Hyperacusis Definitions
(and my Misophobia !)

Richard Tyler, Ph.D., CCC-A

What is hyperacusis?

- Reactions to moderately-loud sounds are too loud, annoying, fearful, and/or painful
- Affects 6-17% of general population

Other terms that are used:

- Select Sound Sensitivity
- Hypersensitivity,
- Misophonia
- Exaggerated sound response
- Decreased sound tolerance
- Phonophobia

CONFUSING TO PATIENTS , HEALTH CARE PROFESSIONS, POPULATION

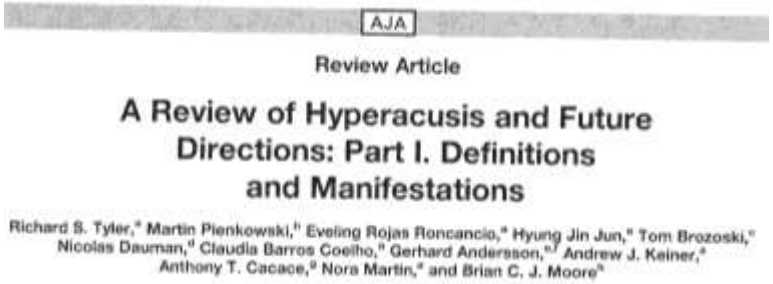
Less confusion if

- Choose simple terms with clear distinct definitions
- Avoid temptation for everyone to make up new terms

- Important for patients, audiologists, other health-care professions and general public to understand terms

Hyperacusis Types

- Loudness Hyperacusis
- Annoyance Hyperacusis
- Fear Hyperacusis
- Pain Hyperacusis



AJA

Review Article

A Review of Hyperacusis and Future Directions: Part I. Definitions and Manifestations

Richard S. Tyler,[a] Martin Pienkowski,[b] Eveling Rojas Roncancio,[a] Hyung Jin Jun,[a] Tom Brozoski,[c] Nicolas Dauman,[d] Claudia Barros Coelho,[e] Gerhard Andersson,[e,f] Andrew J. Keiner,[a] Anthony T. Cacace,[g] Nora Martin,[a] and Brian C. J. Moore[h]

American Journal of Audiology, 2014

Types of hyperacusis

- Loudness hyperacusis
- Annoyance hyperacusis
- Fear hyperacusis
- Pain hyperacusis

LOUDNESS HYPERACUSIS

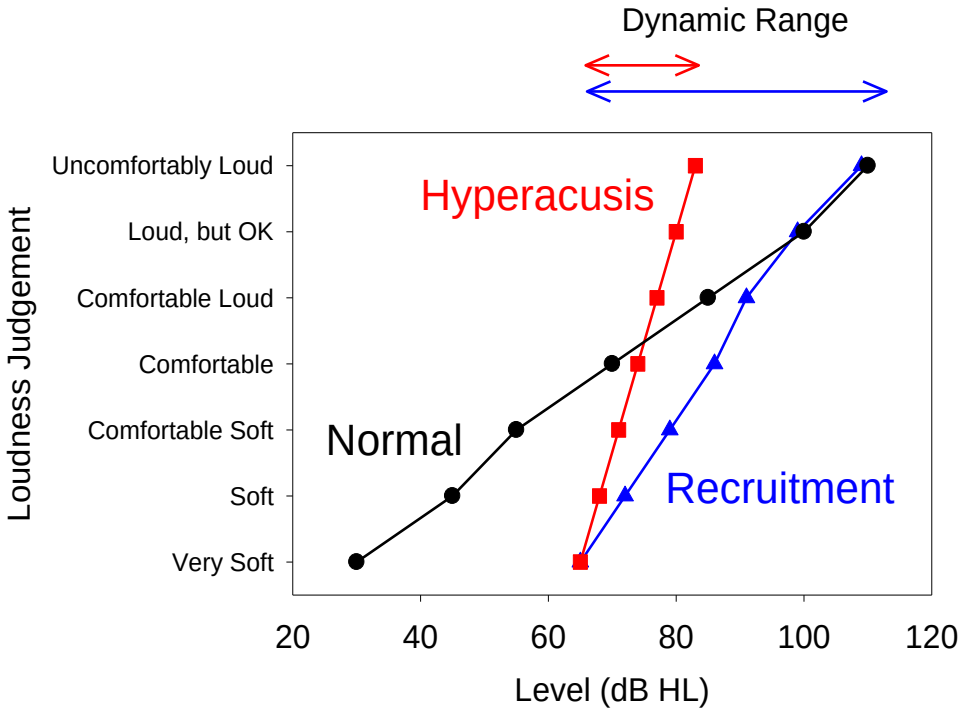
Which of the following sounds or events are often too loud for you?

a. Baby crying/children squealing
b. Crowds/large gatherings
c. Dishes being stacked
d. Dog barking
e. High pitch voices/screaming
f. Lawnmower
g. Music (loud rock concerts)
h. Music (religious service)
i. Music (symphony, quartet, etc.)

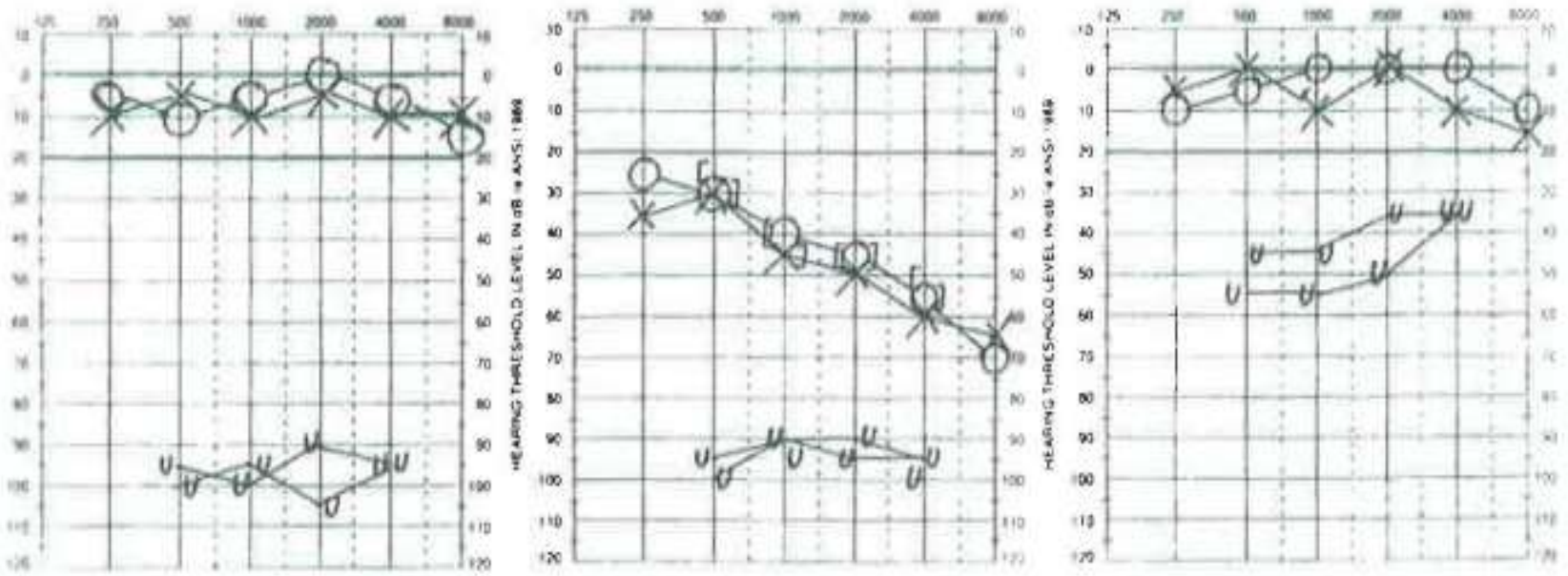
a. Power tools
b. Restaurants
c. Sporting events
d. Telephone ringing
e. TV/radio
f. Vacuum cleaner
g. Whistle/horn/siren
h. Other _____

Loudness Growth for Recruitment vs. Hyperacusis

- Recruitment → high sound levels result in a normal loudness report
- Hyperacusis → lower sound levels are “Uncomfortably Loud” and result in a reduced dynamic range (DR)



Audiometric Representations of Normal Hearing, Loudness Recruitment, and Hyperacusis

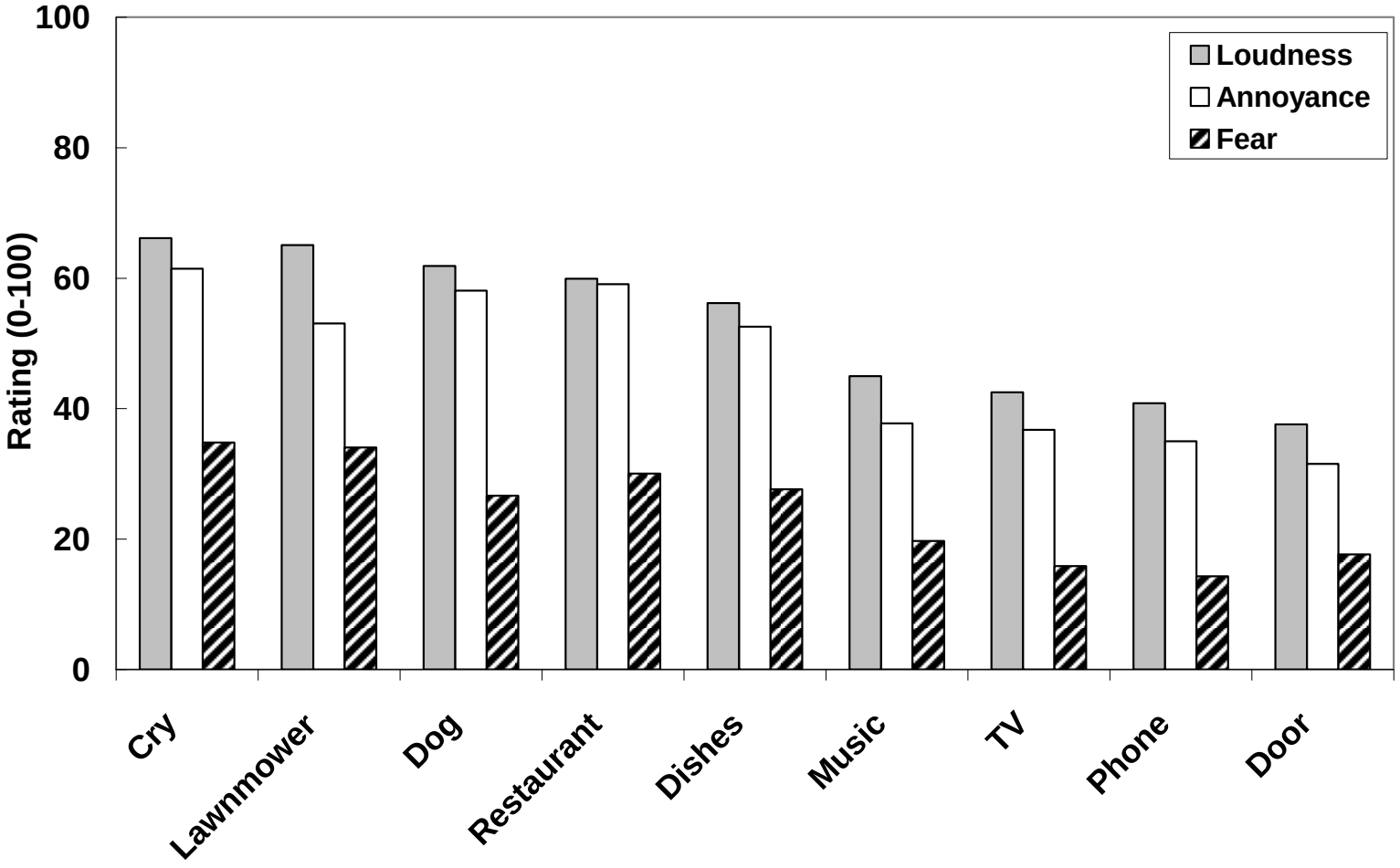


Normal hearing, normal uncomfortable loudness levels	Recruitment: hearing loss, normal uncomfortable loudness levels	Hyperacusis: normal hearing, abnormally low uncomfortable loudness levels

Sandlin and Olsson, 1999

SOME OVERLAP

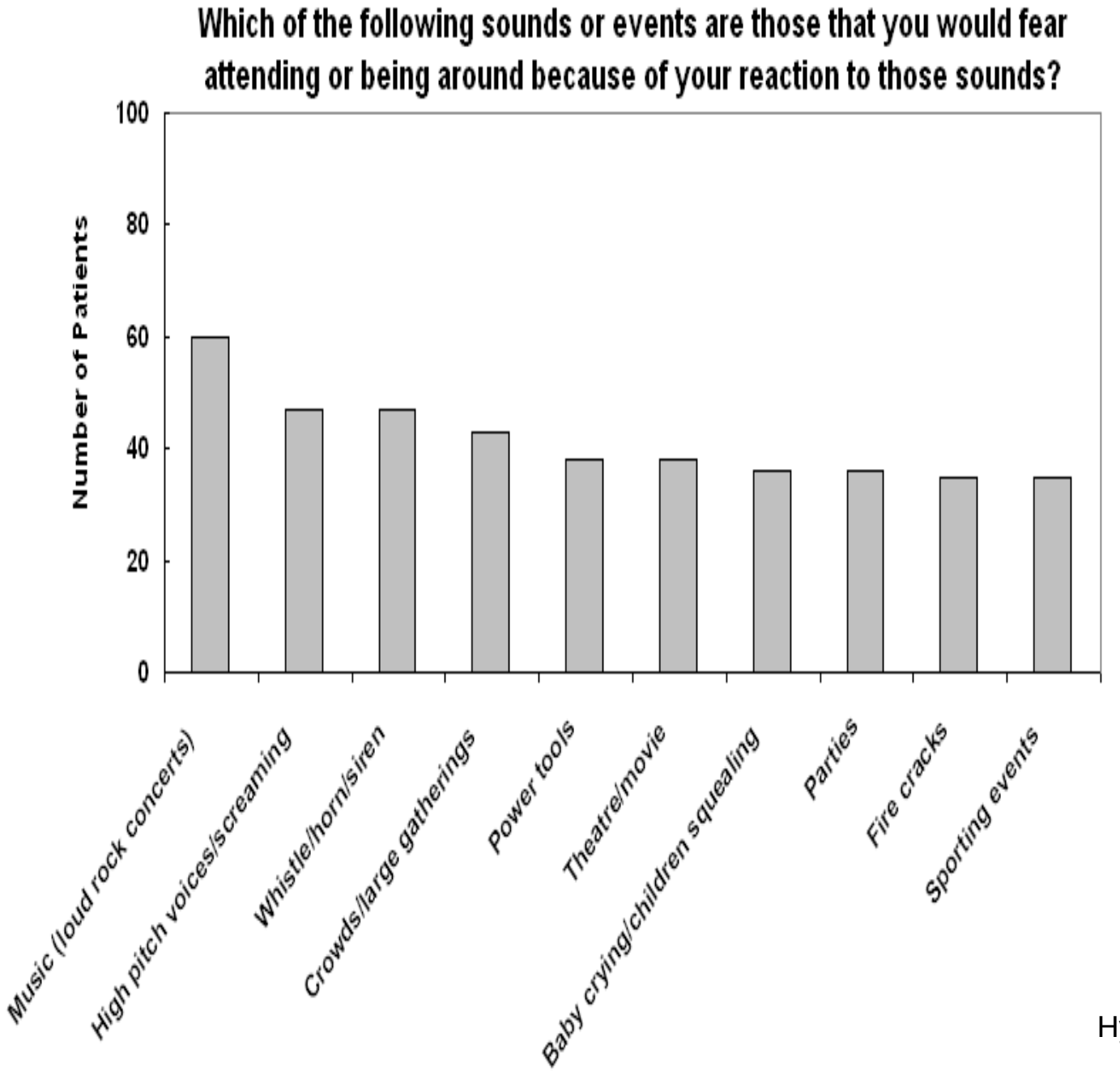
- LOUDNESS
- ANNOYANCE
- FEAR


100
80
60
40
20
0
Rating (0-100)
Loudness
Annoyance
Fear
Cry
Lawnmower
Dog
Restaurant
Dishes
Music
TV
Phone
Door

Annoyance Hyperacusis

- Some sounds I find really annoying
- Not always loud
- Not painful, just annoying
- I don’t want to hear those sounds

Fear Hyperacusis


Which of the following sounds or events are those that you would fear attending or being around because of your reaction to those sounds?
Number of Patients
100
80
60
40
20
0
Music (loud rock concerts)
High pitch voices/screaming
Whistle/horn/siren
Crowds/large gatherings
Power tools
Theatre/movie
Baby crying/children squealing
Parties
Fire cracks
Sporting events

Pain Hyperacusis

pain hyperacusis often associated with tinnitus

- 55% prevalence of pain hyperacusis in tinnitus patients
  - Schecklmann M, Landgrebe M, Langguth B: **Phenotypic characteristics of hyperacusis in tinnitus**. *PLoS One* 2014, **9**(1)
- 63%prevalence of pain hyperacusis in tinnitus patients
  - Schecklmann, et al., 2015 Validation of Screening Questions for Hyperacusis in Chronic Tinnitus BioMed Research International

- Lingering pain
  - "The sound feels like acid being poured into my ears."
  - "It feels as if cool air is passing over my burning ears."

- Burning descriptions
  - "My ear is always burning. It feels like it is sizzling."

Dull Ache / Wound

- "The sound of putting on clothing feels like lightly blowing on an open wound."
- "My ear feels raw and vulnerable to sound as if it were an open wound'
- "Setting a coffee mug on a wooden table feels like a thumb pressing hard on broken bone, deep in the ear."
- "Walking on gravel feels as if I am pressing the gravel into my wounded ears."

Sharp pain descriptions

- " Clinking dishes feel like an icepick stabbing deep into my ears."
- "High frequency noises feel like needles stabbing my eardrum"

Tingle / Itch Descriptions

- "A painful itch I cannot scratch"

Summary
Loudness, Annoyance, Fear and Pain Hyperacusis

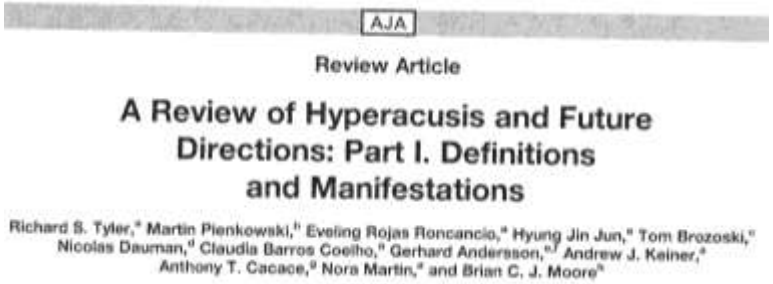
- Loudness and annoyance are more closely linked than fear
- Similar sounds evoke loudness, annoyance and fear hyperacousis
- Fear hyperacusis is less common

Summary

- Keep it clear and simple for everyone (public, health care workers, audiologists…everyone) to understand….)

Hyperacusis Types

- Loudness Hyperacusis
- Annoyance Hyperacusis
- Fear Hyperacusis
- Pain Hyperacusis



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Hyperacusis Mechanisms ??

Possible mechanisms of Hyperacusis

- Abnormal auditory gain control (Hazell, 1987)
  - Brain searches for activity, and magnifies it
  - Abnormal relationship between level and driven neural rate and/or overall/phase locked activity
- Plasticity – more nerve fibers at same best frequency

Disorders for Which Hyperacusis Has Been Reported as a Symptom

Otosclerosis
Efferent dysfunction
TMJ dysfunction
Bell's palsey
Meniere disease
Perilymphatic fistula
Otitis media
Acute acoustic trauma
Lyme disease
Ramsey Hunt syndrome
William's syndrome
Intracranial hypotension
Myasthenia gravis

Autism
Traumatic head injury
Migraine
Depression
Childhood learning disability
Diminished serotonin function
Central auditory pathway lesions

Epidemiology of Hyperacusis

- 85-90% of hyperacusis patients have an associated tinnitus condition (Anari et al, 1999; Nelting, 2002)
- Estimates of patients with tinnitus who suffer hyperacusis range up to 55% (Schecklmann et al, 2014)
- Estimates of the prevalence of hyperacusis in the general population vary between ~ 0.6 and 15%

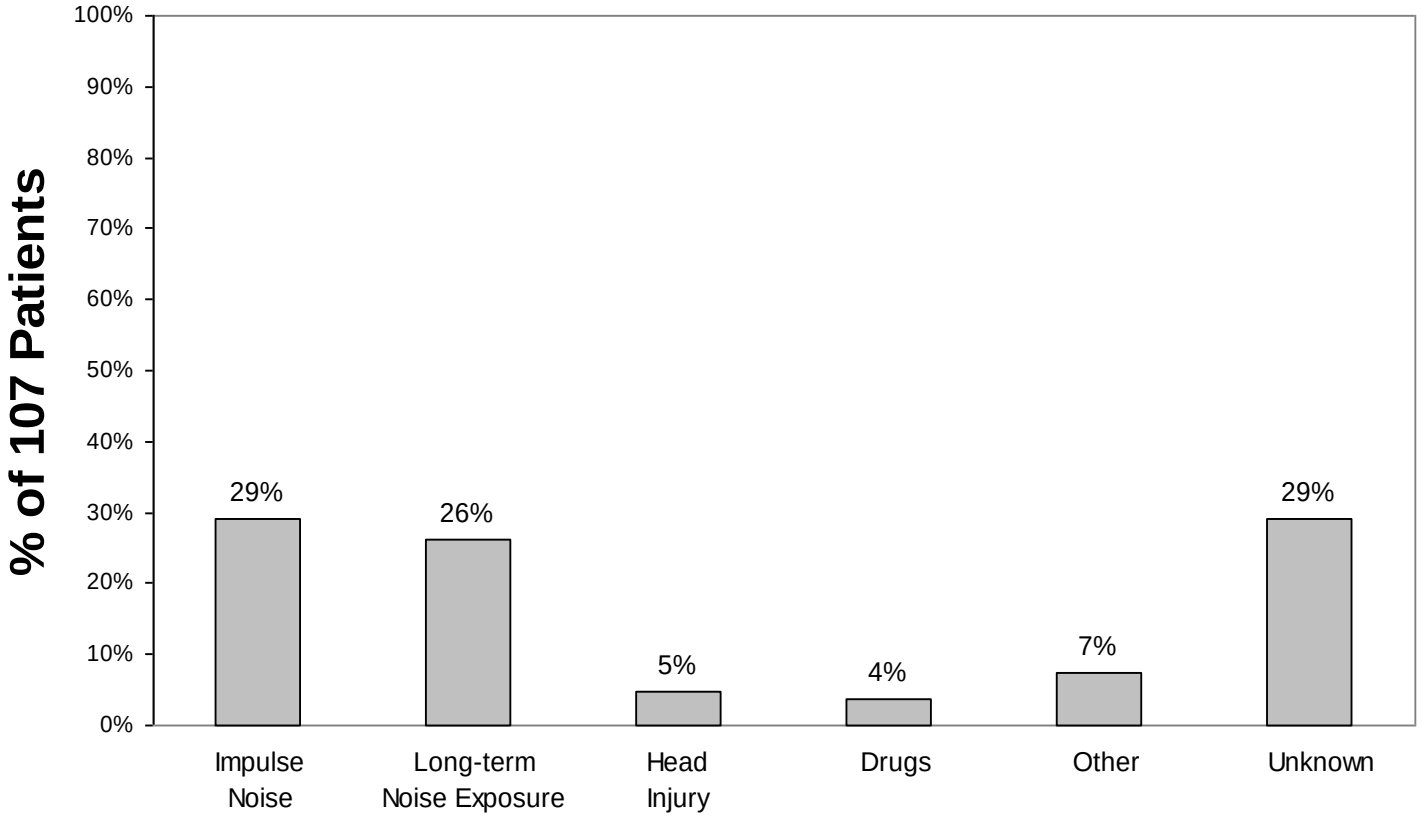
Possible causes of Hyperacusis

Many different causes

- Most unknown
- few diseases and syndromes associated with hyperacusis.
- For example;
  - migraine, depression, post-traumatic stress disorder, head injury, Lyme disease, William's syndrome, fibromyalgia, Addison's disease, autism, myasthenia gravis and middle cerebral aneurysm (Katzenel and Segal, 2001)

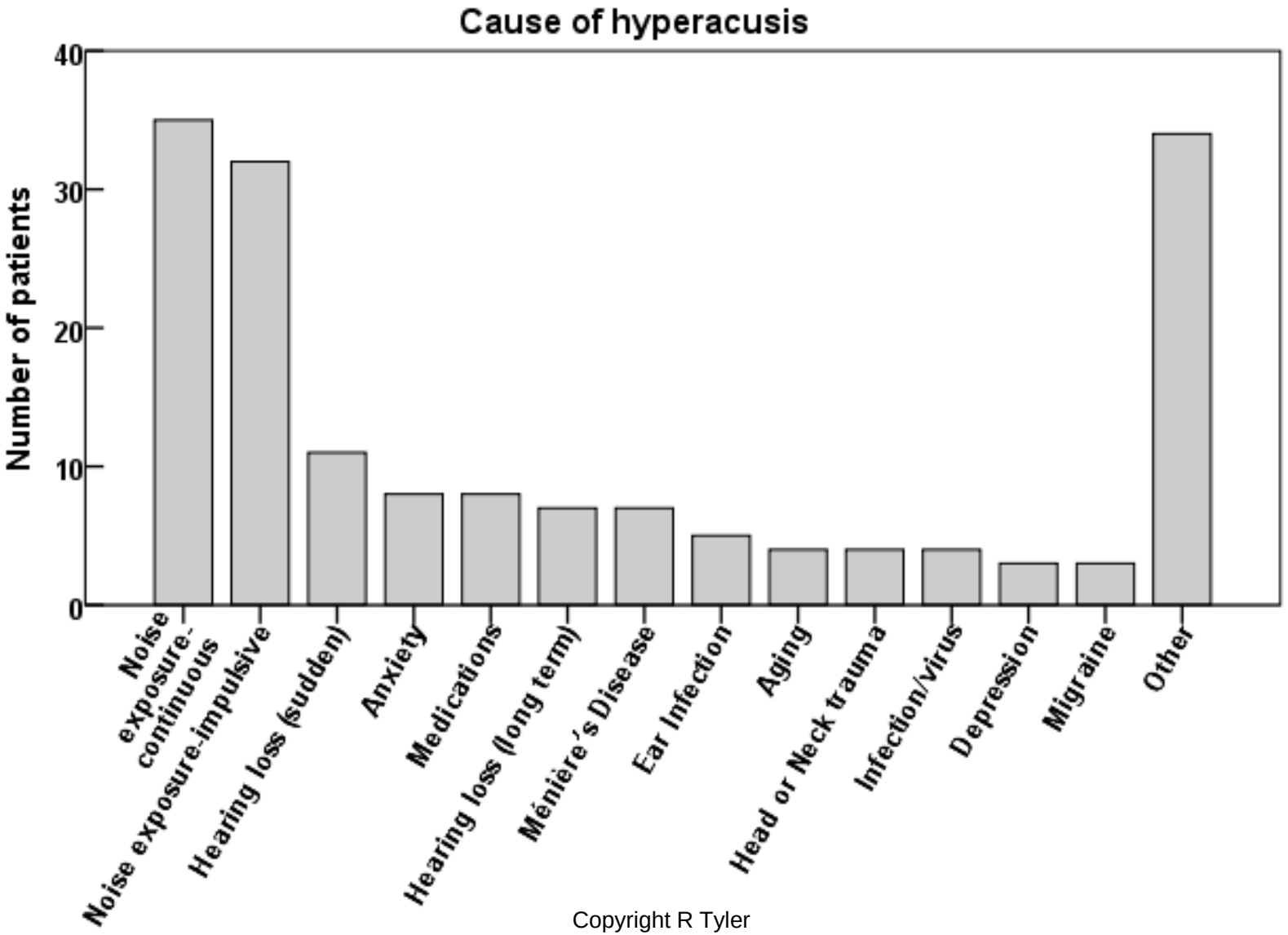
Reported Association with Onset of Severe Hyperacusis

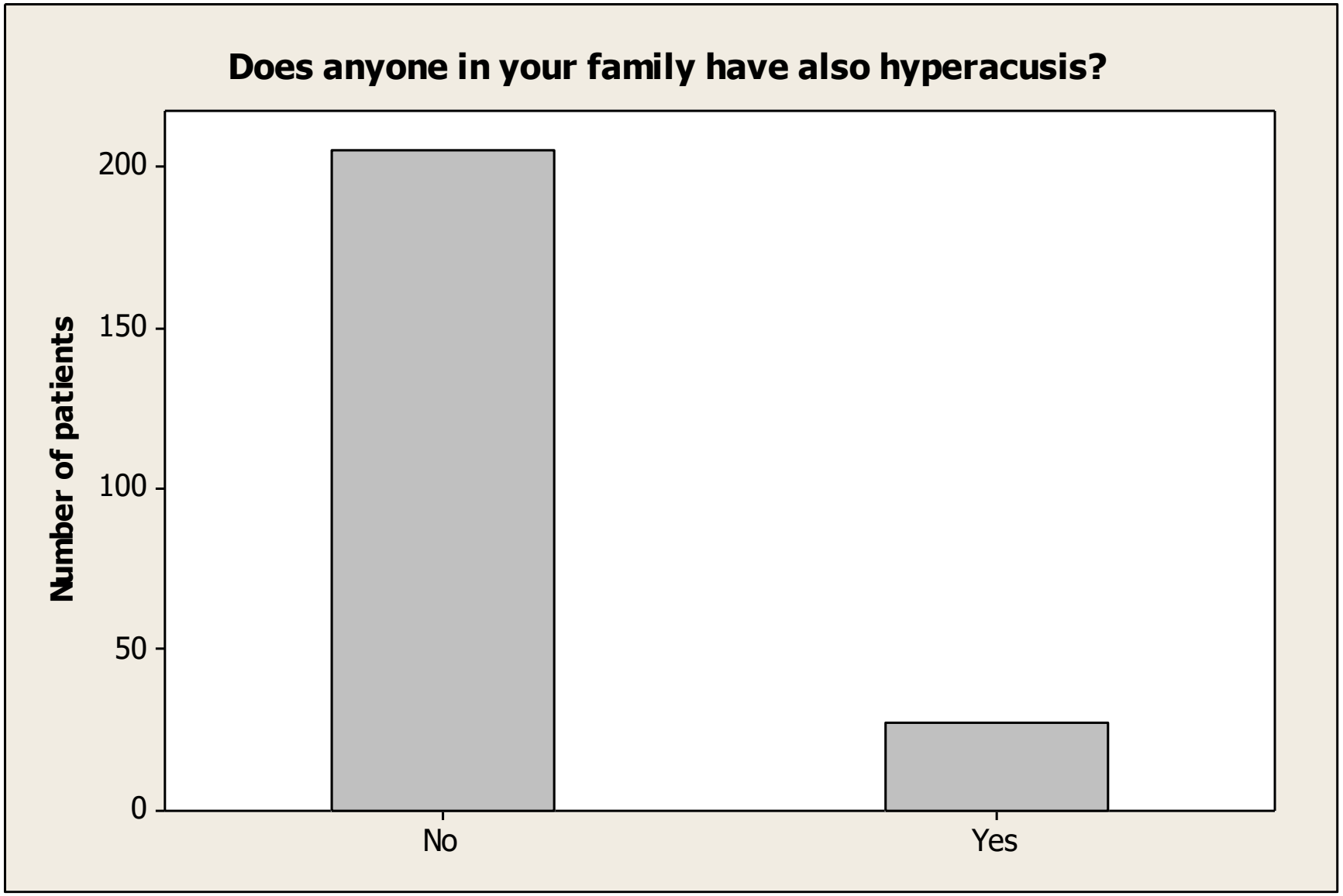
Reich and Griest (1992)



Associated with Onset of Severe Hyperacusis

Patients perspective…



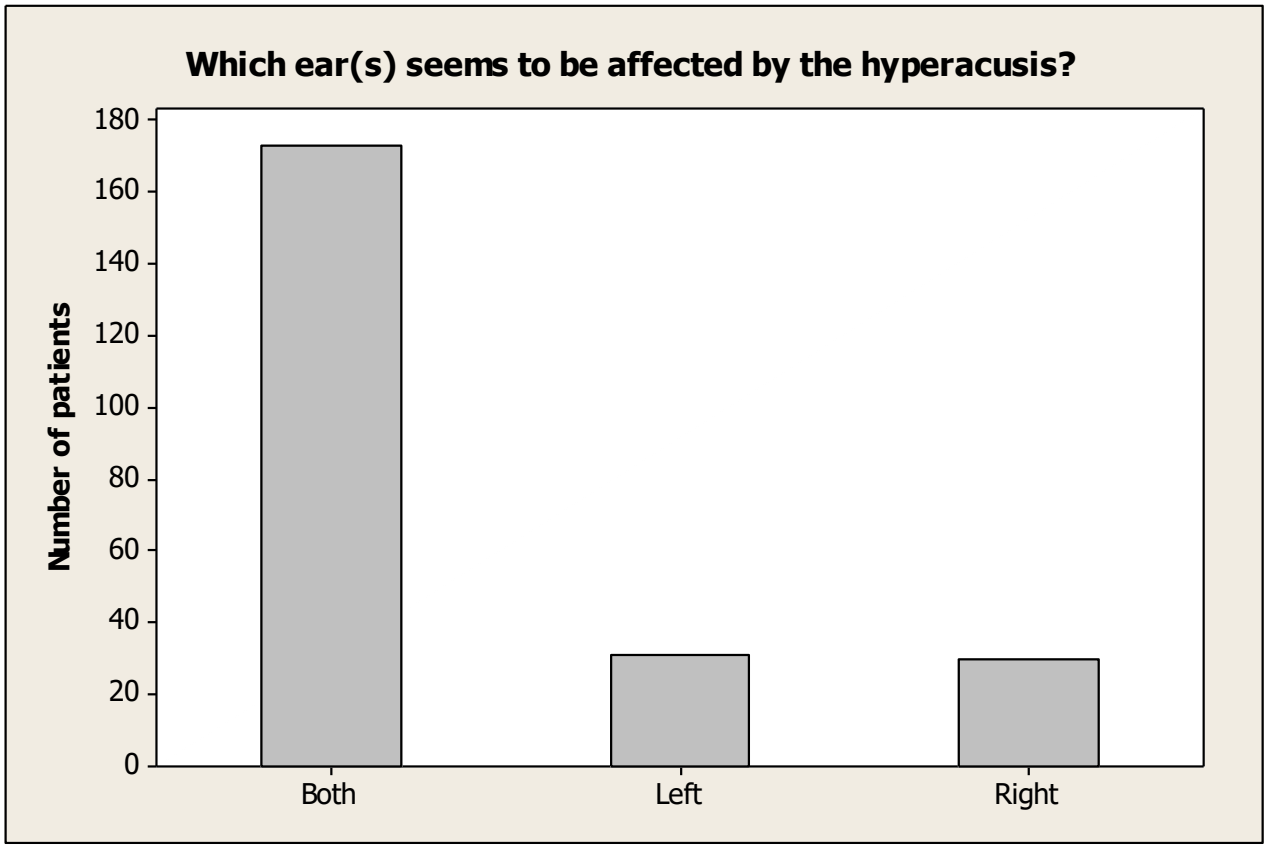

Does anyone in your family have also hyperacusis?
Number of patients
200
150
100
50
0
No
Yes

Genetic?

- **Probably not,**
  - **families working in same noisy factory**
- **But**
  - **William's syndrome**
  - **Prevalence 83.7% (Gothelf et al., 2006)**

Ears Affected ?
Unilateral in some?

Peripheral mechanism in some?



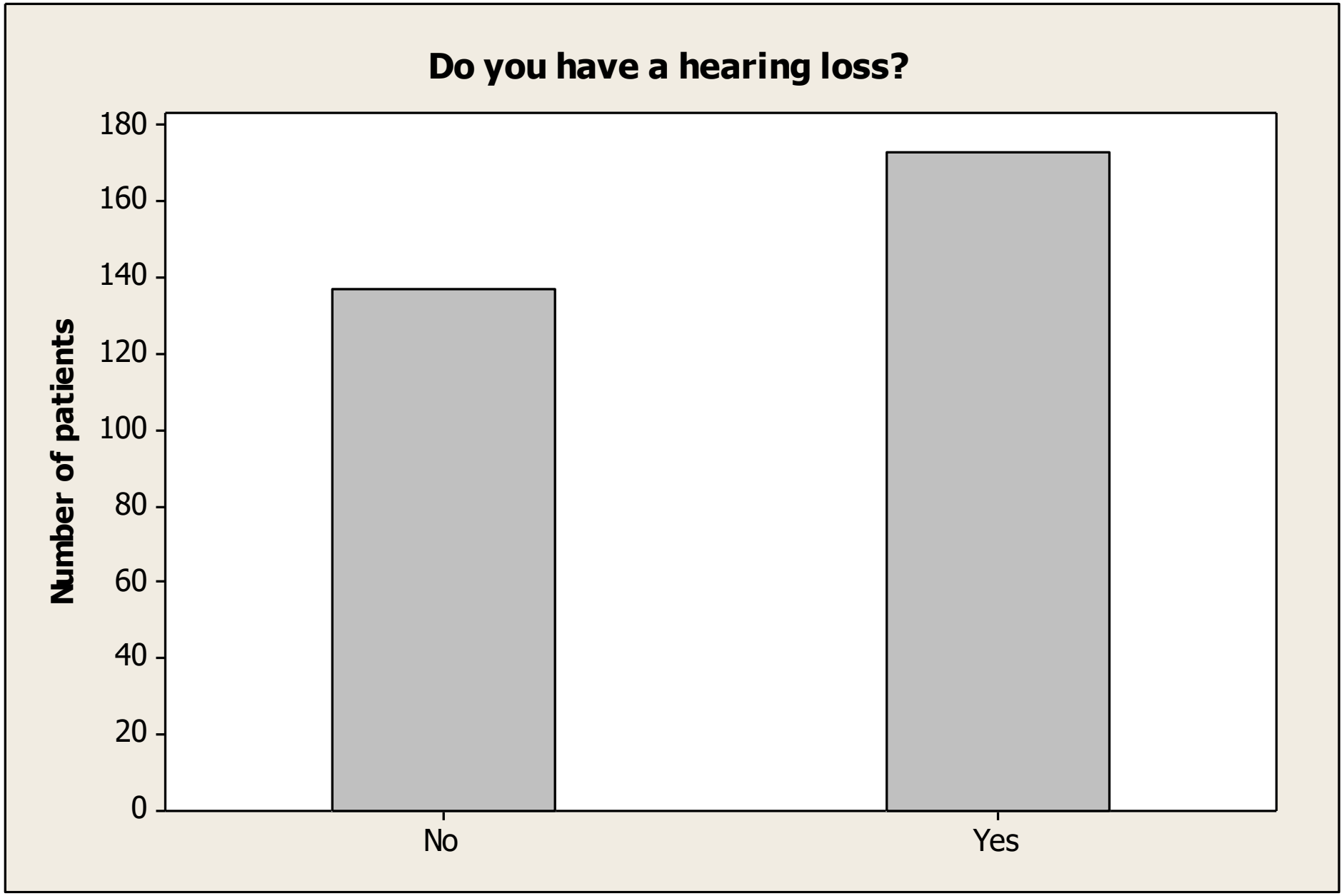
Unilateral Hyperacusis

- Does unilateral hyperacusis imply peripheral source of hyperacusis?
- Unilateral tinnitus patients, can mask in one ear and tinnitus ‘appears’ in the other

Tyler, R. S. (1984). Does tinnitus originate from hyperactive nerve fibers in the cochlea? **J Laryngology and Otology** (Suppl. 9): 38-44.

Hyperacusis and Hearing Loss

- About 40% do not ‘think’ they have a hearing loss
- Likely most (90%?) do
- Hyperacusis is bigger problem than hearing loss and usually tinnitus
- Hyperacusis often occurs with mild hearing loss
- Similar to tinnitus, many hyperacusis patients seek audiological help for hyperacusis, and many end up with hearing aids (Kochkin and Tyler, 2008)



Hyperacusis and Tinnitus

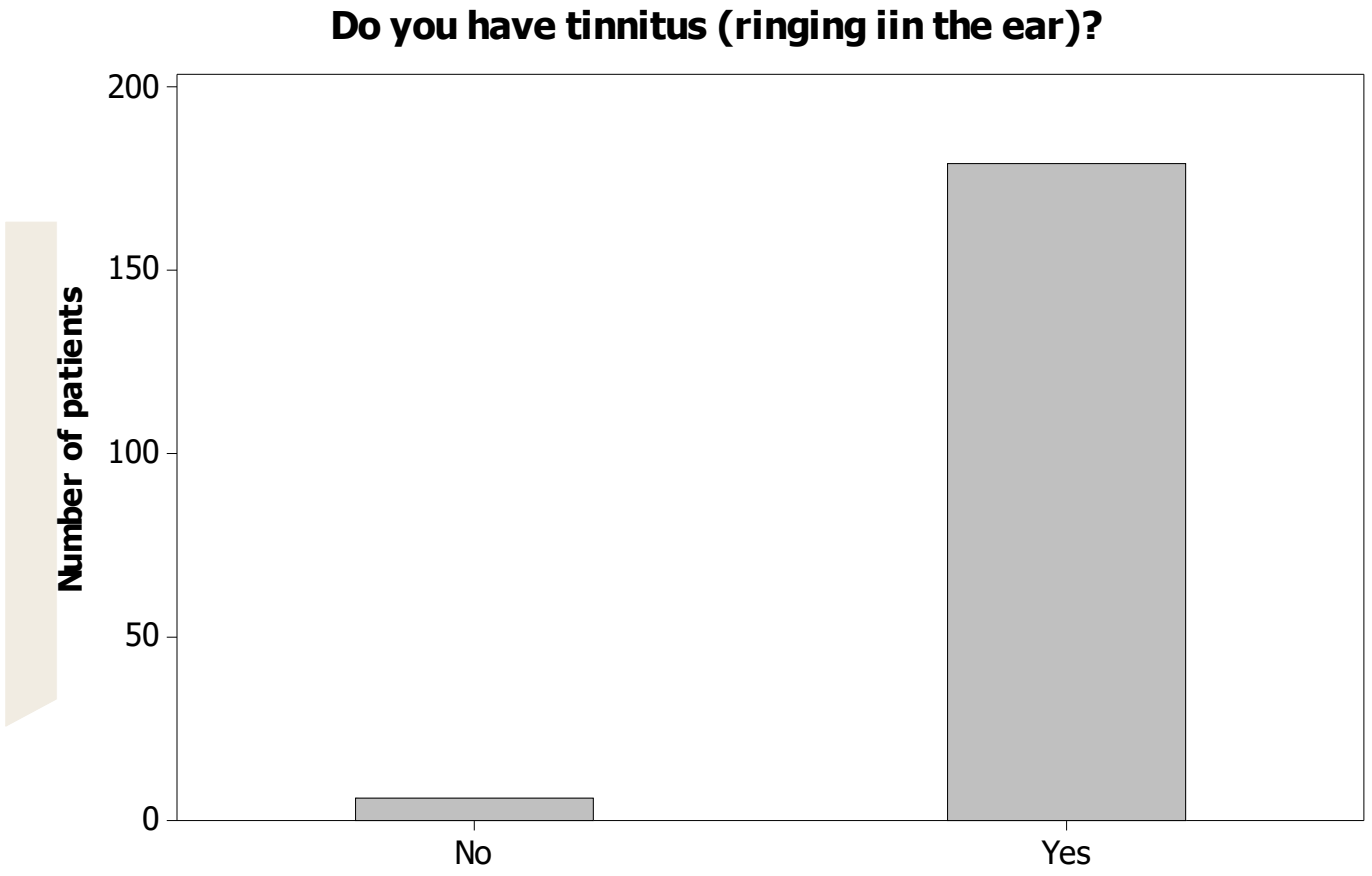
- First linked by
  - Tyler and Conrad-Armes (1983)
- Must have common mechanisms in some
- But also
  - hyperacusis without tinnitus
  - Tinnitus without hyperacusis

patients with tinnitus

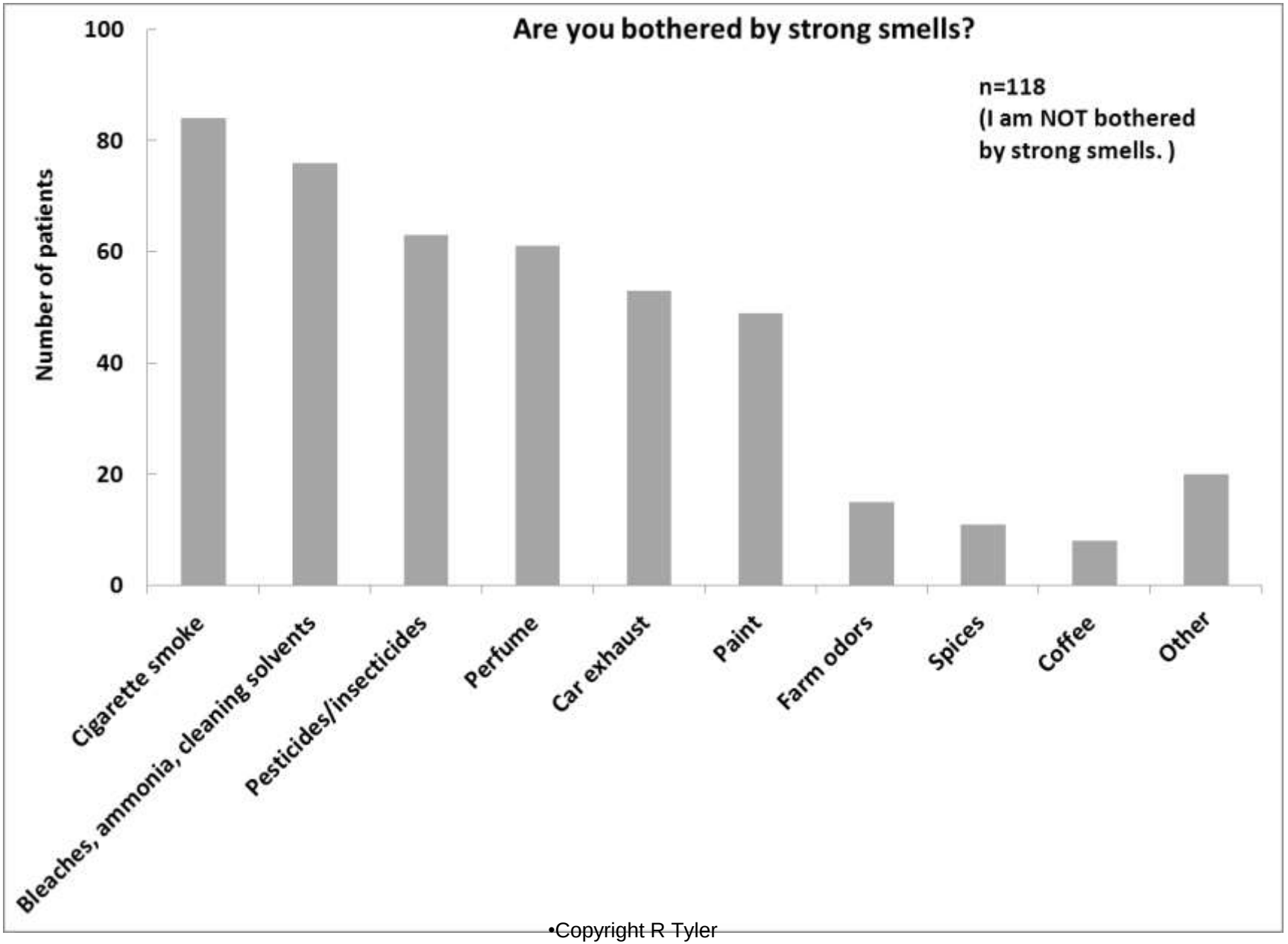
- hyperacousis prevalence 40%
- (Sood and Coles, 1998; Bartnik et al., 1999).

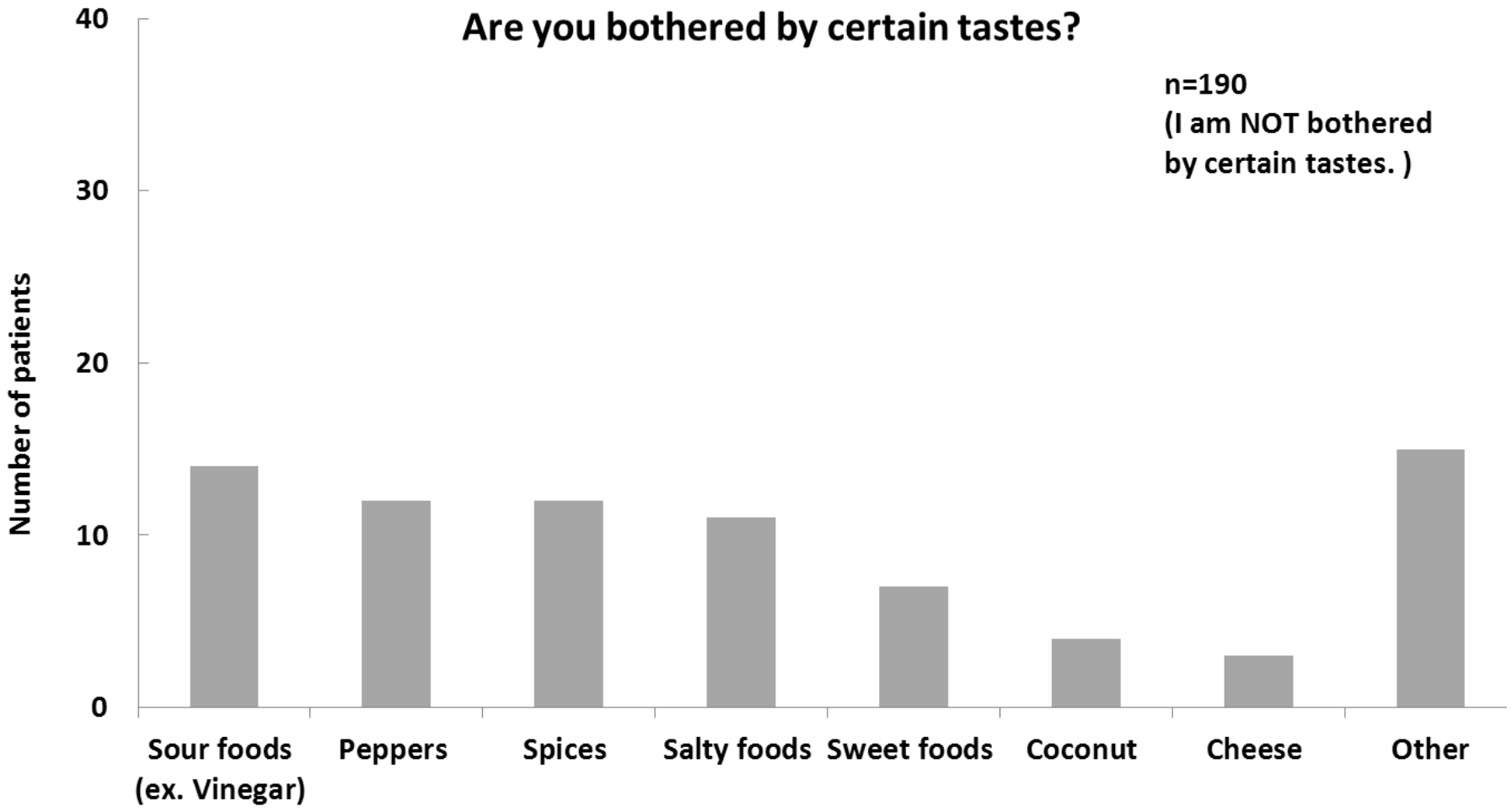
patients with hyperacousis

- prevalence of tinnitus about 86%
- (Anari et al., 1999).

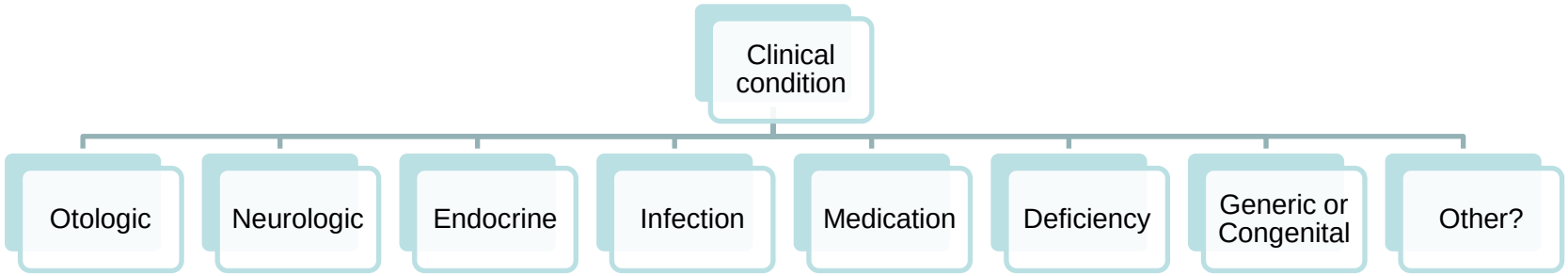

Do you have tinnitus (ringing iin the ear)?
Number of patients
200
150
100
50
0
No
Yes

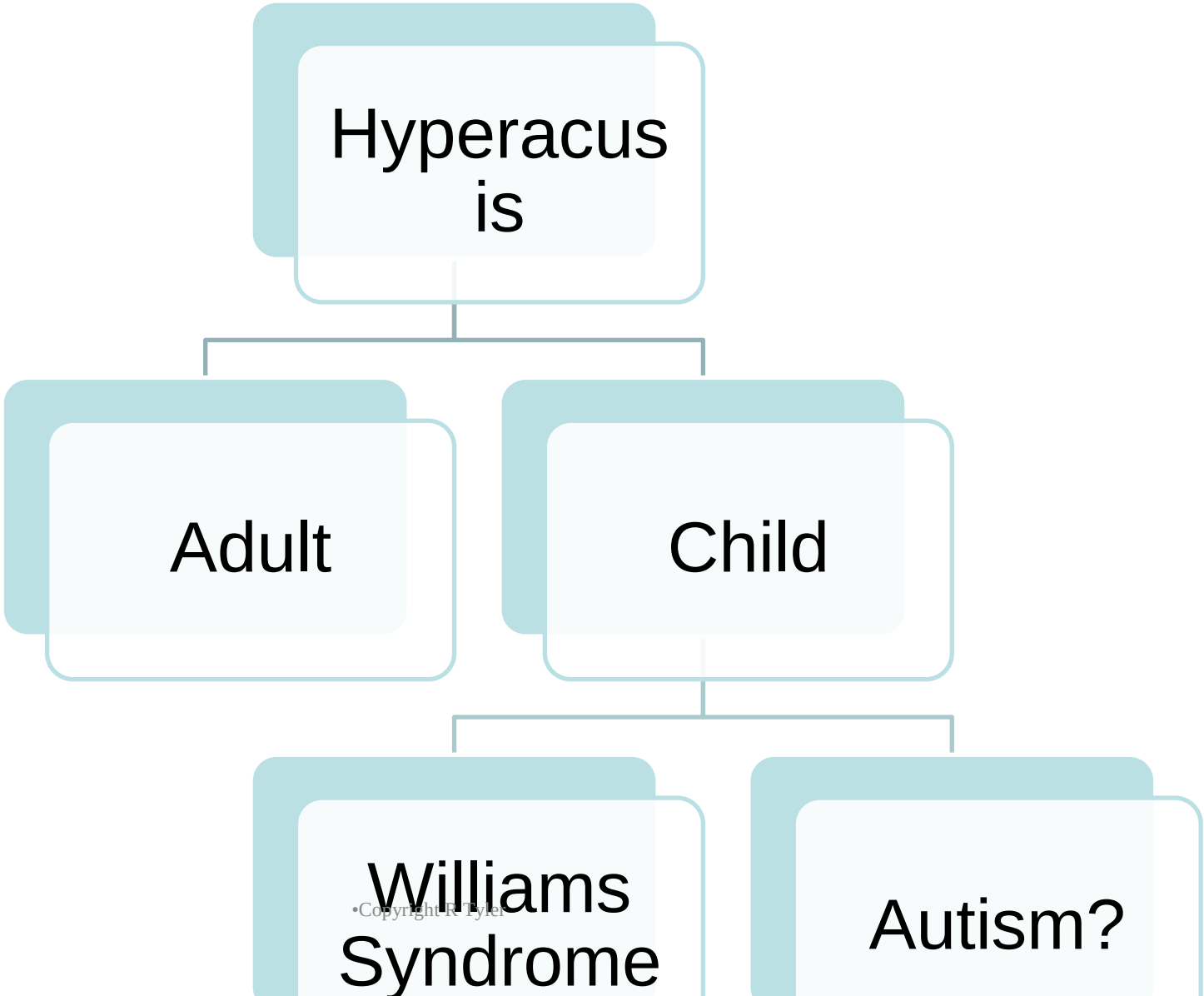
Hyperacusis and Other Sensory Systems

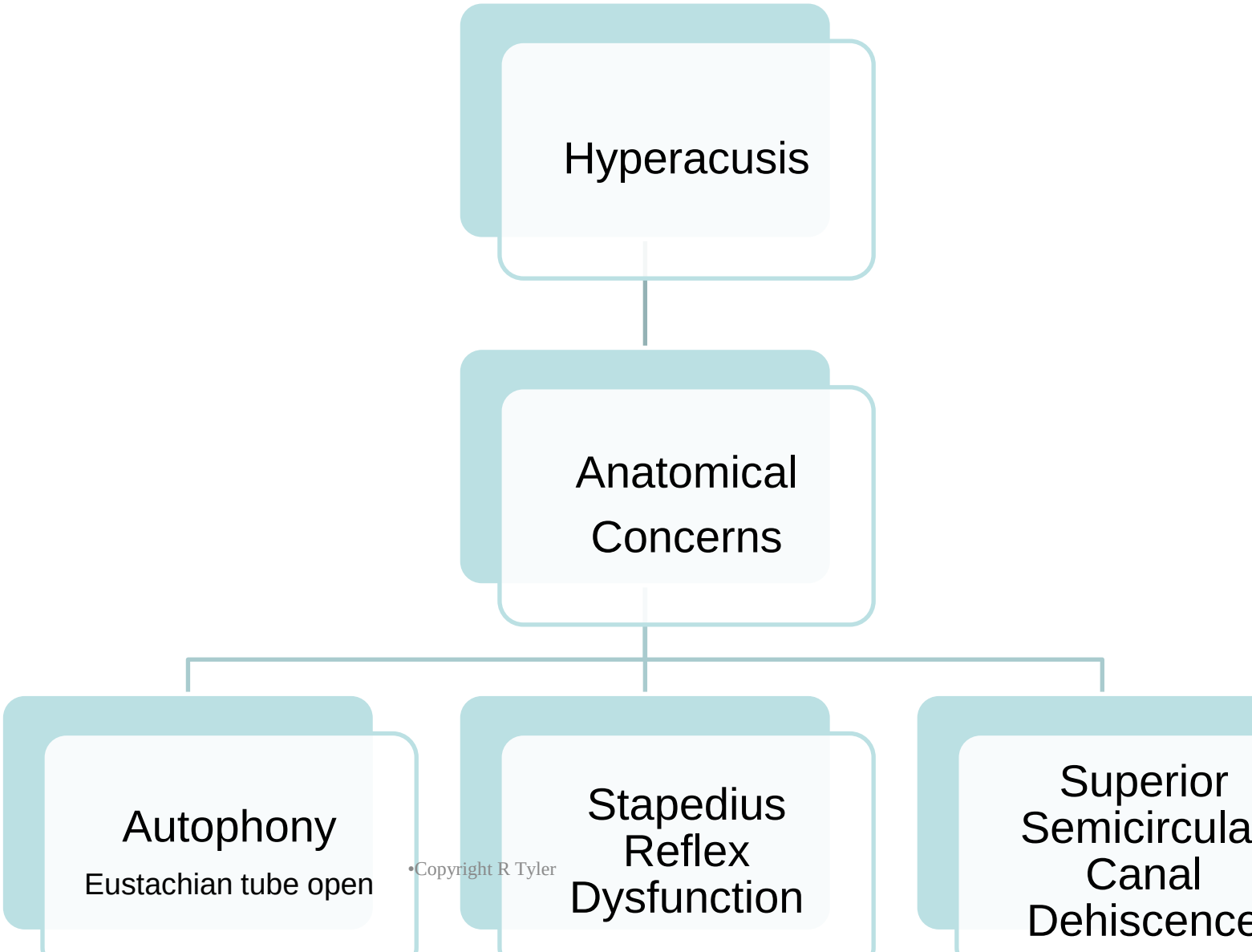



Are you bothered by certain tastes?
n=190
(I am NOT bothered by certain tastes.)
Number of patients
40
30
20
10
0
Sour foods (ex. Vinegar)
Peppers
Spices
Salty foods
Sweet foods
Coconut
Cheese
Other

Clinical conditions associated with hyperacusis.







Hyperacusis Mechanisms

SEVERAL DIFFERENT CAUSES

SOMETIMES LINKED TO HEARING LOSS

SOMETIMES LINKED TO TINNITUS

SOMETIMES LINKED TO GENETICS

SMELL…. TASTE….. ???

SEVERAL DIFFERENT CAUSES….

Initial Interview

Understanding where the patient is at….

Open-ended questionnaire

Open-ended questionnaire

(Tyler and Baker, 1983)

- Please list the difficulties you have as a result of your Hyperacusis
- List them in order of importance
- Allows patient to describe what is important to them

COMMON RELATED PROBLEMS

- Unable to enjoy music
- AVOID places where loud sounds are likely to occur
- Withdraw from socialization and communication

HYPERACUSIS + HEARING LOSS

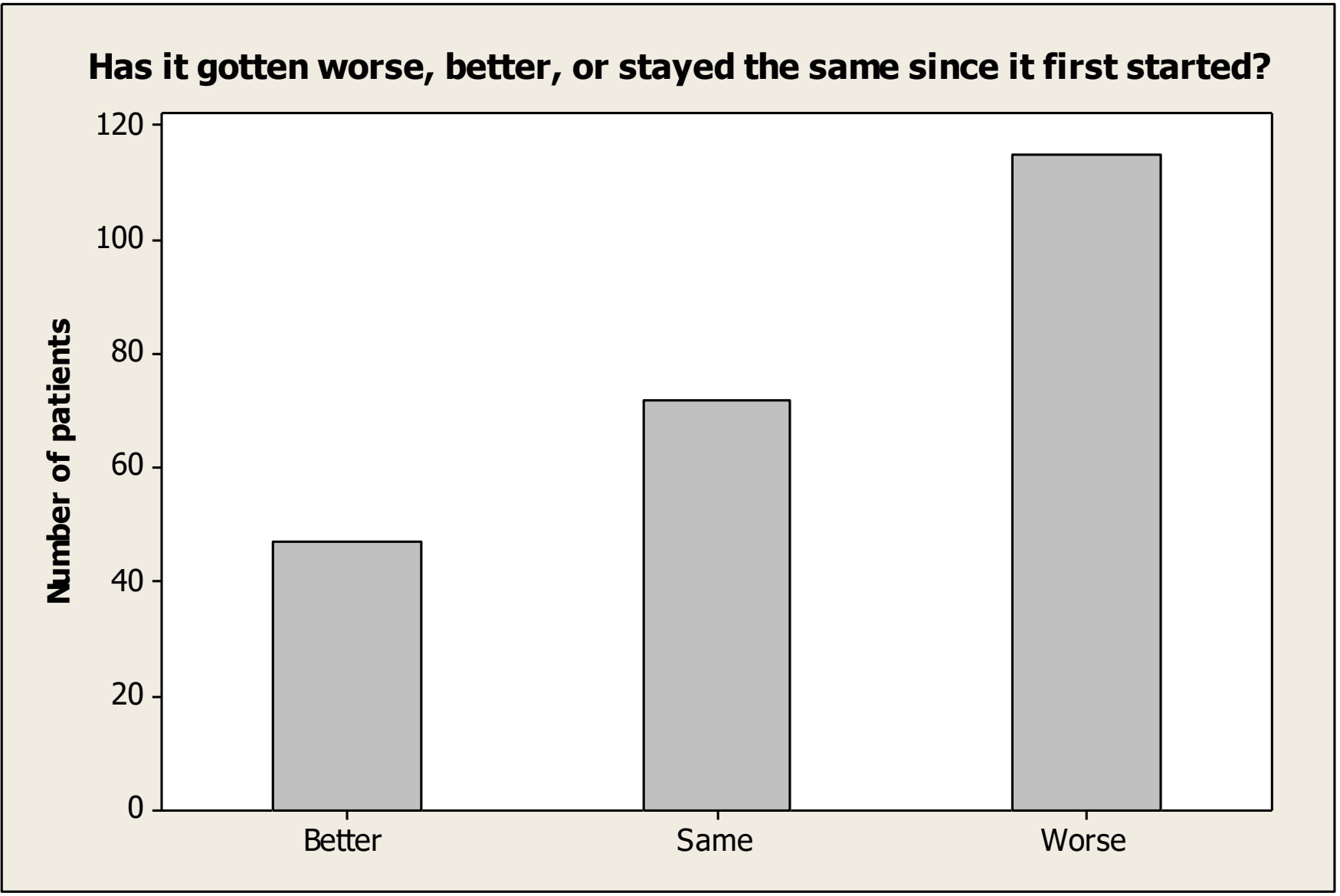
- If require hearing aids
- Amplification can make hyperacusis worse

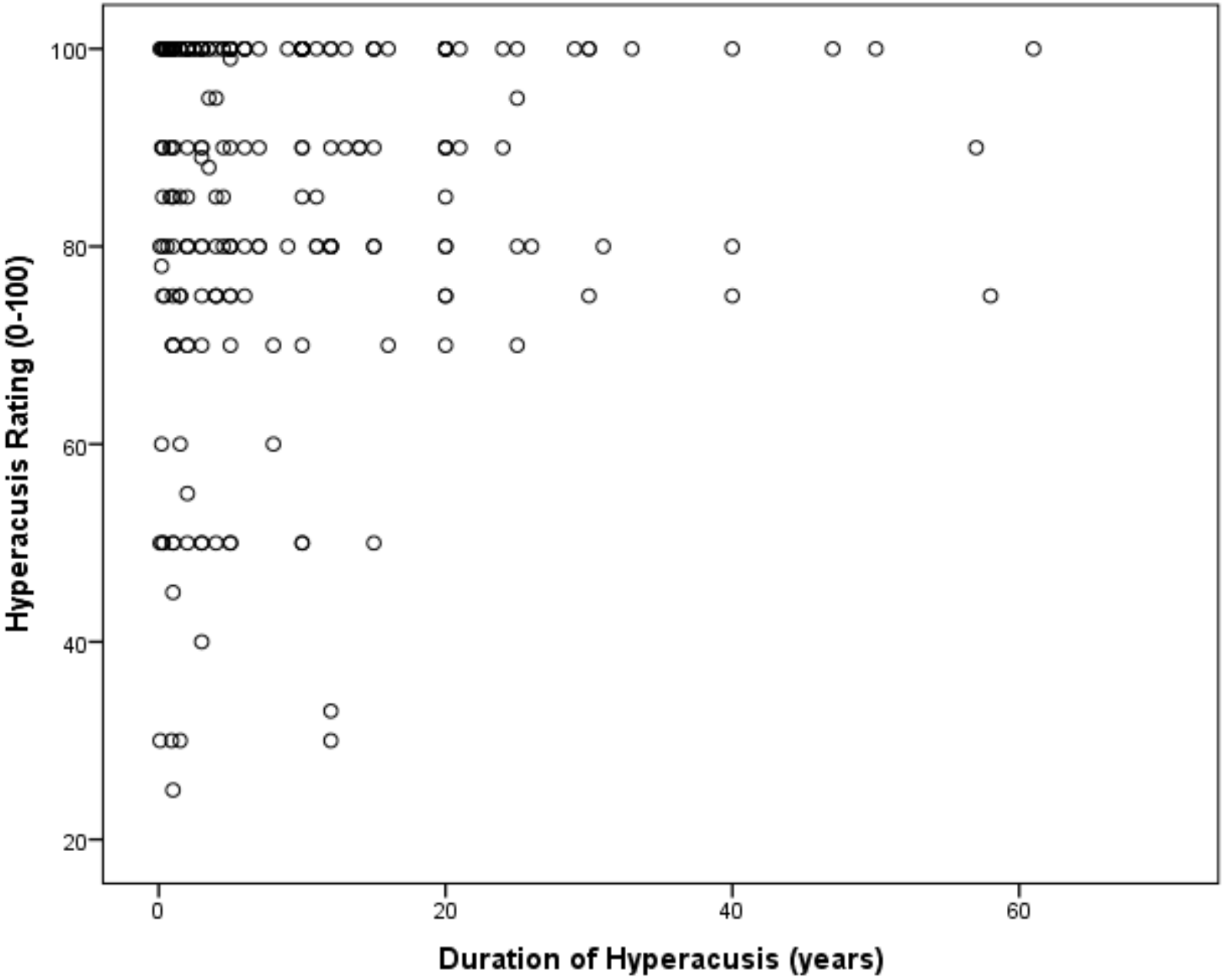
HYPERACUSIS + TINNITUS

- if desire tinnitus maskers
  - noise might make hyperacusis worse

Hyperacusis; different symptoms

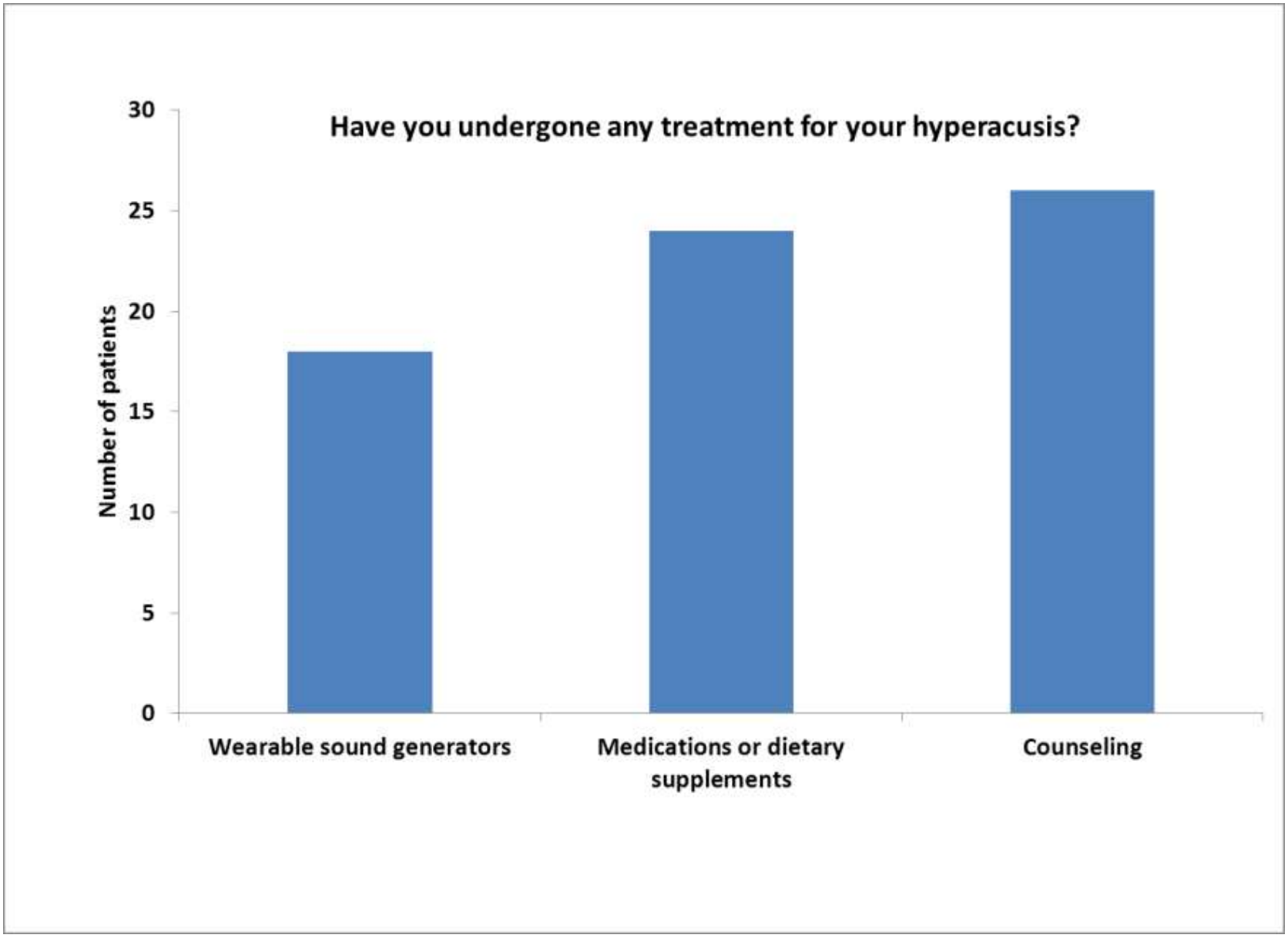
- Only specific sounds
- All loud sounds
- unexpected sounds
- frequency and ear dependent
- specific circumstances

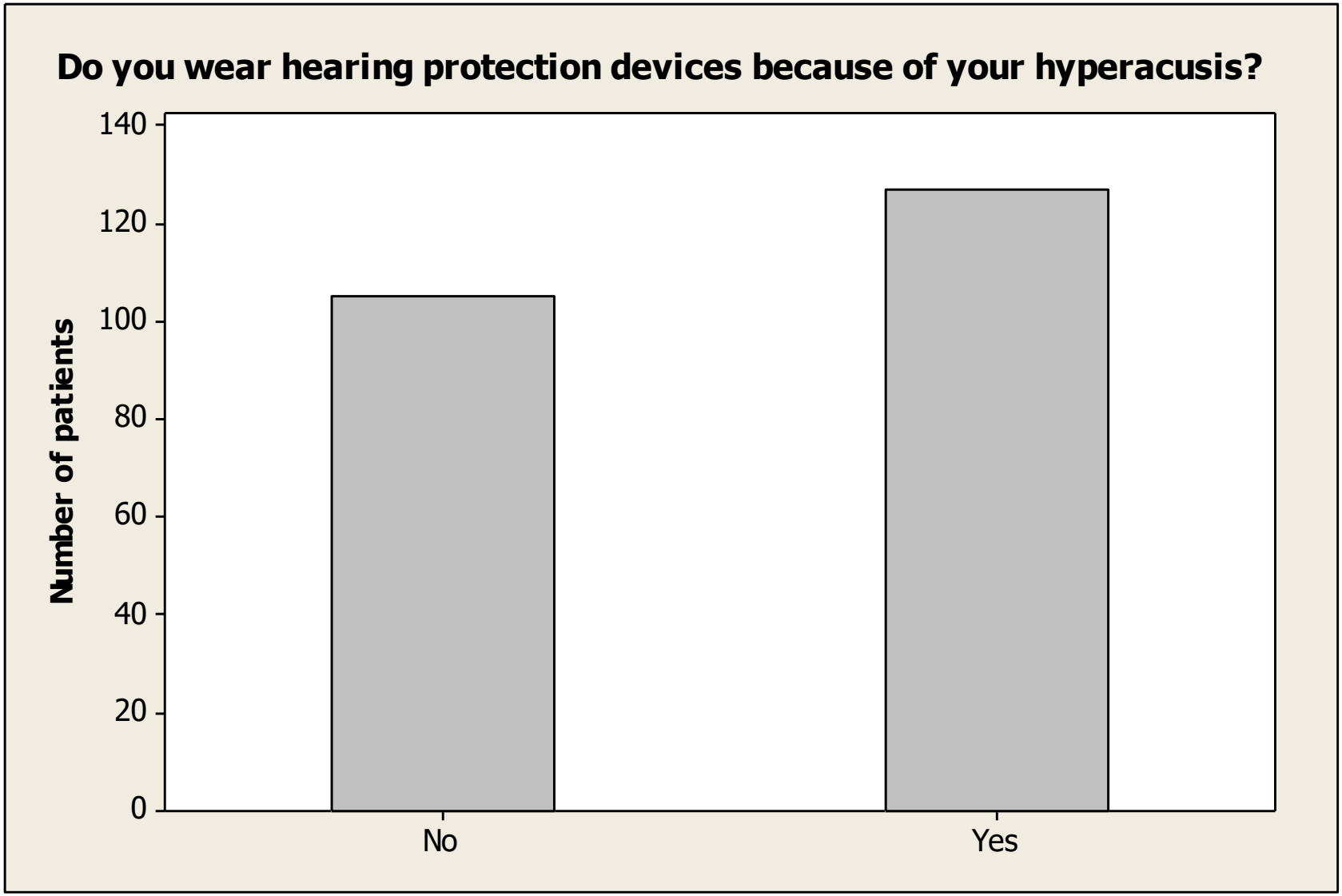

Has it gotten worse, better, or stayed the same since it first started?
Number of patients
120
100
80
60
40
20
0
Better
Same
Worse

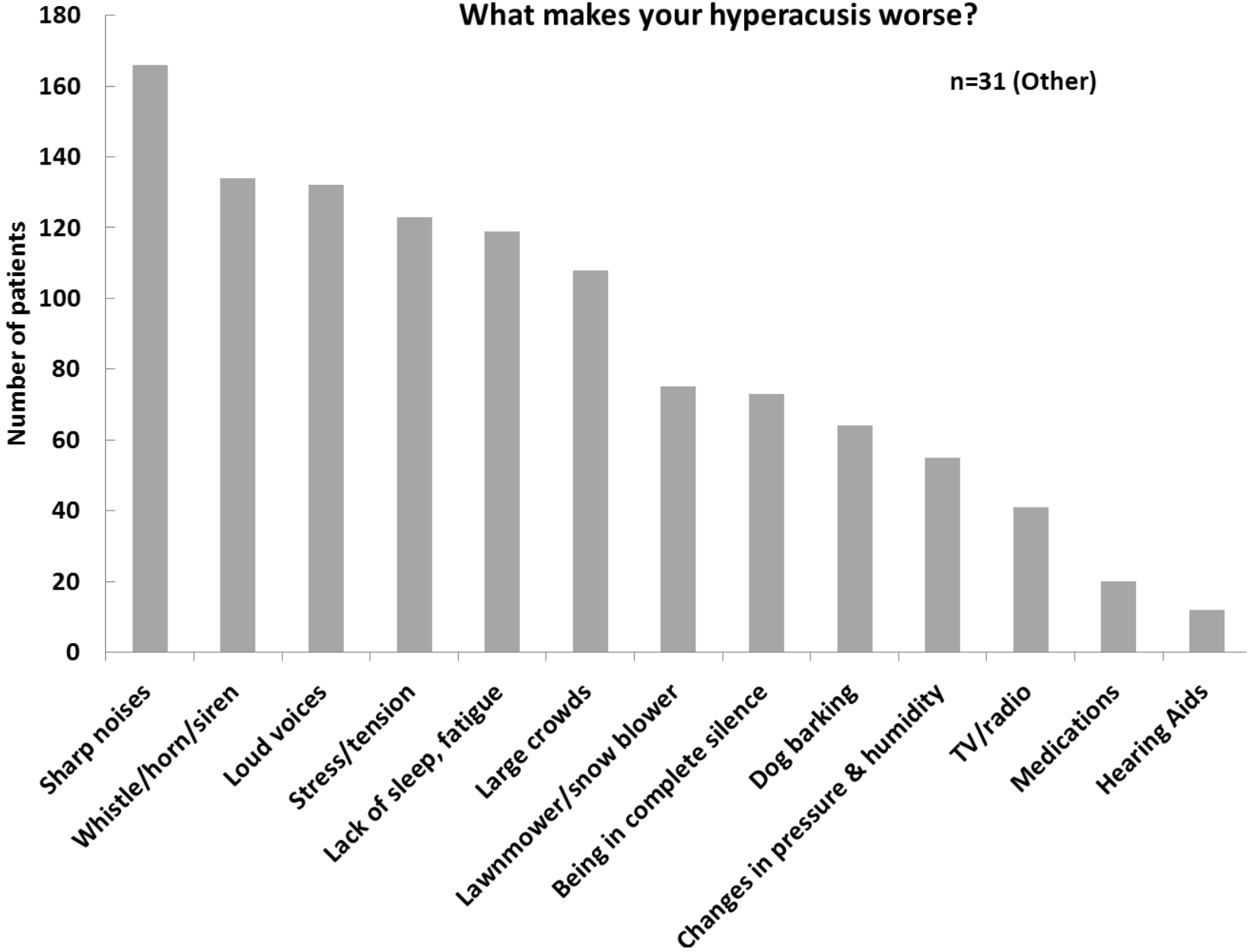

Hyperacusis Rating (0-100)
100
80
60
40
20
0
20
40
60
Duration of Hyperacusis (years)

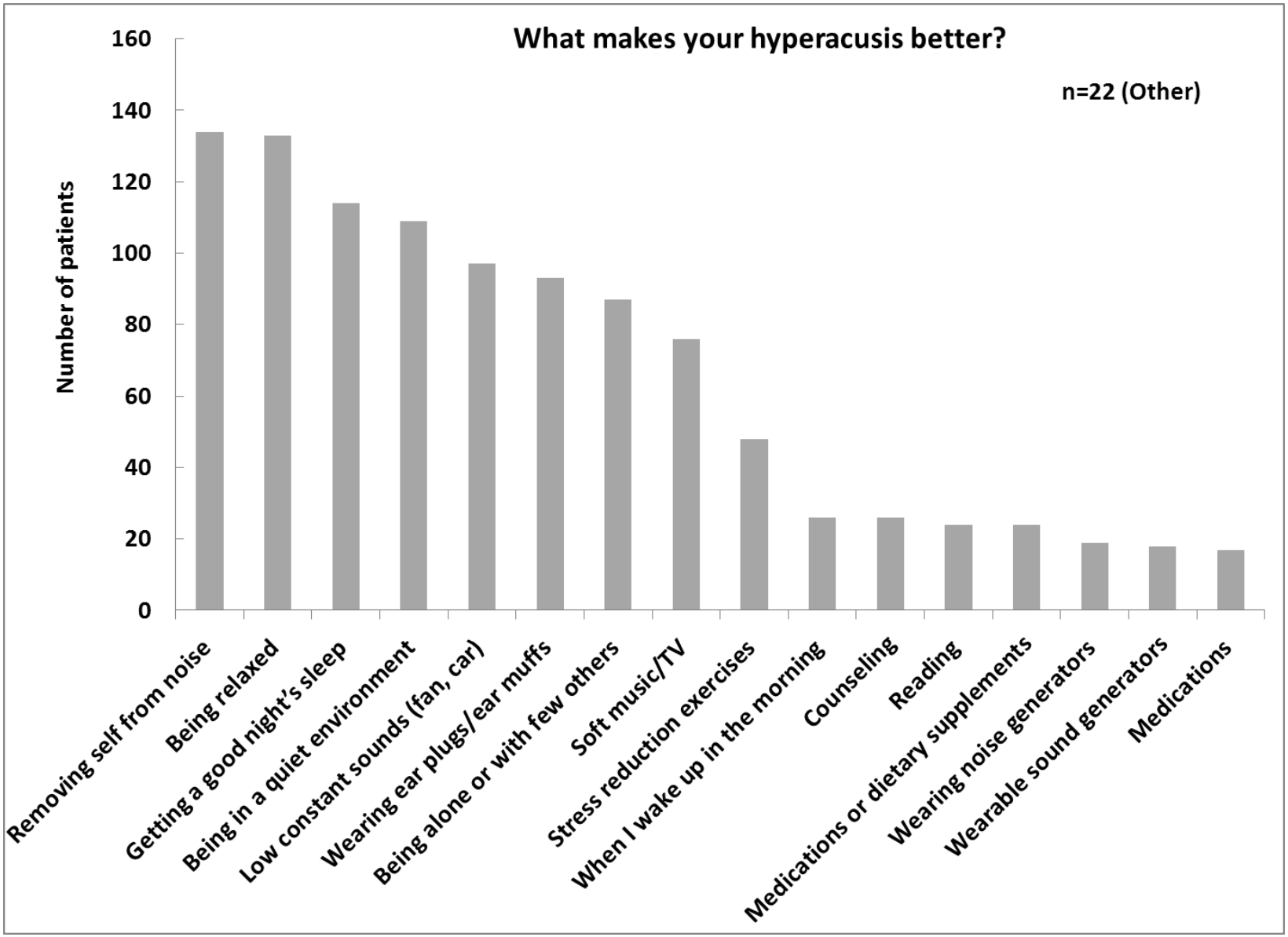
Reactions change over time?

- **Tinnitus**
  - **Number of problems reported decreases over time (Tyler and Baker, 1983)**
- **Hyperacusis**
  - **Less easy to adapt to?**
  - **Bias of survey responders?**
  - **Hyperacusis more likely to get worse over time**

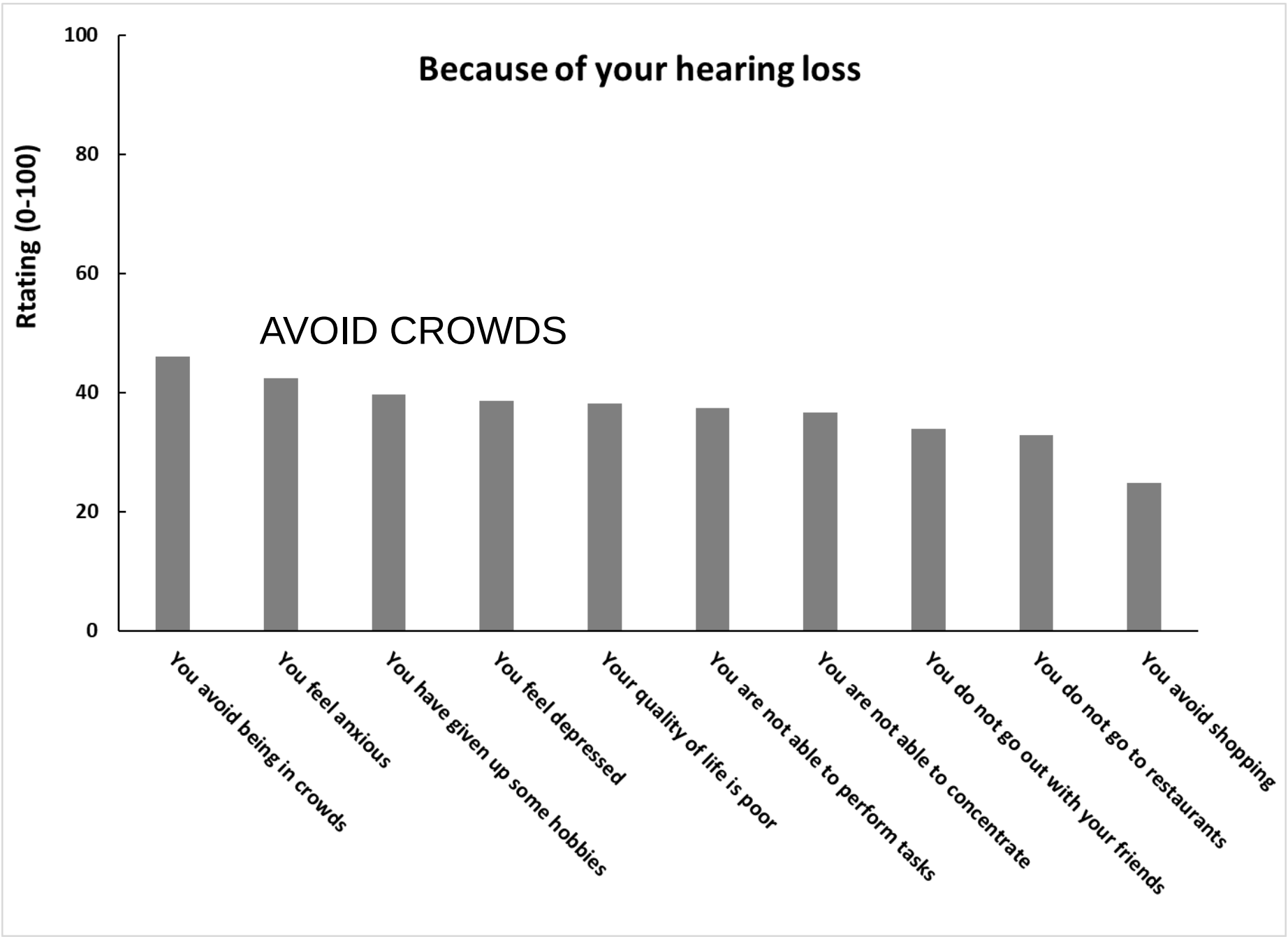

Have you undergone any treatment for your hyperacusis?
Number of patients
30
25
20
15
10
5
0
Wearable sound generators
Medications or dietary supplements
Counseling

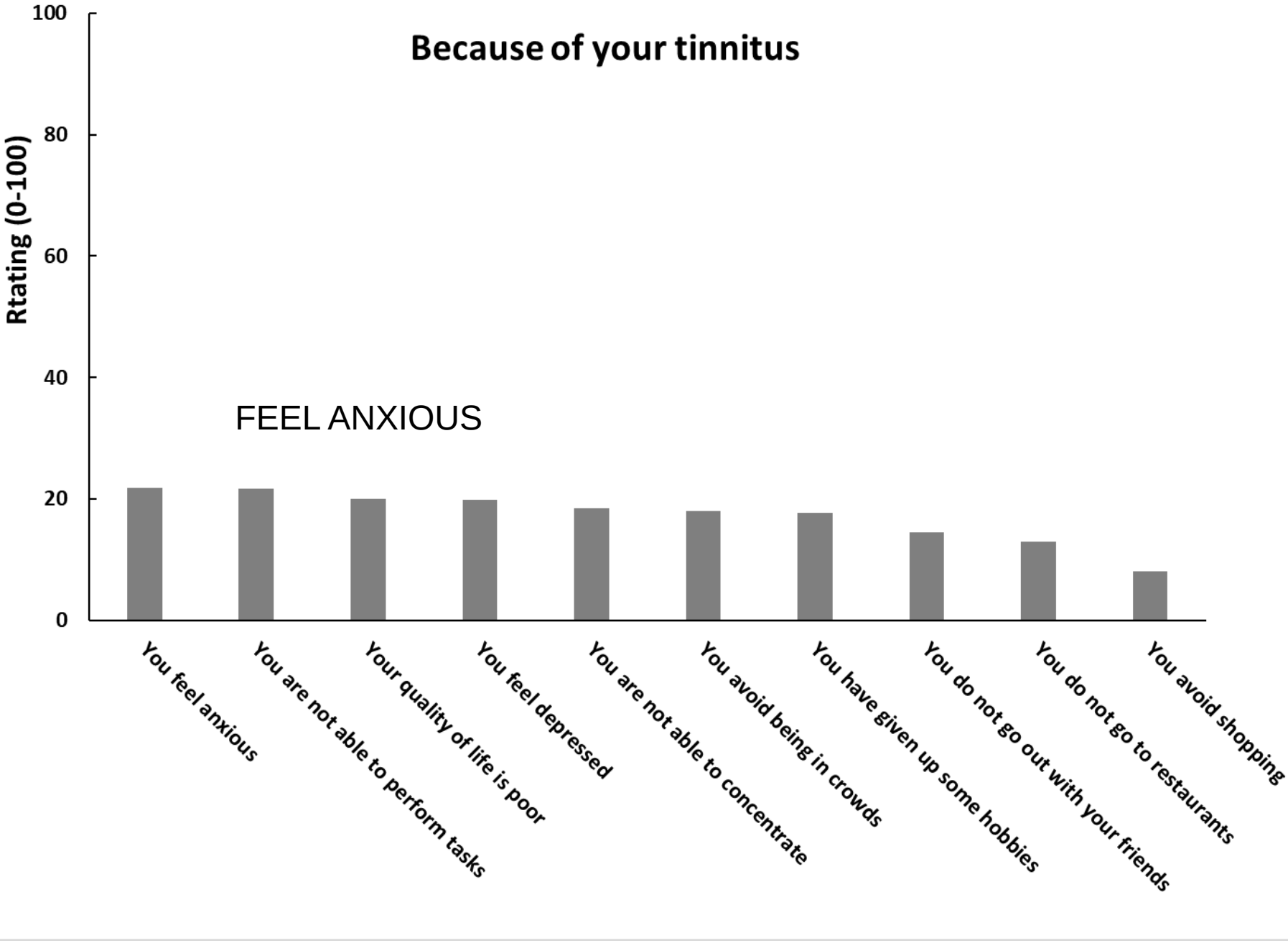

Do you wear hearing protection devices because of your hyperacusis?
Number of patients
140
120
100
80
60
40
20
0
No
Yes

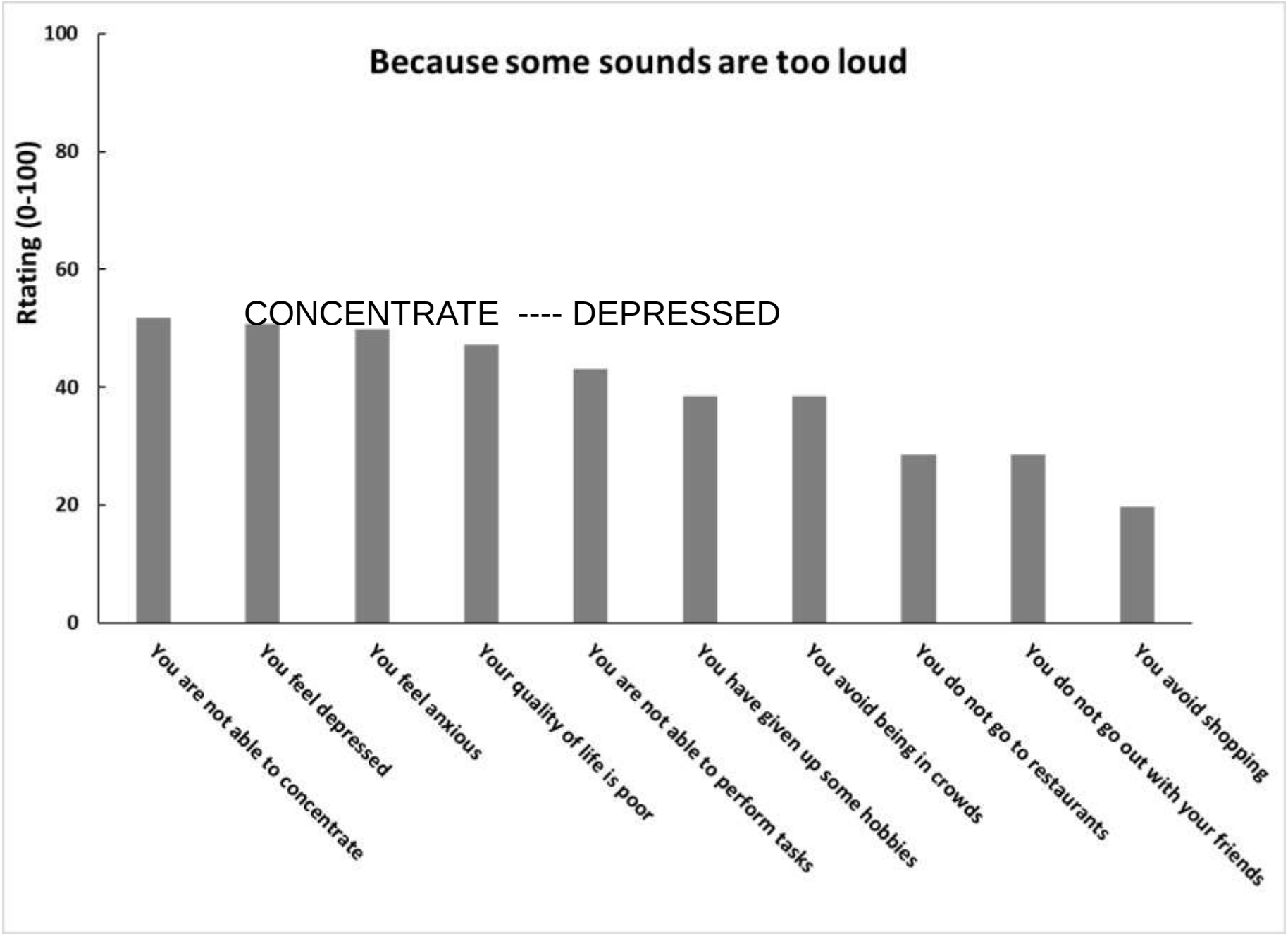

What makes your hyperacusis worse?
n=31 (Other)
Number of patients
180
160
140
120
100
80
60
40
20
0
Sharp noises
Whistle/horn/siren
Loud voices
Stress/tension
Lack of sleep, fatigue
Large crowds
Lawnmower/snow blower
Being in complete silence
Dog barking
Changes in pressure & humidity
TV/radio
Medications
Hearing Aids


What makes your hyperacusis better?
n=22 (Other)
Number of patients
160
140
120
100
80
60
40
20
0
Removing self from noise
Being relaxed
Getting a good night's sleep
Being in a quiet environment
Low constant sounds (fan, car)
Wearing ear plugs/ear muffs
Being alone or with few others
Soft music/TV
Stress reduction exercises
When I wake up in the morning
Counseling
Reading
Medications or dietary supplements
Wearing noise generators
Wearable sound generators
Medications

PROBLEMS EXPERIENCE BY HEARING LOSS TINNITUS and HYPERACUSIS

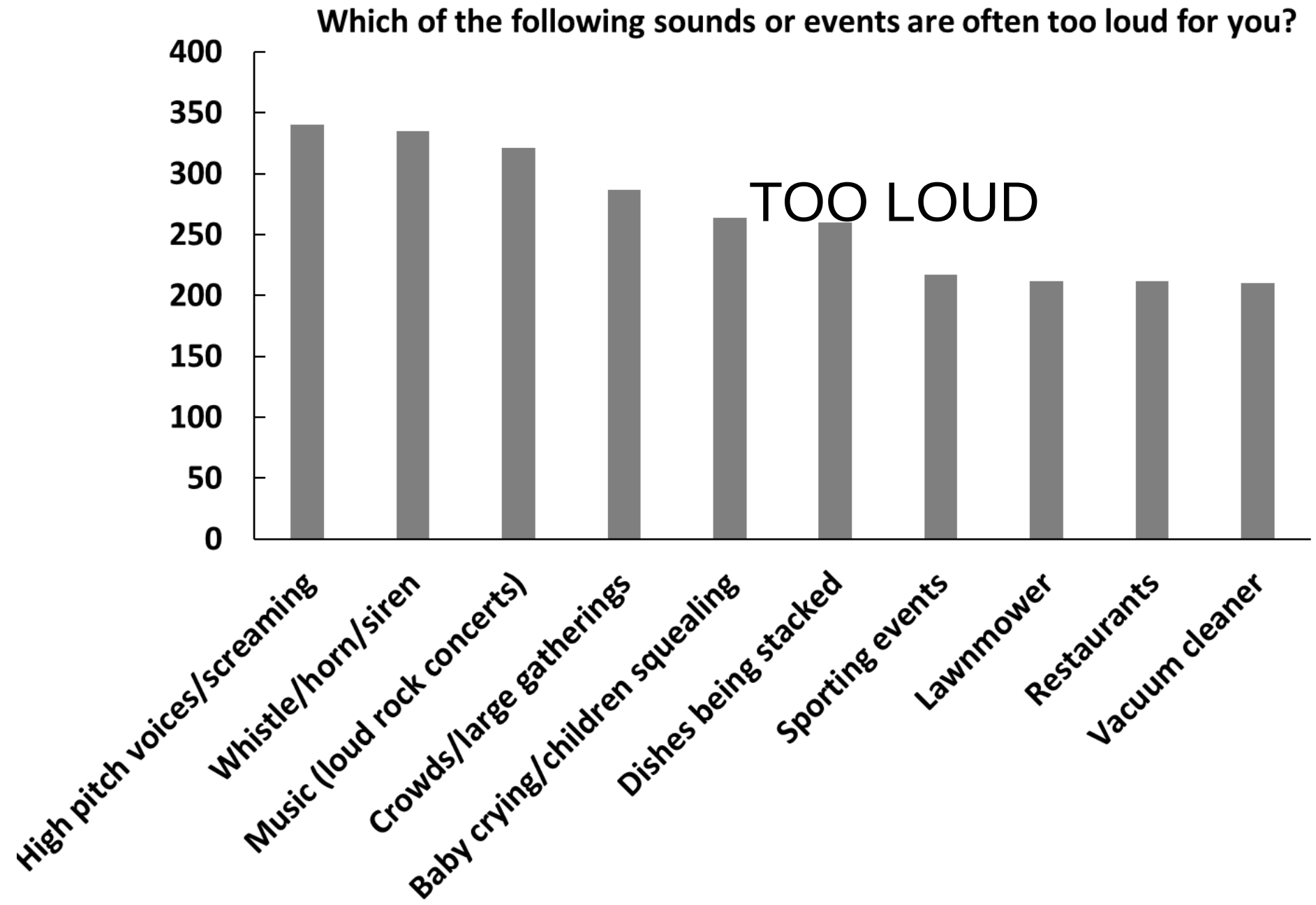

Because of your hearing loss
Rtating (0-100)
100
80
60
40
20
0
AVOID CROWDS
you avoid being in crowds
you feel anxious
you have given up some hobbies
you feel depressed
your quality of life is poor
you are not able to perform tasks
you are not able to concentrate
you do not go out with your friends
you do not go to restaurants
you avoid shopping

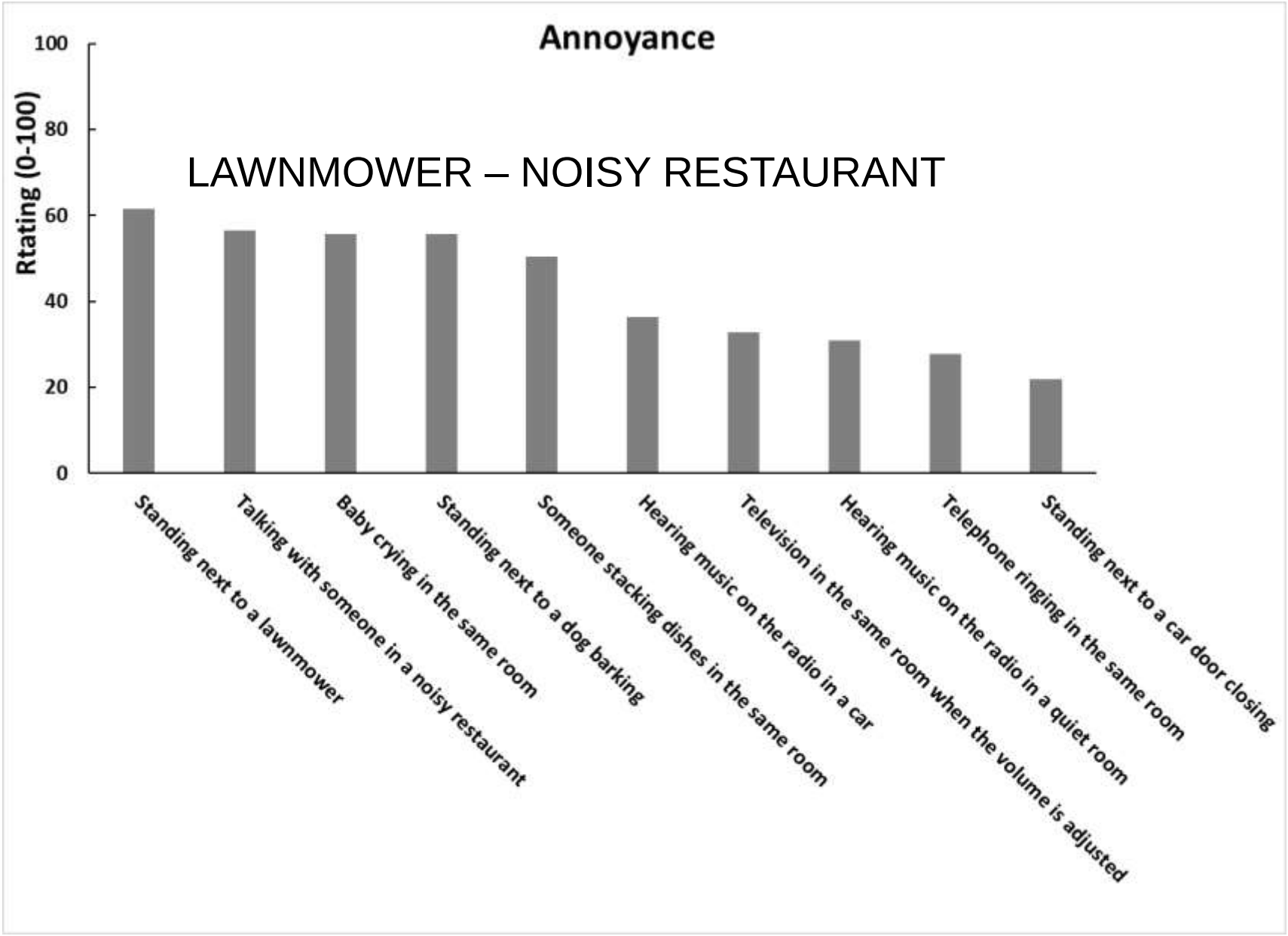

Because of your tinnitus
Rtating (0-100)
100
80
60
40
20
0
FEEL ANXIOUS
You feel anxious
You are not able to perform tasks
Your quality of life is poor
You feel depressed
You are not able to concentrate
You avoid being in crowds
You have given up some hobbies
You do not go out with your friends
You do not go to restaurants
You avoid shopping

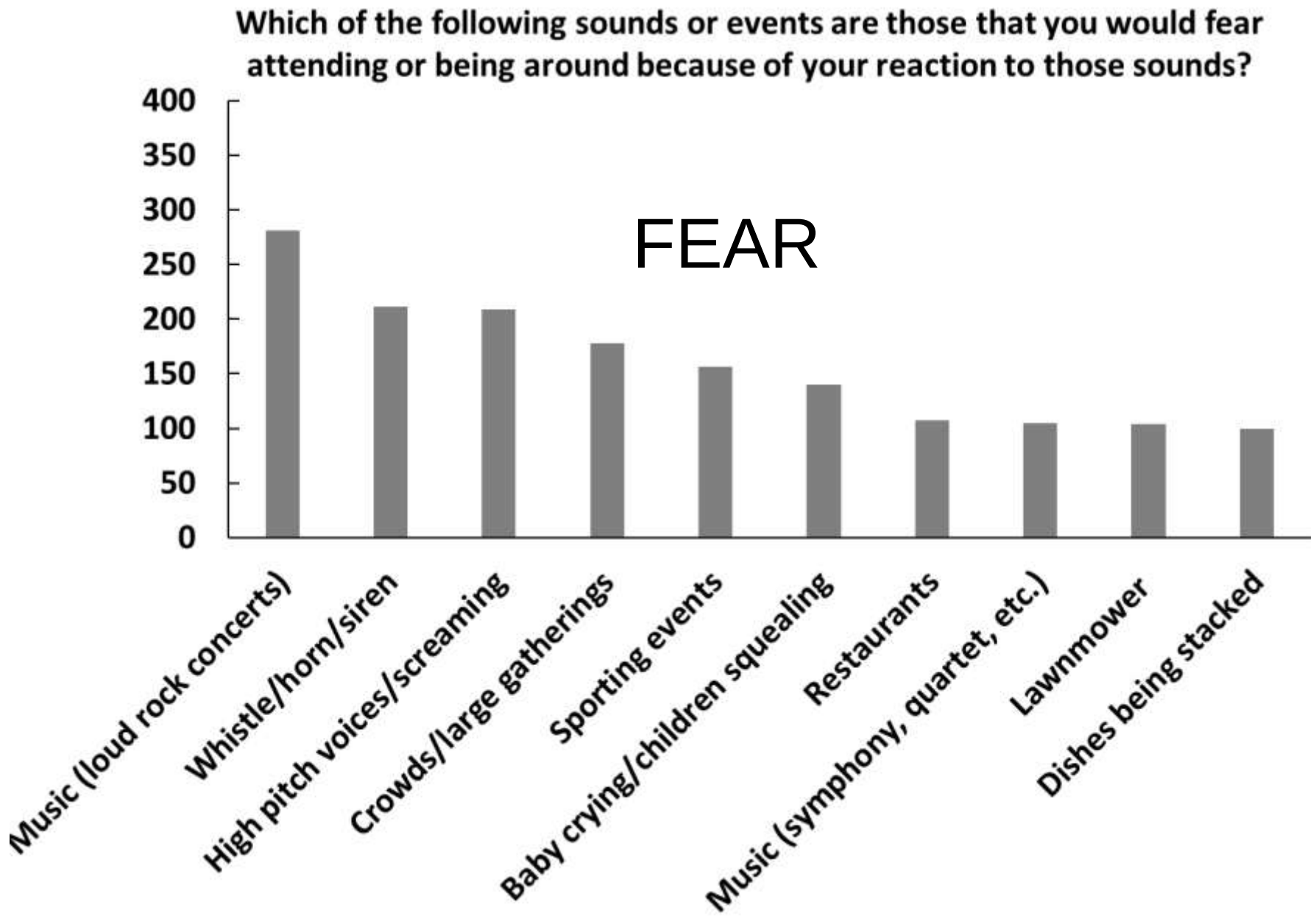

Because some sounds are too loud
Rtating (0-100)
100
80
60
40
20
0
CONCENTRATE ---- DEPRESSED
You are not able to concentrate
You feel depressed
You feel anxious
Your quality of life is poor
You are not able to perform tasks
You have given up some hobbies
You avoid being in crowds
You do not go to restaurants
You do not go out with your friends
You avoid shopping

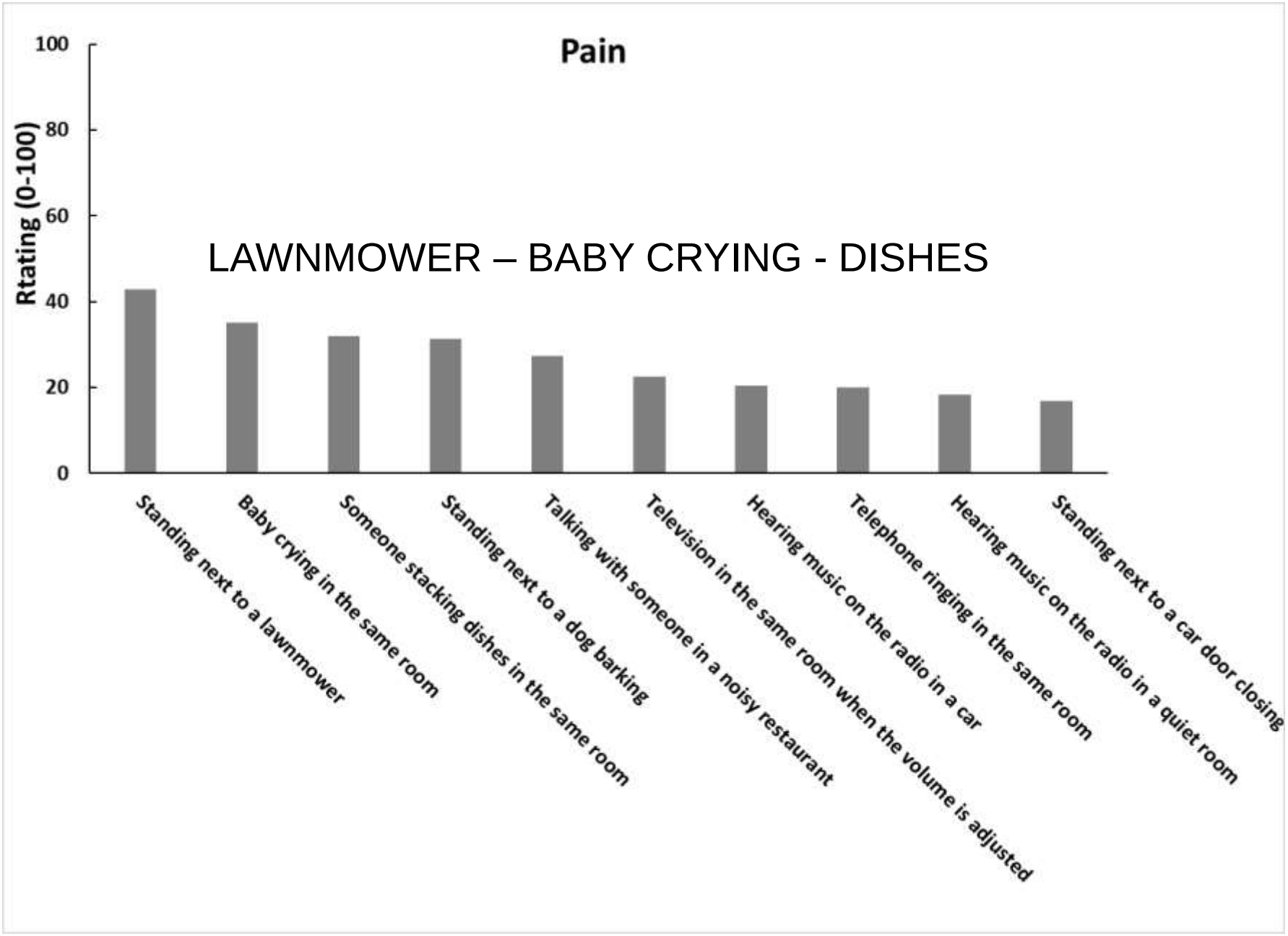
PROBLEMS EXPERIENCE BY LOUDNESS, ANNOYANCE, FEAR, and PAIN

HYPERACUSIS

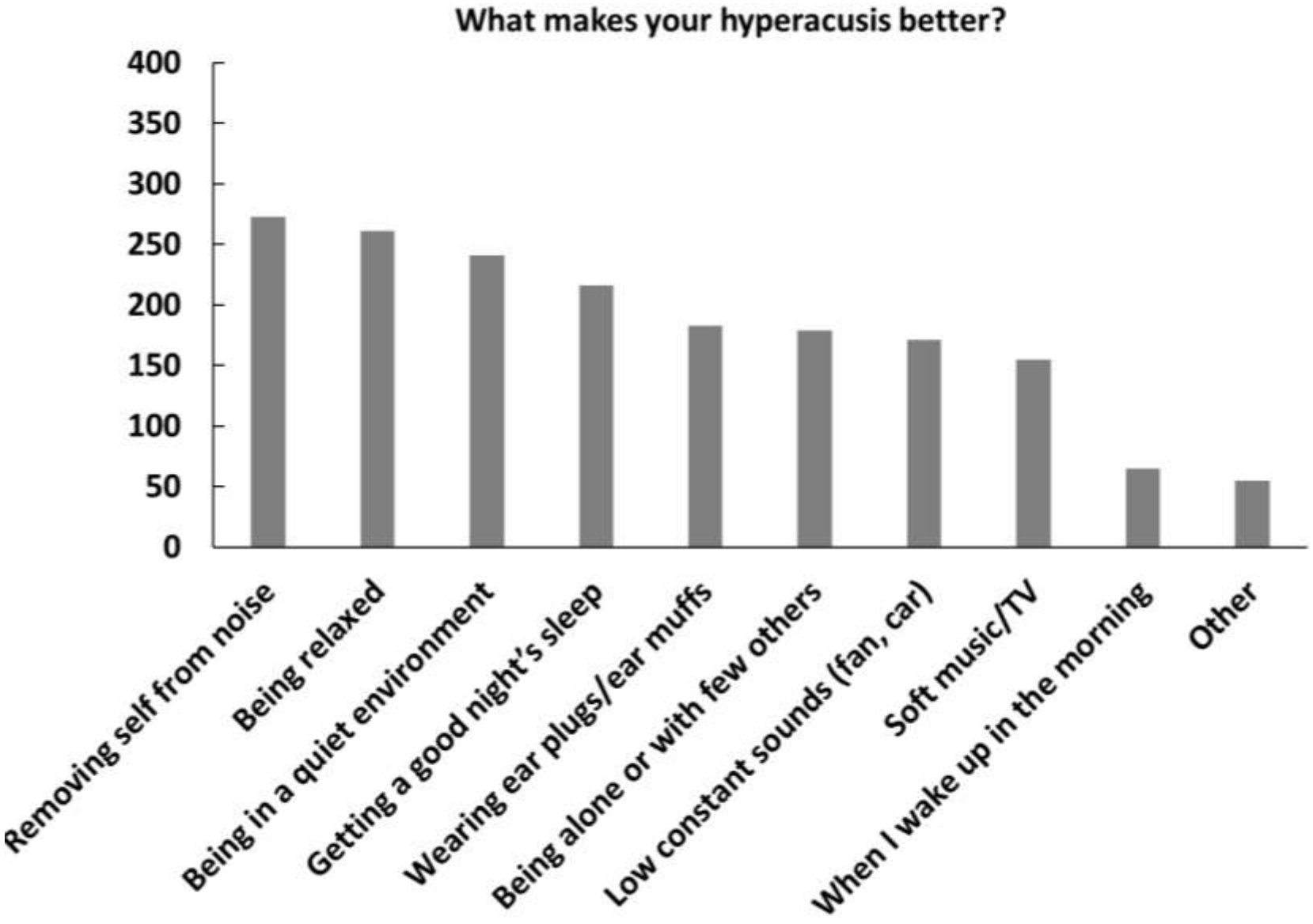

Which of the following sounds or events are often too loud for you?
400
350
300
250
200
150
100
50
0
TOO LOUD
High pitch voices/screaming
Whistle/horn/siren
Music (loud rock concerts)
Crowds/large gatherings
Baby crying/children squealing
Dishes being stacked
Sporting events
Lawnmower
Restaurants
Vacuum cleaner


Annoyance
Rtating (0-100)
100
80
60
40
20
0
LAWNMOWER – NOISY RESTAURANT
Standing next to a lawnmower
Talking with someone in a noisy restaurant
Baby crying in the same room
Standing next to a dog barking
Someone stacking dishes in the same room
Hearing music on the radio in a car
Television in the same room when the volume is adjusted
Hearing music on the radio in a quiet room
Telephone ringing in the same room
Standing next to a car door closing


Which of the following sounds or events are those that you would fear attending or being around because of your reaction to those sounds?
400
350
300
250
200
150
100
50
0
FEAR
Music (loud rock concerts)
Whistle/horn/siren
High pitch voices/screaming
Crowds/large gatherings
Sporting events
Baby crying/children squealing
Restaurants
Music (symphony, quartet, etc.)
Lawnmower
Dishes being stacked


Pain
Rtating (0-100)
100
80
60
40
20
0
LAWNMOWER – BABY CRYING - DISHES
Standing next to a lawnmower
Baby crying in the same room
Someone stacking dishes in the same room
Standing next to a dog barking
Talking with someone in a noisy restaurant
Television in the same room when the volume is adjusted
Hearing music on the radio in a car
Telephone ringing in the same room
Hearing music on the radio in a quiet room
Standing next to a car door closing

WHAT SITUATIONS ARE EASIER FOR HYPERACUSIS PATIENTS ??


What makes your hyperacusis better?
400
350
300
250
200
150
100
50
0
Removing self from noise
Being relaxed
Being in a quiet environment
Getting a good night's sleep
Wearing ear plugs/ear muffs
Being alone or with few others
Low constant sounds (fan, car)
Soft music/TV
When I wake up in the morning
Other

- IMPORTANT TO UNDERSTAND DIFFERENCES AMONG HYPERACUSIS PATIENTS !!

INITIAL INTERVIEW

- BE A GOOD LISTENER
- SAY – REASONABLE YOU ARE BOTHERED BY THIS
- EXPLORE INDIVIDUAL DIFFERENCES
- SITUATIONS WHERE WORSE
- SITUATIONS WHERE BETTER
- BE A GOOD LISTENER
- SHOW THE PATIENT YOU CARE

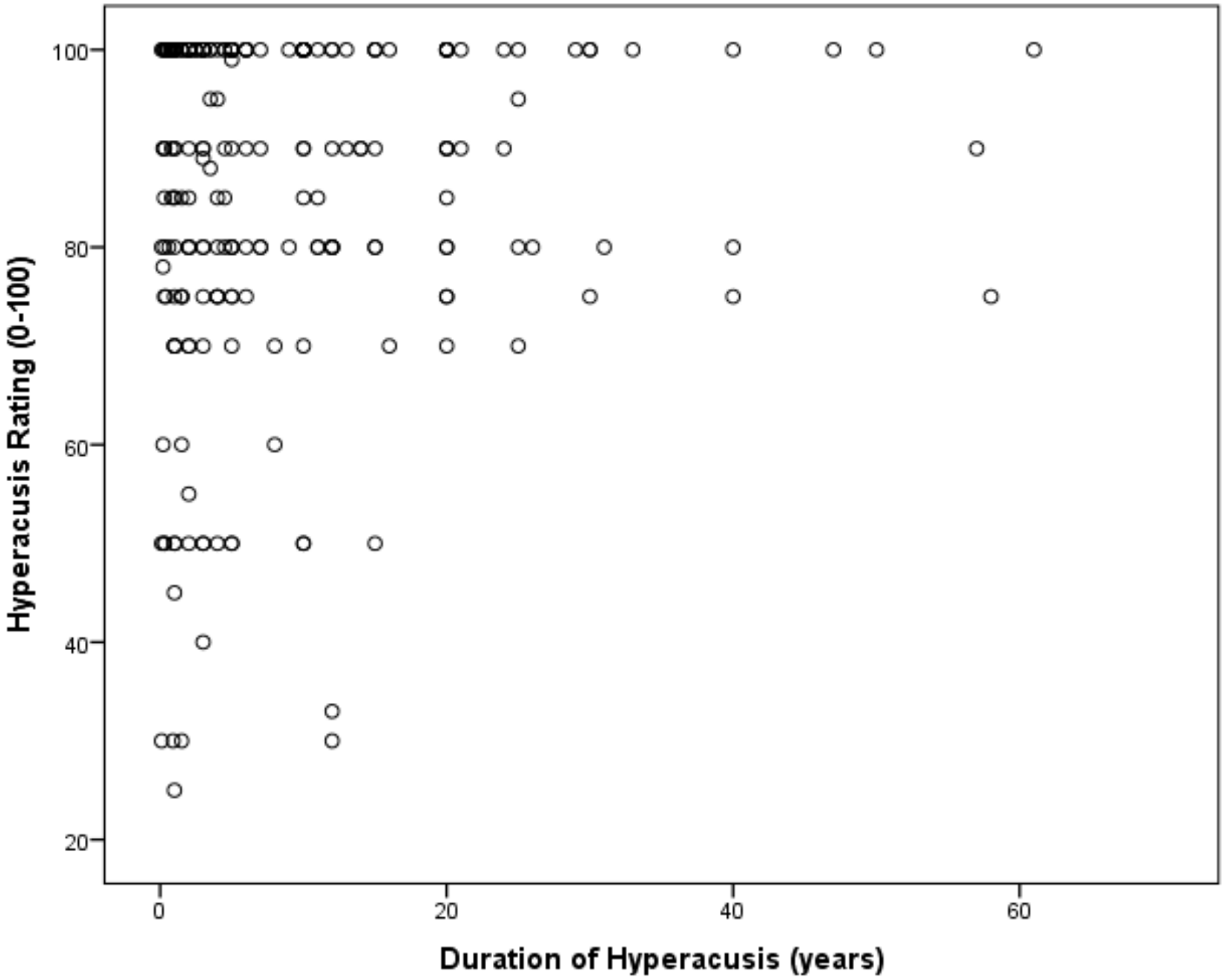
HYPERACOUSIS QUESTIONNAIRES

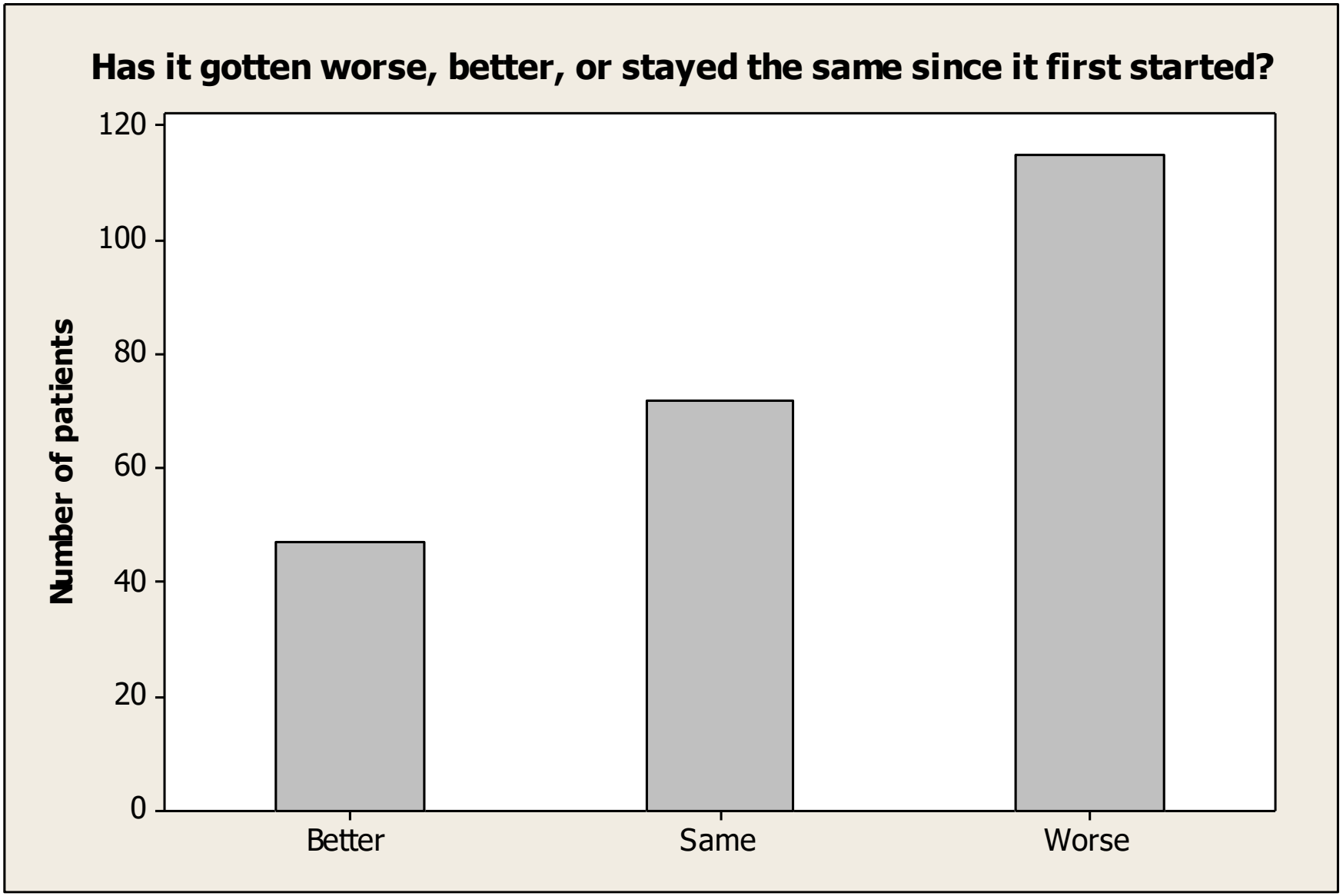
RICHARD TYLER

Understanding
where
the patient is at !!

Reactions change over time?

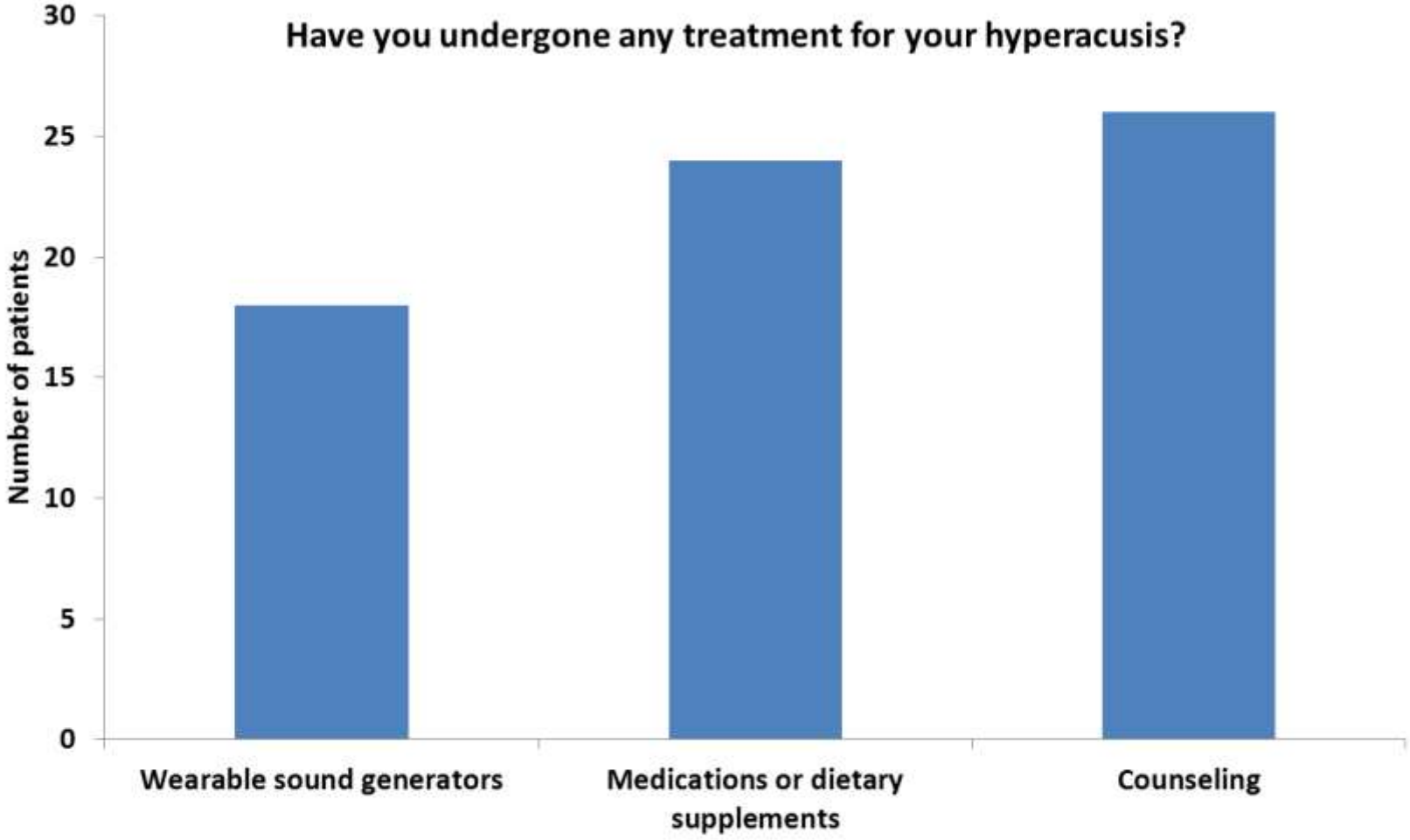
- **Tinnitus**
  - **Number of problems reported decreases over time (Tyler and Baker, 1983)**
- **Hyperacusis**
  - **Less easy to adapt to?**
  - **Bias of survey responders?**
  - **Hyperacusis more likely to get worse over time**

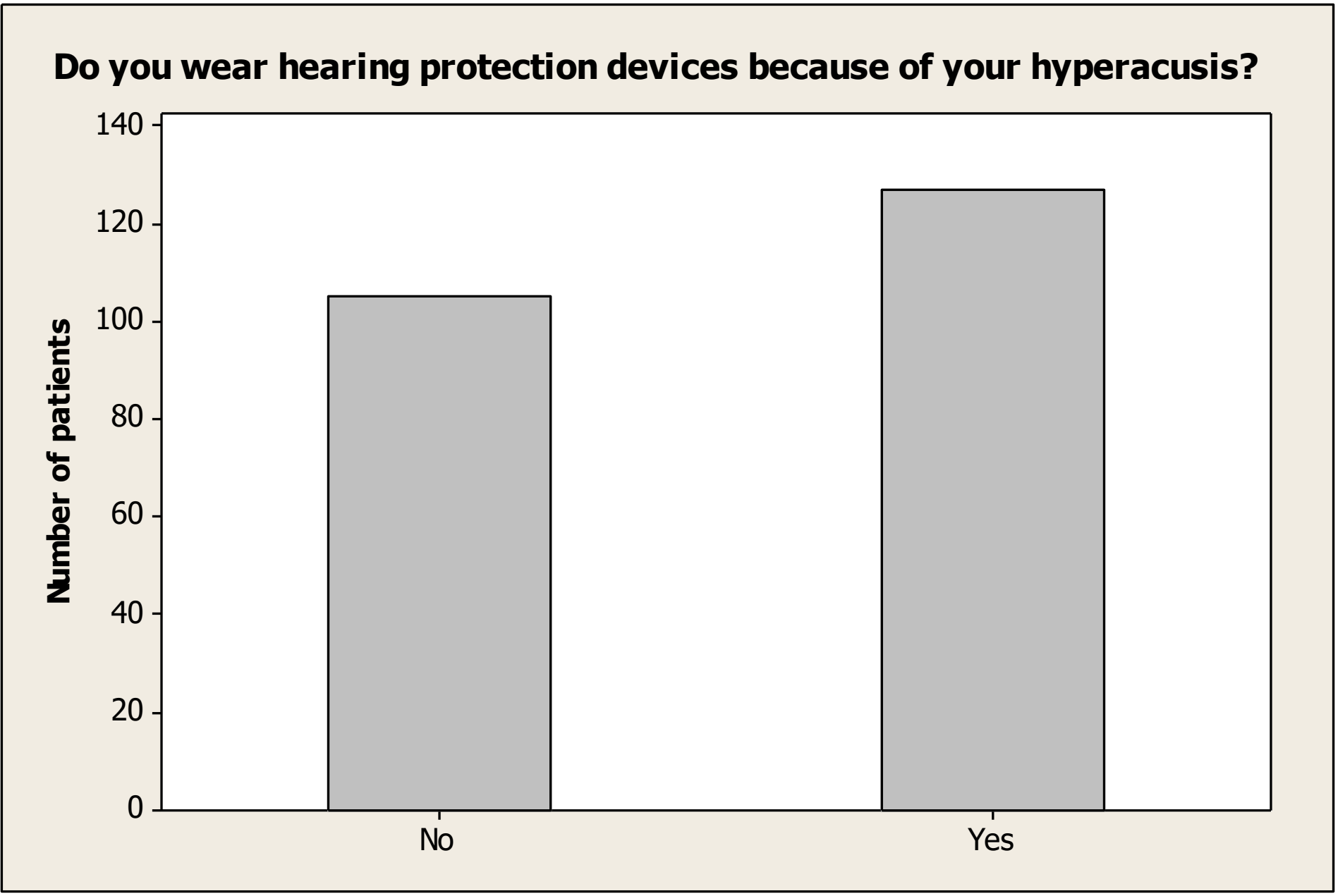

Hyperacusis Rating (0-100)
100
80
60
40
20
0
20
40
60
Duration of Hyperacusis (years)


Has it gotten worse, better, or stayed the same since it first started?
Number of patients
120
100
80
60
40
20
0
Better
Same
Worse

Uncomfortable sounds
(Urnau et al., 2011; n=25)

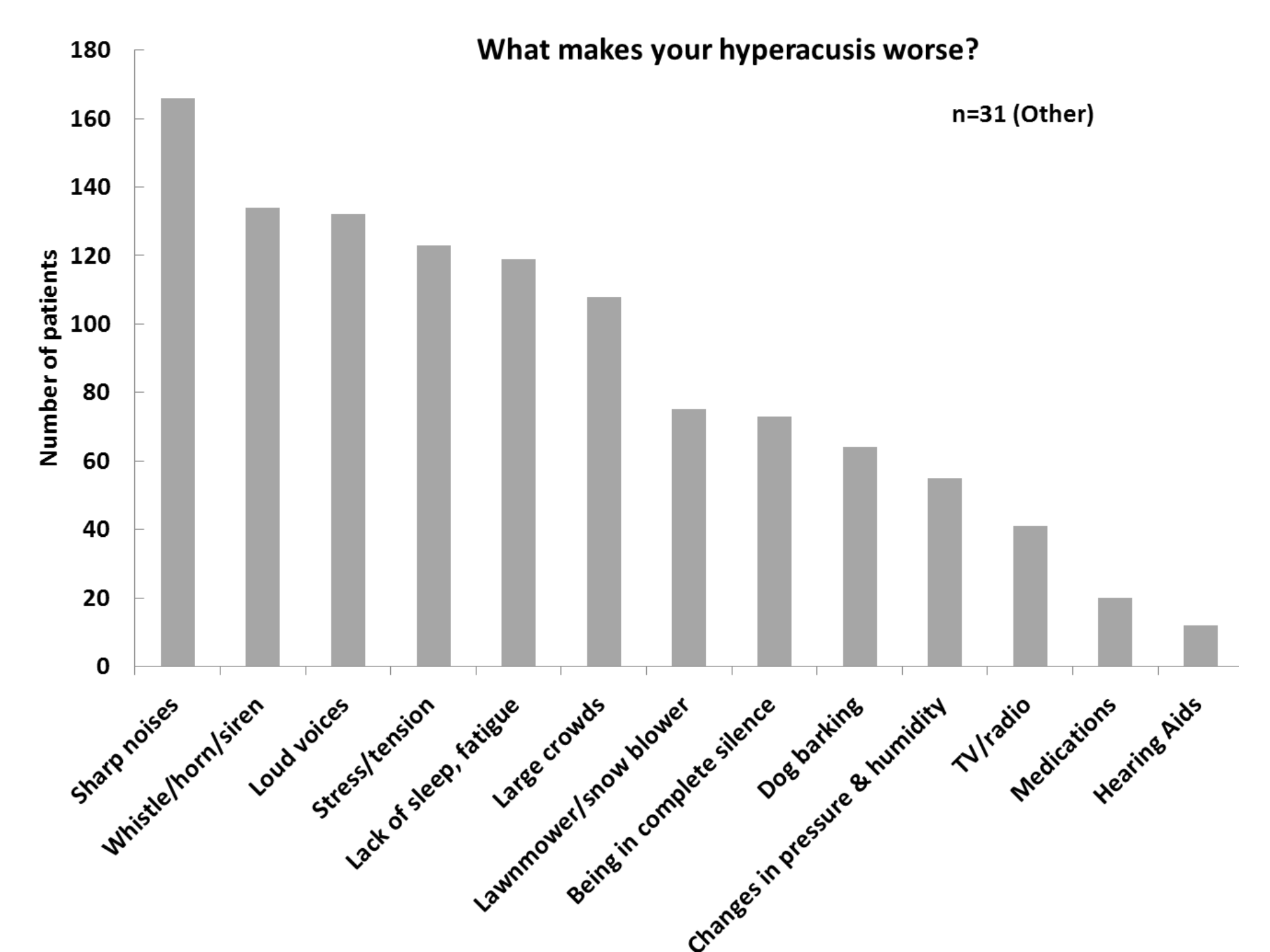
- Loud music 20
- Horn 17
- People talking loudly 17
- Traffic noise 16
- Door slamming 16
- Sudden and loud noise 15
- Sink dripping 13
- Restaurant noise 11
- Door bell 11
- Police siren 11
- Plane 9
- Plastic bag noise 7
- Blender 7
- Phone ringing 6

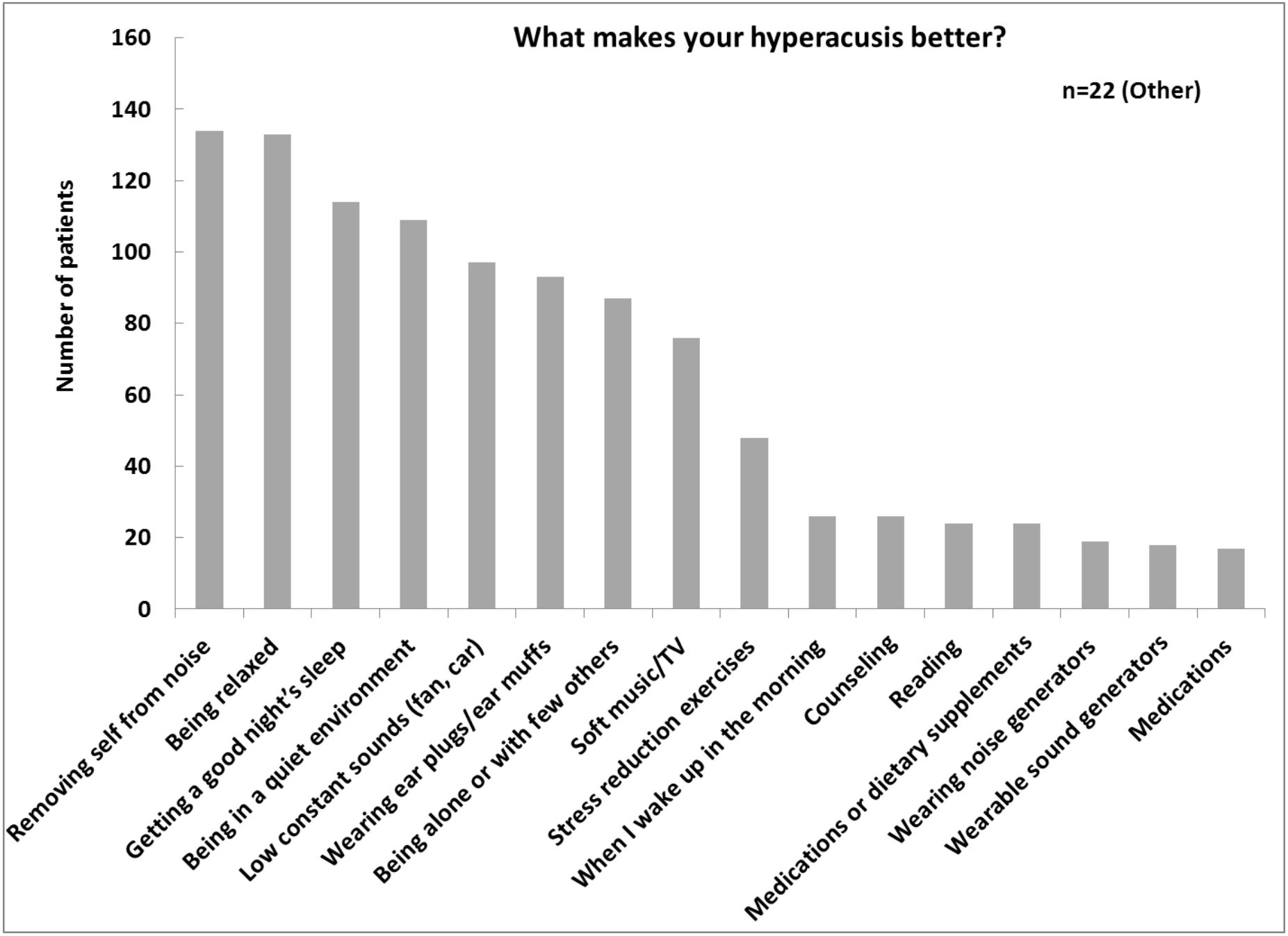

Have you undergone any treatment for your hyperacusis?
Number of patients
30
25
20
15
10
5
0
Wearable sound generators
Medications or dietary supplements
Counseling


Do you wear hearing protection devices because of your hyperacusis?
Number of patients
140
120
100
80
60
40
20
0
No
Yes

Stouffer and Tyler (1990)

- Makes Tinnitus Better
  - Nothing (41%)
  - Sleep, attention to radio, TV, noisy place, quiet place
- Makes Tinnitus Worse
  - Quiet place, noisy place, stress, lack sleep
  - Nothing (20%)


What makes your hyperacusis worse?
n=31 (Other)
Number of patients
180
160
140
120
100
80
60
40
20
0
Sharp noises
Whistle/horn/siren
Loud voices
Stress/tension
Lack of sleep, fatigue
Large crowds
Lawnmower/snow blower
Being in complete silence
Dog barking
Changes in pressure & humidity
TV/radio
Medications
Hearing Aids


What makes your hyperacusis better?
n=22 (Other)
Number of patients
160
140
120
100
80
60
40
20
0
Removing self from noise
Being relaxed
Getting a good night's sleep
Being in a quiet environment
Low constant sounds (fan, car)
Wearing ear plugs/ear muffs
Being alone or with few others
Soft music/TV
Stress reduction exercises
When I wake up in the morning
Counseling
Reading
Medications or dietary supplements
Wearing noise generators
Wearable sound generators
Medications

MEASURING LOUDNESS HYPERACOUSIS

LOUDNESS DISCOMFORT LEVEL (LDL)

"This is a test in which you will be hearing sounds in your right/left ear. We want you to decide ***when the sound first becomes uncomfortably loud****"*

(Berger, Hagberg, and Rane, 1984)

Instructions:

- Present sounds at a comfortable level and then increase the level **until the person signals that it is uncomfortably loud**.
- Decrease the intensity by 15-20 dB and then **increase in 5-dB** steps until it is uncomfortable again.
- The LDL is the highest level the individual chooses on two out of three trials Test 3 times.

(Skinner, 1988).

LOUDNESS DISCOMFORT LEVELS

- Using a pulsed tone, say to the patient: "***Assign a number from 0 to 100 that represents the loudness of the tone***. *A score of 0% would mean that you can't hear the tone. A score of* ***100% would mean that the tone is uncomfortably loud***"
- Start with levels just above threshold and gradually present tones at higher levels, using 5 dB increments. **Do not present a signal that produces a rating above 80%.** Test 2 times at each frequency.
- **Can use 70% instead of 80%**

TEST EAR = _____ ear

500 Hz

dB HL	**10**	**20**	**30**	**40**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**	**105**	**110**
Trial 1																	
Trial 2																	

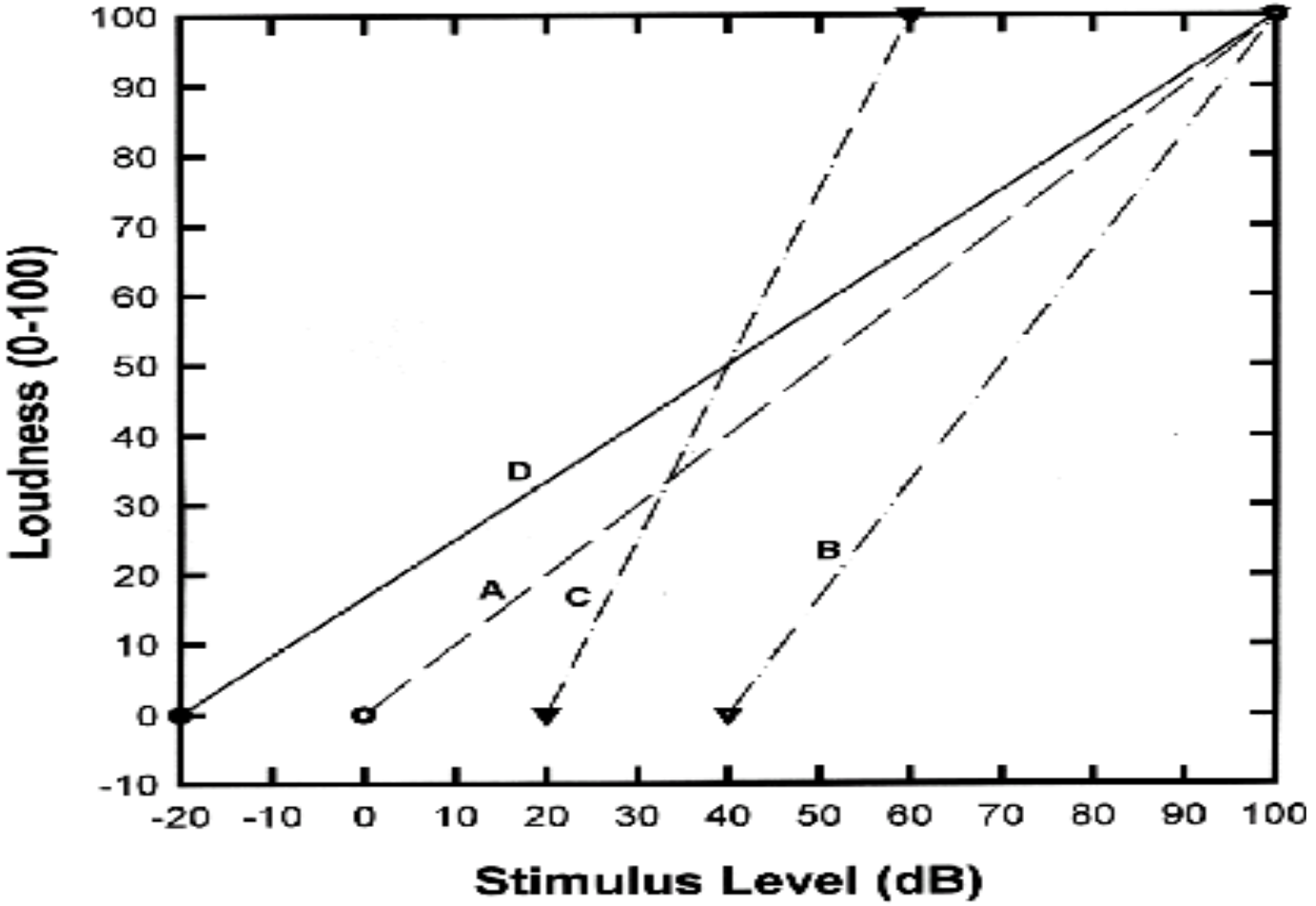
4000 Hz

dB HL	**10**	**20**	**30**	**40**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**	**105**	**110**
Trial 1																	
Trial 2																	

TEST EAR = _____ ear				
	Trial 1	**Trial 2**	**Trial 3**	**LDL**
500 Hz	dB HL	dB HL	dB HL	
4000 Hz	dB HL	dB HL	dB HL	

Please respond to the next 3 statements using a scale from 0 – 100.
(0 = strongly disagree; 100 = strongly agree)

1. Many everyday sounds are unbearably loud to me._____
2. Sounds that others believe are moderately loud, are *too* loud to me. _____
3. I hear very soft sounds that others with normal hearing do not hear._____



Tyler (1999)

Maximum Comfort Level, *or* ***Uncomfortable Loudness Level***, *reached at* ***level lower than those with normal hearing***

Questionnaires

Which of the following sounds or events are often too loud for you?

a. Baby crying/children squealing
b. Crowds/large gatherings
c. Dishes being stacked
d. Dog barking
e. High pitch voices/screaming
f. Lawnmower
g. Music (loud rock concerts)
h. Music (religious service)
i. Music (symphony, quartet, etc.)

a. Power tools
b. Restaurants
c. Sporting events
d. Telephone ringing
e. TV/radio
f. Vacuum cleaner
g. Whistle/horn/siren
h. Other _____

Measuring Annoyance Hyperacousis

Which of the following sounds or events are those that you are annoyed by?

a. Baby crying/children squealing
b. Crowds/large gatherings
c. Dishes being stacked
d. Dog barking
e. High pitch voices/screaming
f. Lawnmower
g. Music (loud rock concerts)
h. Music (religious services)
i. Music (symphony, quartet, etc.)

a. Power tools
b. Restaurants
c. Sporting events
d. Telephone ringing
e. TV/radio
f. Vacuum cleaner
g. Whistle/horn/siren
h. Other _____

Measuring Fear Hyperacousis

Which of the following sounds or events are those that you would fear attending or being around because of your reaction to those sounds?

a. Baby crying/children squealing
b. Crowds/large gatherings
c. Dishes being stacked
d. Dog barking
e. High pitch voices/screaming
f. Lawnmower
g. Music (loud rock concerts)
h. Music (religious services)
i. Music (symphony, quartet, etc.)

a. Power tools
b. Restaurants
c. Sporting events
d. Telephone ringing
e. TV/radio
f. Vacuum cleaner
g. Whistle/horn/siren
h. Other _____

Hyperacusis handicap questionnaires

- Khalfa et al., 2002
  - College students who were not complaining of hyperacusis
  - 4 label category scale - insensitive
- Nelting et al., 2002
- Tyler et al., 2003
- Dauman and Bouscau-Faure, 2005
- Tyler et al., 2009

Hyperacusis Disability and Handicap Scales

- **Part 1 – Disability**
- For example, a sound might be very loud, but you might not be annoyed or afraid of it. Likewise, a sound might be very annoying, but it might not be loud or evoke fear.
- Rate the sounds using a scale from
  - **0 (not loud/annoying/fearful) to**
  - **100 (unbearably loud/annoying/fearful)**.

	Sound	Loudness (0 to 100)	Annoyance (0 to 100)	Fear (0 to 100)
1.	Standing next to a dog barking			
2	Someone stacking dishes in the same room			
3	Hearing music on the radio in a car when the volume is adjusted for normal-hearing listeners			
4	Hearing music on the radio in a quiet room when the volume is adjusted for normal-hearing listeners			
5	Telephone ringing in the same room			
6	Television in the same room when the volume is adjusted for normal-hearing listeners			
7	Standing next to a lawnmower			
8	Standing next to a car door closing			
9	Talking with someone in a noisy restaurant			
10	Baby crying in the same room			

Part 2 – Handicap

- The following questions relate to hearing loss, tinnitus and loudness hyperacusis. Loudness hyperacusis is when sounds that are moderately loud for other people are *too* loud for you.

- Please rate your agreement/disagreement with the following statements, using a scale from
- **0 (completely disagree) to 100 (completely agree):**

		Because of your hearing loss	Because of your tinnitus	Because some sounds are too loud
		(0-100)	(0-100)	(0-100)
1	You avoid shopping			
2	You do not go out with your friends			
3	You have given up some hobbies			
4	You do not go to restaurants			
5	You avoid being in crowds			
6	You feel depressed			
7	You feel anxious			
8	You are not able to concentrate			
9	Your quality of life is poor			
10	You are not able to perform tasks or jobs as well			

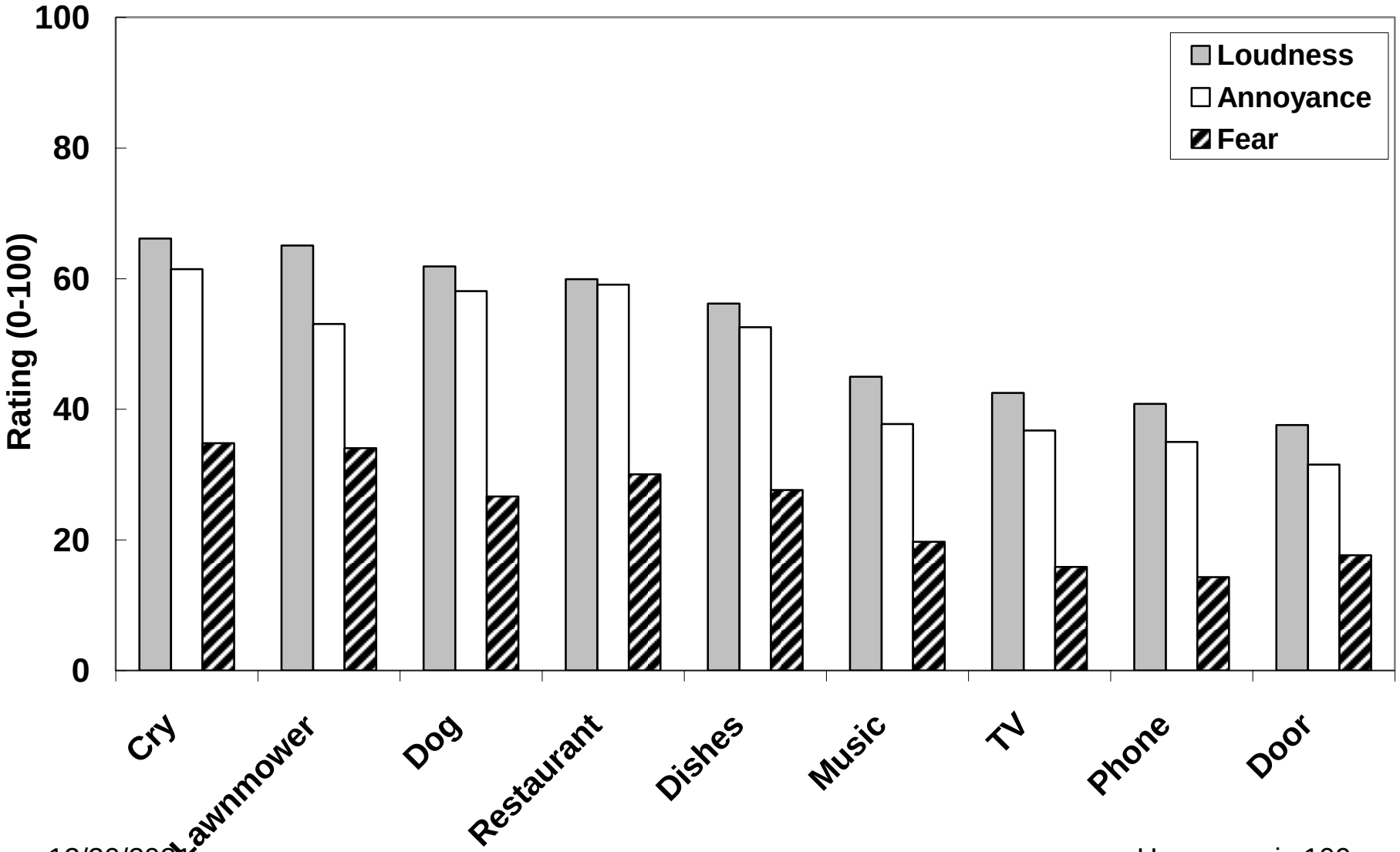
HYPERACUSIS PROBLEMS QUESTIONNAIRE

- Please list the problems that you experience because of your **hyperacusis**. List as many as you can. List them in order of importance.
  - after the Tinnitus version [Tyler and Baker, 1983]
  - Examples
    - I just don't go to restaurants any more.

Which of the following sounds or events are those that you would fear attending or being around because of your reaction to those sounds?

a. Baby crying/children squealing
b. Crowds/large gatherings
c. Dishes being stacked
d. Dog barking
e. High pitch voices/screaming
f. Lawnmower
g. Music (loud rock concerts)
h. Music (religious services)
i. Music (symphony, quartet, etc.)

a. Power tools
b. Restaurants
c. Sporting events
d. Telephone ringing
e. TV/radio
f. Vacuum cleaner
g. Whistle/horn/siren
h. Other _____


100
80
60
40
20
0
Rating (0-100)
Loudness
Annoyance
Fear
Cry
Lawnmower
Dog
Restaurant
Dishes
Music
TV
Phone
Door

MEASUREMENTS: SUMMARY

- IMPORTANT TO UNDERSTAND WHERE THE PATIENT IS AT
- LOUDNESS, AVOIDANCE, FEAR, PAIN ??
- OPEN ENDED… LIST THE DIFFICULTIES…
- UNCOMFORTABLE LOUDNESS LEVELS (dB HL)
  - 80 % or less
- QUESTIONNAIRES – several

Tinnitus/Hyperacusis Questionnaires

- To download Questionnaires go to:

- http://www.medicine.uiowa.edu/oto/research/tinnitus/questionairres/?LangType=1033

- Search “Iowa tinnitus clinic”

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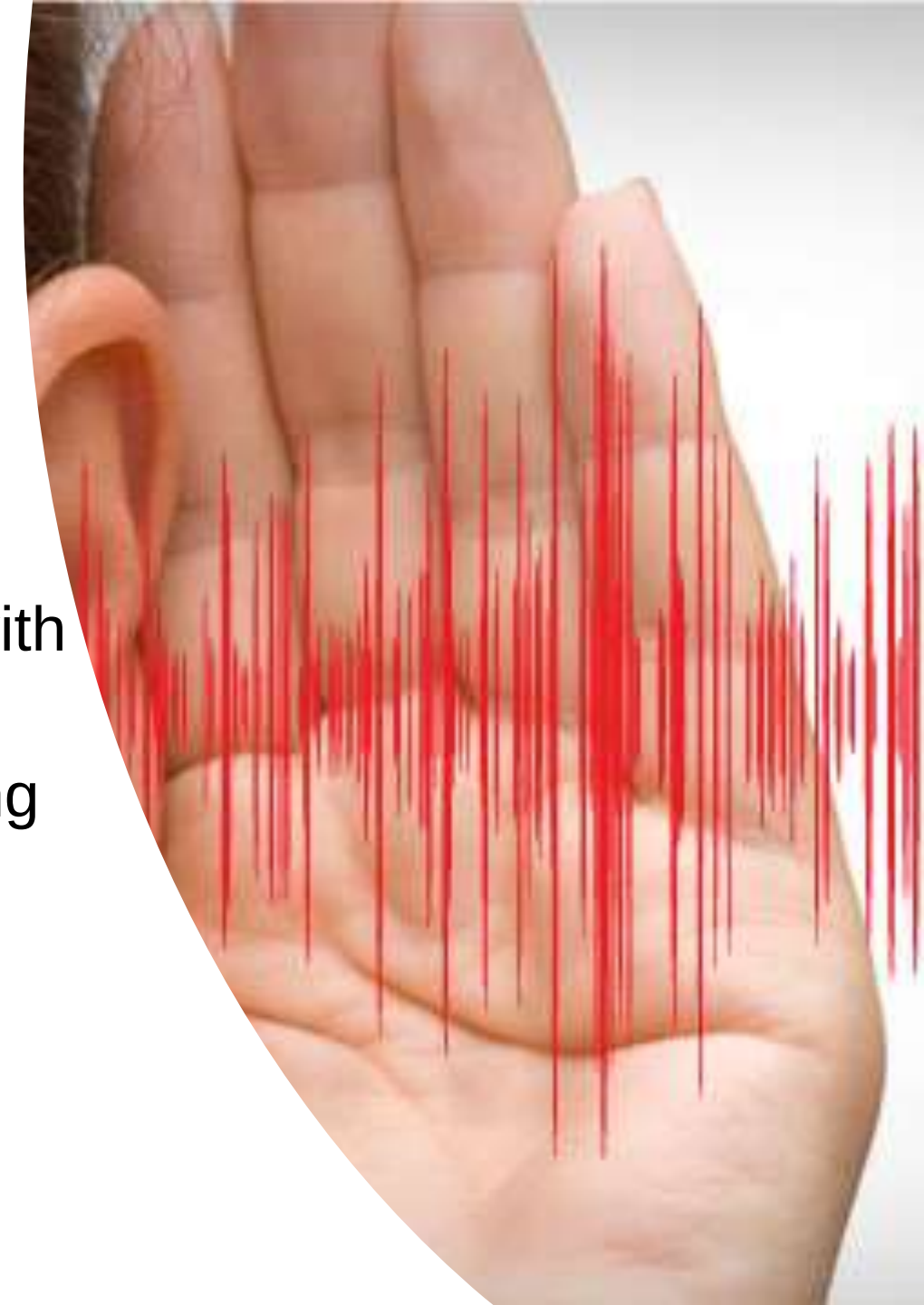
Hyperacusis Activities Treatment

Richard Tyler, Ph.D., CCC-A

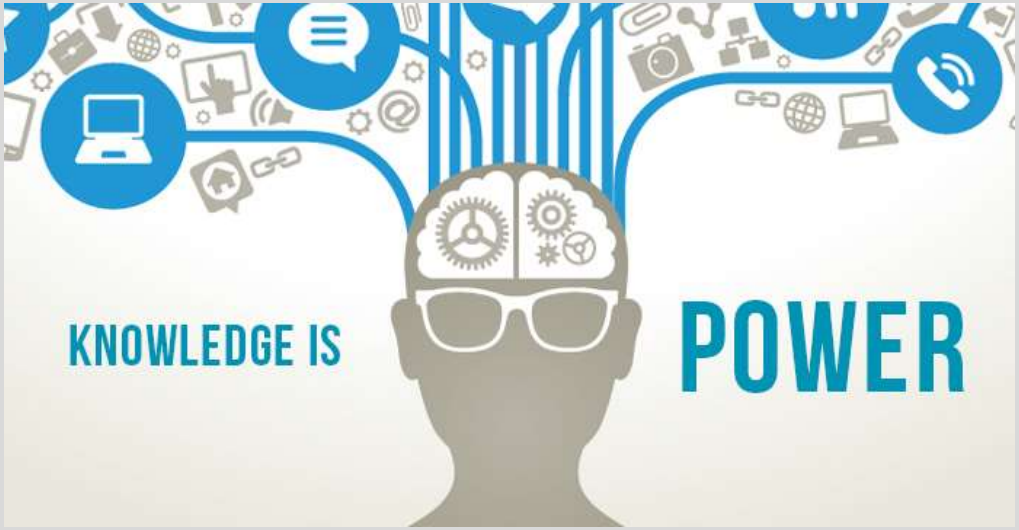
Overview

- Introductions
- Discuss experiences with hyperacusis
- Explain hearing, hearing loss and hyperacusis
- Review treatments for hyperacusis



Education

- Knowledge is the first step to successful management of your hyperacusis
  - How does hyperacusis affect you, in what environments it is most problematic, etc.?
  - What strategies are effective for managing emotions and stressful situations?
- Be confident in communicating your needs to others



What is hyperacusis?

- Reactions to moderately-loud sounds are too loud, annoying, fearful, and/or painful
  - Four types
- Affects 6-17% of general population
- Similar terms:
  - Misophonia
  - Select Sound Sensitivity

Types of hyperacusis

- Loudness hyperacusis
- Annoyance hyperacusis
- Fear hyperacusis
- Pain hyperacusis

Understanding your hyperacusis

- What is your hyperacusis experience?
- How long have you had hyperacusis?
- Does hy  t one or both ears?

Your reactions to sounds

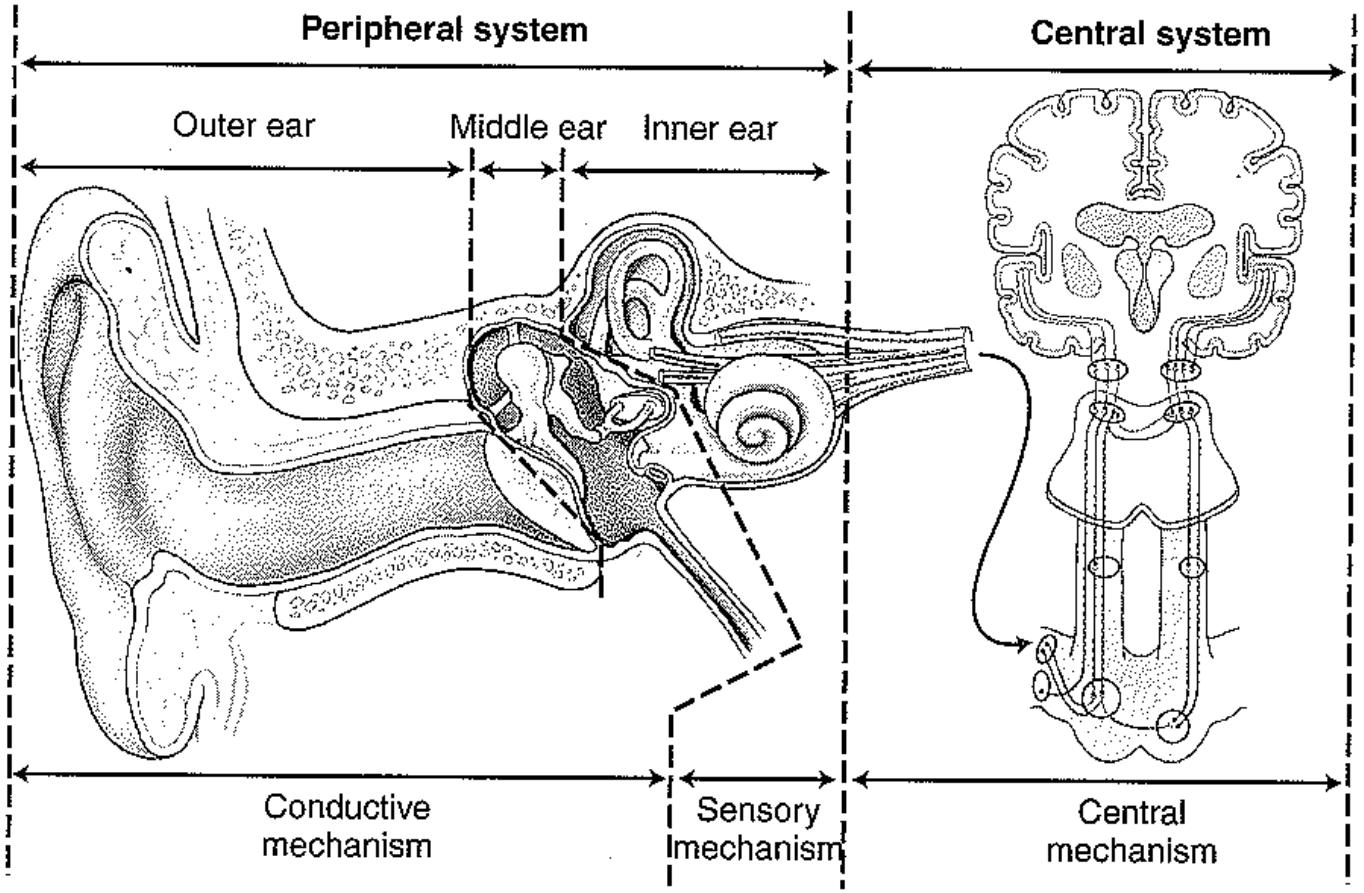
- Are there any sounds that are too loud?
- Are there any sounds that are annoying?
- Are there any sounds that cause fear?
- Are there any sounds that create pain?

Your daily experience with hyperacusis

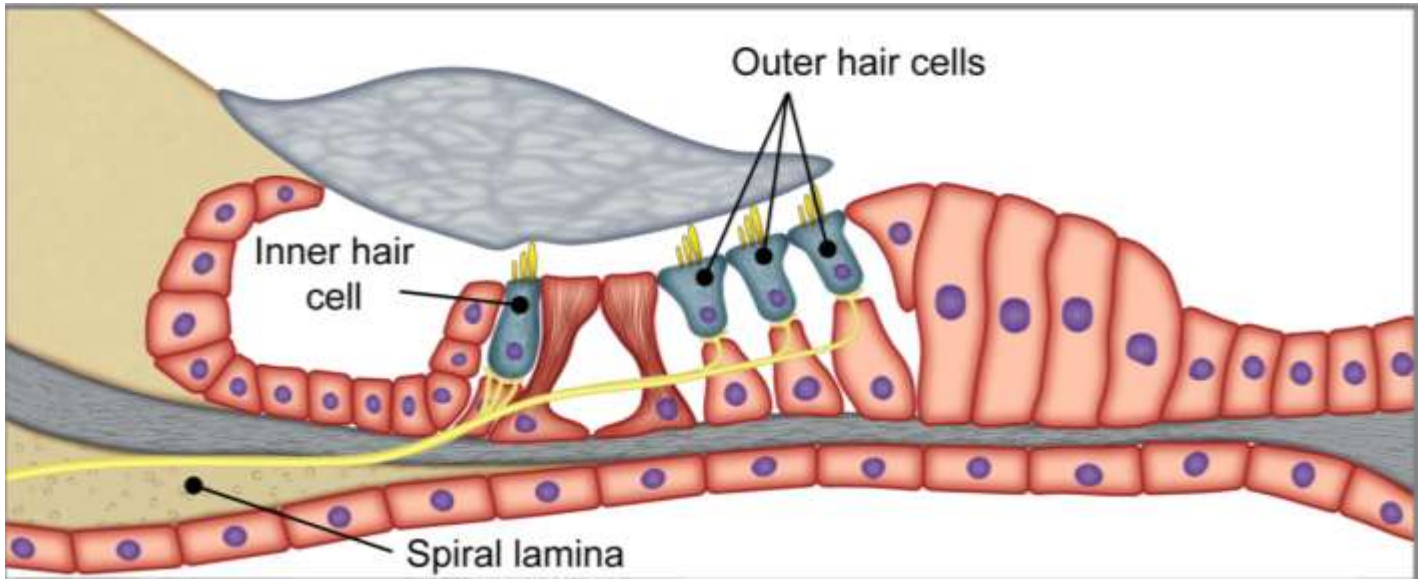
- Are there times during the day when you are particularly bothered?
- Are there times during the day when you are not bothered?
- How long do the episodes typically last after the triggering event?

How do we hear?

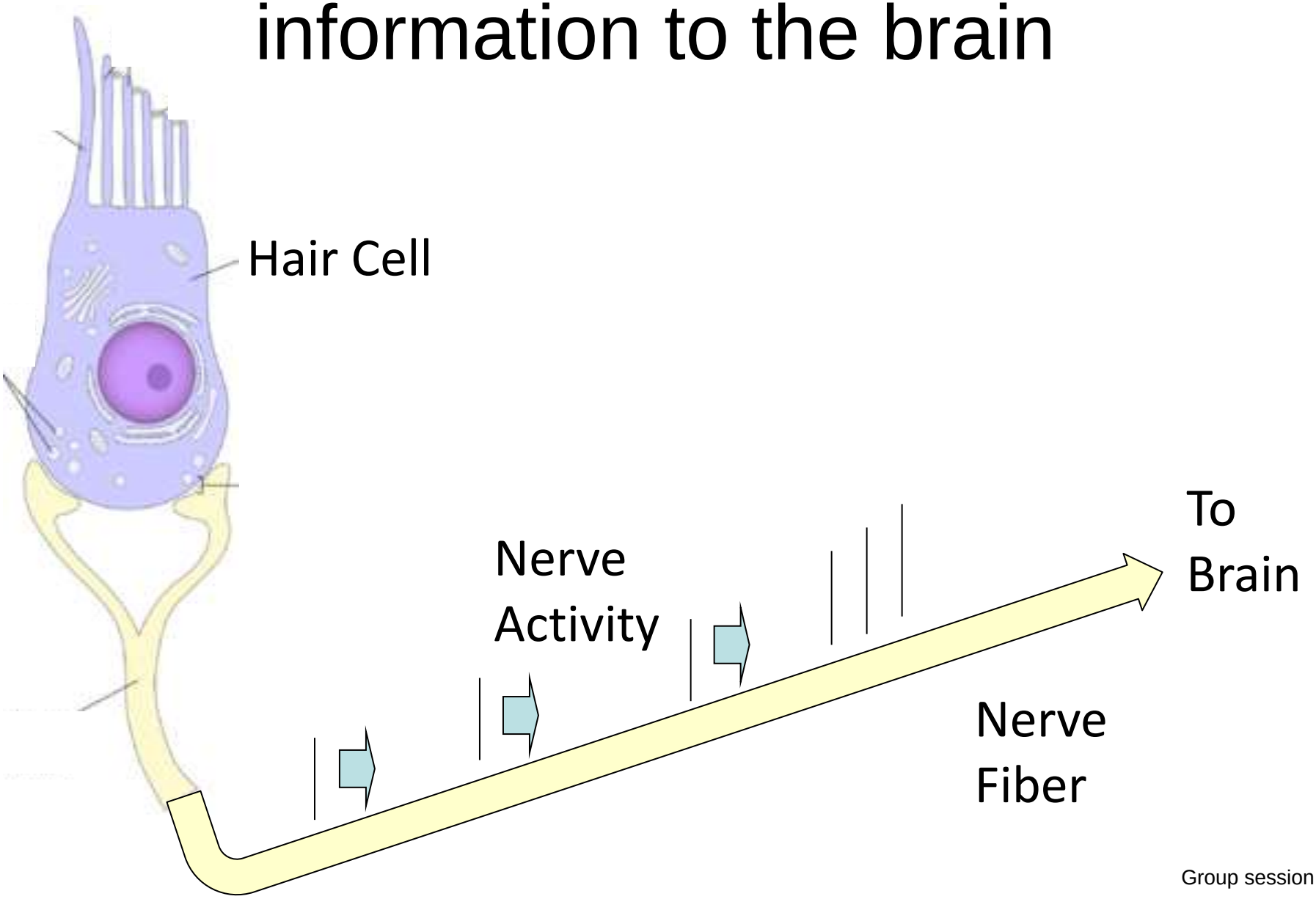
- The Human Auditory System:



Hair cells in cochlea

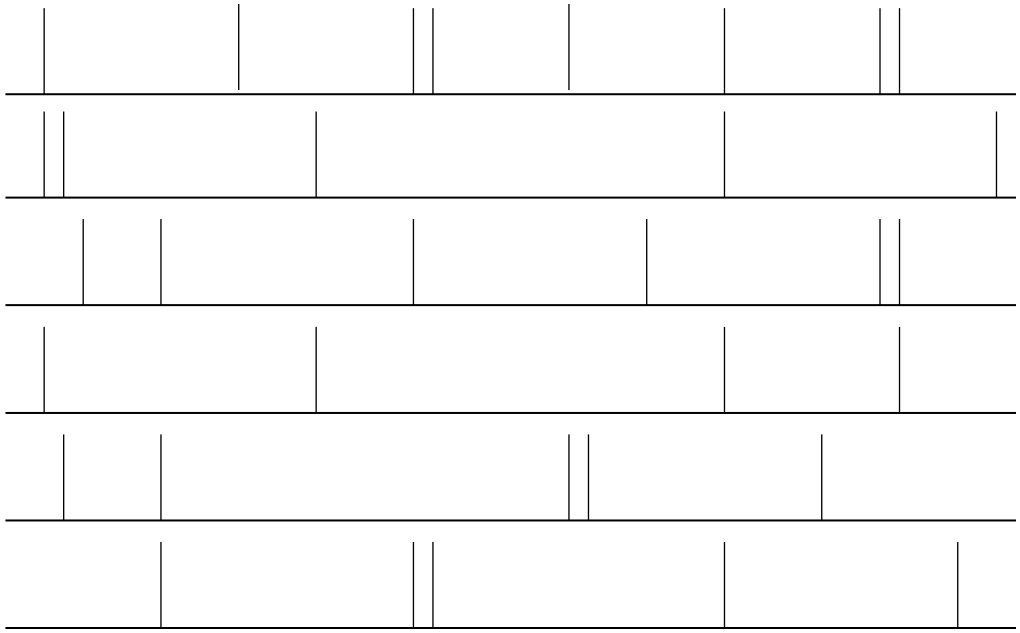


The Auditory Nerve carries information to the brain



Spontaneous Activity on Hearing Nerves

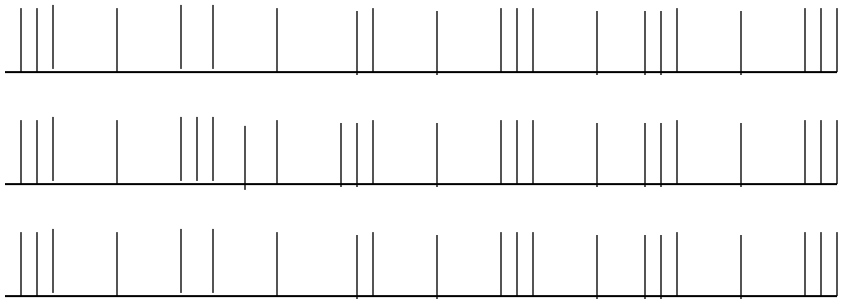
No Sound (Quiet)



Hear Silence

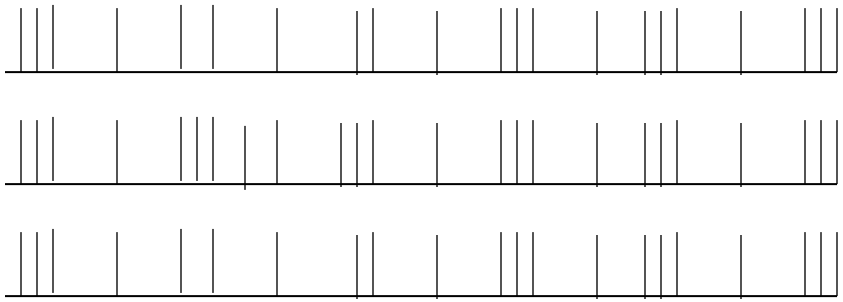
Hyperacusis Nerve Activity

Soft sound



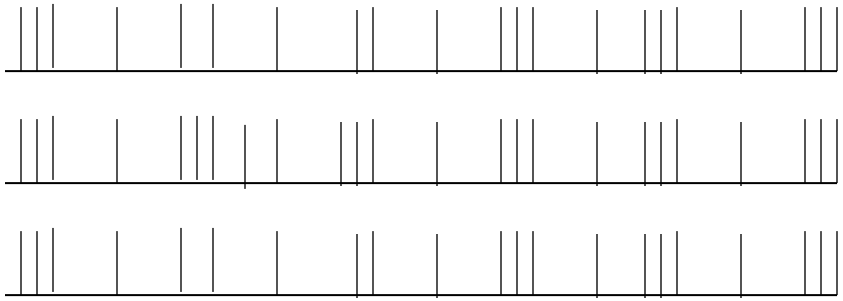
High levels of activity

Moderately loud



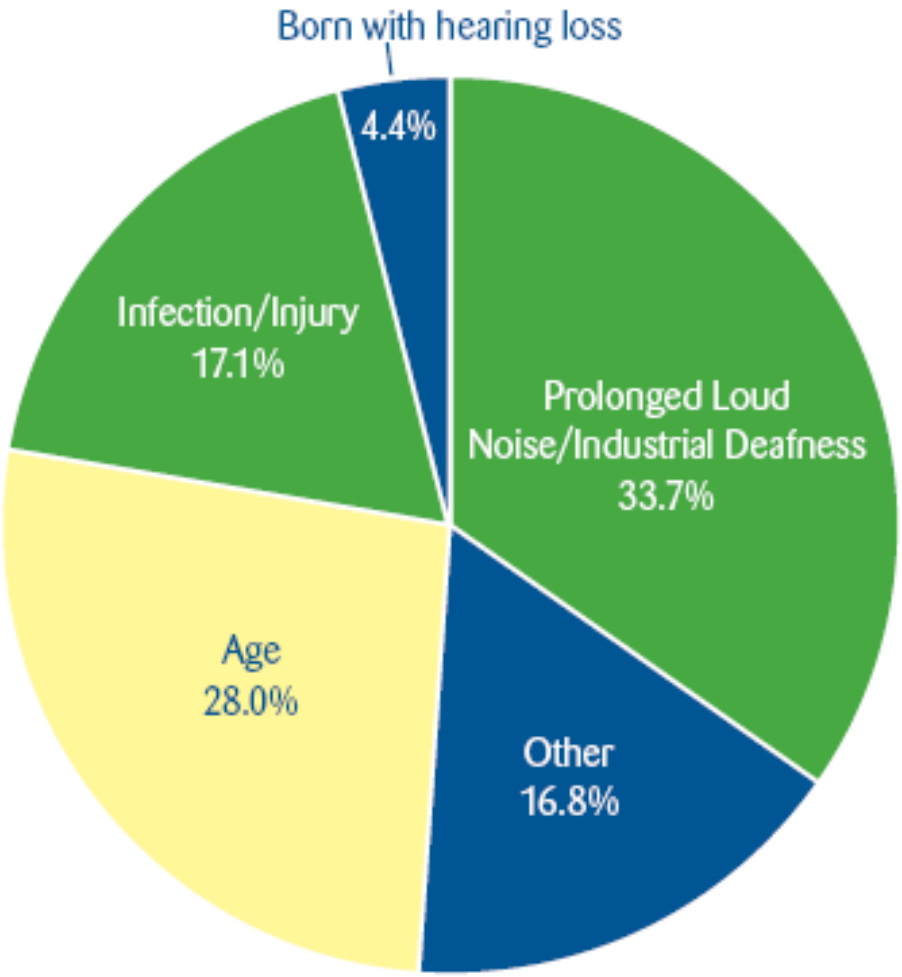
High levels of activity

Loud sound



High levels of activity

Causes of hearing loss



Source: League for Hard of Hearing

There are many different causes of hyperacusis

Reactions to hyperacusis
(Tyler et al., 2014)

- Emotional well-being
- Hearing and communication
- Sleep
- Concentration

Options to treat hyperacusis

- Counseling (Hyperacusis Activities Treatment)
- Ear plugs and sound therapy
- Relaxation exercises
- Medications

Hearing protection

- Ear plugs reduce noise exposure
  - Wear only in noisy environments
- Using ear plugs every day causes communication difficulties, worsens hyperacusis
- Ear plugs allow you to stay active, not be reclusive

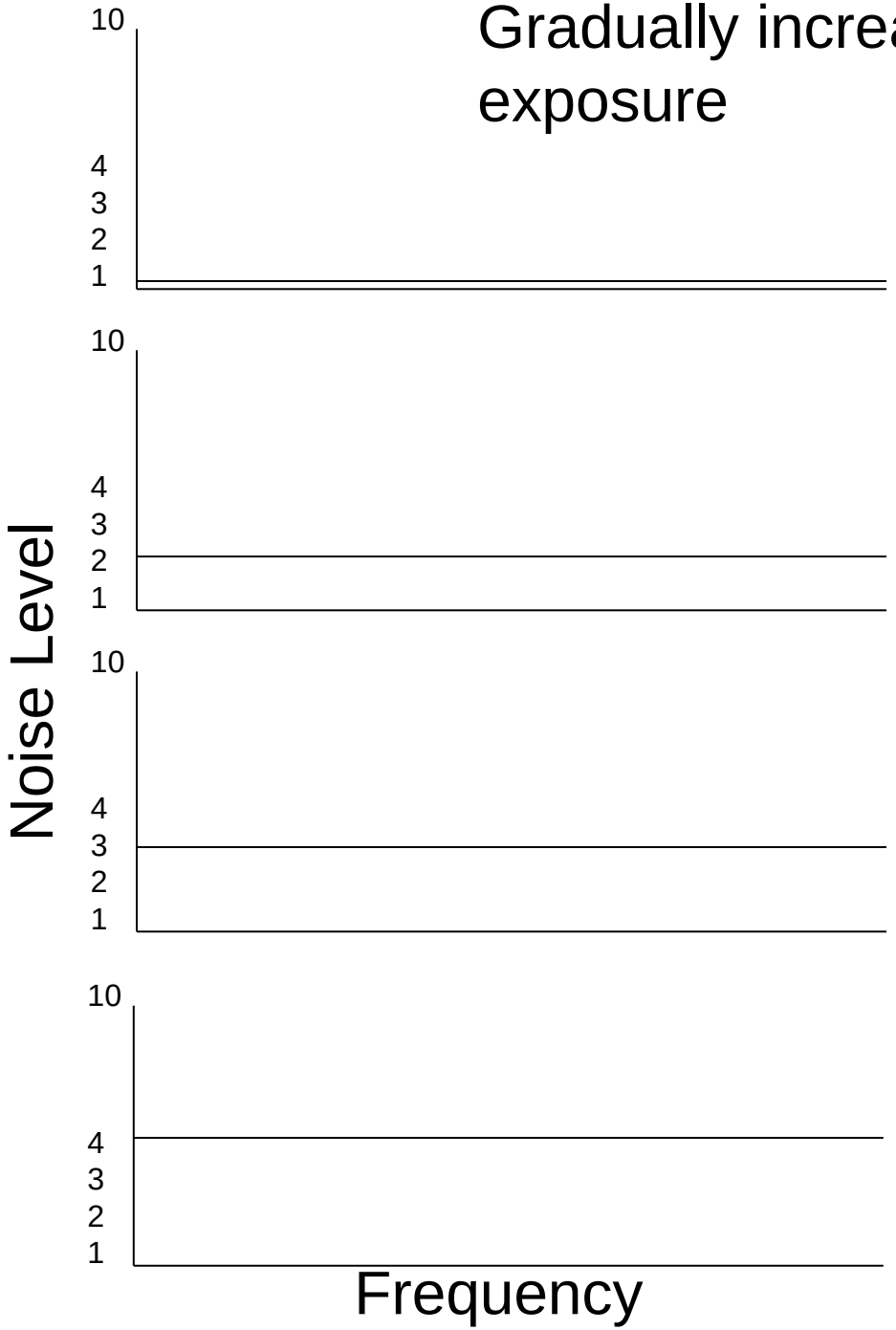
Sound Therapy

- Used to reduce annoyance and/or increase sound tolerance
- Options include non-wearable and ear-level sound generators
- Will take time for results

Sound Therapy Options

- Non-wearable sound generators
  - Sound Pillow
  - Sound Generators
  - Smartphone Apps
  - CDs, radio, etc
- Wearable, ear-level sound generators
  - Tinnitus masking devices

Gradually increase sound exposure



1. Start with a very low level

2. Increase noise gradually

3. Increase noise gradually

4. Increase noise gradually

Background sound partially masks a barking dog

Progressive Muscle Relaxation

- Learn to systematically tense and relax groups of muscles
- With practice, you will recognize a tensed muscle vs. a relaxed muscle
- This skill allows you to produce physical muscular relaxation at the first signs of tension

Progressive Muscle Relaxation

Completed in two steps:

1. Deliberately apply tension to certain muscle groups
2. Stop the tension and focus on how the muscles feel as they relax

Progressive Muscle Relaxation- Practice Exercise

1. Start with your arms
2. Make a fist and tense your arms for 15 seconds
3. Release the tension
4. Breathe deeply and pay attention to the sensation of your arms relaxing

Practice Exercise--continued

5. Continue tensing and relaxing the following muscle groups:
   - Face
   - Shoulders
   - Stomach
   - Legs and feet
6. When finished, release any remaining tension in your body

Deep breathing exercises

- Sit or lie flat in a comfortable position
- Put one hand on your belly just below your ribs and the other hand on your chest
- Take a **deep** breath in through your nose, and let your belly push your hand out
- **Breathe** out through pursed lips as if you were whistling
- Repeat 3 to 10 times

Visual Imagery

- Similar to daydreaming
- Attention is focused on some type of sensory experience
  - Creating novel mental images
  - Recalling past

Visual Imagery - Practice Exercise

1. Close your eyes
2. Think of a relaxing scene (the beach)
3. Try to imagine the scene as clearly as you can
4. The smell of the water, warm sand on feet, sound of ocean
5. Allow yourself to relax as you imagine the location in your mind

Medications

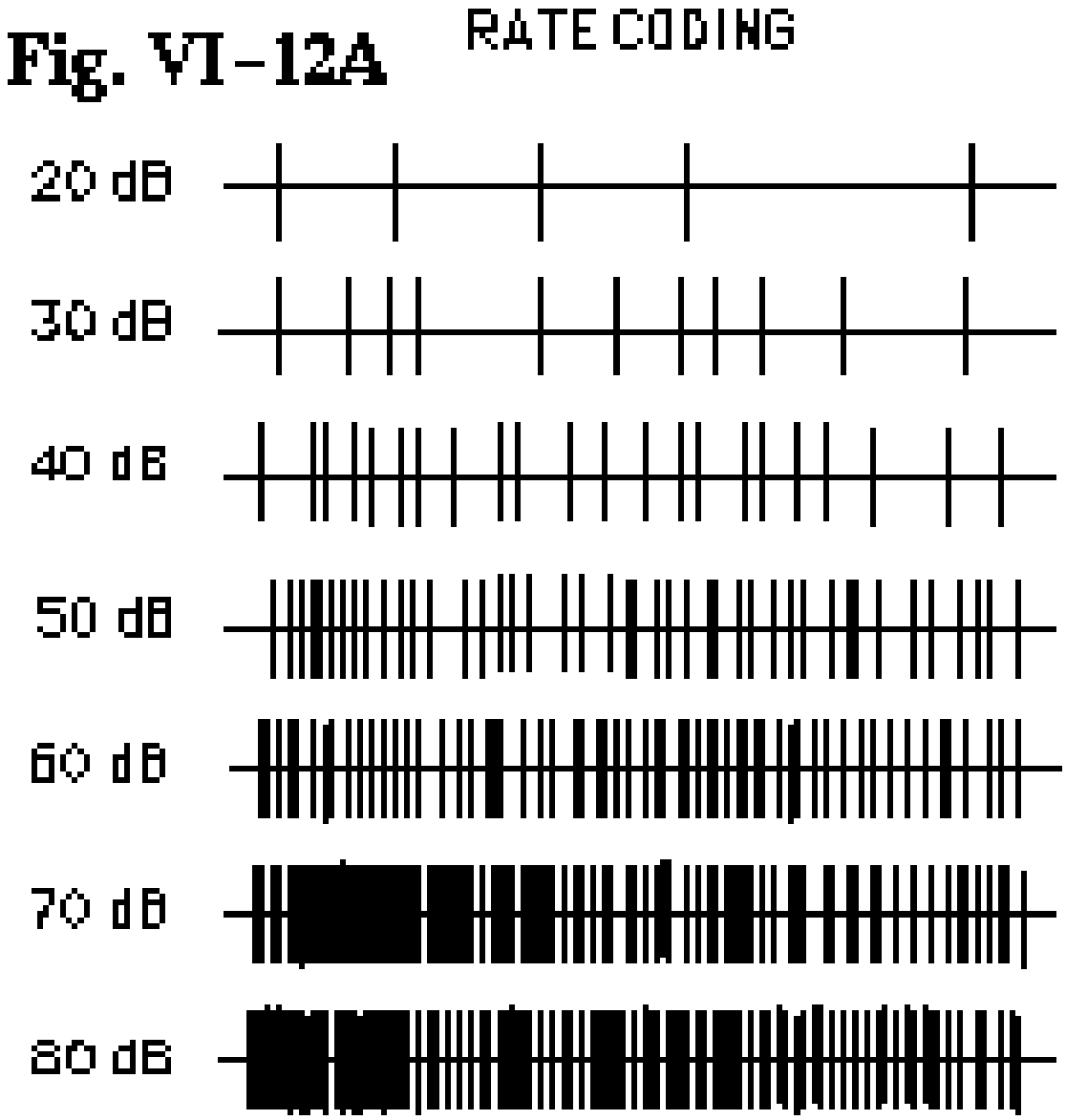
- Currently no drug or surgery can reliably eliminate the source of hyperacusis
- There are effective drugs for:
  - Sleep, anxiety, and depression

Hyperacusis:
Sound Therapies

Normal coding of loudness

- Activity of nerve fiber increases
- Spread of activity across nerve fibers increases
  - More nerve fibers with similar best frequency and phase locking

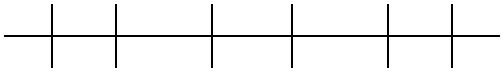
8th Nerve Firing Rate



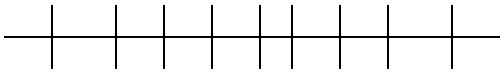
Neural Coding of Intensity

Normal

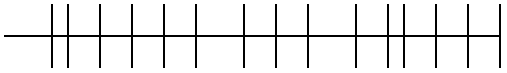
20 dB HL



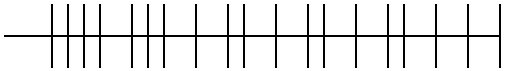
40 dB HL



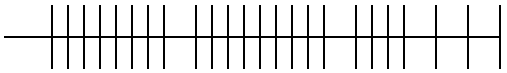
60 dB HL



80 dB HL

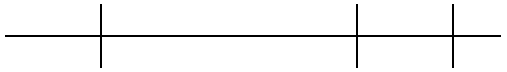


100 dB HL

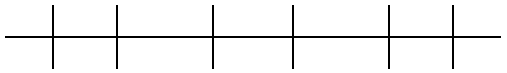


Hyperacusis

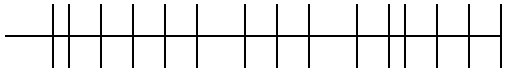
20 dB HL



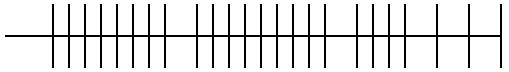
40 dB HL



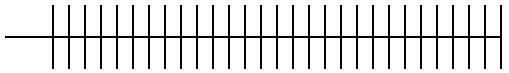
60 dB HL



80 dB HL



100 dB HL



Possible mechanisms of Hyperacusis

- Abnormal auditory gain control (Hazell, 1987)
  - Brain searches for activity, and magnifies it Abnormal relationship between level and driven neural rate and/or overall/phase locked activity
- Plasticity – more nerve fibers at same best frequency

Hyperacusis - Hearing Aid Adjustments

- Hearing aids can amplify sound to distressing levels
- Maximum output can be too high
- Reaction time of automatic gain control might be too slow
- Lower maximum
  - Might reduce speech perception
- progressively increase output over time

Sound Therapy Treatments

1. Hazell & Sheldrake (1989, 1992)
   - Noise generators ….Reduce central gain

2. Vernon & Press (1998)
   - Noise during evening - Desensitization

3. Tyler et al. (2000, 2009)
   - Tinnitus Hyperacusis Treatment
   - Capture and listen to controlled bothersome sounds

4. Hearing Aid Adjustments

(Sammeth, C. A., Preeve, D. A., and Brandy, W. T. (2000). Hyperacusis: Case studies and evaluation of electronic loudness suppression devices as a treatment approach. Scandinavian Audiology. 29, 28-36.)

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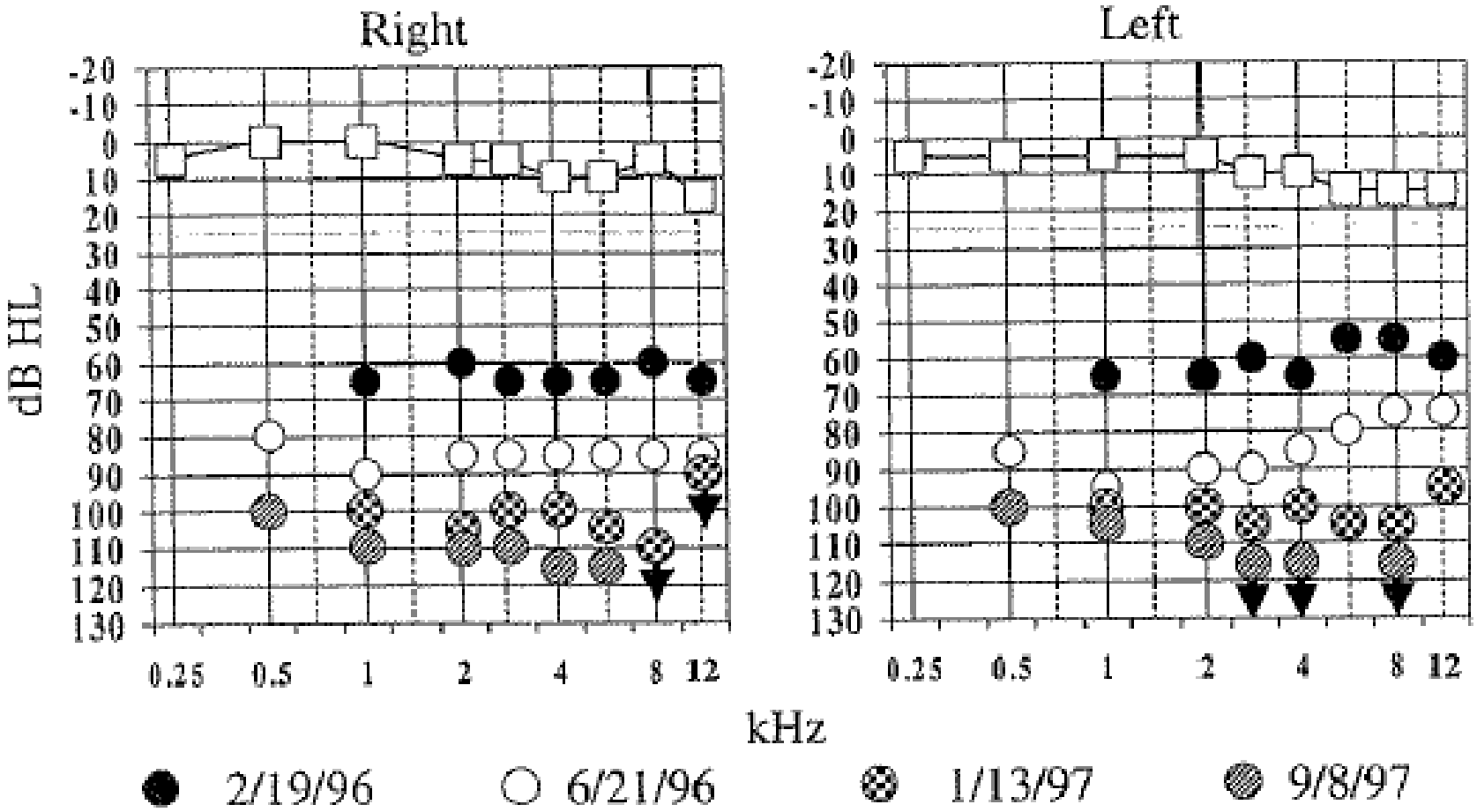
- based on their theory of need to reduce central gain (Hazell, 1987)
- Bilateral noise generators devices
- Continuous exposure low-level noise

Formby et al., 2003; Formby et al., 2007).

- sound generators (no counseling)
- 6-8 dB elevation of LDLs in normals after 2-4 weeks
- ~20 dB LDL shifts for severely impaired hyperacusis patients



Formby and Gold, 2002

2. Vernon & Press (1998)

- Desensitization
- Pink noise, 2 hrs/day earphones
- Increase level gradually
  - to Loudness Discomfort Level
- Requires 3 months to 2 years

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Hyperacusis Activities Treatment

- Desensitization
- **Record specific sounds that are too loud**
- play back at low levels in peaceful environment
- gradually increase levels and duration
- Gradually work into realistic situations

Sound-Limiting Infinite Compression Device for Management of Debilitating Hyperacusis

Carol A. Sammeth Ph.D.[1],
David A. Preves Ph.D.[2,3],
William T. Brandy Ph.D.[4]

Hyperacusis: Case studies and evaluation of electronic loudness suppression devices as a treatment approach*

[1]Roudebush V.A. Medical Center and Indiana University School of Medicine, Indianapolis, IN, USA; [2]Argosy Electronics, Inc., Minneapolis, MN, USA; [3]Micro-Tech, Inc., Minneapolis, MN, USA; [4]The University of Akron, Akron, OH, USA

KEY WORDS:
compression, hyperacusis, loudness, phonophobia

RECEIVED/ACCEPTED:
31 July 1998/23 November 1998

ADDRESS FOR CORRESPONDENCE:
Carol A. Sammeth, Ph.D., Otologics, 5445 Airport Road, Suite 106, Boulder, CO 80301, USA. Tel: +1 303 448 9933, fax: +1 303 448 9944, e-mail: SammethC@otologics.com

Hyperacusis, as defined here, is a relatively rare condition in which the patient, with or without hearing loss, experiences severe loudness discomfort to everyday environmental sound levels. The case studies of 14 patients with severe hyperacusis are described; all wore passive attenuators (earplugs and/or earmuffs) in an attempt to alleviate their discomfort, frequently producing communication difficulties. These subjects were fitted binaurally with experimental electronic loudness suppression devices housed in in-the-ear casings. The devices supplied low-level amplification followed by an extreme form of amplitude compression for moderate or high-level inputs in an attempt to reduce loudness discomfort without reducing audibility. Many of the subjects were found to function with a wider dynamic range with the active devices compared with passive attenuators or the unoccluded ear, and most reported that they benefited from the devices in at least some listening situations.

Scand Audiol 2000;29:28–36

Hearing Aids

- Hearing aids (with closed canal earmolds) can reduce sound by (at most) ~ 30 dB
- Reduce maximum output of hearing aids so that high level sounds are peak-clipped or compressed
- Adjust input/output (gain) so that low-level sounds are amplified, but not high-level sounds
- Followed by gradual transition (over months) to ‘normal’

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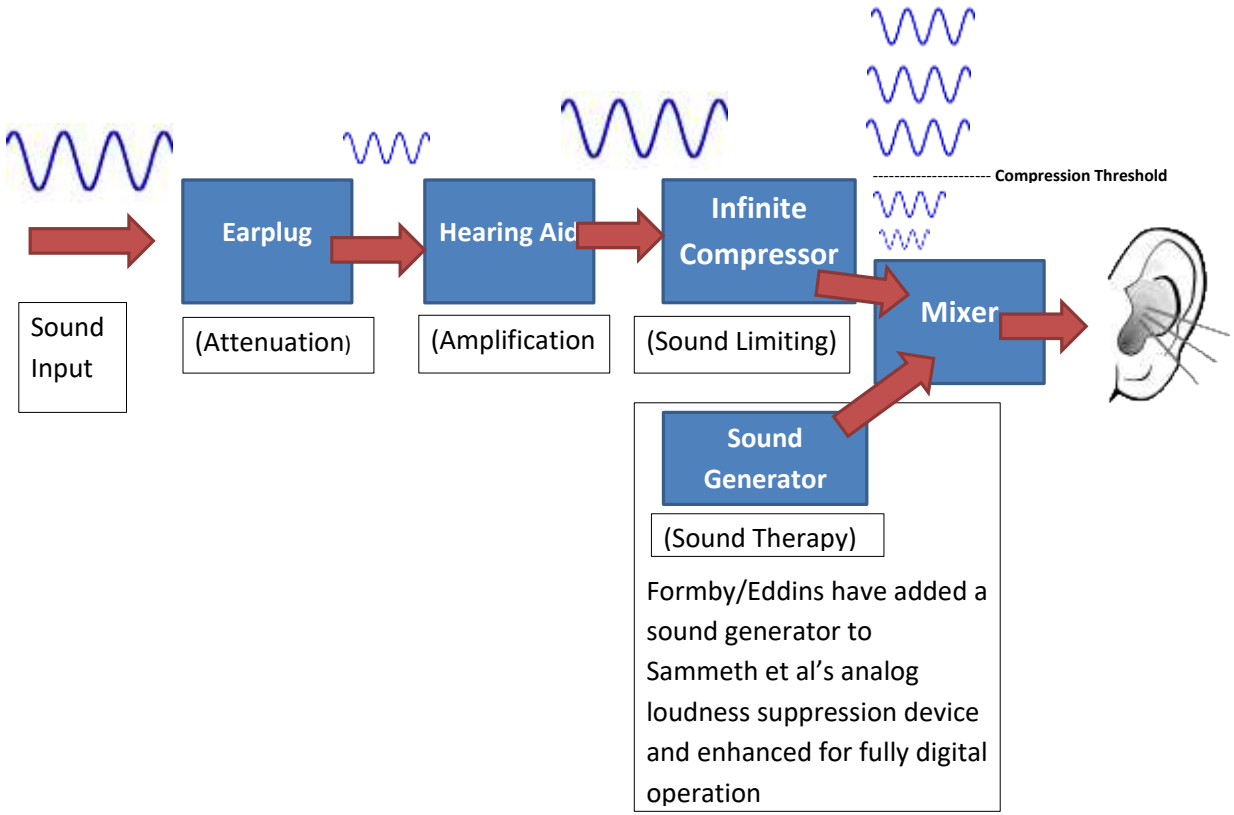
Revisitation of a Loudness Suppression Device, Incorporating a Sound Generator for Treatment of Debilitating Hyperacusis



Summary

- Sound Therapies
  - Low level continuous sound
  - Periods of sound with gradual increased
  - Copy disturbed sounds with gradual approximation to real exposure
  - Hearing Aids – closed canal, reduced maximum output, gradual gain increase

HYPERACUSIS

SUMMARY

Types of hyperacusis

Loudness hyperacusis

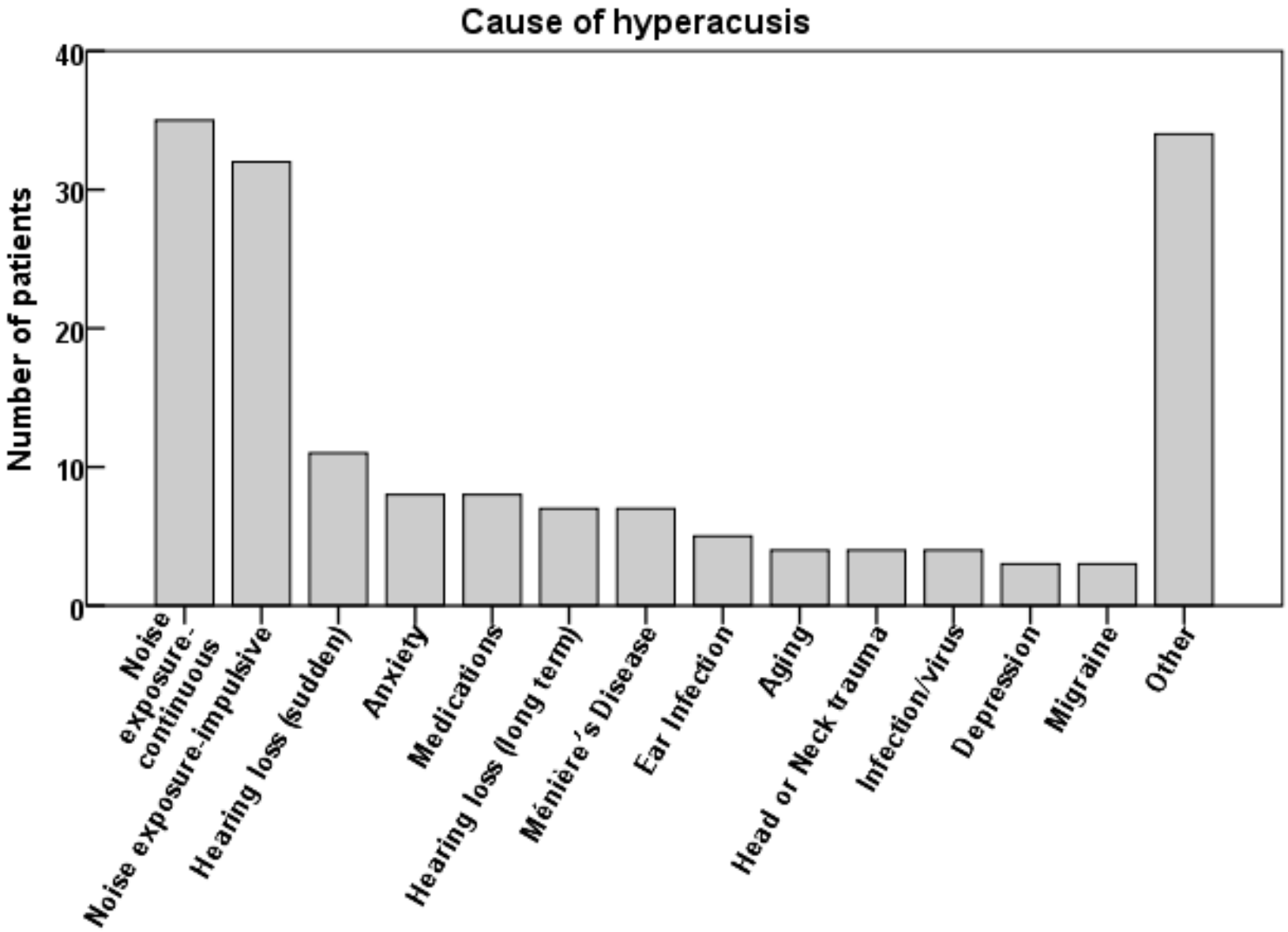
Annoyance hyperacusis

Fear hyperacusis

Pain hyperacusis

Hyperacusis Mechanisms

- SEVERAL….
- NOT ALL RELATED TO HEARING LOSS
- NOT ALL RELATED TO TINNITUS


Cause of hyperacusis
Number of patients
40
30
20
10
0
Noise exposure-continuous
Noise exposure-impulsive
Hearing loss (sudden)
Anxiety
Medications
Hearing loss (long term)
Ménière´s Disease
Ear Infection
Aging
Head or Neck trauma
Infection/virus
Depression
Migraine
Other

Hyperacusis and Tinnitus

- First linked by
  - Tyler and Conrad-Armes (1983)
- Must have common mechanisms in some
- But also
  - hyperacusis without tinnitus
  - Tinnitus without hyperacusis

Questionnaires

Hyperacusis handicap questionnaires

- Khalfa et al., 2002
  - College students who were not complaining of hyperacusis
  - 4 label category scale - insensitive
- Nelting et al., 2002
- Tyler et al., 2003
- Dauman and Bouscau-Faure, 2005
- Tyler et al., 2009

SOUND THERAPIES

1. WEARABLE BROADBAND NOISE (HAZEL)
2. NOISE IN THE EVENING OVER TIME (VERNON)
3. LISTEN TO CAPTURED SOUNDS WITH SUCCESSIVE APPROXIMATION (TYLER)
4. HEARING AID ADJUSTMENT (SAMMETH)

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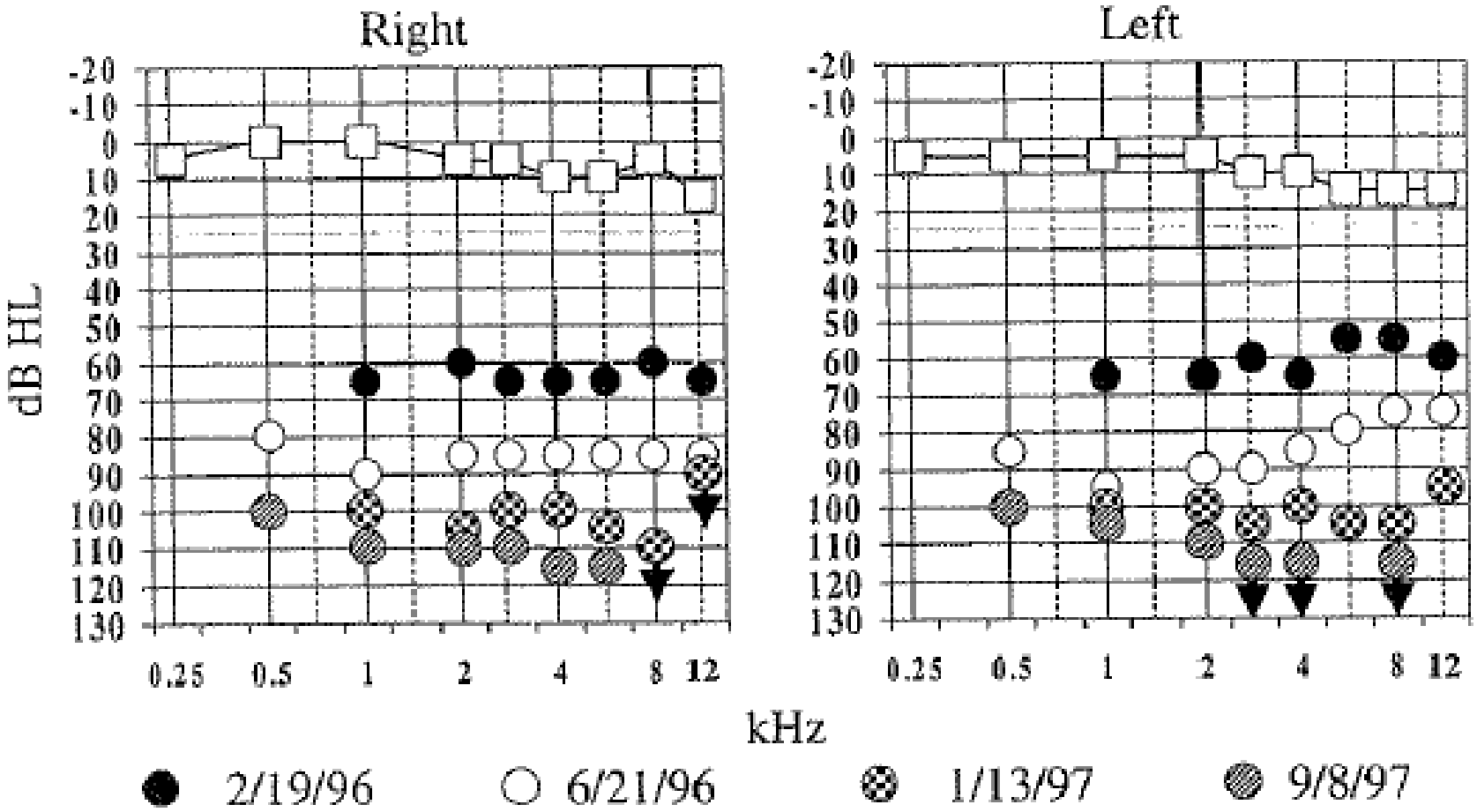

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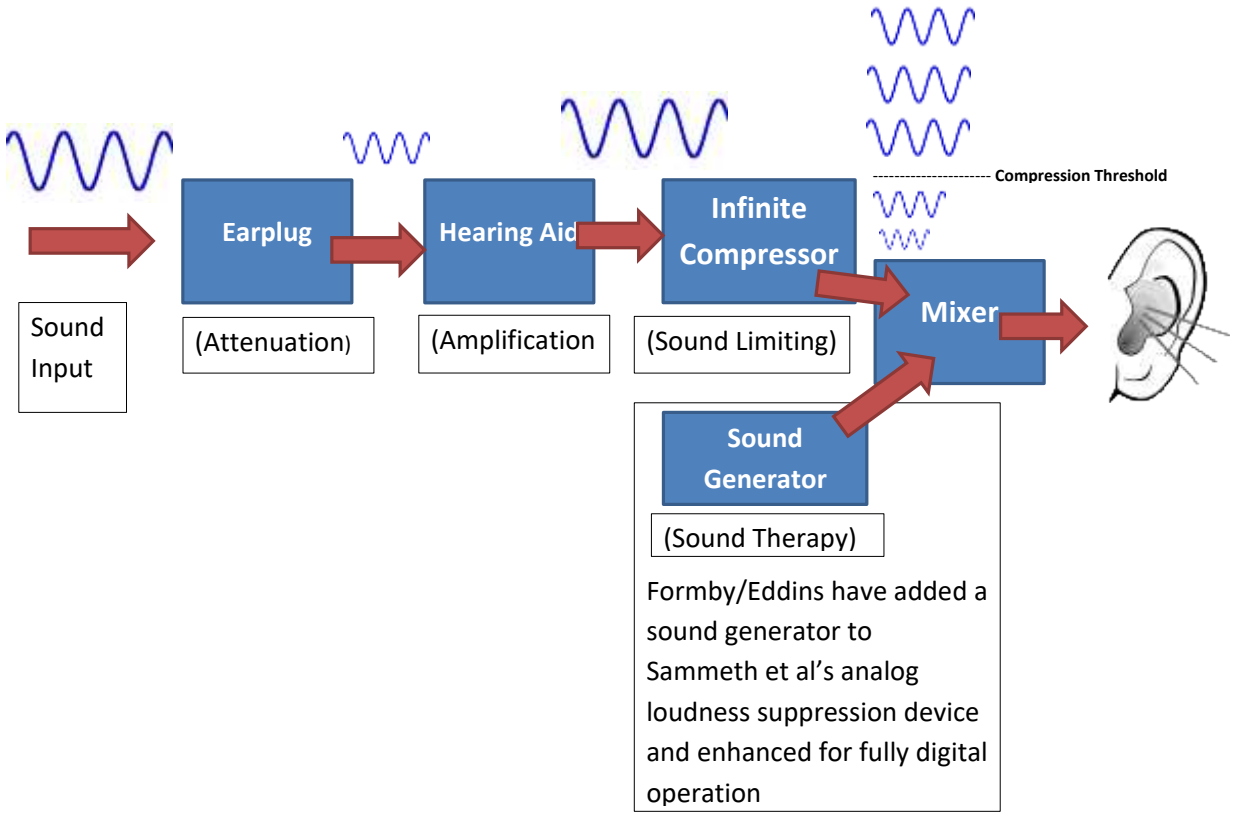

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COUNSELING

Hyperacusis Activities Treatment

Tyler et al., (2000; 2009)

CONCLUSIONS

- Hyperacusis often occurs with tinnitus
- Can be very distressing
- Sound Therapies available
- Hyperacousis Activities Treatment

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