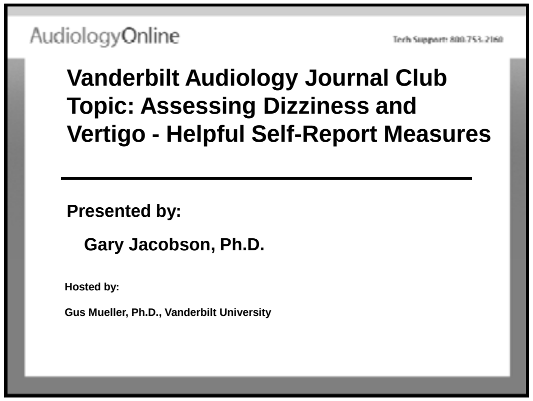

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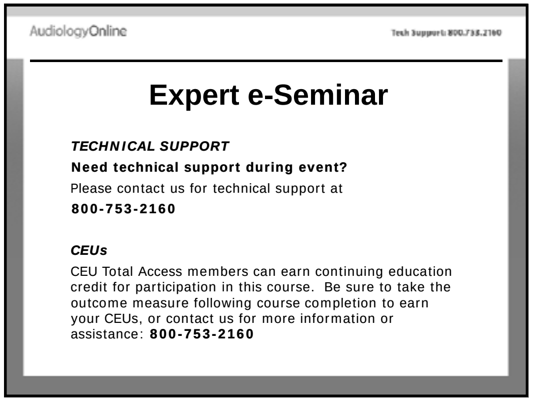
Vanderbilt Audiology Journal Club Topic: Assessing Dizziness and Vertigo - Helpful Self-Report Measures

Presented by:

Gary Jacobson, Ph.D.

Hosted by:

Gus Mueller, Ph.D., Vanderbilt University



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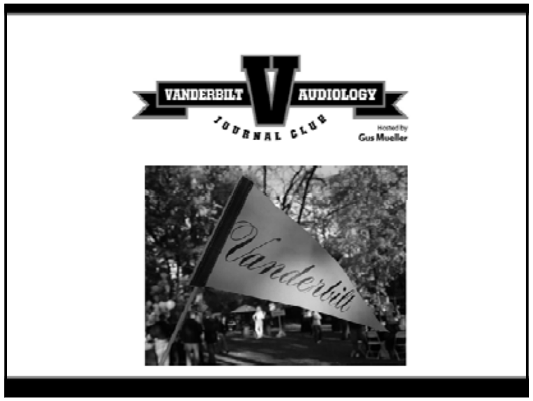

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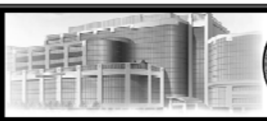

Vanderbilt Audiology Journal Club

Topic: Assessing Dizziness and Vertigo
3 ½ Helpful Questionnaires

Gary P. Jacobson, Ph.D.
Division of Audiology

VANDERBILT AUDIOLOGY
JOURNAL CLUB
Hosted by
Gus Mueller

"What They're Reading At Vandy

Brought to you by
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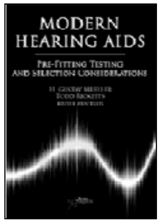
A book that you'll *hopefully* see fairly soon!



Chapter 6 is all about the self-assessment inventories used in the *pre-fitting* of hearing aids.

We selected seven scales that we thought you might be interested in using.

Some tests that you could use to learn more about your hearing aid patients

Hearing Handicap Inventory for the Elderly/Adult (HHIE/A)

- **Measures the degree of handicap for emotional and social issues related to hearing loss.**

Abbreviated Profile of Hearing Aid Benefit (APHAB)

- **Provides "percent of problems" the patient has for three different listening conditions involving speech understanding (in quiet, in background noise and in reverberation) and problems related to annoyance of environmental sounds (aversiveness scale).**

Some tests that you could use to learn more about your hearing aid patients

Expected Consequences of Hearing Aid Ownership (ECHO)

- **Measures the patient's expectations for four different areas: Positive Effect, Service and Cost, Negative Features and Personal Image.**

Client Oriented Scale of Improvement (COSI)

- **Requires patient's to identify 3-5 very specific listening goals/communication needs for amplification. Can then be used to measure patient expectations related to these specific goals..**

Some tests that you could use to learn more about your hearing aid patients

Hearing Aid Selection Profile (HASP)

- **Assesses eight patient factors related to the use of hearing aids: Motivation, Expectations, Appearance, Cost, Technology, Physical, Communication Needs, and Lifestyle.**

Link for form and scoring: http://www.audiologyonline.com/ask-the-experts/hasp-self-assessment-inventory-13

Characteristics of Amplification Tool (COAT)

- **Nine questions designed to determine patient's communication needs, motivation, expectations, cosmetic and cost concerns.**

http://www.audiologyonline.com/articles/improving-efficiency-and-accountability-hearing-995

Some tests that you could use to learn more about your hearing aid patients

Profile of Aided Loudness (PAL)

- **Assesses the patient's loudness perceptions, and satisfaction with these perceptions for 12 different everyday environmental sounds.**

Our headliner for the day . . .

Browse
Vanderbilt's new Vestibular Science Division
Subscribe
Gus Mueller, Ph.D.
Gary Jacobson, Ph.D.
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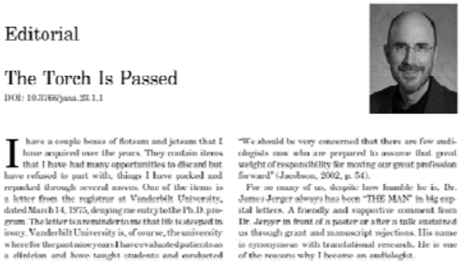
8,359,152

In his first editorial, Dr. Jacobson talks about "Flotsam, Jetsam and Jerger."



Editorial

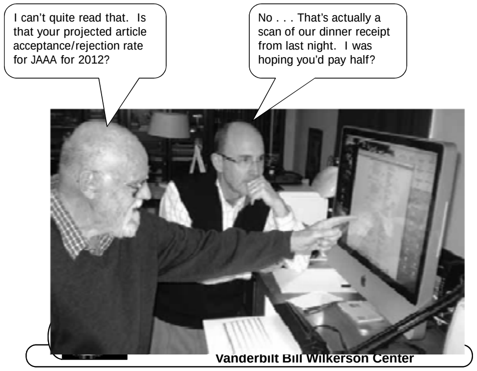
The Torch Is Passed

DOI: 10.3766/jaaa.23.1.1

I have a couple boxes of flotsam and jetsam that I have acquired over the years. They contain items that I have had many opportunities to discard but have refused to part with, things I have packed and repacked through several moves. One of the items is a letter from the registrar at Vanderbilt University, dated March 14, 1975, denying me entry to the Ph.D. program. The letter is a reminder to me that life is steeped in irony. Vanderbilt University is, of course, the university where for the past nine years I have evaluated patients as a clinician and have taught students and conducted

"We should be very concerned that there are few audiologists now who are prepared to assume that great weight of responsibility for moving our great profession forward" (Jacobson, 2002, p. 54).

For so many of us, despite how humble he is, Dr. James Jerger always has been "THE MAN" in big capital letters. A friendly and supportive comment from Dr. Jerger in front of a poster or after a talk sustained us through grant and manuscript rejections. His name is synonymous with translational research. He is one of the reasons why I became an audiologist.


I can't quite read that. Is that your projected article acceptance/rejection rate for JAAA for 2012?
No . . . That's actually a scan of our dinner receipt from last night. I was hoping you'd pay half?

Vanderbilt Audiology Journal Club

Topic: Assessing Dizziness and Vertigo

3 ½ Helpful Questionnaires

Gary P. Jacobson, Ph.D.
Division of Audiology

Balance Function Testing

- Begins with bedside tests as a means for creating hypotheses for what will be the results of q-tests.
- For the same reason also administer:
  - case history,
  - screening instrument for anxiety and depression (e.g. Chronic Subjective Dizziness - CSD),
  - measure of dizziness handicap…

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Paper-Pencil Measures That are Useful in the Balance Disorders Laboratory

- Dizziness Handicap Inventory (DHI)
- Hospital Anxiety and Depression Scale (HADS)
- Structured Interview for Migrainous Vertigo (SIM-V)
- “Expert” Structured Case History

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Dizziness Handicap Inventory (DHI) - Background

Methods of Evaluating Disability/Handicap

- Home made questionnaires (not standardized)
- Outcomes measurement instruments (less subjective) that can be:
  - e.g. General (SF-36), or,
  - Disorder (modality)-specific (i.e. hearing loss, dizziness, tinnitus)

Why Administer Quantitative Self-Report Measures?

- They provide:
  - evidence to patients and 3rd party payers that rehabilitative services are beneficial and cost-effective
  - unique information unavailable and unpredicted from quantitative tests
  - This information may be “diagnostic”

Devices Used for Measuring Dizziness Disability/Handicap

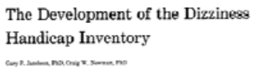
- Assessment of disability/handicap
  - Dizziness Handicap Inventory (DHI), Jacobson & Newman (1990)
  - Vertigo Handicap Questionnaire (VHQ), Yardley and Putnam (1992)
  - Subjective Disability Scale/Post-Therapy Symptom Score (SDS), Shepard et al. (1993)

Addt’l Devices Used for Measuring Dizziness Disability/Handicap

- Assessment of Handicap (Cont’d)
  - Activities-specific Balance Confidence (ABC) Scale, Powell & Myers (1995)
  - UCLA Dizziness Questionnaire (UCLA-DQ), Honrubia et al. (1996)
  - Vestibular Disorders Activities of Daily Living (VADL) Scale, Cohen and Kimball (2000)

Dizziness Handicap Inventory - DHI Modality-specific Self-Report Measure

- 25-item self-assessment inventory designed to measure the impact that dizziness and unsteadiness has on a patients quality of life

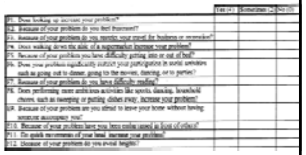


The Development of the Dizziness Handicap Inventory

Gary P. Jacobson, PhD, Craig W. Newman, PhD

Dizziness Handicap Inventory

- 25 questions are answered using a “yes,” 4 pts “sometimes,” 2 pts. and “no,” 0 pts. format.
- Total score ranges between “0” and “100” (0-100 maximum handicap)



	Yes (4)	Sometimes (2)	No (0)
P1. Does looking up increase your problem?			
E2. Because of your problem do you feel frustrated?			
F3. Because of your problem do you restrict your travel for business or recreation?			
P4. Does walking down the aisle of a supermarket increase your problem?			
F5. Because of your problem you have difficulty getting into or out of bed?			
F6. Does your problem significantly restrict your participation in social activities such as going out to dinner, going to the movies, dancing, or to parties?			
F7. Because of your problem do you have difficulty reading?			
P8. Does performing more ambitious activities like sports, dancing, household chores, such as sweeping or putting dishes away, increase your problem?			
E9. Because of your problem are you afraid to leave your home without having someone accompany you?			
E10. Because of your problem have you been embarrassed in front of others?			
P11. Do quick movements of your head increase your problem?			
F12. Because of your problem do you avoid heights?			

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Dizziness Handicap Inventory (DHI)

- 3 subscales: functional, emotional and physical
- Factor analyses failed to support the empirically-derived factor structure of the DHI
  - Clinical application should be limited to total score

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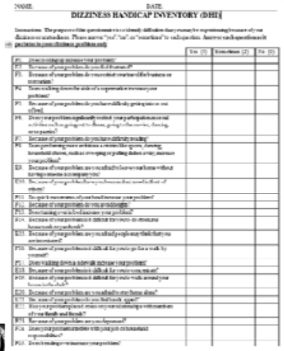

NAME: DATE:

DIZZINESS HANDICAP INVENTORY (DHI)

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Psychometric Adequacy of DHI

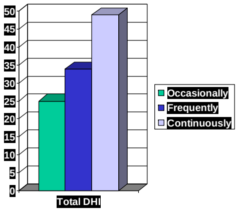
Internal Consistency Reliability
Test-retest Reliability

- Cronbach’s alpha for total and subscales 0.72-0.89
- High test-retest reliability (r = 0.97; 95% confidence interval = 18 pts)

Psychometric Adequacy of DHI

Validity of DHI

- Total DHI score increases with increased frequency of vertiginous spells



Psychometric Adequacy of DHI

Interquartile Ranges-Freq of Spells

Jacobson and Newman, 1990; Jacobson and McCaslin, 2006

Range	Classification	Freq. of Episodes	Mean Total DHI-T
0-14	None	-	-
16-26	Mild	Occasionally (<12/yr)	25
28-44	Moderate	Frequently (≥ 12/yr)	34
>44	Severe	Continuously	49

Significant differences between occasionally and frequently, occasionally and continuously and frequently and continuously

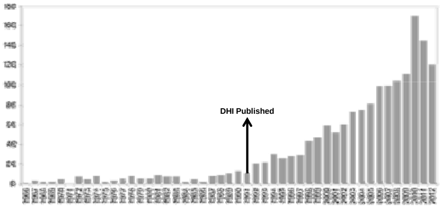
DHI Translations

18 Languages + English

- Arabic
- Argentine
- Brazilian
- Chinese
- Croatian
- Dutch for Belgium
- French
- German
- Hebrew
- Hungarian
- Italian
- Japanese
- Norwegian
- Polish
- Portuguese for Brazil
- Russian
- Spanish
- Swedish
- Ig-pay atin-lay
- Klingon
- Parseltongue
- Esperanto

Numbers of Investigations re: Dizziness Disability/Handicap

1966-2012



Courtesy of E.G. Piker, Ph.D.

Aside from obvious clinical applications, what can you do with standardized self-report measures?

Article 1: Whitney et al. 2005

Otology & Neurotology
26:1027-1033 © 2005, Otology & Neurotology, Inc.

Usefulness of the Dizziness Handicap Inventory in the Screening for Benign Paroxysmal Positional Vertigo

*†‡Susan L. Whitney, §Gregory F. Marchetti, and ‡Laura O. Morris

**Departments of Physical Therapy and †Otolaryngology, University of Pittsburgh, ‡Centers for Rehabilitation Services, University of Pittsburgh Medical Center, and §Duquesne University, Pittsburgh, Pennsylvania, U.S.A.*

Introduction
BPPV

- Affects an estimated 17%-22.5% of patients seen in a dizziness clinic
- Incidence is ~1:1500 with a greater incidence with increased age
- Older patients with undiagnosed BPPV have a greater number of falls, depression, and impairments of ADLs
- Diagnosis of anterior and posterior SCC BPPV:
  - “Dix-Hallpike test”
- Diagnosis of horizontal canal BPPV:
  - “head-roll test”

DHI

- Whitney et al. (2005) proposed that positive endorsements of specific items within the DHI (i.e. physical subscale) could increase the level of suspicion that BPPV might exist
- Hypothesized that responses to those 5 items would assist physician in making an accurate diagnosis of BPPV

Created a “Mini DHI”

(My words not Whitney et al.)

- Item content:
  - Looking up
  - Difficulty getting out of bed
  - Quick head movements
  - Rolling over in bed
  - Bending over
- Created 5-item, and then 2-item “mini-DHIs”

DHI as a Predictor of BPPV

Whitney, Marchetti, Morris, 2005

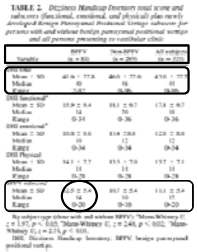
- P1 – Does looking up increase your problem?
- *F5 – Because of your problem do you have difficulty getting into, or out of, bed?
- P11 – Do quick movements of you head increase you problem?
- *P13 - Does turning over in bed increase your problem?
- P25 - Does bending over increase your problem?

*From 2-item DHI

Methods

- Retrospective chart review between Sept. 1998 and March 2003.
- N = 373
  - 90% referred from ENTs & neurologists
    - 22% of sample with dx of BPPV (positive Dix-Hallpike maneuver)
    - 45.6% with dx of dizziness
    - 16.6% with dx of gait impairment

DHI-t scores for those with, and without, BPPV were not significantly different



Results:
Estimated Probabilities and Computed Likelihood Ratios (LR)

- LR is the “…likelihood that a particular test finding would be seen in a patient with BPPV relative to the chance that the same result would be seen in a patient without BPPV”
- LRs were calculated for both the sum of the 2 item DHI (i.e. “getting out of” and “rolling over” in bed”) and the sum of the 5-item DHI

DHI as a Predictor of BPPV

Whitney, Marchetti, Morris, 2005

- Patients scoring 20 pts (100%) on the 5-item scale (“yes” X 5) had a 35% probability of having BPPV
- Patients scoring 4 pts. (i.e. “sometimes” X 2) on the 2-item version
  - 2.7X risk of having BPPV
- Patients scoring 8 pts on the 2-item version (i.e. “yes” X 2)
  - 4.3X risk of having BPPV

Results
5 item mini DHI

- Probability of having BPPV for patients scoring:
  - 0 pts. = 12%
  - 10 pts = 21%
  - 20 pts = 35%

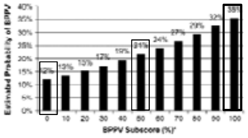


FIG. 2. Estimated probability of having BPPV given responses to DHI items 1 (looking up), 5 (getting out of bed), 11 (quick head movements), 13 (rolling over in bed), and 25 (bending) in individuals presenting to a balance and falls clinic (n = 373). Sum of responses: (looking up) + (getting out of bed) + (quick head movement) + (turning over in bed) + (bending over)/20 × 100.

What, if any, is the usefulness of the mini-DHI (either 2- or 5-item)

- Short to administer to screen for administering the Dix-Hallpike maneuver
- Provides a means of hypothesizing what will be the results of other tests in the battery (e.g. Dix-Hallpike or head roll)
- Might be useful as screening tool in IM or geriatrics to gate the flow of patients to imaging

---

Structured Interview for Migrainous Vertigo - SIM-V Background

Famous Migraineurs

Lewis Carroll
author of
Alice in Wonderland

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Statistics: Migraine Headaches

- 28 million Americans suffer from migraine headaches
- 50% experience migraine headache but have not been diagnosed.
- 39% of migraineurs do not seek medical help
- 21% of those diagnosed with migraine discontinue medical care because of inadequate treatment

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Statistics: Migraine Headaches

- 70% of the 1 million headache consultations are conducted by primary care physicians
- 20% report headache as the reason for their initial physician visit
- Migraineurs have tried, on average, 4.6 different medications before finding effective treatment!!
- Some patients feel migraine headache is a fact of life.

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Inheritance of Migraine

- Migraine is an inherited neurological disorder
  - ~90% of migraineurs have a primary relative with migraine headache
- Migraineurs have sensitive CNS that can be disrupted by: sleep deprivation, strong odors, traveling, skipping meals, stress, sex and changes in hormone levels

---

Epidemiology

- Women experience 2-3x more often than men
- Begin during childhood or adolescence
- For children equally distributed between boys and girls
- During early adolescence more women than men
- After menopause estrogen levels decrease and stabilize reducing migraine frequency
- Therefore if women are placed on HRP, migraine can become persistent into later life

---

Epidemiology

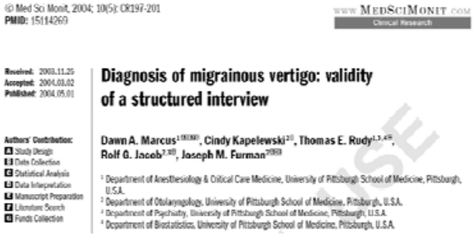
- Can begin having migraine when taking antihypertensives, oral contraceptives, HRP however migraine usually occurs due to multiple coexisting triggers
- Frequency of migraine
  - 59% = 1- 4 attacks/month,
  - 22% = 10 or more attacks/month
- Headaches last 24-72 hours

Epidemiology

- Headache can be disabling and handicapping
- Poorly controlled migraine can result in a downward socioeconomic spiral.

The Henry Ford Hospital Headache Disability Inventory (HDI)

Article 2: Marcus et al, 2004



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Clinical Research

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Diagnosis of migrainous vertigo: validity of a structured interview

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Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

"Migraine-associated Vertigo" aka "Migraine-related Vertigo" aka "Migrainous Vertigo"

- Terms may describe:
  - symptoms where migraine and vertigo co-occur in the same patient, or
  - where vertigo symptoms are integral part of migraine symptomatology (term is "migrainous vertigo")
- Migraine as the cause of vertigo estimated to occur in:
  - 35% of pediatric patients and
  - ~6% of adult patients seen for dizziness

Vestibular Pathology in Migraine

- **Spontaneous and/or positional nystagmus: 5-15%**
- **Abnormal caloric test: 8-24%**
- **Abnormal posturography: 26-33%**

From: Marcus et al. 2004

- **Neuhauser et al. 2001 developed criteria to define migrainous vertigo**
- **Using criteria, Neuhauser et al. identified migrainous vertigo in 9% of migraine patients (~1:10?)**

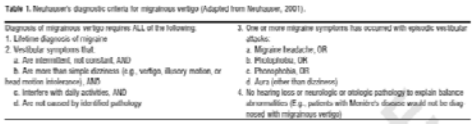


Table 1. Neuhauser's diagnostic criteria for migrainous vertigo (Adapted from Neuhauser, 2001).

Diagnosis of migrainous vertigo requires ALL of the following:

1. Lifetime diagnosis of migraine
2. Vestibular symptoms that:
   a. Are intermittent, not constant, AND
   b. Are more than simple dizziness (e.g., vertigo, illusory motion, or head motion intolerance), AND
   c. Interfere with daily activities, AND
   d. Are not caused by identified pathology
3. One or more migraine symptoms has occurred with episodic vestibular attacks:
   a. Migraine headache, OR
   b. Photophobia, OR
   c. Phonophobia, OR
   d. Aura (other than dizziness)
4. No hearing loss or neurologic or otologic pathology to explain balance abnormalities (E.g., patients with Menière's disease would not be diagnosed with migrainous vertigo)

Using Neuhauser et al. 2001 Criteria

- **Furman et al. (2003) developed a structured interview for migrainous vertigo (SIM-V)**
- **Structured interview results in a standardized application of the criteria**
- **Study objective:**
  - **test the reliability of structured interview compared to physician assessment (i.e. agreement between SIM-V and clinical assessment)**

Sim-V - Marcus et al. 2004
(Flow sheet)

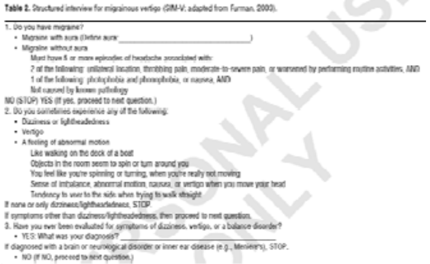


Table 2. Structured interview for migrainous vertigo (SIM-V; adapted from Furman, 2000).

1. Do you have migraine?
   - Migraine with aura (Define aura: ______________________)
   - Migraine without aura
     Must have 5 or more episodes of headache associated with:
     2 of the following: unilateral location, throbbing pain, moderate-to-severe pain, or worsened by performing routine activities, AND
     1 of the following: photophobia and phonophobia, or nausea, AND
     Not caused by known pathology

NO (STOP) YES (If yes, proceed to next question.)

2. Do you sometimes experience any of the following:
   - Dizziness or lightheadedness
   - Vertigo
   - A feeling of abnormal motion
     Like walking on the dock of a boat
     Objects in the room seem to spin or turn around you
     You feel like you're spinning or turning, when you're really not moving
     Sense of imbalance, abnormal motion, nausea, or vertigo when you move your head
     Tendency to veer to the side when trying to walk straight

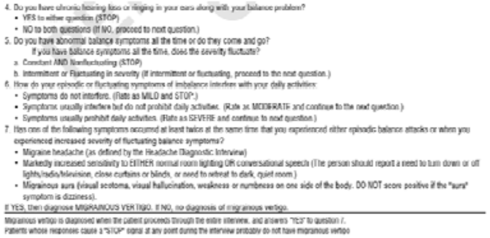
If none or only dizziness/lightheadedness, STOP.
If symptoms other than dizziness/lightheadedness, then proceed to next question.

3. Have you ever been evaluated for symptoms of dizziness, vertigo, or a balance disorder?
   - YES: What was your diagnosis? ______________________

If diagnosed with a brain or neurological disorder or inner ear disease (e.g., Meniere's), STOP.
   - NO (If NO, proceed to next question.)

PERSONAL USE ONLY

SIM-V Marcus et al. 2004



4. Do you have chronic hearing loss or ringing in your ears along with your balance problem?
   - YES to either question (STOP)
   - NO to both questions (If NO, proceed to next question.)
5. Do you have abnormal balance symptoms all the time or do they come and go?
   If you have balance symptoms all the time, does the severity fluctuate?
   a. Constant AND Nonfluctuating (STOP)
   b. Intermittent or Fluctuating in severity (If intermittent or fluctuating, proceed to the next question.)
6. How do your episodic or fluctuating symptoms of imbalance interfere with your daily activities:
   - Symptoms do not interfere. (Rate as MILD and STOP.)
   - Symptoms usually interfere but do not prohibit daily activities. (Rate as MODERATE and continue to the next question.)
   - Symptoms usually prohibit daily activities. (Rate as SEVERE and continue to next question.)
7. Has one of the following symptoms occurred at least twice at the same time that you experienced either episodic balance attacks or when you experienced increased severity of fluctuating balance symptoms?
   - Migraine headache (as defined by the Headache Diagnostic Interview)
   - Markedly increased sensitivity to EITHER normal room lighting OR conversational speech (The person should report a need to turn down or off lights/radio/television, close curtains or blinds, or need to retreat to dark, quiet room.)
   - Migrainous aura (visual scotoma, visual hallucination, weakness or numbness on one side of the body. DO NOT score positive if the "aura" symptom is dizziness).

If YES, then diagnose MIGRAINOUS VERTIGO. If NO, no diagnosis of migrainous vertigo.

Migrainous vertigo is diagnosed when the patient proceeds through the entire interview, and answers "YES" to question 7.
Patients whose responses cause a "STOP" signal at any point during the interview probably do not have migrainous vertigo

---

Methods

- **N = 17**
- **Evaluated by**
  - **neurologist to confirm diagnosis of migraine (IHS)**
  - **neurotologist to confirm diagnosis of migrainous vertigo**
- **Separately, all subjects independently screened by an RN using SIM-V**
- **82% of subjects retested (t/rt reliability)**

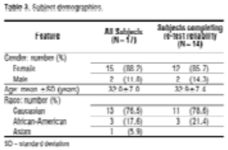


Table 3. Subject demographics.

Feature	All Subjects (N = 17)		Subjects completing re-test reliability (N = 14)	
Gender: number (%)				
Female	15	(88.2)	12	(85.7)
Male	2	(11.8)	2	(14.3)
Age: mean ± SD (years)	32.0 ± 7.0		32.9 ± 7.4	
Race: number (%)				
Caucasian	13	(76.5)	11	(78.6)
African-American	3	(17.6)	3	(21.4)
Asian	1	(5.9)		

SD – standard deviation

Analyses and Results

- Comparison between MD and nurse (i.e. SIM-V) diagnosis: kappa = 0.75
  - i.e. $\geq$ .60 good validity
  - $\geq$ .75 excellent validity
- Predictive values: sensitivity = 71%, specificity = 100% and
- Test/retest reliability (N= 14; mean interval 178 days): kappa = 0.75

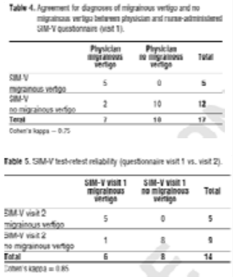


Table 4. Agreement for diagnoses of migrainous vertigo and no migrainous vertigo between physician and nurse-administered SIM-V questionnaire (visit 1).

	Physician migrainous vertigo	Physician no migrainous vertigo	Total
SIM-V migrainous vertigo	5	0	5
SIM-V no migrainous vertigo	2	10	12
Total	7	10	17

Cohen's kappa = 0.75

Table 5. SIM-V test-retest reliability (questionnaire visit 1 vs. visit 2).

	SIM-V visit 1 migrainous vertigo	SIM-V visit 1 no migrainous vertigo	Total
SIM-V visit 2 migrainous vertigo	5	0	5
SIM-V visit 2 no migrainous vertigo	1	8	9
Total	6	8	14

Cohen's kappa = 0.85

•Cohen's kappa is an index of inter-rater agreement

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Conclusions and Comments

- Limitations of study
  - Small sample size
  - Success depends on patient as an accurate historian
  - Need for pediatric version of this structured interview with 35% of pediatric dizziness from migraine
- Merits of study
  - Standardized assessment
  - Provides a means for creating an hypothesis "diagnosing" (per Neuhauser criteria) in the context of the BFT

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And now it's time for . . .

Vandy Vignettes

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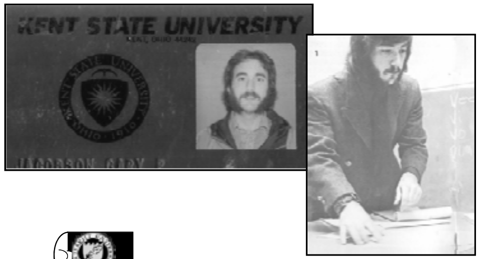
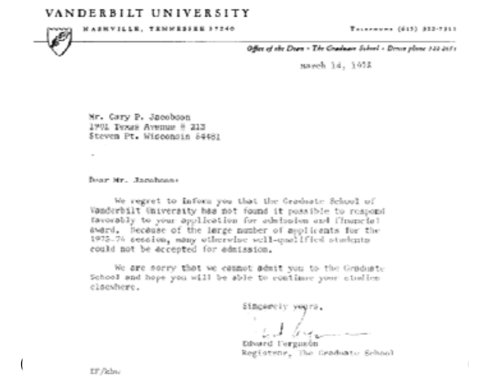
To set the stage . . .
(we'll go back to 1974)



THE LETTER

Mr. Gary Jacobson



VANDERBILT UNIVERSITY
NASHVILLE, TENNESSEE 37240
Office of the Dean · The Graduate School

March 14, 1975

Mr. Gary P. Jacobson
1701 Texas Avenue # 212
Steven Pt. Wisconsin 54481

Dear Mr. Jacobson:

We regret to inform you that the Graduate School of Vanderbilt University has not found it possible to respond favorably to your application for admission and financial award. Because of the large number of applicants for the 1975-76 session, many otherwise well-qualified students could not be accepted for admission.

We are sorry that we cannot admit you to the Graduate School and hope you will be able to continue your studies elsewhere.

Sincerely yours,

Edward Ferguson
Registrar, The Graduate School

EF/kbw

Article 3: Horii et al. 2007

Effects of fluvoxamine on anxiety, depression, and subjective handicaps of chronic dizziness patients with or without neuro-otologic diseases

Arata Horii*, Atsuhiko Uno, Tadashi Kitahara, Kenji Mitani, Chisako Masumura, Kaoru Kizawa and Takeshi Kubo

Department of Otolaryngology, Osaka University School of Medicine, Osaka, Japan

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Introduction

- Two problems in the treatment of dizzy patients
  - Some dizzy patients demonstrate normal q-tests
  - Some patients are abnormal on tests but do not respond to conventional vertigo medications

---

Introduction

- Investigators suggested:
  - dizzy patients without abnormal q-tests most likely had psychiatric disorders
  - dizzy patients with positive tests without improvement on antivertigo medications had pre-existing psychiatric disorder
  - Appropriate treatment of the psychiatric disorder would result in “remission of dizziness.”

Introduction

- Suggested that dizzy patients without positive neurotologic findings would:
  - …have abnormal Hospital Anxiety and Depression Scale (HADS) scores and Dizziness Handicap Inventory (DHI) scores and
  - …demonstrate improvement with a selective serotonin re-uptake inhibitor (SSRI)

Introduction

- Hypothesis: The SSRI would be effective on self-report handicaps and anxiety/depression in neurotology patients by “acting on their possible co-morbid psychiatric disorders”
  - Predicted a positive correlation between scores on the HADS and the DHI

Methods

- Treated 60 (41) consecutive dizzy patients with or without neurotologic diseases using Luvox (fluvoxamine) which is a selective serotonin reuptake inhibitor (SSRI)
- Outcome measures:
  - “slightly modified” Japanese translation of the DHI.
    - 14 items
    - 1 (no handicap) - 5 scale (severe handicap)scale
    - Max. score = 70 pts

“Slightly modified” Japanese adaptation of “Jacobson’s Dizziness Handicap Inventory”

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Dizziness and Unsteadiness Questionnaire

- Administered the HADS and DHI before and then after 8 weeks of pharmacotherapy
  - Week 1 – 100 mg/Luvox per day po
  - Week 2-8 – dosage increased to 200 mg/day.

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Methods

- Hospital Anxiety and Depression Scale (HADS)
  - 14 item
  - validated,
  - self-report measure of anxiety and depression

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Hospital Anxiety and Depression Scale (HADS)

Zigmond and Snaith, 1983

Maximum anxiety subscale score = 21 points

Maximum depression subscale score = 21 points

Abnormal for us = ≥ 11 points

Cut-off of 8 points: yields specificity of .78 and sensitivity of .9 for anxiety and specificity of .79 and sensitivity of .83 for depression

Bjelland et al. (2002)

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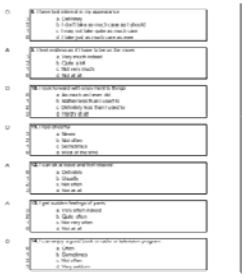
Hospital Anxiety and Depression Scale (HADS)

Zigmond and Snaith, 1983

These investigators used a cut-off value of 12 points (92% sensitivity and 90% specificity)



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Methods

- **Otoneurological examination =**
  - **spontaneous nystagmus test,**
  - **caloric test,**
  - **posturography and**
  - **pure tone audiometry**
- **Patients were diagnosed based on Japan Society for Equilibrium Research criteria**

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Methods

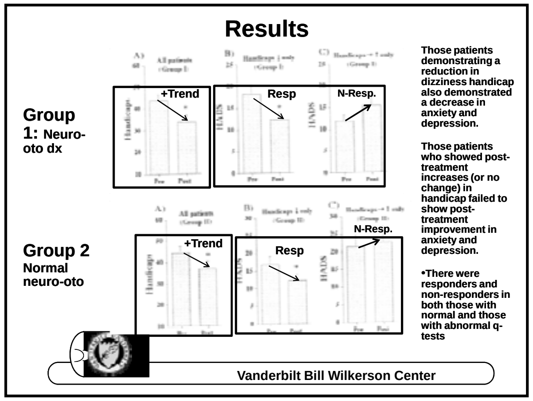
- Began with 60 subjects, final group = 41 subjects
- Patients divided into 2 groups.
- Group 1 (N = 19, mean duration of dizziness = 19 months) = patients with neurotologic diseases (peripheral impairments),
- Group 2 (N = 22, mean duration of dizziness = 21 months) = patients with normal neurotologic findings

Results: Baseline Mean HADS Subscale Scores (≥12 points = abnormal)

	Depression	Anxiety
Group 1	7.5 (+/- 0.7)	8.5 (+/- 0.7)
Group 2	7.9 (+/- 0.9)	9.4 (+/- 0.6)

Results

- Group 1 (Abnormal oto): Trend for self-report handicaps to be reduced following treatment…
  - “Responders:” demonstrated a reduction in self-report handicap and demonstrated a significant reduction in post-treatment HADS
  - “Non-responders”: no significant decrease in handicap or HADS
- Group 2 (Normal oto): Same trends were observed for subjects in Group 2 as in Group 1



Results

Group 1: Neuro-oto dx

Group 2 Normal neuro-oto

Those patients demonstrating a reduction in dizziness handicap also demonstrated a decrease in anxiety and depression.

Those patients who showed post-treatment increases (or no change) in handicap failed to show post-treatment improvement in anxiety and depression.

•There were responders and non-responders in both those with normal and those with abnormal q-tests

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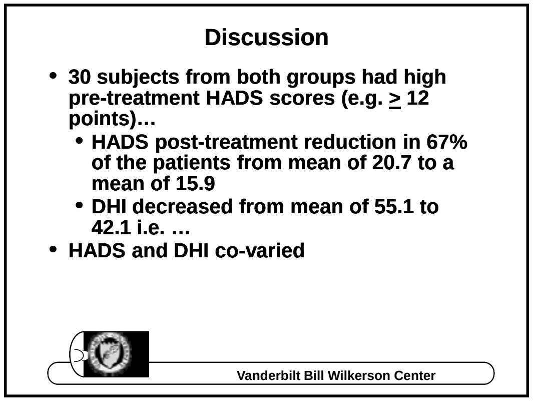

Discussion

- 30 subjects from both groups had high pre-treatment HADS scores (e.g. $\geq$ 12 points)…
  - HADS post-treatment reduction in 67% of the patients from mean of 20.7 to a mean of 15.9
  - DHI decreased from mean of 55.1 to 42.1 i.e. …
- HADS and DHI co-varied

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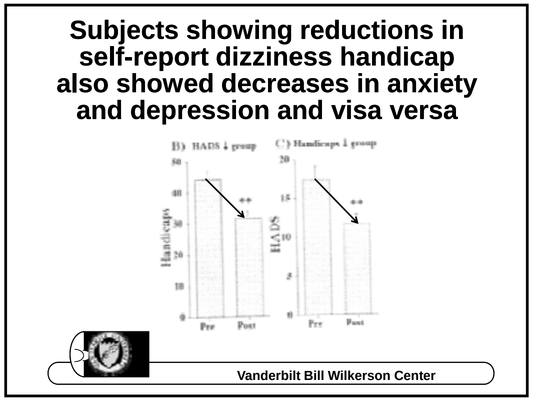

Subjects showing reductions in self-report dizziness handicap also showed decreases in anxiety and depression and visa versa

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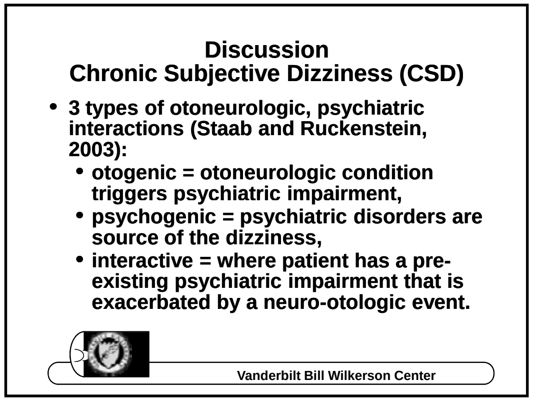

Discussion
Chronic Subjective Dizziness (CSD)

- 3 types of otoneurologic, psychiatric interactions (Staab and Ruckenstein, 2003):
  - otogenic = otoneurologic condition triggers psychiatric impairment,
  - psychogenic = psychiatric disorders are source of the dizziness,
  - interactive = where patient has a pre-existing psychiatric impairment that is exacerbated by a neuro-otologic event.

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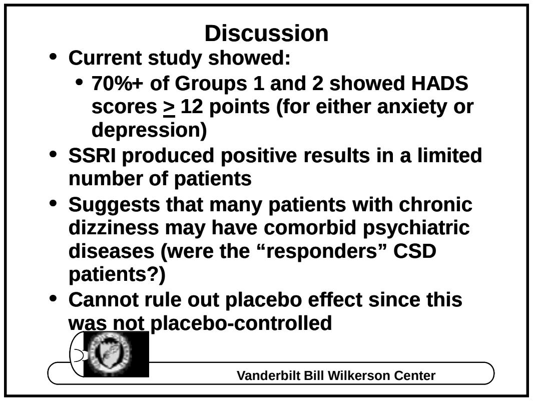

Discussion

- Current study showed:
  - 70%+ of Groups 1 and 2 showed HADS scores $\geq$ 12 points (for either anxiety or depression)
- SSRI produced positive results in a limited number of patients
- Suggests that many patients with chronic dizziness may have comorbid psychiatric diseases (were the “responders” CSD patients?)
- Cannot rule out placebo effect since this was not placebo-controlled

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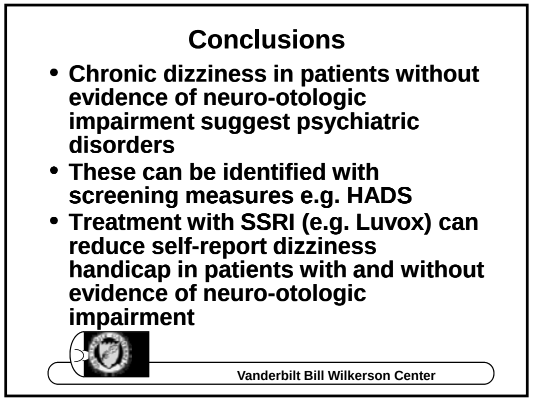

Conclusions

- Chronic dizziness in patients without evidence of neuro-otologic impairment suggest psychiatric disorders
- These can be identified with screening measures e.g. HADS
- Treatment with SSRI (e.g. Luvox) can reduce self-report dizziness handicap in patients with and without evidence of neuro-otologic impairment

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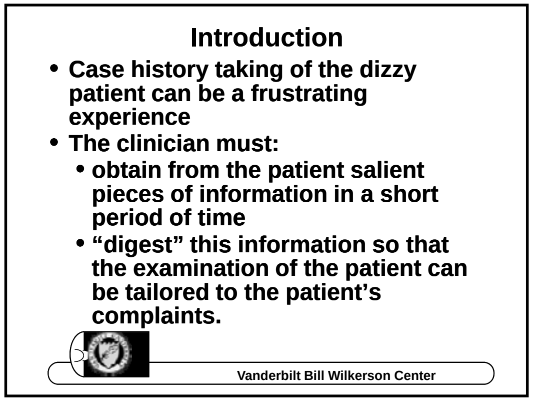
Conclusions

- Action of medication is on both co-morbid anxiety and depression that is either the primary source of dizziness or a reaction to neuro-otologic impairment
- More aggressive psychiatric interventions may be required for non-responders with high pretreatment HADS.

Comments

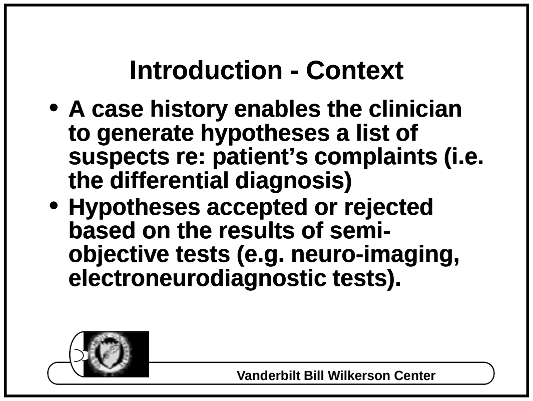
- Illustration of how the HADS can be used in the clinic to:
  - identify subgroups of dizzy patients (anxious and/or depressed)
  - plan treatment
  - measure effects of treatment
- All patients visiting our clinic complete a DHI and a HADS (minimally)

Article 4: “Expert” Case History - Background



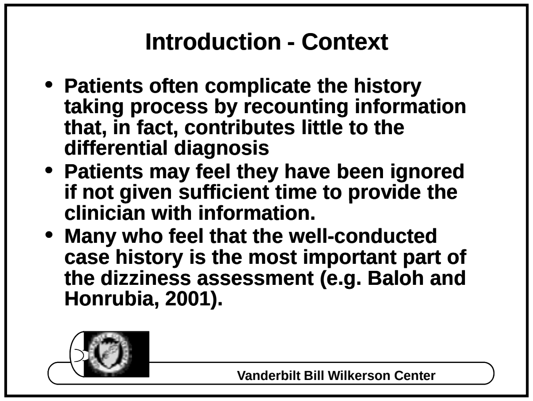
Introduction

- Case history taking of the dizzy patient can be a frustrating experience
- The clinician must:
  - obtain from the patient salient pieces of information in a short period of time
  - “digest” this information so that the examination of the patient can be tailored to the patient’s complaints.



Introduction - Context

- A case history enables the clinician to generate hypotheses a list of suspects re: patient’s complaints (i.e. the differential diagnosis)
- Hypotheses accepted or rejected based on the results of semi-objective tests (e.g. neuro-imaging, electroneurodiagnostic tests).



Introduction - Context

- Patients often complicate the history taking process by recounting information that, in fact, contributes little to the differential diagnosis
- Patients may feel they have been ignored if not given sufficient time to provide the clinician with information.
- Many who feel that the well-conducted case history is the most important part of the dizziness assessment (e.g. Baloh and Honrubia, 2001).

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Commodore Award

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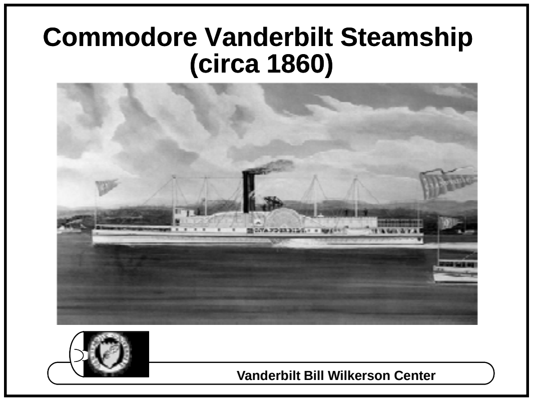

Commodore Vanderbilt Steamship (circa 1860)

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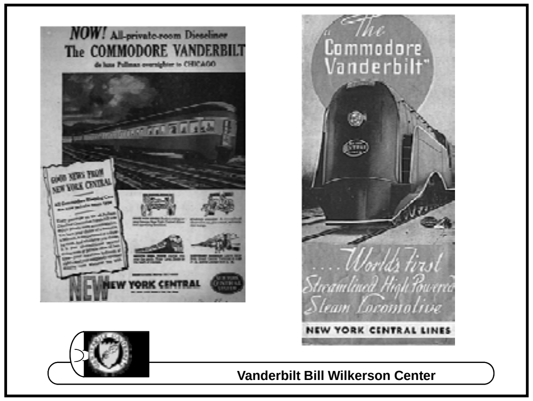
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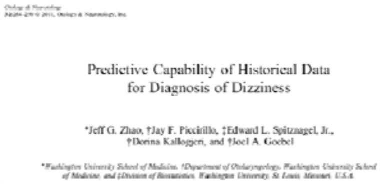
Commodore Award!!
Zhao et al. 2011



Predictive Capability of Historical Data
for Diagnosis of Dizziness

*Jeff G. Zhao, †Jay F. Piccirillo, ‡Edward L. Spitznagel, Jr.,
†Dorina Kallogjeri, and †Joel A. Goebel

*Washington University School of Medicine, †Department of Otolaryngology, Washington University School of Medicine, and ‡Division of Biostatistics, Washington University, St. Louis, Missouri, U.S.A.

Introduction - Context

- **A number of investigators have developed “expert” case history questionnaires**
- **If/Then algorithms modify the questions asked of the patient until a final “working diagnosis” is obtained.**
- **Attempts to develop these “expert" questionnaires have met with varied levels of success**

Introduction - Context

- **There is a place in the dizziness clinic for an “expert diagnostic questionnaire.”**
- **The product of such a questionnaire could be viewed by the provider moments prior to the visit so that case history taking could be more focused on the possible sources of dizziness.**

Introduction - Context

- An “expert” case history device could be used by primary care providers who “gate” the referral of patients to specialists based on history (e.g. BPPV vs Meniere’s Syndrome).
- Lastly, to the extent that dizziness diseases/disorders are diagnosed in large part based on history a device of this type might assist in the determination of the final diagnosis

Zhao: The Differential Diagnosis of Dizziness is Complicated

- Dizziness can be caused by e.g. vestibular, neurological and cardiological disorders, however,…
- Diagnosis often becomes the job of primary care or ER physicians (i.e. who have limited training, time and resources)
- Patient descriptions can be “unclear, inconsistent and unreliable.”

Zhao: The Differential Diagnosis of Dizziness is Complicated

- Physician must rely on history and and PE to determine “next steps”
- When a correct diagnosis occurs often there are efficacious treatments
- In this context “…a simple, inexpensive, and accurate questionnaire-based diagnostic algorithm would be highly welcome.”

For > 20 years

- The balance center at Washington University SOM, Department of Otolaryngology has used a clinical questionnaire completed by the patient before the appointment with the physician
- The questionnaire was used to identify subgroups of items that contributed to the eventual diagnosis…
- …and to determine "…the power of …sets of symptoms to distinguish between different diagnoses of dizziness"

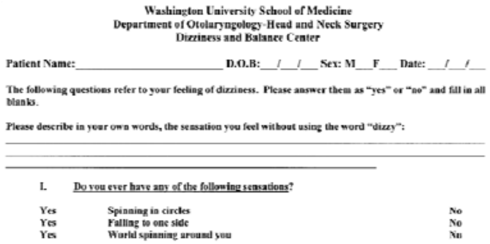
Methods

- Retrospective review of charts from N = 619 patients all with dizziness or postural instability.
- Mean age 57 years (sd 16 years, 40% male)
- 163 item questionnaire, 1 hour to complete
  - 86 questions specific to dizziness
  - 77 questions "general review of symptoms…overall health complaints"
- Some questions had 2 possible answers (e.g. yes/no) others were multichoice ("In which position are you the most dizzy?" (e.g. a, b, c, d)

Questionnaire Study

- Content areas:
  - Description of the spell
  - Symptoms indicative of peripheral cause
  - Symptoms indicative of central cause
  - Auditory complaints
  - General physical and emotional health questions

47-item Version of "Expert Questionnaire"



Washington University School of Medicine
Department of Otolaryngology-Head and Neck Surgery
Dizziness and Balance Center

Patient Name:________________________ D.O.B:\___/___/___ Sex: M___F___ Date: ___/___/___

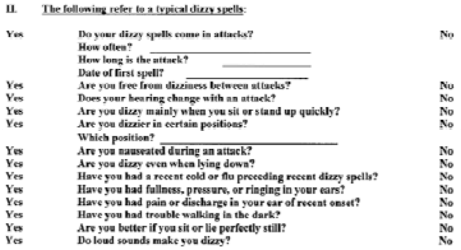
The following questions refer to your feeling of dizziness. Please answer them as "yes" or "no" and fill in all blanks.

Please describe in your own words, the sensation you feel without using the word "dizzy":

I. **Do you ever have any of the following sensations?**

Yes	Spinning in circles	No
Yes	Falling to one side	No
Yes	World spinning around you	No

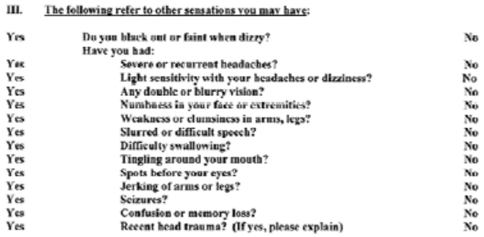
Sample Questions
Peripheral Cause of Dizziness



II. **The following refer to a typical dizzy spells:**

Yes	Do your dizzy spells come in attacks?	No
	How often? ________________	
	How long is the attack? __________	
	Date of first spell? _____________	
Yes	Are you free from dizziness between attacks?	No
Yes	Does your hearing change with an attack?	No
Yes	Are you dizzy mainly when you sit or stand up quickly?	No
Yes	Are you dizzier in certain positions?	No
	Which position? __________________	
Yes	Are you nauseated during an attack?	No
Yes	Are you dizzy even when lying down?	No
Yes	Have you had a recent cold or flu preceding recent dizzy spells?	No
Yes	Have you had fullness, pressure, or ringing in your ears?	No
Yes	Have you had pain or discharge in your ear of recent onset?	No
Yes	Have you had trouble walking in the dark?	No
Yes	Are you better if you sit or lie perfectly still?	No
Yes	Do loud sounds make you dizzy?	No

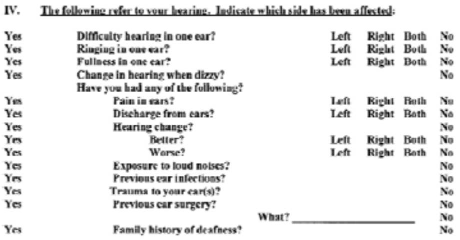
Sample Questions
CNS Cause of Dizziness



III. **The following refer to other sensations you may have:**

Yes	Do you black out or faint when dizzy?	No
	Have you had:	
Yes	Severe or recurrent headaches?	No
Yes	Light sensitivity with your headaches or dizziness?	No
Yes	Any double or blurry vision?	No
Yes	Numbness in your face or extremities?	No
Yes	Weakness or clumsiness in arms, legs?	No
Yes	Slurred or difficult speech?	No
Yes	Difficulty swallowing?	No
Yes	Tingling around your mouth?	No
Yes	Spots before your eyes?	No
Yes	Jerking of arms or legs?	No
Yes	Seizures?	No
Yes	Confusion or memory loss?	No
Yes	Recent head trauma? (If yes, please explain)	No

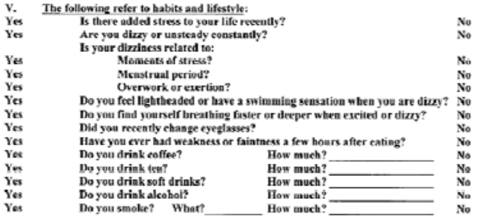
http://links.lww.com/MAO/A45
Sample Items Auditory Complaints



IV. The following refer to your hearing. Indicate which side has been affected:

Yes	Difficulty hearing in one ear?	Left	Right	Both	No
Yes	Ringing in one ear?	Left	Right	Both	No
Yes	Fullness in one ear?	Left	Right	Both	No
Yes	Change in hearing when dizzy?				No
	Have you had any of the following?				
Yes	Pain in ears?	Left	Right	Both	No
Yes	Discharge from ears?	Left	Right	Both	No
Yes	Hearing change?				No
Yes	Better?	Left	Right	Both	No
Yes	Worse?	Left	Right	Both	No
Yes	Exposure to loud noises?				No
Yes	Previous ear infections?				No
Yes	Trauma to your ear(s)?				No
Yes	Previous ear surgery?				No
	What? ____________				No
Yes	Family history of deafness?				No

General Physical and Emotional Health Questions



V. The following refer to habits and lifestyle:

Yes	Is there added stress to your life recently?		No
Yes	Are you dizzy or unsteady constantly?		No
	Is your dizziness related to:		
Yes	Moments of stress?		No
Yes	Menstrual period?		No
Yes	Overwork or exertion?		No
Yes	Do you feel lightheaded or have a swimming sensation when you are dizzy?		No
Yes	Do you find yourself breathing faster or deeper when excited or dizzy?		No
Yes	Did you recently change eyeglasses?		No
Yes	Have you ever had weakness or faintness a few hours after eating?		No
Yes	Do you drink coffee?	How much? ____________	No
Yes	Do you drink tea?	How much? ____________	No
Yes	Do you drink soft drinks?	How much? ____________	No
Yes	Do you drink alcohol?	How much? ____________	No
Yes	Do you smoke? What? ________	How much? ____________	No

Final Diagnoses
(64% with diagnoses)

- BPPV – 26.5%
- Migraine associated dizziness- 16.3%
- Meniere’s disease – 13.2%
- Vestibular neuritis – 7.9%
- Other vestibular – 9.0%
- Other central – 12.3%
- Other miscellaneous – 12.6%
- Unknown – 2.2%

Diagnosis - BPPV

- Items positively correlated =
  - History of dizziness when laying down (OR = 9.7)
  - Position-dependent dizziness (OR = 3.6)
  - Attacks lasting seconds (OR = 2.8)
- Negatively correlated with
  - Hearing changes
  - Light sensitivity
  - Attacks lasting hours to days

Diagnosis – Migraine Associated Dizziness

- Positively correlated with
  - Light sensitivity (OR = 41.8)
  - Menstrual cycles (OR = 6.9)
  - Severe recurrent headaches (OR = 5.5)
- Negatively correlated with
  - Tinnitus
  - Positional dizziness
  - Nocturnal urination

Diagnosis – Meniere’s Disease

- Positively correlated with
  - Auditory symptoms during an attack (OR = 7.5)
  - Unilateral worsening of hearing (OR = 7.4)
  - Unilateral tinnitus (OR = 6.2)
- Negatively correlated with
  - Positional dizziness
  - Recent head trauma
  - Mucus

Vestibular Neuritis

- Positively correlated with:
  - Nausea (OR = 1.98)
- Negatively correlated with
  - Light sensitivity
  - Indigestion
  - Ear pain

Results of Initial Study Enabled the Investigators to Reduce the Number of Items to 47

- Excellent predictive power (>80% sensitivity) for: BPPV, Migraine Associated Vertigo, Meniere's disease
- Good predictive power (> 70%) for vestibular neuritis

Predictive Accuracy of 47-Item Device

Zhao et al. 2010

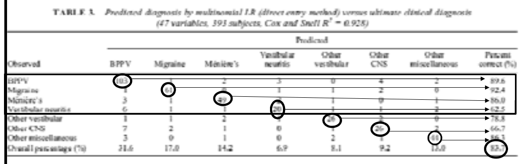


TABLE 3. *Predicted diagnosis by multinomial LR (direct entry method) versus ultimate clinical diagnosis (47 variables, 393 subjects, Cox and Snell $R^2 = 0.928$)*

	Predicted							
Observed	BPPV	Migraine	Ménière's	Vestibular neuritis	Other vestibular	Other CNS	Other miscellaneous	Percent correct (%)
BPPV	103	1	2	3	0	4	2	89.6
Migraine	1	61	0	1	1	2	0	92.4
Ménière's	3	1	49	2	1	0	1	86.0
Vestibular neuritis	6	1	1	20	1	1	2	62.5
Other vestibular	1	1	2	1	26	2	0	78.8
Other CNS	7	2	1	0	1	26	2	66.7
Other miscellaneous	3	0	1	0	2	1	44	86.3
Overall percentage (%)	21.6	17.0	14.2	6.9	8.1	9.2	13.0	83.7

Predictive Accuracy of 32-Item Device However the Sensitivity Suffered

Zhao et al. 2010

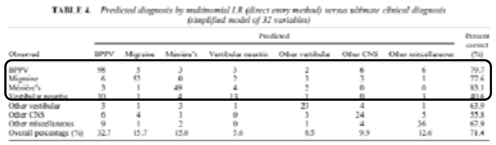


TABLE 4. *Predicted diagnosis by multinomial LR (direct entry method) versus ultimate clinical diagnosis (simplified model of 32 variables)*

	Predicted							
Observed	BPPV	Migraine	Ménière's	Vestibular neuritis	Other vestibular	Other CNS	Other miscellaneous	Percent correct (%)
BPPV	98	5	3	3	2	6	6	79.7
Migraine	6	52	0	2	3	3	1	77.6
Ménière's	3	1	49	4	2	0	0	83.1
Vestibular neuritis	10	1	4	13	1	0	3	40.6
Other vestibular	3	1	3	1	23	4	1	63.9
Other CNS	6	4	1	0	3	24	5	55.8
Other miscellaneous	9	1	2	0	1	4	36	67.9
Overall percentage (%)	32.7	15.7	15.0	5.6	8.5	9.9	12.6	71.4

Discussion

- **For adult patients, the predictive power of the questionnaire was good than demonstrated in the past**
- **Why? 3 of the diagnoses had factors that were both sensitive and specific**
  - **e.g. positional dizziness and brief duration – BPPV**
  - **e.g. Light sensitivity and association with menstruation – Migraine Associated Vertigo**
  - **e.g. Auditory symptoms during spells and tinnitus – Meniere's disease**

Discussion

- **Not so sensitive for vestibular neuritis**
  - **these patients often had 2 types of vertigo (e.g. short-lasting BPPV and long-lasting neuritis)**
  - **The best predictive factor was nausea and that was only OR = 1.98**
- **Unable to reduce factors to 32 and maintain power.**
- **Results represented a "testament to the usefulness of a structured questionnaire as an initial evaluation tool for dizziness"**

Comments

- Merits of questionnaire
  - Ability to render a hypothesis re: the origin of dizziness before formal testing is begun (that hypothesis is supported or rejected based on results of quantitative tests)
  - Could be used in tandem with bedside (pre)tests
  - Could be used by primary care to determine which patients require referral to specialists

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Comments

- Problems with questionnaire
  - Suggested diagnosis is not always correct
  - Questionnaire might be used in an inappropriate manner (e.g. for diagnosis)
  - *Critically dependent on patient as an accurate historian*

Conclusion

- “The capability of historical data to accurately predict the ultimate diagnosis for dizziness emphasizes the importance of a structured questionnaire in the evaluation of such patients.”
- Future: computerized administration for online use?

Vanderbilt University
1st Attempt
Quantitative Dizziness Questionnaire
(qDq)

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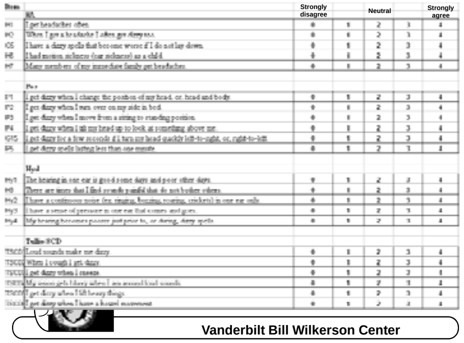
qDq

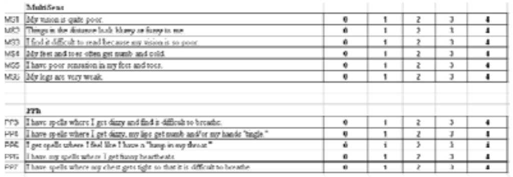
- An attempt to make the conventional case history more directive and quantitative
- Case history questions were converted into 33 statements placed statistically into 6 subscales (migrainous vertigo, positional vertigo, hydrops, Tullio/SCD, multisensory system impairment, chronic subject dizziness-CSD)
- Response to each statement is a 5 point Likert scale (0 = strongly disagree, 2 = neutral, 4 = strongly agree)

"qDq"



Item		Strongly disagree		Neutral		Strongly agree
	MV					
M1	I get headaches often.	0	1	2	3	4
M2	When I get a headache I often get dizzy too.	0	1	2	3	4
[illegible]	I have a dizzy spells that become worse if I do not lay down.	0	1	2	3	4
M6	I had motion sickness (car sickness) as a child.	0	1	2	3	4
M7	Many members of my immediate family get headaches.	0	1	2	3	4
	Pos					
P1	I get dizzy when I change the position of my head, or, head and body.	0	1	2	3	4
P2	I get dizzy when I turn over on my side in bed.	0	1	2	3	4
P3	I get dizzy when I move from a sitting to standing position.	0	1	2	3	4
P4	I get dizzy when I tilt my head up to look at something above me.	0	1	2	3	4
G15	I get dizzy for a few seconds if I turn my head quickly left-to-right, or, right-to-left.	0	1	2	3	4
P5	I get dizzy spells lasting less than one minute.	0	1	2	3	4
	Hyd					
Hy1	The hearing in one ear is good some days and poor other days.	0	1	2	3	4
[illegible]	There are times that I find sounds painful that do not bother others.	0	1	2	3	4
Hy2	I have a continuous noise (ex. ringing, buzzing, roaring, crickets) in one ear only.	0	1	2	3	4
Hy3	I have a sense of pressure in one ear that comes and goes.	0	1	2	3	4
Hy4	My hearing becomes poorer just prior to, or during, dizzy spells.	0	1	2	3	4
	Tullio/SCD					
TSCD	Loud sounds make me dizzy.	0	1	2	3	4
TSCD	When I cough I get dizzy.	0	1	2	3	4
TSCD	I get dizzy when I sneeze.	0	1	2	3	4
[illegible]	My vision gets blurry when I am around loud sounds.	0	1	2	3	4
TSCD	I get dizzy when I lift heavy things.	0	1	2	3	4
[illegible]	I get dizzy when I have a bowel movement.	0	1	2	3	4

“qDq”



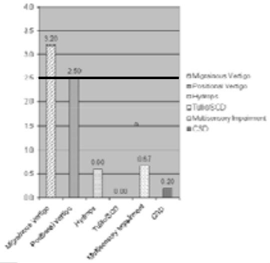
	MultiSens					
MS1	My vision is quite poor.	0	1	2	3	4
MS2	Things in the distance look blurry or fuzzy to me.	0	1	2	3	4
MS3	I find it difficult to read because my vision is so poor.	0	1	2	3	4
MS4	My feet and toes often get numb and cold.	0	1	2	3	4
MS5	I have poor sensation in my feet and toes.	0	1	2	3	4
MS6	My legs are very weak.	0	1	2	3	4
	PPh					
PP3	I have spells where I get dizzy and find it difficult to breathe.	0	1	2	3	4
PP4	I have spells where I get dizzy, my lips get numb and/or my hands "tingle."	0	1	2	3	4
PP5	I get spells where I feel like I have a "lump in my throat."	0	1	2	3	4
PP6	I have my spells where I get funny heartbeats.	0	1	2	3	4
PP7	I have spells where my chest gets tight so that it is difficult to breathe.	0	1	2	3	4

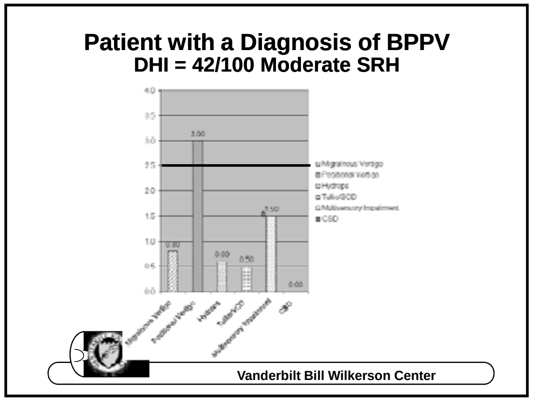
qDq Data Views

- At it’s simplest, the qDq provided a “snapshot” of what is the patient’s primary complaint, and *possibly, their final diagnosis.*
- Our suggestion is that a mean subscale score of 2.5 points or greater represents an endorsement of that subscale
- Examples follow

Patient with a Diagnosis of Migrainous Vertigo

DHI = 24/100 Mild SRH





Patient with a Diagnosis of BPPV
DHI = 42/100 Moderate SRH

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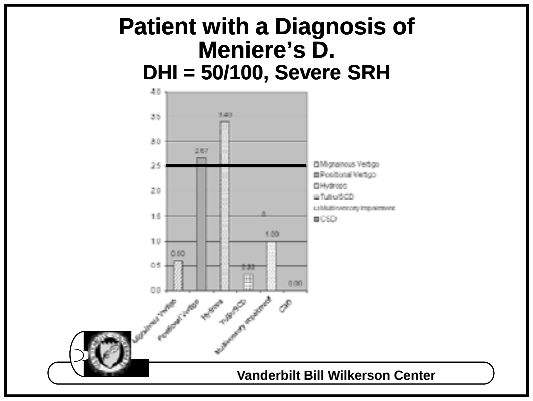

Patient with a Diagnosis of Meniere's D.
DHI = 50/100, Severe SRH

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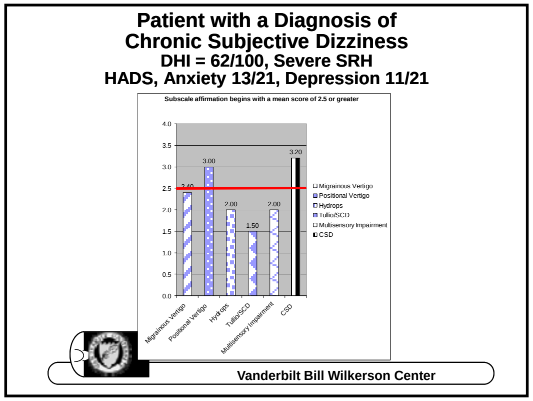

Patient with a Diagnosis of Chronic Subjective Dizziness
DHI = 62/100, Severe SRH
HADS, Anxiety 13/21, Depression 11/21

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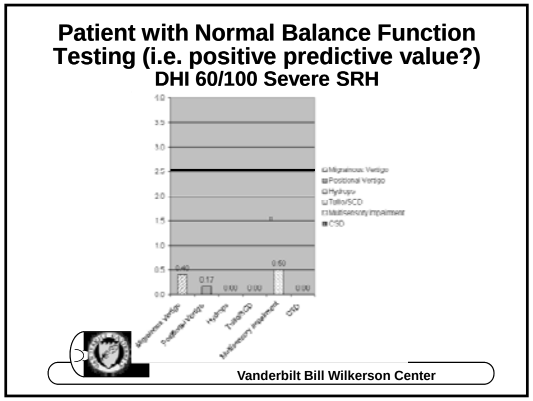
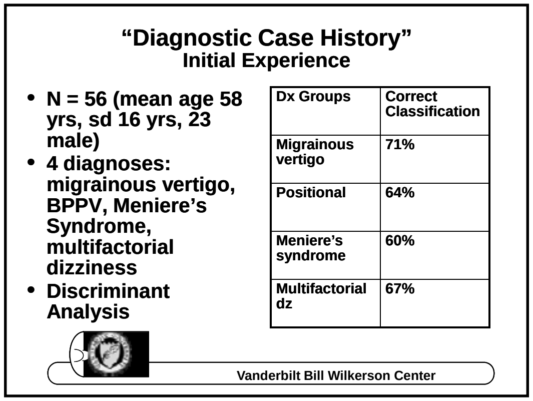


Patient with Normal Balance Function Testing (i.e. positive predictive value?)

DHI 60/100 Severe SRH

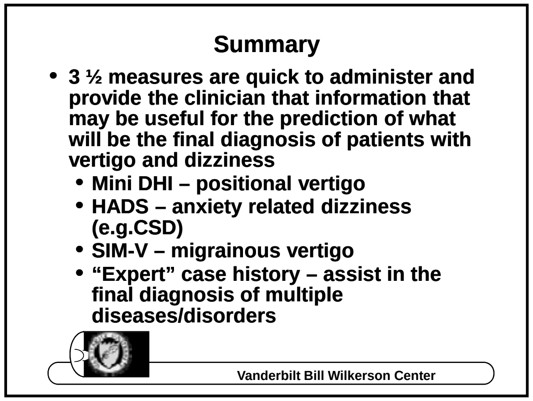


"Diagnostic Case History"

Initial Experience

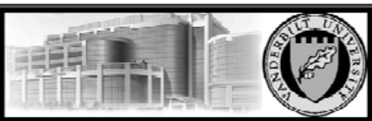
- N = 56 (mean age 58 yrs, sd 16 yrs, 23 male)
- 4 diagnoses: migrainous vertigo, BPPV, Meniere's Syndrome, multifactorial dizziness
- Discriminant Analysis

Dx Groups	Correct Classification
Migrainous vertigo	71%
Positional	64%
Meniere's syndrome	60%
Multifactorial dz	67%



Summary

- 3 ½ measures are quick to administer and provide the clinician that information that may be useful for the prediction of what will be the final diagnosis of patients with vertigo and dizziness
  - Mini DHI – positional vertigo
  - HADS – anxiety related dizziness (e.g.CSD)
  - SIM-V – migrainous vertigo
  - "Expert" case history – assist in the final diagnosis of multiple diseases/disorders



Vanderbilt Audiology Journal Club

Topic: Assessing Dizziness and Vertigo
3 ½ Helpful Self-Report Measures

Audiology Online 2012
Gary P. Jacobson, Ph.D.
Division of Audiology

VANDERBILT AUDIOLOGY
JOURNAL CLUB
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Performance Characteristics of the 5-item mini-DHI

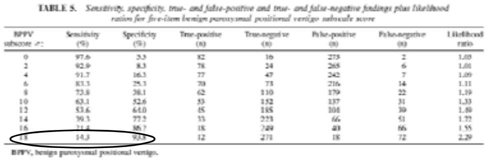

TABLE 5. *Sensitivity, specificity, true- and false-positive and true- and false-negative findings plus likelihood ratios for five-item benign paroxysmal positional vertigo subscale score*

BPPV subscore ≥:	Sensitivity (%)	Specificity (%)	True-positive (n)	True-negative (n)	False-positive (n)	False-negative (n)	Likelihood ratio
0	97.6	5.5	82	16	273	2	1.03
2	92.9	8.3	78	24	265	6	1.01
4	91.7	16.3	77	47	242	7	1.09
6	83.3	25.3	70	73	216	14	1.11
8	73.8	38.1	62	110	179	22	1.19
10	63.1	52.6	53	152	137	31	1.33
12	53.6	64.0	45	185	104	39	1.49
14	39.3	77.2	33	223	66	51	1.72
16	21.4	86.2	18	249	40	66	1.55
18	14.3	93.8	12	271	18	72	2.29

BPPV, benign paroxysmal positional vertigo.

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What explains the relatively low sensitivity of the mini-DHI

- Frail, obese, patients post-CVA, orthopedically compromised difficult to position
- Items chosen for mini DHI are not just sensitive to BPPV but also other disorders affecting the vestibular system
- Patients as poor historians
- Time of day tested (more likely to see BPPV in AM. In PM otoliths have been distributed)
- Duration of patient's symptoms and co-morbidities were not recorded

Performance Characteristics of the 2-item mini-DHI

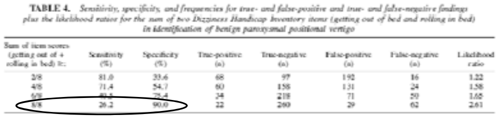


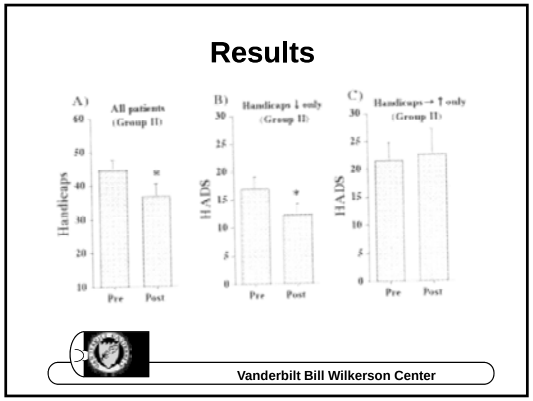
TABLE 4. *Sensitivity, specificity, and frequencies for true- and false-positive and true- and false-negative findings plus the likelihood ratios for the sum of two Dizziness Handicap Inventory items (getting out of bed and rolling in bed) in identification of benign paroxysmal positional vertigo*

Sum of item scores (getting out of + rolling in bed) ≥:	Sensitivity (%)	Specificity (%)	True-positive (n)	True-negative (n)	False-positive (n)	False-negative (n)	Likelihood ratio
2/8	81.0	33.6	68	97	192	16	1.22
4/8	71.4	54.7	60	158	131	24	1.58
6/8	40.5	75.4	34	218	71	50	1.65
8/8	26.2	90.0	22	260	29	62	2.61

Dizziness Handicap Inventory

Jacobson and Newman (1990)

- Document +/- changes over the course of rehabilitation
- Scores have been correlated with falls
- Has become ubiquitous as a balance outcome measure



Results

A)
All patients
(Group II)
Handicaps
60
50
40
30
20
10
*
Pre
Post
B)
Handicaps ↓ only
(Group II)
HADS
30
25
20
15
10
5
0
*
Pre
Post
C)
Handicaps → ↑ only
(Group II)
HADS
30
25
20
15
10
5
0
Pre
Post