BATTERY DRAIN IN DIFFERENT CATEGORIES OF BODY LEVEL HEARING AIDS

Reg. No. M 9102

AN INDEPEDENT PROJECT SUBMITTED AS PART FULFILMENT FOR FIRST YEAR M.SC. (SPEECH & HEARING) TO THE UNIVERSITY OF MYSORE.

ALL INDIA INSTITUTE OF SPEECH AND HEARING, MYSORE - 570 006.

1992

SRI RAGHAVENDRA

CERTIFICATE

This is to certify that the Independent Project entitled: Battery drain in different catecories of body 1evel hearing aids is the bonafide work in part fulfilment for the Degree of Master of Science (Speech and Hearing) of tho student with Regiter No.M9102.

Director
All India Institute of
Speech&Hearing,Mysore

Mysore
1992

CERTIFICATE

This is to certify that this Independent Project entitled Battery drain in different categories of. body

leve hearing aids has been prepared

under my supervision and guidance.

Mysore Dr.(Miss)S.Nikam,

1992 GUIDE

DECLARATION

This Independent Project entitled

Battery drain in different categories of

body level hearing aids is the result of my own work undertake under the guidance of Dr.(Miss) S.Nikam, Prof. and HOD - Audiology Department, All India Institute of Speech and Hearing , Mysore, and has not been submitted earlier at any University for any other Diploma or Degree.

Mysore
1992

Reg.No.M9102

ACKNOWLEDGEMENTS

I am highly indebted to Dr.(Miss) S.Nikam, Prof. & HOD of the Department of Audiology, and the Director, All India Institute of Speech and Hearing, Mysore for her constant encouragement invaluable guidance and support rendered to me in every difficult aspects and facets of this project. I also thank her for giving me this opportunity to under-take this project and finish it in time.

I sincerely thank Ms.Manjula, Research Officer, for her valuable assistance in data collection and analysis.

I also thank Mrs. Ramadevi, Ms.Asha and other staff of the Dept. of Audiology for their timely help.

I am greatful to Mr. B.D.Jayaram, Res. Officer, CIIL, Mysore for his valuable guidance In statistical analysis.

Special thanks to my friend Animesh Who is always ready to render his helping hand whenever I need.

Heart-felt thanks to Sathya# Sowmyanarayan, Shanthi, Rashmi for their valuable suggestions and timely help that gave final touch to this project.

To Jaya, Sheela, Buvana cs for their timely help.

Thanks to Saru and Stella for their support and Jayanthi for understanding me and rendering her helping hand at needed times.

Balaraju, Pathro, Niladri, Ravanan, Pitu, Swathi, and my other classmates for their constant enquiries that motivated me to finish this project.

I sincerely thank Mr.Ramesh Babu for his kind cooperation and help.

I am grateful to Rajalakshmi Akka for preparing this manuscript neatly with in short period of time.

From the bottom of my heart I thank my beloved brothers and sister-in-laws for their constant love and affection which keeps my spirits high and makes my life meaningful.

words are not enough to express my gratitude to my dear Appa and Amma whose everlasting love, encouragement blessings and moral support made me what I am today.

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INTRODUCTION

"The ear ts the organ of language learning"

- Aristotle

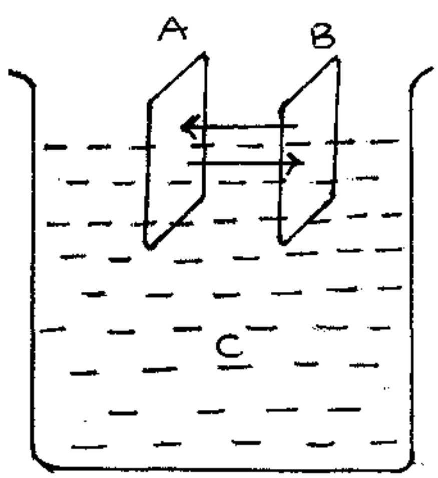
Our life obligation to nature is to protect one of the valuable gifts which has been provided to us. And that is hearing. Normal hearing is vital for the development of speech and language skills from our birth. Hence the effects of hearing loss is profound both in adults and children. The most outstanding problem is the breakdown in communication and helping the hearing-impaired individual overcome this problem is the task of aural rehabilitation clinicians.0

One of the major steps in rehabilitation of the hard-of-hearing is the fitting of an appropriate amplification devices. The purpose of amplification is to utilise the individual's residual hearing to the fullest extent possible and hearing aid is used for this purpose. The hearing aids are grossly classified as body level hearing aids, ear level or behind the ear hearing aids, all in the ear or canal type hearing aids.

The hearing aid has many components such as microphone, amplifier, receiver, battery etc. and battery is the most important component among them. It is the vital part of the hearing aid and no hearing aid can function without it. Just as the burning of gasoline supplies the power that makes ears run, batteries supply electricity, that makes hearing aid function.

Battery is anelectrical source of power which possesses a large number of electrons at one point, considerably fewer at another point and in hearing aids they are commonly labelled as cells.

Functioning: A cell is a cup or a vessal which contains two metal plates (A, B) dipped in a chemical solution (C). One plate has (+) charge and the other has (-) charge. The liquid allows current flow from one plate to another and thus working of the cell starts.



The symbol for the cell is represented by two lines together as -| |-. A group of cells connected together form a battery but most of the hearing aids use only a single cell.

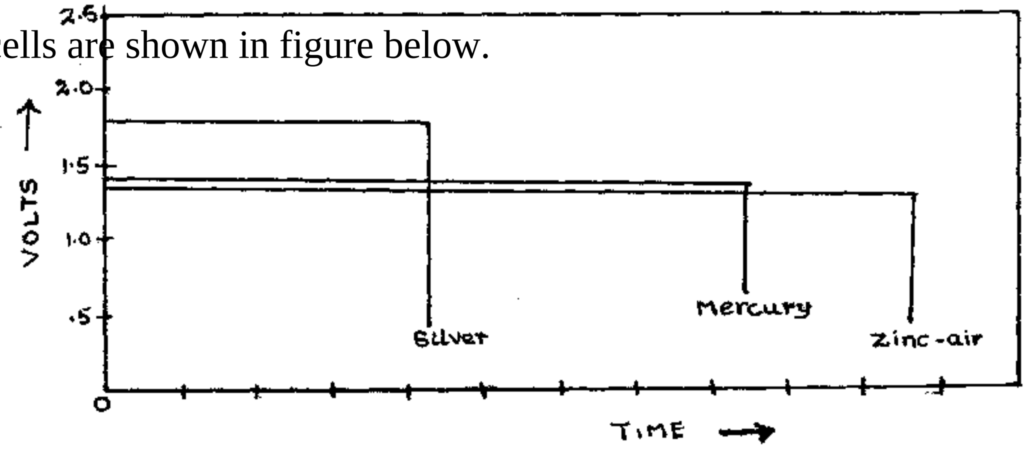
Types: Based on the metal plate and liquid present in the

cell, the cells are classified into three types as follows.

1) Mercury cell
2) Silver oxide cell
3) zinc air cell.

Among the three cells the zinc air cells have longer life compared to silver oxide and mercury cells. The voltage drops suddenonly in silver oxide and mercury cells, but in zinc air cells it drops gradually at a significant slower rate (Olsen, 1977).

The voltage consistency over a time of use for different cells are shown in figure below.



The cells are also divided into primary cell and secondary cells based on whether they are rechargeable or not.

Size: The size of the battery varies along with the type of hearing aids. For body level hearing aids, cells which are similar in shape known as **pentorch** cells are used. For behind-the-ear and spectacle aids a flat and round cells called **button** cells are used.

Most hearing aids use single cell capable of developing 1.3 to 1.5 volts. They maintain a relatively constant voltage until virtually all the stored chemical energy is converted to electrical energy. This characteristic is important for the hearing aid as it allows the gain and function of the hearing aid to remain constant, during the life of the battery. The hearing aid ceases to function when the voltage of the battery drops below a critical level. This dropping of voltage is called battery drain. Thus, the life of the battery comes to an end when all the chemical energy is consumed fully after a period of time and it can no longer trigger the function of the hearing aid. This calls for the replacement of new battery.

The question that is most often asked by the hearing aid user is how long a new battery expected to last in a hearing aid. The parent of aided child also needs thorough explanation regarding batteries since the child may be too young to communicate that his battery is wearing down.

Most hearing aid manufacturers usually specify the type of battery to be used and the expected life of battery with their aids.

Martin (1991) suggested that hearing aid user can mark the date when a new battery is purchased in order to keep track of battery consumption. He can also check whether it meets the standards specified by the manufacturer.

But predicting the life of the battery is a difficult task, as the life of the battery depends on many variables such as type of batteries, type of circuits, volume control setting, number of hours of continuous usage in a day. However, by practical study of the average battery drain with hearing aids, it is possible to estimate the life of the battery to an extent.

Martin (1992) gives range of battery drain ratings for different category hearing aids as follows:

0.2 mA to 0.4 mA for efficient mild gain hearing aids.
0.6 mA to 0.8 mA for typical behind the ear hearing aids.
2.0 to 4.0 mA for high power hearing aids.

He states that the life of the battery can be determined by dividing battery's mAh rating by the drain value of the hearing aid.

NEED OF THE STUDY

A search of existing literature reveals that there are no studies reported on life of battery for Indian body level hearing aids. Hence the present study of undertaken -

1) To measure the current drain in difference categories of body level hearing aids. _
2) To compare the current drain
   - among different categories of hearing aids and compare it.
   - With Indian Standards (IS 10775-1980).
3) To estimate the life of the battery in terms of hours for mild, moderate and strong category hearing aids.

***Note**: Both battery drain and current drain can be used interchangeably.

METHODOLOGY

A total of 30 hearing aids were taken for the study. Of these 30 hearing aids 17 were newly redeived from the manufacturers and 13 belonged to used group. These used hearing aids were taken from the stock kept for hearing aid evaluation and had been used for a period of 4 year..

Out of these 30 hearing aids 10 hearing aids belonged to mild category and 10 belonged to moderate and 10 belonged strong category. These hearing aids were classi-f ied into mild, moderate and strong by the manufacturers as per standard specification (IS:10775-1984).

All these hearing aids came from Indian manufacturers and divided into 5 models such as Model A, Model B, Model C, Model D, Model E.

Test environment:

The test was carried out in a sound treated room. The ambient noise levels inside the room wes within per-missible levels (IS:10776-1984).

Instrumentation:

A computer controlled new hearing aid analyzer FONIX 6500 with sound chamber was used for the study.

The accessories used along with the Instrument were -

1) Microphone (M1550)
2) Standard HA-2, 2cc coupler
3) Battery voltage module which supplies voltages (ANSI S3.22-1982) for measurement of battery current.
4) Battery substitution pill.

Calibration:

Before testing, the instrument was calibrated and levelled each time when it wes turned on as specified in the manual. (Levelling of the sound chamber was performed to correct frequency response irregularities).

Procedure

The microphone (M1550) was inserted into the 2cc coupler and the receiver of the body level aid was connected to other 1/4" recessed end of the coupler.

The battery substitution pill which was appropriate in size for the body level hearing aid was selected and placed into the aid under test. Then the hearing aid was placed in the sound chamber, in such a way that the microphone opening is close to the reference point. The 2cc coupler was located outside the sound chamber to obtain consistent results.

Measurements and recording:

The hearing aid was switched on and volume was set at RTG position. The silver oxide cell button was selected from the battery voltage module, The voltage supply was changed from 1.5 volts to 1 volts and the measures of current drain was noted down down for each hearing aid and recorded on data sheets.

Analysis:

The statictical method of analysis of variance was used to find the significant differece among the categories in terms of current drain. The mean values of current drain for each category was also computed.

The life of the battery for each category was estimated in terms of hours, by dividing the capacity of battery (in mA hrs) with the average current (mA) measured.

The data thus obtained is given in tabular form in the following pages.

DATA SHEETS

Table-1: Showing the number of hearing aids taken from used group and number of new hearing aids among the total number of hearing aids.

Total no.of hearing aids	Used hearing aids	New Hearing aids.
30	13	17

Table-2: Gives data on current drain obtained for different models of mi1d category hearing aids at RTG position.

Models of hearing aids	Current drain (inmA)
Model A1	1.7
A2	1.6
A3	1.6
A4	1.7
A5	1.6
A6	1.9
Model B1	2.3
B2	2.2
B3	3.3
B4	3.0

Table-3: Gives data on current drain (in mA) obtained for different models of moderate category hearing aids at RTG position.

Models of hearing aid	Current drain (in mA)
Model A1	3.4
A2	3.4
Model B1	6.1
B2	6.0
B3	6.3
Model C1	3.1
C2	4.4
C3	4.1
Model D1	4.3
D2	4.2

Table-4: Gives data on current drain in (mA) obtained for different models of strong category hearing aids ar Me position.

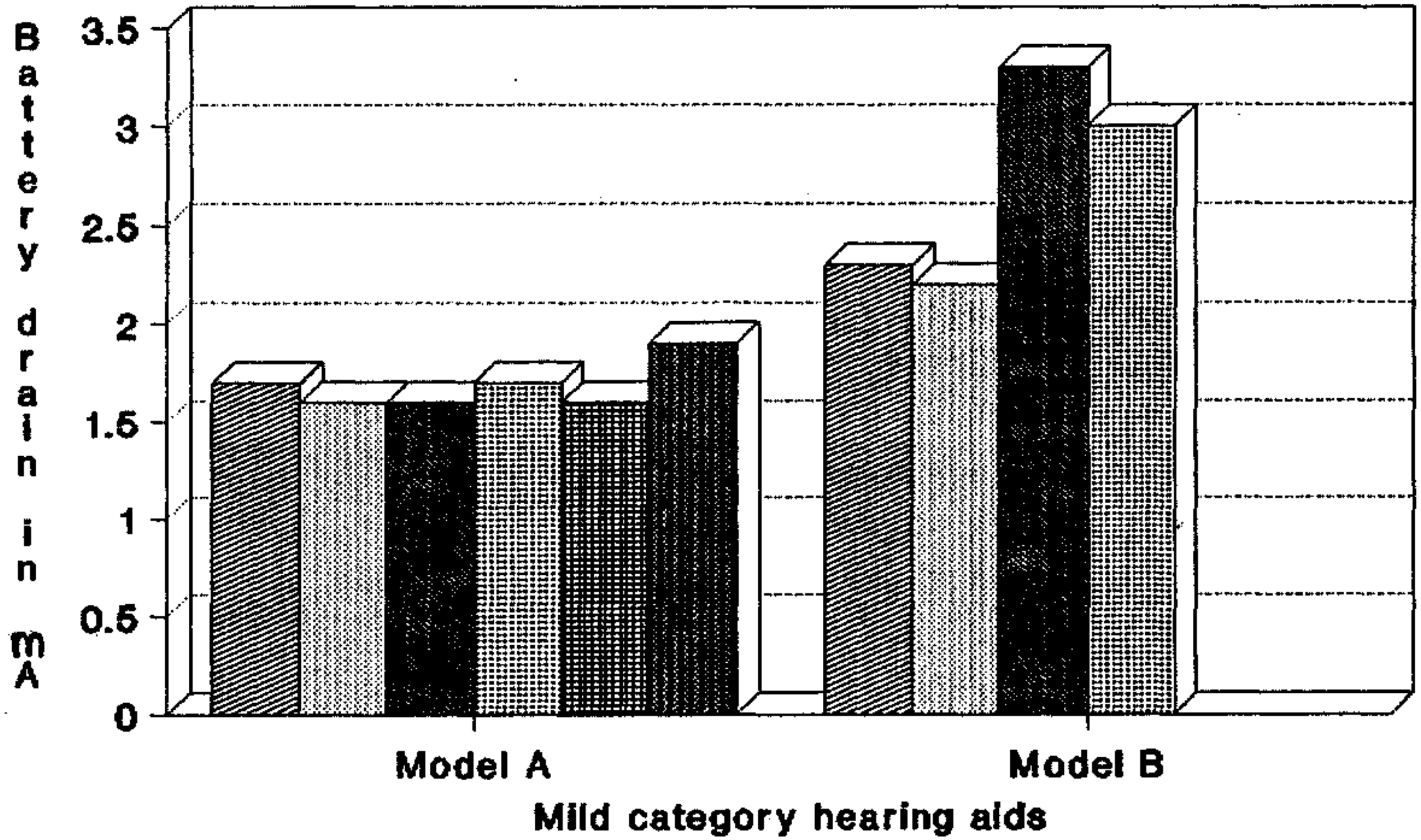
Models of hearing aid	Current drain (in mA)
Model B1	5.4
B2	13.2
B3	5.8
B4	7.4
Model C1	8.0
C2	11.4
C3	5.3
C4	5.3
Model E1	7.3
E2	5.5

Table-5: Gives the standard deviation and mean values of current drain for mild, moderate and strong category hearing aids at RTG position.

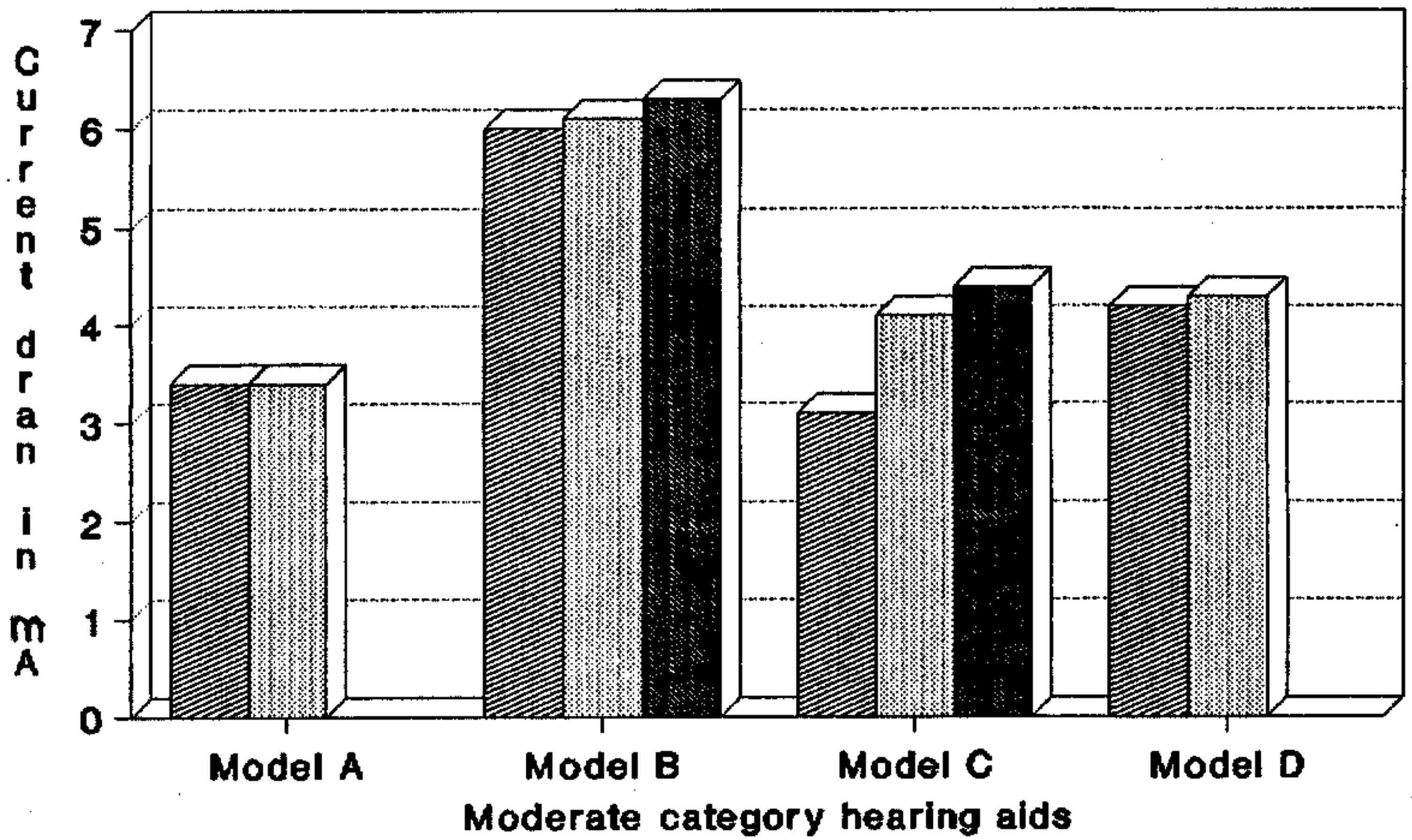
Hearing aid category	Current drain (in mA)	Standard deviation
Mild	2.09	6.86
Moderate	4.41	14.45
strong	7.4	25

Table-6: Gives the data on estimated battery life in terms of hours for each category aid.

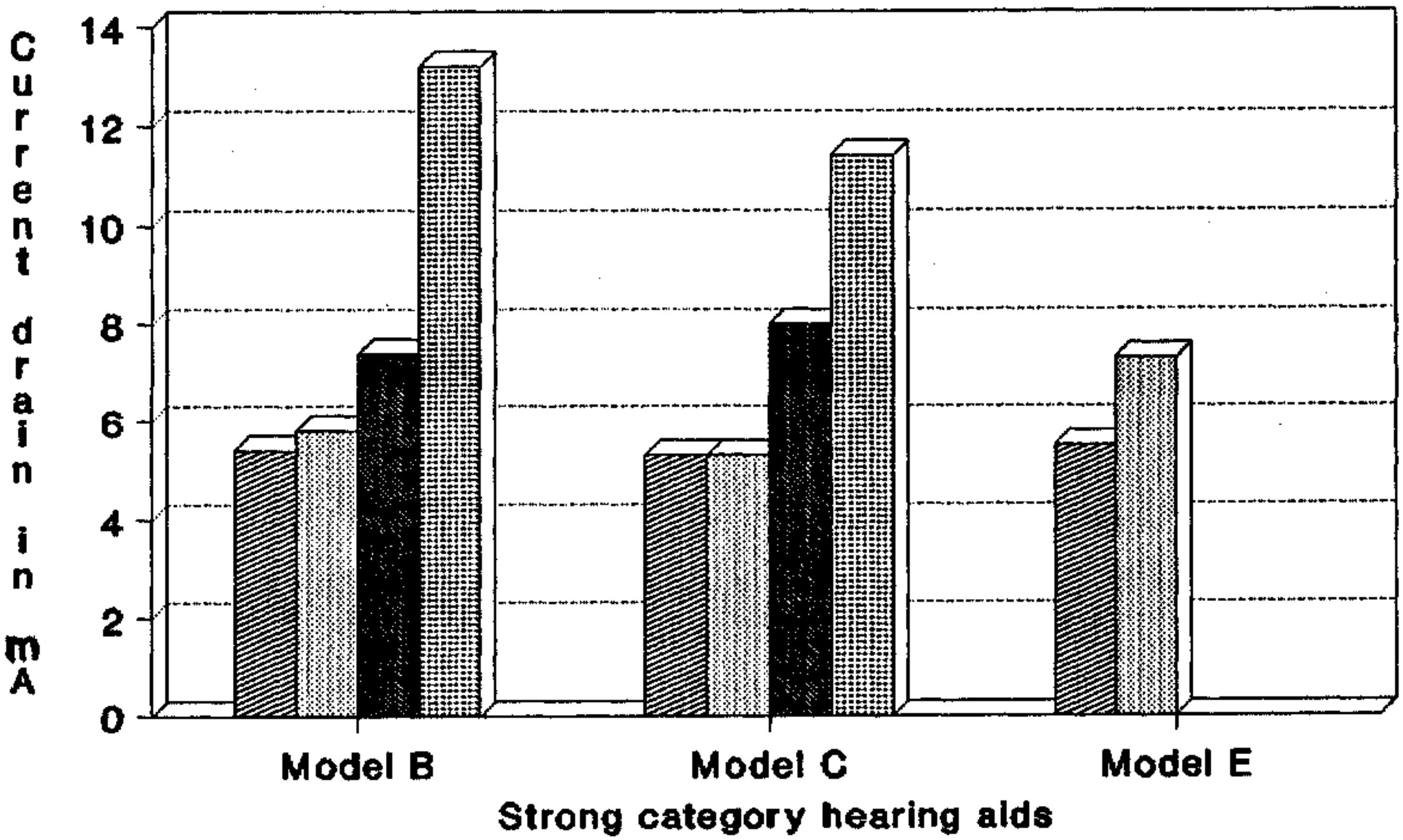
Category	Battery life (in hrs)
Mild	215
Moderate	102
Strong	60



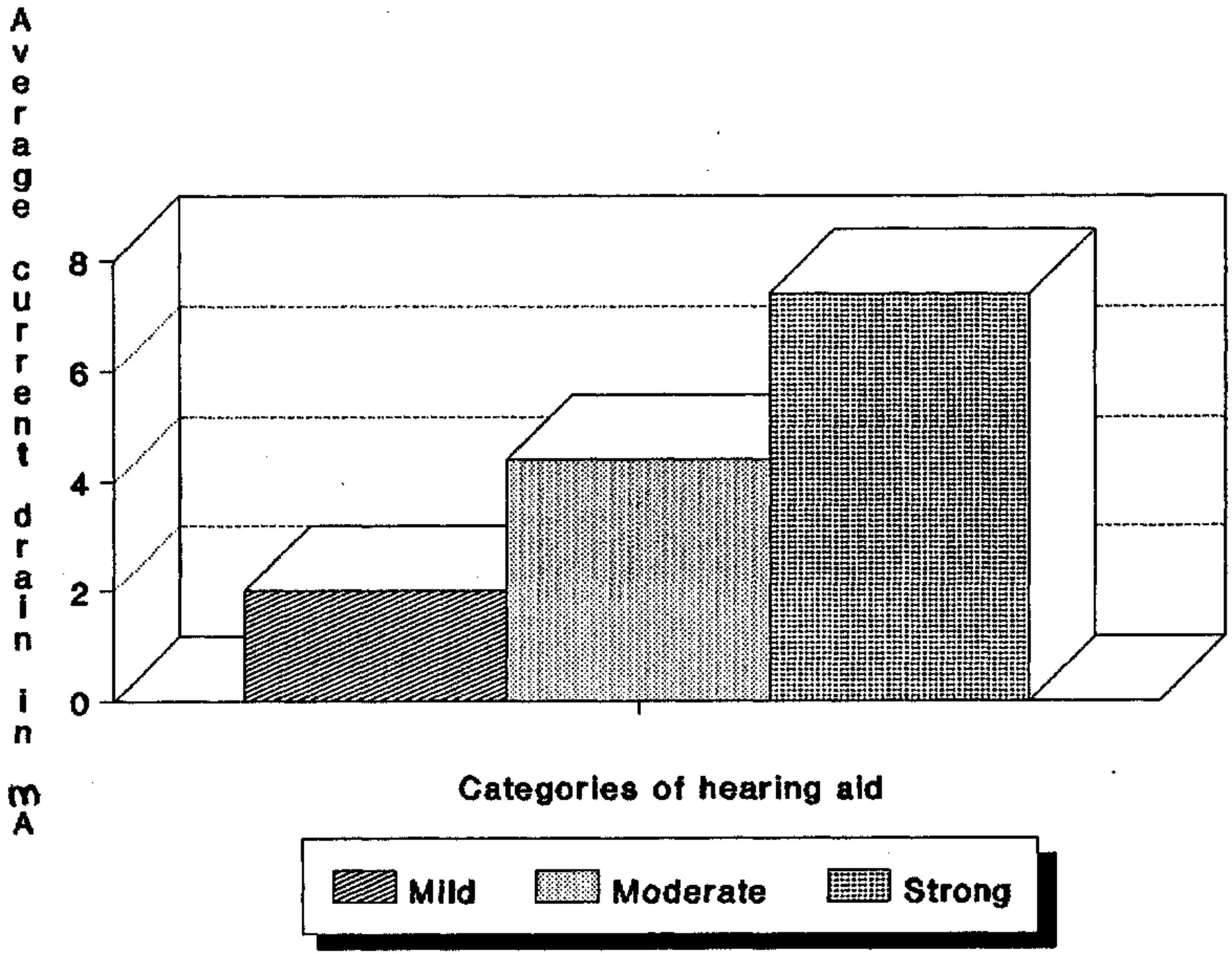
Graph-1: Showing the battery drain across different models of mild category hearing aids.



Graph-2: Showing the battery drain across various models of moderate category hearing aids.



Graph-3: Showing the current drain across various models of strong category hearing aids.



Graph-4: Showing the average current drain across different categories of hearing aid.

RESULTS AND DISCUSSION

By looking at the data sheets and graphs that depict the currant drain for different categories of hearing aids, the following inferences can be made -

Table-2 indicates that the current drain for mild . category hearing aids with different models ranges from 1.6 - 3.3 mA with a mean of 2.09 mA (6,86),

Table-3 indicates that the current drain for moderate category hearing aids ranges from 3.1 - 6.3 mA with a mean of 4.41 mA (14.45),

And from Table-4_r it is observed that the current drain for strong category hearing aids ranges from 5.3 mA - 13.2 mA with a mean of 7.4 mA (25).

Standard deviation and mean values of current drain of different categories of hearing aid are given in the Table-5.

According to IS (10775-1984), the maximum current drain for: mild category hearing aids shall be 5 mA and for moderate category hearing aids 10 mA and for strong category hearing aids 15 mA.

A comparison of average current drain with the standard (IS 10775-1984) Indicates that only mild category hearing. aids meet the specification among the three categories.

Analysis of data using analysis of variance revealed a significant difference at 0.01 level. This proves that there is a significant difference exists in terms of battery drain between mild, moderate and strong hearing aids.

Among the used and new hearing aids most of the used hearing aids found to have maximum current drain as compared to new hearing aids.

Graphs 1, 2, 3 depicts the current drain across different models of mild, moderate and strong category hearing aids. This shows that model B hearing aid has a maximum current drain as compared to other models.

A comparison of battery drain across different categories of hearing aids as depicted in graph 4, indicated that current drain is morein stronger category hearing aids.

The number of hours that a battery last in a hearing aid is estimated for all the categories and this is given in Table-6.

As indicated in Table-6, the mild catetgory hearing aids with a drain of 2.09 mA can function on silver oxide battery (1.5 volts) for 215 hours and moderate category hearing aids with a drain of 4.4 mA can function for 102 hours and strong category aids with a drain of 7.4 mA for 60 hours.

The above results indicated that among all the categories, batteries used for stronger category hearing aids have shorter life span due to higher current drain ratings. This suggests that the currant drain of a hearing aid increases as the gain increases.

This is found to be in agreement with Martin's study (1992) who gives range of current drain ratings for mild gain hearing aids as 0.2 - 0.4 mA and 0,6 mA - 0.8 mA for behind-the-ear hearing aids and 2.0-4.0 mA high power or digitally programmed hearing aids.

The results also show that the measured current . drain is lesser than. the value a specified in the standards (IS 10775-1994) and this leads to an assumption that the battery may last long in actual usage. Comparison between new and used hearing aids reveals that condition of a hearing aid also has an effect on currant drain ratings.

The above findings hold good for easily silver oxide batteries with 1.5 volts used for body level hearing aids.

Hence predicting the life of the battery for an individual hearing aid demands skill as it is influenced by many factors such as type of the battery, size of the . battery, type of circuit, volume setting number of hours of usage, type of receiver and cord used and noise level in which the hearing aid is used.

This emphasis that an audiologist or hearing aid dispernser must have knowledge on these characteristics of hearing aid and this also should be taken into account while counselling the patient regarding the usage of battery.

The various clinical implications of the present study are -

A. I- **Counselling:** It enables the audiologists to inform the patients how long a battery would last in a hearing aid. This is valuable information especially for the parents of the deaf children as the children cannot indicate that the battery is wearing out.

II. Depending on the number of hours to be used, the user can also be informed about the number of batteries needs to be purchased for a month.

III. The information also helps the user to check whether it meets the manufacturer's claim.

B. Financial implication:

An hearing aids are issued free of cost or at subsidized rate under SADP scheme, this information is necessary to estimate recurring expenditure incurred on batteries.

C**. Public information:**

Based on the data obtained, a chart giving the battery life for hearing aids of different categories could be maintained in deaf school/lnstitution where hearing aid is used regularly.

Thus, the present study deleniates the fact that the rate of current drain depends on the category of the hearing aid and this helps us to predict the life of the battery for a hearing aid which serves as a highly valuable information for both rehabilitation clinicians and clients and those related to the field of audiology.

SUMMARY AND CONCLUSIONS

An experimental study was conducted in order to measure the current drain and estimate the life of the battery for different categories of body level hearing aids.

A total of 30 body level hearing aids were taken for the study. Out of these 30 hearing aids, 13 hearing aids were used hearing aids and 17 hearing aids were newly received from the manufacturers. Of these 30, 10 hearing aids belonged to mild and 10 belonged to moderate and 10 belonged to strong category. All the hearing aids came from Indian manufacturers and were classified into five models.

Current drain was measured at RTG position using battery pills and life of the battery (in terms of hours) was estimated for each category hearing aids by dividing the battery's mAh ratings by the drain value of the hearing aid. The data was statistically analysed and the results were tabulated.

Results indicated that among all the categories only mild category met the standard specifications

(IS: 10775-1984) in terms of average current drain. The current drain was found to increase as the gain increases and hence batteries used for stronger category hearing aids have shorter life span as compared to other categories,

Thus, the present study implies that a hearing aid user who uses strong hearing aids needs to spend more amount on batteries, since the battery has to be changed quite frequently.

Hence it can be concluded that as most of the hearlng-impaired children fall into severe category hearing loss and as majority of them in India come from lower economic status, the Government can bringout a scheme whereby even batteries can be sold at subsidized rates or given free of cost, so that people of lower economic status can be . . benefitted.

Recommendations for further study:

1. Further study can be conducted on larger number of different types of hearing aids with various models.
2. Current drain can be measured and compared among different types of batteries for different categories of hearing aid with V cord and S cord.
3. Further study can be undertaken to estimate the life of the battery for body level and behind-the-level hearing aids on continuous and intermittent usage.

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APPENDIX

Hearing aid test system Fonix 6500R) showing its various connections.