

## Authors' Response

Dear Editor:

We appreciate the opportunity to respond to the recent letter to the editor about our article, "Consensus definition of sport specialization in youth athletes using a Delphi approach."<sup>1</sup> We believe our response will offer clarity to your readers as there appears to be a misinterpretation of our research by the letter authors. Additionally, the letter authors appear to have misunderstood our definition and its application as a potential measurement tool (how we operationalize our definition).

Our work is the first attempt to develop a consensus definition that provides a unified understanding of the concept of sport specialization using strong scientific methods. The new definition for *sport specialization* is "intentional and focused participation in a single sport for a majority of the year that restricts opportunities for engagement in other sports and activities."<sup>1</sup> It is important to note that the elements presented in our article exist to help clinicians, parents, or coaches identify athletes who may be exhibiting specialized behavior. They are not intended to serve as a formal measurement tool.

Through the development of a definition of sport specialization using a modified Delphi method, we were deliberately taking the first step toward standardization in research methods in this area. We recognize that sport specialization has previously proven difficult to precisely describe, but we also recognize that sport specialization exists and influences important physical and psychosocial outcomes in young athletes. To advance scientific study in this area, we first need to standardize our understanding of the underlying construct. When strong empirical evidence is lacking, a Delphi consensus method is commonly used to create agreement on a definition.<sup>2</sup> Doing so allows for consistent approaches to evaluate the relationships between sport specialization and outcomes, predictors of sport specialization, and the efficacy of interventions to mitigate any identified negative consequences. For this reason, we undertook the development of a definition using a validated method that has been used in similar circumstances for other medical topics that are difficult to define.<sup>3,4</sup> We do so with the full expectation that this definition will continue to be evaluated and revised in the future as additional data are collected and more information becomes available. This process is representative of the iterative nature of science. However, abiding by the criteria described in the letter to the editor would preclude this first step and fail to accommodate the similar approaches that have been used to standardize and advance both research and clinical care.

Additionally, the argument that a scientific statement should be formulated as simply as possible ignores the fact that statements of different complexities likely also have various amounts of predictive ability. Popper<sup>5</sup> argued that

simpler theories were "better" because they presumably would include more cases and were therefore more likely to be falsifiable. But this is surely only the case when 2 competing theories of different complexities have a similar predictive ability, and it offers no guidance for theories that do not explain the available data equally well. In these cases, should we just choose the simpler, less predictive statement? It seems we should seek to exclude elements of a statement that do not add to the predictive ability and include those that do. That is exactly what we have tried to do by using a validated method to identify and include elements that were found to be sufficiently and independently related to sport specialization. This suggests that each element adds to the predictive ability of the overall formulation of the definition of sport specialization. Nonetheless, we have done this fully expecting that, as researchers evaluate the relationship between these elements and clinical outcomes, the relative predictive abilities of these components will become clear. This will allow for the continued refinement of the constituent elements and how they are used in both research and clinical practice. Also, the complexity of a statement or formula does not impede empirical testing. The authors of the letter to the editor concluded that our definition was not suitable for guiding empirical research. We argue that a consensus-derived definition is necessary for meaningful research in sport specialization.

The argument against the use of the word *may* is impractical given the inherent variability of the concept of sport specialization. Although Aristotle may have argued this in *Organon* more than 2000 years ago,<sup>6</sup> the authors' other cited work by Popper does not.<sup>5</sup> In fact, Popper argued that you simply cannot definitively prove the truth of "any universal statement," as you cannot ever assume you have exhausted the possibility of a single counterfactual that would refute it. This is exactly why we have chosen to use words such as *may* and attempted to humbly acknowledge that science is an iterative process and that our collective understanding of the elements of sport specialization will surely evolve over time. Although we have provided general responses to the letter in the previous paragraphs, we will now respond to each major critique.

1. The first critique is that we "used several empirically meaningless criteria." We disagree with this statement. The Delphi method is an accepted empirical technique used to gain consensus through expert opinion on a real-world problem.<sup>7</sup> Sport specialization, a unique type of sport participation, likely requires a complex systems approach to understand how the multitude of relationships between direct and indirect risk factors result in some athletes demonstrating specialized behaviors.<sup>8</sup> Youth athletic programs, coaches, parents, and athletes across the globe will

be best served by contemporary approaches because sport specialization is a complex phenomenon that cannot be explained using reductionism. Our new definition fulfills the need for a standard, comprehensive, accepted definition of sport specialization.<sup>9</sup> Clearly defining the construct is a critical first step for selecting valid assessments or developing new measures when an appropriate one does not exist.<sup>10</sup>

2. The second critique is that we based our definition “on undefined key terms.” Accepted definitions adequately and accurately convey each word’s meaning and together reflect the consensus definition of sport specialization created by experts in the field. “Intentional and focused participation” includes conscious actions or deliberate choices made by an athlete to deliberately concentrate on a particular sport or, conversely, avoid specialization. This can be measured by strategically querying athletes about their intentions surrounding sport participation. Participation “in a single sport for the majority of the year” is easily measured and has consistently been included in previous definitions of sport specialization.<sup>11</sup> The consensus panel felt that athletes’ decisions supporting sport specialization inherently “...restrict opportunities for engagement in other sports or activities” because sport specialization behaviors represent an opportunity cost for activities outside sports. We urge readers to consider the literal meaning of the consensus definition separately from the measurement techniques quantifying an athlete’s specialization behaviors.

3. The third critique is that we failed “to operationally define variables.” The purpose of our study was to develop a conceptual and operational consensus definition of sport specialization in youth. Items 1 and 2 articulate the justification for the definition and state that such a definition is a critical step that must precede valid measurements. We feel this critique highlights the authors’ failure to separate the conceptual definition from how the concept will be measured. For example, in the letter to the editor, the authors ask the following: how does one determine if participation in a sport is “intentional,” “focused,” or “if restrictions are casually evoked by one’s main sport participation”? Our answer is to ask the athlete those questions. Given that sport specialization is centered on an athlete’s behaviors, we fully anticipate and expect an individual athlete’s experiences with the concepts will vary, but this variability is necessary to fully understand and capture an athlete’s degree of sport specialization. Patient-reported assessments are common measurement tools that can evaluate the athlete-specific motivations, reasons, and consequences incorporated in the definition of sport specialization. Psychometrically sound, patient-reported assessments are often used to assess unobservable, latent traits, including measures of health status.<sup>12</sup> Researchers<sup>10,12</sup> who have established standards specific to developing novel patient-reported assessments recommend starting with an established conceptual definition to avert future confusion or problems. This is the same practice that allows clinicians to evaluate symptoms of depression by asking whether an individual is “feeling down, depressed, or hopeless” without explicitly defining “down,” “depressed,” or “hopeless.”<sup>13</sup> Similarly, we rely on universally

accepted definitions when we ask athletes to report the degree to which they experience “sensitivity to light” or “feeling like in a fog” during the evaluation of concussion.<sup>14</sup> Content validity standards stipulate that careful attention must be paid to the interpretation of the instructions, each item, and all response options when operationalizing patient-reported assessment tools.<sup>15</sup>

4. The fourth major critique is “failing to provide cutoff values for dichotomized criteria.” We intentionally did not provide cutoff or criterion values in the umbrella definition of sport specialization because the assessment techniques resulting from this definition are beyond the scope of this project. We are not convinced that cutoff values are the most appropriate way to measure sport specialization but instead view specialization on a continuum. We recommend adherence to standards for the development of patient-reported outcome measures and best practices when creating instruments to measure sport specialization. Additionally, we do not endorse common lay terminology differentiating specialized athletes from nonspecialized athletes as we believe sport specialization is much more nuanced and complex. There is much work to be done before a dichotomized criterion would be appropriate.

## SUMMARY

We are thankful for the opportunity to clarify our work. In summary, (1) we developed a new consensus-based conceptual definition for sport specialization; (2) the elements of sport specialization described in our article are not central to the primary definition but can be used by clinicians, parents, or coaches to potentially identify athletes who may be participating in specialized behavior; (3) the Delphi method is a well-established, accepted empirical technique used to gain consensus through expert opinion on a real-world problem; (4) researchers who developed standards specific to creating novel patient-reported assessments recommend starting with an established conceptual definition to avert future confusion or problems; and (5) sport specialization behavior is best measured on a continuum. The consensus definition provides a starting point for researchers in the field to develop and operationalize new tools to accurately measure sport specialization.

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