Journal of Vestibular Research 34 (2024) 205–214
DOI:10.3233/VES-240002
IOS Press

Investigating health disparities in vestibular rehabilitation

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Received 3 January 2024
Accepted 9 April 2024

Abstract.
BACKGROUND: Health disparities (HD) impact care delivery and health outcomes in individuals with vestibular disorders (IVD).
OBJECTIVE: The purpose of this study is to identify whether health disparities (HD) exist in Vestibular Rehabilitation (VR) between individuals identifying as Caucasians or racial or ethnic minorities (REM).
METHODS: This study was a retrospective chart review of IVD who attended outpatient VR between 1/2014 and 9/2020. Data recorded included age, gender, race/ethnicity, vestibular diagnosis, VR interventions, and pre-post outcome measures such as Dizziness Handicap Inventory (DHI), and Activities-Specific Balance Confidence Scale (ABC), Gait speed (GS), and Functional Gait Assessment (FGA). Chi-squared tests, one-tailed, and two-tailed *t*-tests ($\alpha = 0.05$) were utilized to compare Caucasian and REM groups.
RESULTS: Three hundred and forty-three charts ($N = 343$) met inclusion/exclusion criteria. REM demonstrated higher median DHI scores (46 vs. 38, $p = 0.008$) and lower ABC scores (53.10% vs. 66.30%, $p < 0.001$) at VR evaluation compared to Caucasians. There were no statistically significant differences in DHI, ABC, FGA, and GS scores between Caucasians and REM at discharge.
CONCLUSIONS: VR was able to equalize HD in DHI and ABC which initially existed between REM and Caucasians. VR therapists should work with public health and policy researchers to improve access to VR.

Keywords: Vestibular rehabilitation, health disparities

1. Introduction

Health Disparities (HD) are an unfortunate occurrence in the United States of America (USA) and have far reaching consequences for impacted individuals and the health system. Although there are multiple definitions and iterations of the term "health disparity", Braveman's research on this phenomena found that the most commonly used definitions identify a "difference in which disadvantaged social groups – such as the poor, racial/ethnic minorities, women, or other groups who have persistently experienced social disadvantage or discrimination – systematically experience worse health or greater health risks than more advantaged social groups" [7]. Possible causes of HD include but are not limited to trust of the healthcare system and healthcare providers, access to health insurance, socioeconomic status, access to transportation, employment status, sick time provision in employment, and physical proximity to

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healthcare [37]. HD impact healthcare access and delivery across all types of providers, including physical therapy (PT).

Vestibular Rehabilitation (VR) is a specialty area of PT practice. VR addresses dizziness and imbalance resulting from vestibular system dysfunction. Gaze stabilization, ocularmotor, canalith repositioning, gait, balance, and sensory integration exercises are common VR strategies [6, 17, 34]. Large population-based studies find that dizziness effects about 15 to 20% of adults across all racial and ethnic backgrounds yearly, with vestibular disorders accounting for one quarter of these cases [11]. Over 11.1% of American adults report dizziness in a 12-month timeframe [11].

Individuals with chronic dizziness have a decreased quality of life in the physical, functional, and emotional areas [28]. Those who report dizziness or vertigo demonstrate a higher incidence of medical consultation, sick leave, interruption of daily activities, and avoidance of leaving the house, as well as increased risk of falls, fall-related injuries, anxiety, panic disorder, and social phobia [16, 22, 26, 36]. In individuals 65 and older dizziness is significantly disabling [26]. VR is an effective treatment approach to improve dizziness and imbalance in individuals with a vestibular disorder (IVD) [1, 4, 6, 17].

Access to VR and physicians specializing in vestibular disorders may be limited and impacted by a variety of factors. For example, individuals living in the southern region of the USA had a longer time since onset of symptoms and time from their first physician visit to when they were given a diagnosis by nearly threefold [30]. For individuals with benign paroxysmal positional vertigo, factors such as insurance coverage, referring physician specialty, geographic location, and urban vs. non-urban area of physician office all impacted referral to VR [13]. For individuals with peripheral vestibular disorders, those with more comorbidities, referring physician specialty, and urban vs. non-urban location impacted referral to VR [13].

Once an IVD reaches a specialized physician, care provided may differ based on social determinants of health. When looking at radiotherapy for treatment of acoustic neuroma (AN), Gamma Knife radiation therapy (more costly, occurring over several sessions) compared to linear accelerator-based radiation therapy (less costly, delivered in one treatment session) is utilized more often in individuals with private insurance, higher income levels, living in an urban location, living in the northeast or western regions of the USA, living closer to the center, receiving care at an academic medical center, and receiving care at a facility with a radiation oncologist on staff [12]. Investigating care of individuals with AN at a single facility, those with more advantageous social determinants of health received an earlier diagnosis of AN [14]. There is conflicting evidence evaluating the impact of race on care of individuals with AN, with some studies demonstrating race does not impact care delivery [8, 14] and another [3] demonstrating African Americans were less likely to receive surgery for AN compared to Caucasians, even though their tumors were on average larger upon diagnosis [3, 8, 14]. Furthermore, individuals who were Black and Hispanic have a higher mortality rate following AN resection compared to Caucasians [8].

It is tempting to attribute racial HD directly to differences in socioeconomic status, however when controlling for socioeconomic status HD persist in racial-ethnic minorities (REM) [37]. Structural factors in the USA such as systemic racism, wealth accumulation, environmental racism, living in underserved communities, and uneven treatment by the criminal justice system interact to impact the health outcomes of REM [37]. Even when controlling for socioeconomic status a few examples of situations when REM experienced worse health outcomes compared to Caucasians: Shorter survival for Black heart transplant patients and increased cardiovascular risk factors such as hypertension, diabetes, and obesity [5, 24]. Even when isolating individuals from REM who have high incomes these HD persist. For example, individuals from a Hispanic background demonstrated disadvantages in weight and dental visits and individuals from Asian backgrounds demonstrated higher cholesterol, participation in routine physical activity, less dental checks, and less often rating of themselves in excellent and very good health compared to Caucasians [35]. African Americans with high income fared worse than individuals from Asian or Hispanic backgrounds with high income [35]. Compared to Caucasians, African Americans demonstrated increased rates of diabetes, obesity, and hypertension, less routine physical activity, less dental checkups, and less often rate themselves in excellent or very good health [35].

Previous research has identified HD in IVD regarding who has access to physician or VR care and the type of medical care delivered; however, there is no research to date on the impact of race on VR care delivery or on VR outcomes. The purpose of this study is to identify whether HD in care delivery or outcomes exist in VR between individuals identifying as Caucasians and REM.

1.1. Objective

The purpose of this study is to identify whether HD exist in VR between individuals identifying as Caucasians and REM.

2. Methods

2.1. Role of funding

There was no funding in design, conduct, or reporting of this study.

2.2. Institutional review board

Prior to data collection researchers received permission from the Institutional Review Boards at Louisiana State University Health Sciences Center and Our Lady of the Lake Medical Center and have conducted this study in compliance with all policies set forth by those boards.

2.3. Design

This study was a retrospective chart review design.

2.4. Data sources and searches

A chart review of patients with vestibular disorders was performed from three different outpatient VR clinics: Louisiana State University Health Sciences Center Department of Physical Therapy Faculty Practice Clinic, Our Lady of the Lake Hearing and Balance Center, and National Dizziness & Balance Center. Despite the urban location of these three clinics, they draw patients from urban, suburban, and rural areas because they deliver specialty care. Data were collected between the dates of 1/1/2014–9/18/2020 for Louisiana State University Health Sciences Center Department of Physical Therapy Faculty Practice Clinic and Our Lady of the Lake Hearing and Balance Center and 7/1/19–9/18/20 for the National Dizziness & Balance Center.

2.5. Study selection

The inclusion criteria for this study were as follows: (1) between 18 and 100 years of age at VR evaluation, (2) diagnosed with a vestibular disorder from physician, (3) patient charts ranging from 1/1/2014 to 9/18/2020, (4) completed VR (meaning the patient met all assigned goals or plateaued in progress). The exclusion criteria for this study were as follows: (1) inability to ambulate without physical assistance at least 150 ft at one time, (2) impaired sensation of the peripheral lower extremity (LE), recent (within 3 months) surgery to the trunk or LE which was impacting mobility, (3) presence of any other neurologic disease or balance disorder not related to vestibular dysfunction, (4) premature discharge from VR (by physician, patient self-discharge, or did not attend remaining appointments). These exclusion criteria control for issues that may affect a patient's ability to fully participate in VR or indicate an unrelated issue that cannot be treated through VR and will affect their outcomes.

2.6. Data extraction and quality assessment

Study data were collected and managed using REDCap electronic data capture tools hosted at LSU Health Sciences Center School of Public Health. REDCap (Research Electronic Data Capture) is a secure, web-based software platform designed to support data capture for research studies, providing 1) an intuitive interface for validated data capture; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for data integration and interoperability with external sources [18, 19].

Demographic data collected included age, gender, and race/ethnicity. Specific information about each patient's vestibular involvement was recorded, including vestibular diagnosis, duration of symptoms prior to VR exam, weeks of VR received, number of VR sessions, and category of VR interventions received (i.e. gaze stabilization, sensory integration, or dynamic balance). The intervention category was counted for each subject as long as they had at least one intervention belonging to that category performed during the course of their VR care. See Table 1 for VR intervention category descriptions and examples. The treating VRT selected specific VR interventions for each patient based on the patient's specific needs. Finally, patient reported outcome measures (PROM) and objective outcome measure data were collected at initial evaluation and upon discharge from VR.

Table 1
Description of treatment categories with intervention examples

Interventions	Description
Dynamic balance	Treatment challenged patient's balance or postural control while base of support was moving. Example: Walking with head turns, tandem gait, walking with direction changes
Static balance	Treatment challenged patient's balance or postural control while base of support was stationary. Examples: Romberg, Sharp Romberg, Single limb stance
Sensory reintegration	Treatment removed or impaired one or more afferent inputs to balance (vision, vestibular, or somatosensory). This activity could be either static or dynamic. Examples: Romberg with eyes closed, walking on foam mat, standing on foam with eyes closed
Gaze stabilization	Treatment performed to change gain, phase, or response of Vestibular Ocular Reflex (VOR). Examples: VOR X 1, VOR X 2
Habituation	Treatment sought to reproduce symptoms for the purpose of desensitization. Examples: Bending, sit to/from supine, rolling
Canalith repositioning	Treatment performed to move canaliths out of semicircular canals to place back into otolithic organs. Example: Barbecue Roll, Canalith repositioning treatment to the posterior canal
Other oculomotor	Treatment provided addressed ocular motor deficits other than VOR. Example: Smooth Pursuit, Saccades, Vergence
Gait training	Treatment addressed gait pattern, quality, speed, or training with assistive device. Example: Teaching patient to walk with a cane, treadmill walking at various speed with head stationary
Lower extremity strengthening	Treatment designed to increase force production of lower extremity muscle(s). Example: Squats or mini-squats, heel raises
Optokinetic stimulation	Treatment provided visual stimulation to desensitize patient to vestibular symptoms brought on by visual stimulation. Examples: Watching videos such a driving in car or walking in store
Stretching/Range of motion	Treatment designed to increase muscle and/or joint length. Example: Hamstring Stretch, Gastrocnemius/Soleus Stretch
Other	Treatment not best otherwise described by any other category

2.7. Outcome measures

The clinics used the Dizziness Handicap Inventory (DHI) to capture the patient's perception of disability due to dizziness [21]. Individuals rate the occurrence of dizziness as "yes", "no", or "sometimes" on 25 activities performed in the home and community. Scores on the DHI range from 0 (no disability) to 100 (total disability) [21]. The DHI has high internal consistency reliability ($\alpha = 0.89$) for the total scale, and high test-retest reliability ($r = 0.97$), indicating this outcome measure is appropriate to be used to obtain a baseline score to compare pre and post treatment measures [21]. The DHI has a minimal clinically important difference (MCID) of 18 points in IVD [21].

The Activities Specific Balance Confidence scale (ABC) was the PROM utilized to assess balance confidence. The ABC is a measure of a person's self-reported confidence in their balance while completing 16 different activities in the home and community [29]. Self-reported confidence on each item is summed and averaged, resulting in a total score ranging from 0% (no confidence) to 100% (complete confidence) [29]. A score less than 67% is indicative of increased fall risk in older adults [27]. The ABC demonstrates a high negative correlation ($r_s = -0.6350$) with the DHI for adults with vestibular dysfunction and adults with peripheral vestibular disorders ($r = -0.841$) [20,33]. The ABC has an MCID of 18.1% in IVD [32]. The ABC was selected because it shares correlation to other outcome measures used in this study and because vestibular disorders impact balance confidence.

The researchers also collected dynamic balance capacity data using the Functional Gait Assessment (FGA). The FGA is a 10-item test of dynamic balance during various gait activities [39]. This test is scored out of 30 points, with a higher score indicating better performance, and a score of 22 or less indicating an increased risk of falls for adults 65 years or older [39]. The FGA is a reliable test, with intraclass correlation coefficients of 0.86 and 0.74 for interrater and intrarater reliability of the total FGA scores [39]. The FGA demonstrates good concurrent validity with the ABC ($r = -0.64$) and DHI ($r = 0.64$) in IVD [38]. The FGA is responsive to change over time, with a minimal detectible change (MDC) and MCID of four points in IVD [23, 32]. The FGA was selected as it is a challenging dynamic balance test appropriate for IVD, shares correlations with other outcome measures utilized in this study (ABC and DHI) and because of its excellent reliability, validity, and responsiveness to change.

Data were also collected on self-selected gait speed (GS). GS was calculated from one of two measures:

Table 2
Ethnicity demographics

Race/Ethnicity	*N*	Average age (years)	Male	Female
All subjects	343	61.2 ± 14.4 (25–92)	125	218
Caucasian	295	62.1 ± 14.4 (27–92)	112	183
REM	48	55.8 ± 12.7 (25–80)	13	35
• Hispanic or Latino	3	56.3 ± 15.01 (41–71)	1	2
• African American	36	57.2 ± 11.0 (33–75)	7	29
• Asian	3	48.0 ± 7.1 (43–53)	1	2
• Other	6	49.5 ± 20.8 (25–80)	4	2

the first item of the FGA or the 10-meter walk test. GS can be measured at distances between five to ten meters without influencing the results [15]. For both measurement distances, participants were given a two-meter acceleration/deceleration distance and the middle 6.1 or 10 meters was measured and recorded using a stopwatch to the hundredth of a second. GS has a MCID of 0.09 m/s in IVD [32]. GS data were collected because it is considered the sixth vital sign and because imbalance associated with vestibular disorders impacts gait function.

2.8. *Data synthesis and analysis*

Subjects were only included if their chart contained both pre and post measurements of DHI, ABC, FGA, and GS and if they met inclusion/exclusion criteria. The total number of charts reviewed and excluded for not meeting inclusion/exclusion criteria was not consistently tracked and therefore not able to be reported in this study. The typical clinical volume of initial VR evaluations over the research time frames for the sites would have been about 2,000, 150, and 2,000 for Our Lady of the Lake Hearing and Balance Center, LSU Health Sciences Center New Orleans Physical Therapy Faculty Practice Clinic, and National Dizzy and Balance Center respectively.

Three hundred and ninety-six charts $N = 396$ met inclusion/exclusion criteria from these clinics during the study interval. Participants were further excluded if there was missing data from the pre and/or post VR target outcome measures (DHI, ABC, FGA, and GS). If the participant's data was included if they had pre and post data for at least one outcome measure. For example, if a subject had DHI, ABC, and FGA data but not GS they were included in the DHI, ABC, and FGA analyses but not GS.

Data was analyzed using Statistical Analysis Software (SAS) version 9.4. Descriptive statistics (mean, standard deviation, and range for all, median when applicable) were calculated for each group. Due to the small number of subjects with REM background, we categorized the subjects into only two groups: Caucasian and REM. Chi-squared tests were used to compare diagnostic information between Caucasian and REM groups to ascertain if these groups are statistically similar. Since the data violated the assumption of normality, Wilcoxon Signed-Rank tests was performed to compare the change in DHI, ABC, FGA and GS from the beginning to the end of VR for the total sample, Caucasian, and REM.

3. Results

The final sample for analysis consisted of 343 participants. Among these participants, all had completed the DHI, 241 had completed the ABC), 282 had completed FGA, and 323 had completed the GS measurements. The Caucasian group overwhelmingly outnumbered the REM group, with a total of 286 participants identifying as Caucasian ($N = 295$, 85.9%) and 47 participants identifying as a member of a REM ($N = 47$, 14.1%). There were 218 female participants (63.5%) and 125 male participants (36.5%) (Table 2). The clinic distribution of the subjects were as follows: Our Lady of the Lake Hearing and Balance Center ($N = 242$), LSU Health Sciences Center New Orleans ($N = 21$), and National Dizzy and Balance Center ($N = 81$).

Participants included in this study represented a wide variety of vestibular diagnoses (Table 3). The most frequently reported diagnoses were unspecified unilateral vestibular hypofunction ($N = 89$, 25.9%), benign paroxysmal positional vertigo ($N = 82$, 23.6%), other central vestibular disorder ($N = 42$, 12.6%), vestibular migraine ($N = 40$, 12.0%), and AN status-post resection ($N = 34$, 9.8%). Chi-square tests comparing the numbers of Caucasians vs. REM in each diagnostic category were all >0.05 indicating that there was no statistically significant difference in racial/ethnic distribution of each diagnostic category represented in this sample.

Table 3
Vestibular diagnoses

Vestibular diagnosis	N (%)
Unspecified unilateral vestibular hypofunction*	89 (25.9%)
Benign paroxysmal positional vertigo	82 (23.6%)
Other central vestibular disorder^^	42 (12.6%)
Vestibular migraine	40 (12.0%)
Other peripheral vestibular disorder^	40 (12.0%)
Meniere's disease	31 (8.9%)
Unspecified central vestibular dysfunction**	37 (11.1%)
Acoustic neuroma status post resection	34 (9.8%)
Vestibular neuritis/Labyrinthitis	17 (5.1%)
Mixed central and peripheral vestibular dysfunction	11 (3.3%)
Bilateral vestibular hypofunction	8 (2.4%)

*Unspecified Unilateral Vestibular Hypofunction category includes patients with unilateral vestibular hypofunction on vestibulometric testing (i.e. greater than 25% loss on caloric testing) without more specific diagnosis or surgical vestibular nerve resection. **Unspecified Central Vestibular Dysfunction category included patients with signs of central involvement on vestibulometric testing (i.e. positive saccades or smooth pursuits, central positional nystagmus) without more specific diagnosis. ^Other Peripheral Vestibular Disorder included disorders such as Superior Semicircular Canal Dehiscense, Translabrynthine Cholesteatoma Removal, Disequilibrium, Endolymphatic Hydrops, Fistula Repair of Round or Oval Window, Ramsay Hunt Syndrome, Surgical repair of Super Semicircular Canal Dehiscence. ^^Other Central Vestibular Disorder includes disorders such as Stroke, Mal de Debarquement, Meningioma, Subdural Hematoma, Vertebrobasilar artery syndrome, Motion Sensitivity of unknown etiology, Persistent Postural Perceptual Dizziness, and Multiple Sclerosis.

The median interquartile range (IQR) symptom duration prior VR evaluation was 21.0 (44.00) weeks for all participants, 20.0 weeks for the Caucasian group, and 22.0 weeks for the REM group. The difference in median symptom duration prior to initial VR exam, tested using Wilcoxon signed-rank test, was not statistically significant between the Caucasian and REM groups ($p = 0.812$). See Table 4 for more information on symptom onset and start of VR, duration of VR for the total sample and Caucasian and REM groups.

The median IQR number of VR sessions and the duration of VR session for all participants was 8.0 (8.0) and 5.0 (4.0) weeks, respectively. The median number of VR sessions and the duration of VR sessions were the same in Caucasian and REM groups, 8.0 and 5.0 weeks, respectively (Table 4).

In this sample the four most frequent interventions utilized were dynamic balance ($N = 308$, 92.5%), static balance ($N = 302$, 90.7%), gaze stabilization ($N = 239$, 71.8%), and sensory reintegration ($N = 227$, 68.2%). When comparing the interventions received between the Caucasian and REM groups, all interventions were received similarly in both groups except sensory reintegration and lower extremity (LE) strengthening. Sensory integration was performed statistically significantly more often in the REM group ($p = 0.007$) whereas strengthening was performed statistically significantly more often in the Caucasian group ($p = 0.010$). See Table 5 for more information about VR interventions and comparison between groups.

All subjects, when analyzed together or in the Caucasian and REM groups made statistically and clinically significant changes in DHI, ABC, FGA, and GS measures from the beginning to end of VR. When comparing the median (IQR) outcome measure values at the beginning of VR between the Caucasian and REM groups, the REM group reported statistically significantly differences on both PROMs, with higher DHI (46 vs. 38, $p < 0.008$) and lower ABC (53.1 vs. 66.3, $p < 0.001$) scores. The differences between these groups in FGA (23 vs. 23, $p = 0.578$) and GS scores (1.00 vs. 0.90, $p = 0.239$) was not statistically significant. At the end of VR, there was no statistically significant difference between the Caucasian and REM groups in DHI, ABC, FGA, and GS scores. See Table 6 for pre and post scores in DHI, ABC, FGA, and GS, along with changes in median scores and p-values within and between groups. The changes on the DHI, ABC, and FGA for the entire sample, Caucasian, and REM group met or surpassed the MCID in IVD whereas GS changes for the entire sample, Caucasian, and REM groups did not meet the MCID in IVD [21, 32].

Table 4
Symptom onset and start of VR, duration of VR, and number of VR sessions

	All Subjects ($N = 343$)	Caucasian ($N = 286$)	REM ($N = 47$)	p-value
Symptom duration (weeks)	96.44 (259.34) (0–2,210)	97.96 (247.1) (0–1,872)	86.91 (328.8) (1–2,210)	$p = 0.83$
Duration of VR (weeks)	10.36 (9.21) (1–89)	10.65 (9.75) (0–89)	8.70 (4.43) (3–20)	$p = 0.03$*
# of VR sessions	6.53 (4.09) (1–27)	6.66 (4.27) (1–27)	5.66 (2.67) (2–14)	$p = 0.03$*

*Statistical significance ($p = < 0.05$).

Table 5
Vestibular rehabilitation interventions comparison

Interventions	Total sample *N* (%)	Caucasian *N* (%)	REM *N* (%)	*p*-value
Dynamic balance	308 (92.5%)	262 (91.6%)	46 (97.9%)	0.23
Static balance	302 (90.7%)	258 (90.2%)	44 (93.6%)	0.60
Gaze stabilization VOR	239 (71.8%)	201 (70.3%)	38 (80.9%)	0.14
Sensory reintegration	227 (68.2%)	187 (65.4%)	40 (85.1%)	**0.01***
Habituation	108 (32.4%)	92 (32.2%)	16 (34.0%)	0.80
Canalith repositioning	71 (21.3%)	63 (23.5%)	8 (17.0%)	0.57
Other ocular exercises	36 (10.8%)	31 (10.8%)	5 (10.6%)	1.000
Lower extremity strengthening	36 (10.8%)	36 (12.6%)	0 (0%)	**0.01***
Gait training	34 (10.2%)	33 (11.5%)	1 (2.1%)	0.06
Stretching/ROM	28 (8.4%)	25 (8.8%)	3 (6.4%)	0.78
Optokinetic stimulation	17 (5.1%)	13 (4.6)	4 (8.5%)	0.28
Other^	16 (4.8%)	15 (5.2%)	1 (2.1%)	0.71

^Other Intervention category included Manual Therapy, Yoga, Cervical Joint Position, Cervical Spine Stretching and Strengthening, Deep Breathing Exercises, Dual Task Training, Patient Education, Tai Chi, Trunk Stability on Physioball.
*Statistical significance ($p = < 0.05$).

4. Discussion

Results of this study suggest that racial HD may exist in VR. Caucasian and REM groups demonstrated a difference in PROMs at initial evaluation, however this difference resolved by discharge. The only interventions which demonstrated a statistically significant difference in delivery between Caucasians and REM groups were sensory reintegration and LE strengthening.

The types of interventions received by this sample were roughly equivocal between the Caucasian and REM group. Lower extremity strengthening was utilized more often in the Caucasian group, which may possibly have been attributed to the fact that the Caucasian group was slightly older on average than the REM group (62.1 year vs. 55.8 years), and as such perhaps they had more LE weakness due to age related changes or comorbidities which required strengthening interventions. Sensory integration interventions were performed much more often in the REM group for unknown reasons. The wide variety of vestibular diagnoses represented in this sample may also have had an impact on the intervention categories utilized. The differences in interventions delivered may also have been influenced by the fact that interventions in this sample were delivered by four different VRTs, however this difference was mitigated by the consistent training and continuing education of the VRTs in this study. While all VRTs have freedom to make different decisions, the VRTs included in this study have attended the same entry level VRT training (American Physical Therapy Association Credential Course for Vestibular Rehabilitation) and are members/leaders of the Vestibular Special Interest Group of the Academy of Neurologic Physical Therapy which disseminates clinical practice standards.

Both PROMs, the DHI and ABC, were statistically significantly worse at initial evaluation in the REM group compared to the Caucasian group. The scope of this study is unable to ascertain a detailed explanation why, but we may be able to use literature to hypothesize some reasons. A literature search for the relationship of social determinants of health, PROMs, and vestibular disorders revealed no results, so we investigated literature about PROM related to pain. Investigating PROM related to pain and physical functioning prior to spine surgery, Mohanty et al. reported that Black or African American race predicted lower PROM scores on a measure capturing data on global physical health/functioning, pain intensity, and fatigue even when controlled for by socioeconomic status [25]. In this study Caucasian and Black patients in the lowest socioeconomic level presented with lower scores on PROM scores on measures capturing data on quality of life, physical/mental health, fatigue, social/emotional wellbeing, and pain, and that individuals from all racial backgrounds living in disadvantaged neighborhoods did have more severe presenting pathology, which the authors hypothesized could be due to care access and barriers to communication with health care providers [25]. Cheng et al investigated the influence of race, gender, and social disadvantage on self-reported health in patients with chronic pain, demonstrating that overall individuals from social disadvantaged backgrounds did have overall worse physical and mental health across different domains; when controlling for race the black race was asso-

Table 6
Average change in all subjects and Caucasian and REM groups for dizziness handicap inventory (DHI), activity specific balance confidence scale (ABC)

	All subjects					Caucasian					REM					p-value between groups pre	p-value between groups post
	N	Median (IQR) Pre	Median (IQR) Post	Median change	p-value pre-post	N	Median (IQR) Pre	Median (IQR) Post	Median change	p-value pre-post	N	Median (IQR) Pre	Median (IQR) Post	Median change	p-value pre-post		
DHI	343	40.00 (30.00)	16.00 (24.00)	24.00^	<0.001*	295	38.00 (28.00)	15.00 (23.00)	23.00^	<0.001*	48	46.00 (31.00)	19.00 (19.00)	20.91^	0.040*	0.008*	0.222
ABC (%)	241	63.00 (31.10)	85.00 (20.60)	19.46^	<0.001*	199	66.30 (31.50)	85.00 (22.70)	18.70^	<0.001*	42	53.10 (31.00)	83.70 (18.20)	30.60^	0.010*	<0.001*	0.400
FGA	282	23.00 (5.00)	27.00 (4.00)	4.00^	<0.001*	239	23.00 (5.00)	27.00 (4.00)	4.00^	<0.001*	43	23.00 (6.00)	27.00 (4.00)	4.00^	<0.001*	0.578	0.571
GS (m/s)	323	1.00 (0.31)	1.07 (0.28)	0.07	<0.001*	277	1.00 (0.30)	1.07 (0.26)	0.07	<0.001*	46	0.93 (0.29)	0.98 (0.29)	0.05	0.015*	0.239	0.206

*Statistical significance ($p = < 0.05$). ^Average change meets or exceeds MCID in IVD [32].

ciated with increased levels of anxiety only [10]. Relating findings from those studies to ours, possible reasons for increase in PROM in the REM group in this sample may be related to care access, barriers to communication with healthcare providers, or perhaps higher levels of anxiety [10, 25]. Further research, perhaps focused on qualitative methods, may explain this phenomenon and elucidate other reasons.

The most important finding of this study was that despite the differences between PROMs in REM and Caucasian groups which existed prior to VR, these groups did not have any differences in DHI, ABC, FGA, or GS at the end of VR. In essence VR was able to neutralize any HD related to the ABC and DHI which existed prior to treatment in this sample. These positive results are tempered by access limitations. The Metropolitan Service Area (MSA) racial/ethnic profile for the three areas represented in this study is as follows: Baton Rouge MSA 57% White, 35% Black, 4% Hispanic, 2% Asian; Minneapolis 72.5 % White, 8.9% Black, 6.2% Hispanic, and 6.8% Asian; New Orleans 51% White, 35% Black, 9% Hispanic, and 3% Asian [2, 9, 31]. REM constituted only 13.9% of our total sample, exemplifying that individuals from REM backgrounds in these areas do not have equal access to care compared to Caucasians in these specialty VR clinics. The scope of this study did not investigate the reasons for unequal access, but literature suggests that barriers of access to healthcare for minority or disadvantaged populations include insurance coverage, lower participation in jobs which have paid time off for medical appointments, disruptions to transportation, smaller specialist networks, and less likelihood in receiving referrals to specialist care [37]. For IVD from REM backgrounds to benefit from VR they must first make it into these specialty clinics. Since VR is a powerful intervention which appears at least in this sample to equalize HD in PROM outcome measures between Caucasian and REM, VR therapists should work with public health and policy workers to address barriers to access.

4.1. Limitations

This study presented with some limitations. Data on the number of charts excluded was not collected. Participants from this study came mostly from south Louisiana and may not be representative of the entire country. Specific data was not collected on whether participants came from rural, urban, or suburban areas. Future directions should include participants from a wide variety of geographic areas across the

USA to be truly inclusive. This sample also lacks racial diversity compared to regional demographics. Future directions should explore if individuals from REM access VR less than Caucasians. Another limitation was not consistently tracking the charts which were excluded for not meeting inclusion/exclusion criteria. Perhaps prospective REM participants were excluded because they did not finish VR (perhaps due to access/transportation issues) or had compounding health comorbidities. Furthermore, excluding individuals who self-discharged may have led to selection bias, as individuals from REM may have not continued care for a variety of barriers. Data was not collected on the type of referring provider (i.e. primary care vs. neurotologist). Further qualitative and quantitative research looking more closely into VR referral, attendance, and adherence for individuals from REM would answer these questions and guide public health policy experts to targeted solutions. Lastly this sample lacked analysis by different age subgroups, which would not have been feasible due to the limited number of subjects from REM. Future studies should expand the number of subjects and analyze by age subgroups to see if differences exist.

5. Conclusions

Data from this study suggests that HD may exist in VR in the initial PROM scores. Regardless of these differences, VR was beneficial and resulted in equal outcomes for all. Future research should pair VRTs with public health and policy professionals to address access to VR because individuals from REM will receive significant benefit from VR.

Acknowledgments

The authors would also like to acknowledge Martin Schmidt, PT, DPT, Vincent Nguyen, PT, DPT, Megan Snellgrove, PT, DPT, Garland Smith, PT, DPT, and Justin Webb, PT, DPT for contributions to this study which was completed for their Capstone Research Assignment for fulfilment of their Doctor of Physical Therapy degree.

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