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Article

Feasibility for Utilization of Assessment for Lack of Protective Sensation as Part of Foot Screening for Persons with Intellectual Disabilities

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Abstract

Background: Persons with intellectual disability have a significantly higher prevalence of diabetes than the general population. Special Olympics Fit Feet, a major screening process for evaluating foot health in persons with intellectual disability, has not included an assessment for the risk of diabetic foot ulcers thus far. A probable reason for this may be that clinicians in the past have felt that persons with intellectual disability were not capable of understanding how to complete the Semmes–Weinstein test for lack of protective sensation. A study was designed to assess whether the Special Olympics athletes could complete the Semmes–Weinstein test for lack of protective sensation. **Methods**: In total, 31 Special Olympics athletes with intellectual disability participating in a Fit Feet foot screening underwent a Semmes–Weinstein test for lack of protective sensation (LOPS). An assessment was completed using predetermined criteria to establish whether the subject understood what was required and could satisfactorily complete the test. Likewise, it was also determined if the Special Olympics athletes believed they understood the test. **Results**: Study findings determined that approximately 67% of the athletes in the study were able to successfully complete the test and 90% of the Special Olympics athletes reported they completely understood the test. These results do not apply to the intellectual disability population at large. **Conclusion**: A significant percentage of the test population appeared able to successfully undergo the Semmes–Weinstein test for lack of protective sensation (LOPS). Therefore, it is recommended that any foot screening process for Special Olympics athletes should include an assessment for loss of protective sensation including use of monofilament testing.

Keywords: diabetes; protective sensation; Special Olympics; intellectual disabilities

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1. Introduction

Given the very high prevalence of diabetes in persons with intellectual disability (ID), one can surmise this population would be at risk for diabetic foot ulcers (DFUs). The performance of a proper assessment for risk of DFUs will include a determination of lack of protective sensation (LOPS). Including a risk assessment for DFUs in this population seems prudent. However, some clinicians have questioned the ability of persons with ID to understand and therefore complete the Semmes–Weinstein monofilament test. The following pilot study seeks to determine if Special Olympics athletes can indeed comprehend and undertake the Semmes–Weinstein monofilament test. Importantly, this topic, study and

its design are novel and, to the best of the authors' knowledge, nothing similar has been reported in the existing literature.

1.1. Intellectual Disabilities

Intellectual disability (ID) stems from either an environmental or genetic process that occurs before adulthood. These limitations manifest during the developmental period and impact an individual's ability to effectively participate in activities related to conceptual, social, and practical domains of daily life [1]. There are around 1000 named and unnamed causes of ID, some of which are very rare. Any of these ID conditions may result in or be associated with multiple consequences including obesity and diabetes.

1.2. Special Olympics

Special Olympics is an international sports organization dedicated to providing year-round athletic training and competition for individuals with ID. Special Olympics supports this mission by providing several health-related events at Special Olympics games. Fit Feet is among several disciplines under the Healthy Athletes® Initiative. "Special Olympics Fit Feet offers free optional screenings to evaluate ankles, feet, lower extremity biomechanics, and proper shoe and sock gear to participating athletes. Many athletes suffer from foot and ankle pain, or deformities that impair their performance. During Fit Feet events, volunteer foot healthcare specialists work with athletes to evaluate problems in the feet, ankles and lower extremity biomechanics [2].

Initially, these screenings primarily focused on biomechanical/gait analysis, shoe size assessment, and dermatological examinations. It was believed that because participants were athletes, the typical components of a traditional foot exam such as pulses and assessing protective sensation were not necessary. However, given the significant rise in diabetes incidence, particularly in persons with ID [3], there is a growing need to expand the scope of the Fit Feet exam.

1.3. Diabetes and Intellectual Disability

Research on diabetes, as it relates to persons with ID, is relatively limited, but existing articles suggest increased prevalence rates and predisposition for diabetes. Oyetoro et al. report that adults with intellectual and developmental disabilities (IDD) are 2–3 times more likely to incur type 2 diabetes compared to the general population due to comorbid conditions, hereditary influences and lifestyle challenges [4]. A meta-analysis of 22 studies was performed in the United Kingdom by MacRae et al. which identified highly variable prevalence rates of diabetes in people with ID ranging from 0.4% to 25% [3]. In total, 11 of the studies evaluated determined that the rate of diabetes occurs more frequently in the ID population than the general population, which in the United States has been reported to be 11.3% by the American Diabetes Association [5]. Another study determined individuals with ID were 2.46 times more likely to have diabetes than the general population [6].

Certain intellectual disabilities, such as Down syndrome, are highly associated with diabetes. Studies suggest that people with Down syndrome have 4 to 35 times greater prevalence of type 1 diabetes compared to the general population [7,8].

Despite the widely variable prevalence data of diabetes in the ID population, there is agreement that persons with ID are predisposed to developing diabetes which is influenced by multiple factors such as endocrine dysfunction related to various ID conditions, medications, higher rates of obesity, a sedentary lifestyle, and limited access to healthcare due to socio-economic and cultural barriers [9].

For example, people with ID are significantly more likely to be prescribed antipsychotic medications (up to 56% of the IDD group home population vs. less than 1% of the general population). These medications tend to promote weight gain and result in a significantly

increased risk of developing diabetes [10,11]. Higher rates of obesity are also incredibly common in the ID community which also leads to an increased risk of diabetes. Special Olympics global data show that 69% of athletes over the age of 20 are obese or overweight, ranging from 23% in the African region to over 73% in the North American region [12].

1.4. The Risk for Diabetic Foot Ulcers

Although reports noted above discuss diabetes in persons with ID, an extensive literature search found no publications related to DFUs in persons with ID. Likewise, no studies that determine the prevalence of diabetic neuropathy are found in the literature. Despite this, it would be logical to infer that those with ID will experience a correspondingly higher prevalence of neuropathy and DFUs.

As described above, Fit Feet events offer comprehensive foot screenings conducted by healthcare professionals, including foot and ankle specialists, and trained medical volunteers. These screenings assess the athletes' foot health, identify potential issues, and determine the need for further evaluation or treatment. The comprehensive podiatric exam includes checking for any musculoskeletal deformities, a thorough dermatological exam checking for any ulcers or skin concerns, and a gait analysis where an athlete is observed ambulating and gait abnormalities are recorded. Additionally, proper shoe fit is determined. Given the high association between ID and diabetes described above, screening for risk of DFUs would be prudent.

DFUs are one of the most common complications of diabetes leading to potentially months to years of wound care, soft tissue infections, bone infections, gangrene, and amputations of the lower extremity. Following an amputation, the overall 5-year mortality rate ranged from 53% to 100% in patients with a combination of minor and major amputations and 52–80% in patients with major amputations [13]. The risk of DFUs illustrate the importance of prevention and risk management, such as with foot screenings, before they even appear.

In the general population, a typical foot screening for DFUs entails palpation of pedal pulses, noting the presence of sores or points of irrigation secondary to underlying bony prominences or deformities and assessing for lack of protective sensation (LOPS). The commonly used tool to assess neurological dysfunction such as LOPS would be the Semmes–Weinstein monofilament which is a commonly used and validated tool. One of the barriers to use of the Semmes–Weinstein has been the prevailing attitude that persons with ID participating in Special Olympics would not understand the directions to successfully complete the exam. Having worked with Special Olympics athletes in Fit Feet for the past 18 years, it is author DJ's experience that many athletes would be able to complete the test, despite the prevailing attitudes that they may not, and the lack of literature studying this issue. Indeed, some athletes will not be able to complete the test, but the vast majority will, it is proposed.

2. Methods

The purpose of this pilot study was to assess if trained clinicians are of the opinion that a tested athlete indeed understood the directions and was able to complete the test. Actual testing for LOPS was not determined. If a majority of the athletes appear to understand and perform the test then this would be a notable incentive to including DFU risk assessment in Fit Feet.

This study addresses two primary research questions: does it appear that Special Olympics athletes are capable of understanding and completing the Semmes–Weinstein monofilament test for LOPS, and do Special Olympics athletes believe they understand how to complete the Semmes–Weinstein monofilament test for LOPS?

2.1. Ethical Considerations

Approval for IRB Protocol #AZ 1312 from the Midwestern University Institutional Review Board (IRB) was obtained for this study 18 March 2022. Written informed consent was obtained from subjects prior to the study.

2.2. Informed Consent/Confidentiality

A written informed consent from was gone over with each of the subjects. Key factors in the consent included the following.

The study subject was invited to participate in a research study; the nature and purpose of the study was stated in layman's terms; the study subject individual's responses were anonymous and no identifiable information would be collected or used in a resultant publication; the subject understood there was no obligation for them to participate in this research study, and that they may stop participating at any time; and all minors that took the survey had adult consent. Subjects were fully informed and participated willingly.

2.3. Participants

In total, 31 athletes were enrolled out of 32 recruited individuals. The study recruited 32 athletes who were participating in the Special Olympics Arizona Summer Games on 7 May 2022. One participant was excluded from the study because they declined to sign the consent form, resulting in no data collection for that individual (Table 1).

Table 1. Summary of statistics.

	Overall (N = 31)
Age	
Mean (SD)	27 (11.6)
Range	11–50
Gender	
Female	10 (32.3%)
Male	21 (67.7%)
Primary Language	
English	26 (83.9%)
English/Nonverbal	1 (3.2%)
English/Spanish	2 (6.5%)
Spanish	2 (6.5%)
Patient Comprehension level	
1	21 (67.7%)
2	9 (29.0%)
3	1 (3.2%)
4	0 (0%)
5	0 (0%)
Patient Perception of Comprehension	
Completely understand	28 (90.3%)
Did not understand	1 (3.2%)
Think so?	2 (6.5%)

2.4. Data Collection

An assessment tool was developed by the investigators to determine participant comprehension levels of the Semmes–Weinstein monofilament test. As there was no remotely similar assessment tool found in the literature, the authors constructed one with the assistance of the Midwestern University Biostatistician. Indeed, the assessment incorporates significant subjectivity; however, the authors and biostatistician endeavored to develop observed behaviors that may be found in the test subjects that would indicate a lack of comprehension. The tool outlined specific criteria indicating comprehension, and a grading system was used to assign comprehension levels (Table 2). Additionally, demographic data such as age, gender, and primary language were recorded for each participant. Additional specifics on the assessment tool are found below in Section 2.6.

Table 2. Grading tool to assess participant comprehension level of the Semmes–Weinstein monofilament test.

Special Olympics Monofilament Test Assessment Tool								
Number	Age	Gender	Primary Language	Patient comprehension level 5 = no comprehension, 1 = total comprehension				
				1	2	3	4	5
Grading								
1	Clinician has no doubt that athlete understands instructions and was able to follow them and perform test successfully.							
2	Clinician believes the athlete understands the instructions but not 100% sure athlete can perform test flawlessly.							
3	Clinician believes athlete understands instructions but questions if athlete is actually able to do the test.							
4	Clinician not certain athlete understands instructions for the test and thus not confident athlete can perform the test.							
5	Clinician believes the athlete does not understand the instructions and is fully unable to perform the test.							
Criteria (5 = no comprehension, 1 = total comprehension)								
1	Inconsistent results when testing same general area for protective sensation			1	2	3	4	5
2	Poor focus/Easily distracted/Not paying attention/activity fatigue			1	2	3	4	5
3	Fearful or scared			1	2	3	4	5
4	Peeking/cheating			1	2	3	4	5
5	Quizzical look/Body language—not getting it			1	2	3	4	5
Add each number for each criterion and divide total by 5. Round up or down as per the value.								
Note: Criteria that assisted the clinician in their determination that the subject understood the testing process								
☐ **Completely Understand**			☐ **Think so?**			☐ **Didn't get it**		

2.5. Procedure

The study itself took place at the Special Olympics Arizona Summer Games. A total of 140 athletes were screened at the Fit Feet examinations. Essentially, this was a convenience sample, that is, those that completed the Fit Feet station were approached by student volunteers and invited to take part in the study. There were no specific selection criteria based on age, gender, primary language, or mental acuity. The inclusion criteria were any athlete with intellectual disability willing to participate in the study. Participants who agreed to participate were provided with an explanation of the Semmes–Weinstein monofilament exam, and a consent form was completed with the assistance of their caretaker if necessary. The Semmes–Weinstein monofilament test was conducted by one examiner, author MV, using a 5.07 Semmes–Weinstein monofilament applied with a force of 10 g in 10 different areas of the foot.

2.6. Measures

The best indication that the athlete understands the test as per instructions is the pretest where with the eyes open, the subject is asked if they can feel the monofilament on their hand—it touches their hand and they are asked if they can feel; if it is clear they can, then they are asked to close their eyes and say yes when they feel it touch distinct spots on foot (feet) and these spots are chosen randomly and without a perceptible pace.

Significant inconsistency during the test, where one time they feel and then on the same general spot they do not—would be a notable indicator the subject does not understand the process. In most cases, one has protective sensation, or they do not, so obvious inconsistency is good evidence a subject is not comprehending the process.

The examination was performed on both feet of each participant. Another examiner, author HM, evaluated participant comprehension using five criteria: 1. inconsistent results when testing the same general area for protective sensation, poor focus or being easily distracted, 2. poor focus, easily distracted, not paying attention due to activity fatigue, 3. fearfulness or being scared, 4. peeking or cheating and 5. quizzical look/body language/not getting it. Each participant was then assigned a comprehension level on a scale of 1 to 5, with 1 indicating the highest level of confidence that the athlete understood the instructions and could successfully participate in the test. Table 2 represents the actual assessment tool. Examiners maintained their respective roles to reduce bias and decrease variation between skills.

Following the examination, participants were asked to report their perceived understanding of the monofilament test by indicating one of the following options: "completely understand," "think so," or "didn't understand."

2.7. Statistical Methods

Summary statistics were calculated using percentages for categorical variables and means with standard deviations for continuous variables.

3. Results

3.1. Participants and Summary Statistics

The mean age of the 31 participants was 27.0 years, with a standard deviation (SD) of 11.6 years. The age range spanned from 11 to 50 years. Among the participants, 67.7% (N = 21) were male while 32.3% (N = 10) were female. A summary of the statistics is outlined in Table 1.

3.2. Subject Comprehension Level

When assessing the comprehension levels of participants during the Semmes–Weinstein monofilament test, 67.7% (N = 21) of the athletes were classified as level 1, indicating a high level of comprehension. 29% (N = 9) were categorized as level 2, indicating the ability to mostly understand, but with some confusion. Only 3.2% (N = 1) fell into level 3, indicating partial understanding.

3.3. Subject Perception of Comprehension

The participants' self-reported perception of comprehension showed that 90.3% (N = 28) felt they completely understood the monofilament test. Further, 3.2% (N = 1)) reported not understanding the test, and 6.5% (N = 2) were unsure, responding with "think so?"

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4. Discussion

These initial findings suggest that a majority of Special Olympics athletes demonstrate a high degree of observed and self-reported comprehension and ability to participate in the Semmes–Weinstein monofilament test for LOPS. This contradicts the prevailing perception that they would be unable to do so. With 67.7% of the athletes demonstrating a complete understanding of the examination and an additional 29.0% showing substantial comprehension of the LOPS monofilament test, these results challenge preconceived notions about the ability of Special Olympics athletes to comprehend and participate in such assessments. That 90% of the tested athlete subjects reported they understood the test is additional evidence the Semmes–Weinstein check for protective sensation can be successfully administered in the Special Olympics population.

With a greater awareness of the impact of diabetes on this population, it is has been recommended to expand the scope of Fit Feet assessments to include a comprehensive evaluation for risk factors related to DFUs. Indeed, Special Olympics International (SOI) has recently incorporated diabetic screening questions during intake, and added the evaluating pedal pulses, and is utilizing validated screening techniques such as the Semmes–Weinstein monofilament test for assessing LOPS. Additionally, addressing potential factors contributing to foot ulcers, such as bony prominence and proper shoe fit, have been integral parts of the examination process. There are numerous systems for the classification and assessing of DFUs and an easy-to-use tool that can incorporate DFU risk findings could be a useful addition to the Fit Feet screening documentation. The authors believe that inclusion of assessment for risk of DFUs in the Special Olympics Fit Feet exam will add very little time and cost to the process.

Offering educational resources on diabetes foot care during the check-out process further supports the prevention of diabetic foot ulcers and highlights the importance of maintaining exercise routines beyond competition periods.

Although all subjects were Special Olympics athletes and one cannot generalize the results to all persons with ID, this robust rate of comprehension could signify the potential for more effective communication and understanding within this population, thus opening new avenues for enhancing their healthcare and overall well-being. In other words, clinicians may be less reluctant to provide important health-related information if they know those with ID may more effectively comprehend what they are told than expected. The implications of these comprehension levels are noteworthy. Although study results hold practical implications for the enhancement of Fit Feet examinations in athletes with ID, the authors hope those healthcare providers working with persons with ID can likewise utilize these findings to enhance their screening and care of podiatric health.

Not only does this research shed light on the capability of Special Olympics athletes to grasp medical instructions, but it also underscores the importance of tailored communication strategies to ensure effective healthcare delivery. These findings have the potential to inform healthcare professionals, caregivers, and organizers of events like the Fit Feet component of Healthy Athletes. Although this study incorporated Special Olympics athletes, study outcomes may be of benefit to the ID community at large. By recognizing what appears to be high comprehension rates, healthcare practitioners can develop more inclusive and accessible methodologies for assessing risk factors such as DFUs in individuals with ID.

It should be noted that Special Olympics does not track the specific medical condition responsible for the ID; therefore, associating level of understanding with a specific cause of ID is not possible in the Special Olympics population.

4.1. Recommendations for Future Research

Building upon the current study, future research could consider incorporating additional assessment methods to further validate the comprehension levels observed. Although this study utilized the Semmes–Weinstein monofilament for protective sensation, some experts have suggested clinicians consider using the Ipswich technique which indeed may be even simpler to understand and assess. The Ipswich test, which evaluates LOPS through a different sensory approach, would provide a comprehensive understanding of the athletes' perception of protective sensation. According to Raymen et al., the Ipswich test's sensitivity and specificity, and operating characteristics, are comparable to the monofilament test and could provide complementary insights into the participants' ability to detect sensory stimuli accurately [14].

The utilization of persons with ID, in this case Special Olympics athletes, in our research is something we hope other researchers will consider, as it is well known that historically, persons with ID have been excluded from participation in research projects [15].

Sadly, the tendency has been an increasing prevalence of diabetes with the associated significant morbidity that would include diabetic foot ulcers and amputations. That the intellectually disabled community has a significantly greater rate of diabetes than the general population is an especially distressing trend [6].

Though there are numerous publications that describe the higher prevalence of diabetes in those persons with diabetes, publications that look at prevalence of diabetic foot ulcers and/or neuropathy in this population are not available. A study to determine these prevalences would be valuable.

4.2. Limitations

Several limitations were identified in this study. First, during recruitment, study volunteers briefly described the examination to athletes and those electing to participate may have felt they would be able to understand the test which could introduce bias. Another limitation was the small sample size, which may impact the generalizability of the results. In fact, it should be noted that our results are not generalizable to the ID community at large. Another limiting factor to generalizability is that this study was undertaken at a single site, and given that subjects were Special Olympics athletes, this may skew towards a cohort of persons with ID of a milder degree. Additional data is needed to assess whether these findings are generalizable to all levels of intellectual disability. It is important to note that this is preliminary data and needs to be replicated in other settings to confirm the findings.

When assessing test comprehension, there is likely an element of social desirability bias—i.e., the participants wanting to please the clinicians in a position of authority and may fear some shame if they reported a lack of understanding. The determination of the athletes' comprehension was based on subjective criteria, but these were designed with the assistance of the Midwestern University Biostatistician to reduce the subjectivity as best as possible.

5. Conclusions

Special Olympics athletes with ID participating in Special Olympics Arizona exhibited a high level of comprehension and participation in the Semmes–Weinstein monofilament test for lack of protective sensation. A large proportion of Special Olympics athletes believe they understood the test. These results do not apply to the ID population at large.

These preliminary data support the incorporation of the Semmes–Weinstein monofilament test into foot screenings for Special Olympics athletes.

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These outcomes challenge prevailing assumptions regarding the abilities of individuals participating in Special Olympics to participate in their own healthcare and serve as an ongoing reminder that all healthcare practitioners should challenge these assumptions to better meet the healthcare needs of those with ID and create a more inclusive healthcare environment.

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