The Impact of Socioeconomic Status on Accurate Pain Reporting in Diabetic Patients

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Abstract

The use of the Numerical Pain Scale (NPS) to know pain levels in minority patients and patients of lower socioeconomic status can make it difficult for them to differentiate their physical pain from other social issues in their life. Implementing the use of postural sway assessment to receive accurate pain levels can possibly be a way to eliminate underreporting of pain from patients. Previous research studies have shown that if patients had a higher level of postural sway that would correlate to a higher pain level and if patients had a lower level of postural sway that would correlate to lower pain levels (Hirata et al., 2021). This research will compare diabetic patient self-reported pain using the NPS to the level of pain observed during postural sway assessment using limits of stability and modified clinical test of sensory integration in balance protocols from the BTrackS force plate and software. From the data that is collected, it can suggest a way for healthcare providers to use the BTrackS balance assessment to receive new information about accurate pain levels. This may help improve diagnosis and treatment speed, leading to an improvement in the quality of life in people dealing with diabetes. This is especially relevant for patients in underserved communities who may under report pain levels at greater rates. Using physical examinations to determine pain gives a more accurate depiction of the pain level patients are experiencing.

Introduction

The biopsychosocial model is an idea applied within the healthcare system that encourages healthcare practitioners to not be solely focused on caring for patients from a disease standpoint, but to also be concerned with patients' overall well-being. The biopsychosocial (BPS) model was designed for healthcare practitioners to consider the influence of psychological and social factors on how diseases arise in patients (Havelka et al., 2009). The model is made up of three interconnected components; biological, psychological, and socio-environmental factors.

Figure 1: Depicts how this research study can be mapped through the biopsychosocial model

Biological components are focused on the disease and its effect on the human body (Megan, 2021). Healthcare practitioners are responsible for treating these diseases and helping

patients return to regular daily life. Biological factors associated with diabetes include genetics, diet/metabolism, neuromuscular system, and exercise.

The psychological component is focused on the mental and emotional wellness of the patient. Healthcare practitioners should make it a part of their routine care to check on how their patients are handling the stressors of life and ensure that they have healthy and balanced coping mechanisms. Currently, many healthcare providers use the Patient Health Questionnaire-9 (PHQ-9), which is a self-assessment tool for healthcare workers to screen, diagnose, monitor, and measure the patient's severity of depression (Kroenke et al., 2010). This is helpful in determining if the patient should be given other guidance such as therapy or other psychological help. For persons with diabetes, dietary impulse control and exercise motivation are some additional factors that go into the psychological area of the BPS model.

The social-environmental component is focused on the social interactions such as cultural, work issues, and family circumstances . Healthcare practitioners should ask what activities their patient is involved in outside of work and school and if they feel like they have relationships with people that they can trust and confide in. Peer support and influences of the local built environment play major roles in the health management of diabetes. Race, culture, and socioeconomic status intersect and may cooperate with biological and psychological factors.

The importance of understanding the biopsychosocial model within healthcare is essential for healthcare practitioners to provide quality care. Having an understanding of how their patients' lives can have an impact on their health will allow for more individualized care specifically to the patients needs. Primarily among underrepresented patients who may live in unhealthy living conditions, dealing with isolation, or high levels of stress. If they can

determine if their psychological and social factors are influencing their biological health, physicians can provide a more holistic treatment plan against diseases. This can allow for less invasive treatment as well if it is determined that changing the mental or social health of someone can help manage or resolve their health issues.

Type 2 diabetes (T2D) is the body's inability to regulate and use glucose as fuel causing too much sugar to circulate in the bloodstream leading to more diseases as the condition worsens (DeFronzo et al., 2015). T2D is more common in older adults or those classified as obese and is caused by muscle, fat, and liver cells becoming resistant to insulin and the pancreas can no longer produce insulin. A few complications of diabetes are neuropathy, retinopathy, and vestibulopathy (Papatheodorou et al., 2018). Neuropathy is nerve damage that can lead to the loss of feeling, pain, and numbness starting at the toes and/or fingers and spreading. Retinopathy is the development of new blood vessels in the eyes that are fragile and bleed more often leading to vision loss and ultimately blindness. Vestibulopathy is damage to the inner ear that can lead to postural imbalance. Damage to these senses can cause major concern when it comes to balance and falls risk and can also cause people to feel discomfort and pain.

When healthcare practitioners are dealing with patients who have T2D and are a minority they should focus their treatment around the biopsychosocial model. T2D can be regulated by eating healthy and exercising, but can be difficult particularly among African Americans (Bhattacharya, 2012). Socio-environmental factors that can impact minority patients living in a disadvantaged community can experience having trouble finding fresh food options forcing them to have to eat more processed foods or not being able to afford fresher food options which are more expensive than processed foods (James et al., 2014). Also, environmentally there are not

many gyms available in disadvantaged communities making it difficult to find a safe place to exercise (Hawes et al., 2019). When physicians have a better understanding of the resources that are available for their patients to change their behavior they can prescribe better treatment plans that will allow them to succeed in the lifestyle and environment they currently live in.

Currently, the healthcare system relies heavily on the Numerical Pain Scale (NPS) to receive an accurate pain perception from a patient (Adeboye et al., 2021). The NPS is self-reporting, and many people may under-report or exaggerate their pain, which can cause physicians to use unnecessary or inadequate diagnostic plans; this wastes a lot of time to come to a proper treatment plan.

In 1996, pain was established as the 5th vital sign leading to the development of the NPS, which is very unidimensional (Levy, Sturgess, J., & Mills, P., 2018). Adeboye et al. (2021) stated that the NPS is a self-reporting measurement of pain on a scale of 0 (no pain) to 10 (unbearable pain). This makes it difficult for patients to differentiate their multidimensional life, such as stressors of racial discrimination and/or economic status, from their self-report. Levy et al., (2018) suggested that the NPS is inadequate alone, and that it is more important to focus on how the pain affects the ability of the patient to function.

Other factors that can influence self-reported pain levels are racial/cultural issues; according to Booker, Herr, and Paero (2015, p.70), African American patients are more likely to underreport pain or not report pain at all. This is in direct relation to past and current racial stereotypes of being perceived to be insensitive to pain or labeled as malingering or drug-seeking by healthcare providers (Hoffman et al., 2016). Also, healthcare providers may have stereotypes of other races and cultures. Moorley, Ferrante, Jennings, & Dangerfield (2020), stated that black,

asian, and minority ethnic patients expressed their pain levels and were met with some healthcare providers thinking they were overexaggerating due to racial bias, such as believing minority patients have a higher pain tolerance. If a proper physical examination is given along with the NPS, it may be observed whether the patient is or is not experiencing the pain level they have described.

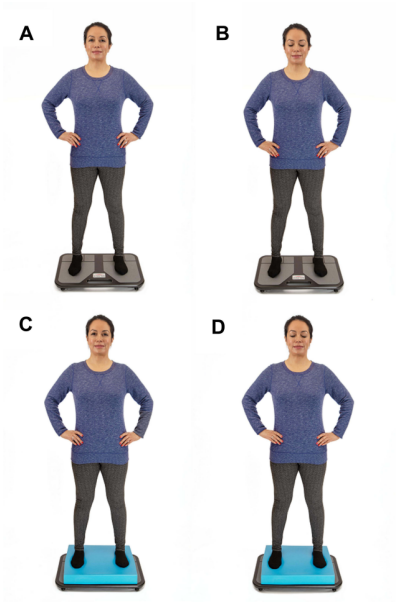
There may be a way healthcare providers can get a more accurate perception of pain levels from patients who do not have visible injury. They can do this through physical examinations, by observing patients' body language as well as mechanical functions of the area that presents pain in addition to, or in replacement of the NPS. Since the NPS has been shown to not consider other social and psychological factors of pain, it can be misinterpreted by patients. There have been a few studies using postural sway assessments to show the correlation between pain and postural sway. (Ruhe et al., 2011) their research proved that those with neck pain showed higher postural instability while those without neck pain showed higher postural stability.

This research project will focus on diabetic patients who are classified as lower socioeconomic status and how the Balance Tracking System (BTrackS) stability protocols can be used to provide a supplementary way to receive an accurate pain level from a patient. Moving to physical examinations as a basis for pain can more directly assess a patient's pain level. This will allow patients to be diagnosed, provided proper pain medication, and properly provided treatment plans much quicker.

Methods

This study will have an experimental design. A group of 10 female patients of lower socioeconomic status with preexisting conditions of diabetes will be recruited from a free clinic through advertisement of the research project through flyers. First, they will be asked to self-report their current pain levels using the NPS. Then, they will complete a survey asking if they feel comfortable accurately reporting pain levels to their primary care physician and why or why not. Next, the researchers will have them complete 2 protocols on the BTrackS force plate: modified clinical test of sensory integration in balance (mCTSIB) for sensory data and limits of stability (LoS) to collect data on postural sway.

Figure 2: Model of the mCTSIB conditions



In the mCTSIB protocol, the patients will stand in 4 different postures and conditions: with eyes open on the plate, eyes closed on the plate, eyes open on foam, and eyes closed on foam. In the Limits of Stability protocol the patients will lean back and forth as far as they can

without moving their feet. They will receive feedback on their performance throughout the trial and be able to self-adjust as needed. Within each, the pathlength is a common outcome, representing the total distance traveled by the center of pressure.

The data that is collected will be analyzed using the BTrackS Assess software. The analysis of the sway area and sample entropy will be calculated using Matlab software. Statistical analysis will be performed using ANOVA and regression models. From the analysis of the data the pathlength covered during the two protocols will show the correlation between pain levels and the level of stability that can be achieved. The shorter the pathlength the more pain being experienced and the longer the pathlength the less pain being experienced. This data can be used to compare the NPS rating of pain with the pain that is being shown through the results of the protocols.

Results

Data collected from study Lance et al. (2022) of participants with T2D (see Table 1) had a larger amount of sway and scored below the 50th percentile when compared to normative data (see Table 2). Female participants scored between 30-40th percentile for standard and vestibular conditions and 40-50th percentile for vision. Proprioception condition where they scored within the 10-20th percentile range. Showing greater impairments of proprioception leading to a larger sway.

Table 1: Average path length of females during the four mCTSIB conditions with their percentile rankings (age 50-59) according to previously published normative data.

Condition	**Female (n=4) Mean (SD)**	**Percentile**

Standard	18.75 (3.5)	30-40th
Proprioception	32.5 (9.32)	10-20th
Vision	35.25 (5.31)	40-50th
Vestibular	89.75 (28.93)	30-40th

Table 2: Percentile Ranking for Female Postural Sway Test Results by Age Group

Percentile Ranking for BTrackS Balance Testing

Age Group (years)	**10th**	**20th**	**30th**	**40th**	**50th**	**60th**	**70th**	**80th**	**90th**
20-29	30	27	24	23	21	20	18	17	14
30-39	31	27	25	23	21	20	18	16	14
40-49	34	29	27	24	22	21	19	18	15
50-59	39	33	30	27	26	23	21	19	17
60-64	43	36	33	29	27	25	22	20	17
65-69	49	40	35	31	29	25	23	21	18
70-74	55	42	37	32	29	27	24	22	19
75-79	62	51	43	38	33	30	27	24	20
80-100	78	60	51	43	38	33	30	24	20

Normative data from (Goble & Baweja, 2018) study of female participants who completed the postural sway assessment using the BTrackS Balance Plate. As the age groups increased the number of participants within the 10th-50th percentile increased. Indicating that as participants aged the level of postural sway decreased.

Table 3: Center of Pressure Path Length for Females 50 to 59 years old in each of the BTrackS mCTSIB conditions

Percentile Rank	**Standard (eye open/firm)**	**Proprioception (eyes closed/firm)**	**Vision (eyes open/foam)**	**Vestibular (eyes closed/foam)**
1st	42	47	78	192
10th	25	36	55	127
20th	22	31	48	102
30th	19	28	42	95
40th	18	26	37	85
50th	16	23	34	77
60th	15	22	31	71
70th	13	20	29	64
80th	12	17	25	59
90th	11	13	21	54
99th	8	10	15	40

Normative data of female participants aged 50-59 years old from (Goble et al., 2020) study who completed the mCTSIB assessment using the BTrackS Balance Plate. As more senses were compromised the lower percentile participants ranked meaning they had a larger path length and worse center of pressure.

Discussion

The use of the postural sway and balance assessments as a component of physical examinations within healthcare settings can allow for healthcare practitioners to determine the level of pain that a patient may be experiencing. A common cause of these increases in path length and postural sway can be due to diseases caused by diabetes affecting the feeling of certain areas of the body that are critical to balance (D'Silva, 2017). In Table 1 & 3, female T2D participants showed a decline in all areas of mCTSIB compared to normative data (Table 2) for the assessment. From the normative data females of the age group 50-59 years old should place within the 20-30th percentile for proprioception compared to the 10th-20th percentile that the T2D group placed in. Also, with standard postural sway female participants place in the 30th-40th percentile compared to Table 2 normative data of postural sway indicating that participants should place within the 70th-80th percentile. With the T2D group placing in a lower percentile compared to normative data it shows that T2D may be experiencing pain or discomfort leading to them not being able to reach the normative levels as those without T2D.

Figure 3: Conceptual model of the manifestation of T2D mapped onto the sensorimotor control of postural sway

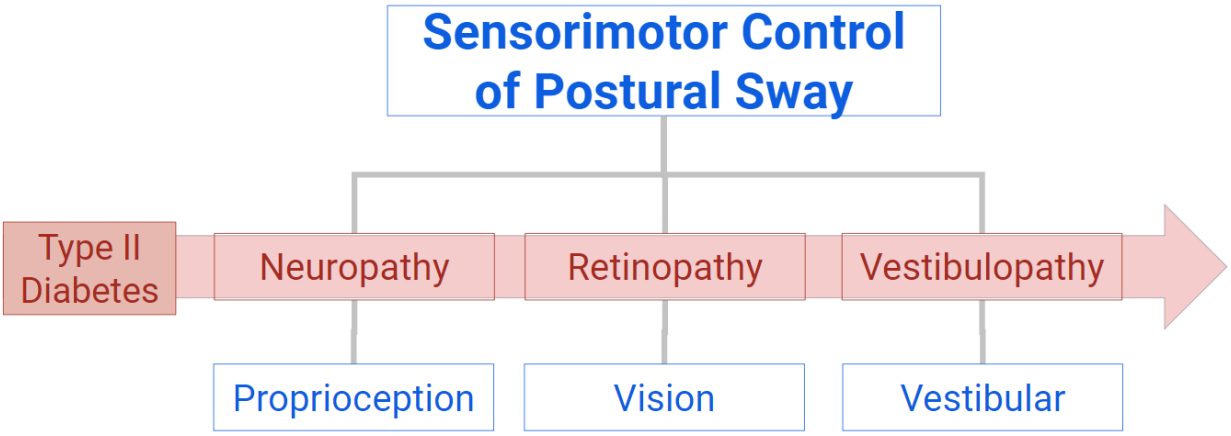


Figure 3 indicates a theoretical model of how T2D can lead to development of other diseases such as neuropathy, retinopathy, and vestibulopathy that affect senses necessary to prevent balance and falls risks. Proprioception allows people to feel the position and movement of their body, but with neuropathy this loss of sensation can cause a declined ability to determine the position that they are in. Neuropathy is a disease that affects proprioception because nerve damage results in the loss of feeling of signals being sent by the nervous system. Due to numbness, irregular signaling can feel like static or can result in pain (Peripheral neuropathy fact sheet, n.d.). Neuropathy is most common in the feet which host large sensory fibers and impact the ability to properly feel touch and vibrations. This can contribute to the increased postural sway and path length that can lead to balance and falls risk and is commonly determined through electromyography test and blood test.

Retinopathy is a common cause of vision loss or blindness among adults who have T2D because of the new blood vessels forming, leaking, and scarring leading to blurriness and scarring of the retina and ultimately detachment (Donald et al., 2004). With vision loss there is then an inability to orient oneself in space and properly balance doing everyday activities contributing to the increase of balance and falls risk.

The vestibular system is a component responsible for balance because it provides information on the spatial orientation (D'Silva et al., 2016) this allows the brain to be aware of balance, motion, and where the head and body is in relation to the surroundings. Vestibulopathy is the loss of hearing within the inner ear and is common among people with diabetes and poor glucose control. With this damage to the inner ear it is common for there to be an increase in dizziness and imbalance leading to increased postural sway. To diagnose these diseases there are highly invasive methods such as biopsies and nerve taps (Lubec et al., 1999). As well as the diagnosis of these diseases being difficult due to their symptoms overlapping with various diseases.

Using a balance assessment such as BTrackS within a clinical setting can allow for healthcare practitioners to see the effects of T2D on a patients postural sway. Balance assessments should be an essential component of examination when dealing with diabetic patients (Dixon et al., 2017). It has already been determined that disease that interrupts the proper function of proprioception, vision, and vestibular senses can contribute to increased balance and falls risk. Physicians who are caring for patients who may be newly diagnosed to T2D or are having symptoms related to neuropathy, retinopathy, or vestibulopathy can use mCTSIB or Limits of Stability postural sway and path length assessments to determine the onset and/or severity of diseases. Continuing with these assessments can also allow for easy monitoring of progression of symptoms that can allow physicians to tailor a treatment plan for their patient to get ahead of the disease and ensure they are properly prepared when conditions reach a point of high concern.

When caring for minority patients or patients who are of lower socioeconomic status it is crucial for healthcare practitioners to be aware of underreporting of pain and know how to close

that gap. By having patients complete a self-assessment of the level of pain they are experiencing using the NPS they can then incorporate the use of balance assessments to determine if the reported values measure the data collected. For example, a diabetic patient who is having symptoms of numbness and tingling sensation in their feet, rates their pain based on the NPS to be a two, but when they complete the mCTSIB protocol they score within the 10th percentile. This can allow healthcare practitioners to visually see the pain level that the balance assessment is showing the individual to be experiencing and then be able to compare that with the self-reported score. From there, further conversations can happen for the physician to ask questions to uncover if they truly are experiencing a lower pain level than measured or if they are underreporting their pain for a certain reason.

Balance assessments are also a non-invasive, inexpensive, and efficient way to evaluate the postural sway of a patient and compare the self-reported pain levels. With this being less time consuming this can allow physicians to spend more time building a relationship with their patient, so they can better trust their physician and feel more compelled to be honest about the pain they are experiencing. Also, having this ability to determine if there is a gap between self-reported and measured pain will allow for the elimination of racial bias within the medical field because if a patient self-reports a pain level of eight and their postural sway assessment aligns with this report there is minimal room for a healthcare practitioner to deny how their patient is feeling.

There are several limitations to this study that need to be addressed for future research to be continued on this topic. First, this study only focused on diabetic patients of lower socioeconomic status without incorporating diabetic patients of higher socioeconomic status and the self-reported pain levels they reported compared to their postural sway assessment. Using

participants of lower socioeconomic status was beneficial because there is a lot of research on the treatment of minority patients and their underreporting of pain from themselves and from healthcare providers. This study can open up conversations and further research about how to remove racial biases within medicine through data based evidence.

Also, with implementing the use of balance assessments there is a level of training that needs to be completed for healthcare practitioners to be able to administer the test correctly and interpret the results. This adds on a time commitment to healthcare workers outside of their scheduled time as well as during their appointments with clients. The use of these protocols will not be as effective for other areas of medicine as it would for diabetic patients who are experiencing diseases that directly affect postural sway, so it is not a universal solution. For example, within obstetrics to better understand the pain level of a patient during labor. This may not be effective or beneficial in dissolving those underreporting or racial bias barriers because of the low willingness for the patient to want to complete a balance assessment during active labor. There should be developments of other methods for all areas of medicine that can allow physicians to get a measured level of pain and be able to compare it to the NPS value a patient provides.

Finally, the use of balance assessment to receive pain levels can be very broad when looking at the results. Increased postural sway and imbalance can indicate a lot of different conditions that someone may be experiencing. There would need to be further testing done and research to be able to pinpoint an exact medical reasoning as to why a patient may be experiencing increased postural sway.

Conclusion

The implementation of balance assessments into physical examinations can be used as an assessment of a patient's pain level. Minority patients underreport their pain level due to various reasons, but with the use of balance assessments the validity of their self-reported pain can be compared to the measured pain. Patients who have a known disease such as T2D showed an increased postural sway ranking them in a lower percentile compared to normative data. Being able to interpret the results from the postural assessment will allow for healthcare practitioners to properly diagnose pain level being experienced and diseases that could be developing. From truly understanding the patients' pain level a healthcare practitioner can provide proper pain medication and treatment plan so their patients' can live a more comfortable life. Further research should be done to allow for a more universal method to determine accurate pain reporting and how to properly implement this method into clinical settings.

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