary concerns of all participants may be beneficial as the common codes were highly consistent (pain, sport, mobility/muscle function of involved limb, emotional functions/experiences, etc.) regardless of phase or location of injury. In addition, we see there is an obvious need for the improved recognition of emotional experiences (anxiety, depression, frustration, etc.). Overall, the results of our study validate the concerns expressed by clinicians regarding PROM content while showing that the primary concerns of an athletic population are pain and sport participation ability.

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Appendix:

1. MYMOP-2

* MYMOP2 *

Full name .... Date of birth ....

Address and postcode..

....

Today's date .... Practitioner seen ....

Choose one or two symptoms (physical or mental) which bother you the most. Write them on the lines. Now consider how bad each symptom is, over the last week, and score it by circling your chosen number.

SYMPTOM 1:	0 As good as it could be	1	2	3	4	5	6 As bad as it could be
SYMPTOM 2:	0 As good as it could be	1	2	3	4	5	6 As bad as it could be

Now choose one activity (physical, social or mental) that is important to you, and that your problem makes difficult or prevents you doing. Score how bad it has been in the last week.

ACTIVITY:	0 As good as it could be	1	2	3	4	5	6 As bad as it could be

Lastly how would you rate your general feeling of wellbeing during the last week?

0 As good as it could be	1	2	3	4	5	6 As bad as it could be

How long have you had Symptom 1, either all the time or on and off? Please circle:

0 - 4 weeks 4 - 12 weeks 3 months - 1 year 1 - 5 years over 5 years

Are you taking any medication FOR THIS PROBLEM ? Please circle: YES/NO

<u>IF YES:</u>

1. Please write in name of medication, and how much a day/week

....

2. Is cutting down this medication: Please circle:

Not important a bit important very important not applicable

<u>IF NO:</u>

Is avoiding medication for this problem:

Not important a bit important very important not applicable

MYMOP. Measure Yourself Medical Outcome Profile

2. mDPA

Disablement in the Physically Active Scale©

Instructions: Please answer **each statement** with one response by shading the square that most closely describes your problem(s) within the past **24 hours**. Each problem has possbile descriptors under each. Not all descriptors may apply to you but are given as common examples.

0- No problem
1- I have the problem(s), but it does not affect me
2- The problem(s) slightly affects me
3- The problem(s) moderately affects me
4- The problem(s) severely affects me

DPA-Physical Summary Component	**No Problem** 0	**Does not affect** 1	**Slight** 2	**Moderate** 3	**Severe** 4
Pain- "Do I have **pain**?"	☐	☐	☐	☐	☐
Motion- "Do I have impaired **motion**?" Ex. Decreased range/ease of motion, flexibility, and/or increased stiffness	☐	☐	☐	☐	☐
Muscular Functioning- "Do I have impaired **muscle function**?" Ex. Decreased strength, power, endurance, and/or increased fatigue	☐	☐	☐	☐	☐
Stability- "Do I have impaired **stability**?" Ex. The injured area feels loose, gives out, or gives way	☐	☐	☐	☐	☐
Changing Directions- "Do I have difficulty with **changing directions** in activity?" Ex. Twisting, turning, starting/stopping, cutting, pivoting	☐	☐	☐	☐	☐
Daily Actions- "Do I have difficulty with **daily actions** that I would normally do?" Ex. Walking, squatting, getting up, lifting, carrying, bending over, reaching, and going up/down stairs	☐	☐	☐	☐	☐
Maintaing Positions- "Do I have difficulty **maintaining the same position** for a long period of time?" Ex. Standing, sitting, keeping the arm overhead, or sleeping	☐	☐	☐	☐	☐
Skill Performance- "Do I have difficulties with **performing skills** that are required for physical activity?"					
1) Ex. Running, jumping, kicking, throwing & catching	☐	☐	☐	☐	☐
2) Ex. Coordination, agility, precision & balance	☐	☐	☐	☐	☐
Overall Fitness- "Do I have difficulty maintaining my **fitness** level?" Ex. Conditioning, weight lifting & cardiovascular endurance	☐	☐	☐	☐	☐
Participation in Activites- "Do I have difficulty with **participating in activities**?"					
1) Ex. Particpating in leisure activities, hobbies, and games	☐	☐	☐	☐	☐
2) Ex. Participating in my sport(s) of preference	☐	☐	☐	☐	☐

DPA-Physical Score = _____/ 48

DPA-Mental Summary Component					
Well-Being- "Do I have difficulties with the following…?"	0	1	2	3	4
1) Increased uncertainty, stress, pressure, and/or anxiety	☐	☐	☐	☐	☐
2) Altered relationships with team, friends, and/or colleagues	☐	☐	☐	☐	☐
3) Decreased overall energy	☐	☐	☐	☐	☐
4) Changes in my mood and/or increased frustration	☐	☐	☐	☐	☐

DPA-Mental Score = _____/ 16

DPA-Total Score = _____/ 64

(DPA-Mental + DPA-Physical)

Vita

Jennifer Tinsley was born in Charleston, WV, to David and Miriam Tinsley. She graduated from Woodford County High School in Versailles, Kentucky in June 2014. The following autumn, she entered Murray State University, but transferred to Eastern Kentucky University in January of 2015. She earned her Bachelor of Science in Athletic Training from Eastern Kentucky University in 2018. In the fall of 2018, she began a research assistantship at Appalachian State University under Dr. Jennifer Howard and commenced study towards a Master of Science in Exercise Science. The M.S. was awarded in May 2020. In August of 2020, Ms. Tinsley will begin her work towards a Ph.D. in Rehabilitation Science at the University of Kentucky while working as the Lexington Fire Company's first Athletic Trainer.

Ms. Tinsley is a licensed athletic trainer, certified by the National Board of Certification. She currently resides in Lexington, Kentucky with her fiancé and family.