



## Review Article

## Utilization of Sound Devices by Teenagers

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### Abstract

#### Objective

To verify the utilization of electronic device (iPod, MP3, Cell Phone and PC) by teenagers who are students in public schools of São Paulo, Brazil.

#### Methodology

Transversal, observational and quantitative study carried out in 2011, in a school of São Paulo/Brazil, involving students from 10 to 17 years old. The sample answered to a questionnaire containing questions which referred to electronic devices: type of phones, time and places utilized, elevated volume. It was done the chi-square and it was considered  $p < 0.05$ .

#### Results

Among the 249 teenagers studied, 55.8% were females, the average age was 12.6 ( $\pm 1.42$ ) years old. Utilization of phones: 89.9% girls and 73.6% boys ( $p=0,01$ ). Type: 17% external, 18.9% internal and 64.1% occlusive. Time of usage: cell phone -  $>1$  hour/day by 26.4% girls and 38.3% boys ( $p=0,03$ ); iPod/MP3 -  $>1$  hour/day by 26.4% girls and 18.5% boys ( $p=0,06$ ). Related to the places: 50% streets, 87% home, 45% car, 31% subway, 47% bus and 21% park. Elevated volume in cell phone: 28% by females and 35.8% by males ( $p=0,83$ ); in iPod/MP3, 16.7% and 25.9% ( $p=0,06$ ), respectively.

#### Conclusion

The teenagers of female gender utilize the earphones and the electronic devices for a longer time than the male ones; the teenagers of male gender utilize the electronic devices in a louder volume than the female ones; among the types of earphones, the teenagers choose principally the occlusive one; a huge part utilize in competitive background noise situation such as in buses, cars and subway.

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**Citation:** Alcântara EF, de Nóbrega A, Ferrari GLM, Passos MAZ, Vitalle MSS, et al. (2017) Utilization of Sound Devices by Teenagers. J Otolaryng Head Neck Surg 3: 013.

**Received:** August 03, 2017; **Accepted:** September 11, 2017; **Published:** September 25, 2017

### Introduction

The huge increment in the popularization of portable electronic devices increased the exposition of young people to elevated levels of sounds and music. Several researches reported that an increasing number of children and teenagers past now to experiment indicative symptoms of hearing impairment such as hearing distortion, buzzing, hyperacusis, or changes in the hearing threshold [1-3].

In a research sponsored by American Speech Language Hearing Association (ASHA), 61% of the teenagers owned such devices, while 51% of American secondary schools students presented symptoms of hearing loss. Most of the students prefer loud volumes, whereas the adults tend to more moderate ones.

“The Hearing Alliance of America” Institute reports that 15% of teenagers who graduate in American college have nowadays a hearing loss which is equal or superior to their parents, in its majority due to listening to music using earphones in a very loud volume [4]. Nowadays, the usage of portable electronic devices may be the most important risk factor to hearing loss inducted by music in young people.

### Objective

To evaluate the utilization of iPod, MP3 player, cell phone and PC by teenagers of public schools, according to gender and age, type of earphone, time of utilization and places utilized.

### Methods

Study of cross-sectional, observational, quantitative involving teenagers from 10 to 17 years old, both male and female genders, subscribed in public educational system in the city of São Paulo, Brazil, within April to November, 2011.

### Inclusion criteria

All the teenagers present in the scholar ambit due to the occasion of data collection and excluded the ones who present any deficiency which impair the research evaluation.

The study has been coordinated by the Teenage Medicine Sector with the support of the Pediatric Otorhinolaryngology Department of UNIFESP, where the data collection was taken by a nutritionist, previously trained for the application of the questionnaire in teenagers who utilize electronic device in a daily basis-cell phones, iPods, MP3 players and PC's.

All the questionnaires applied were utilized and tabulated, with no occurrence of losses due to inadequacy in the including criteria.

Each questionnaire contained 11 multiple choice questions (Questioner 1) being utilized for this study the questions numbers 1, 4, 5, 6, 8, 9, 10 and 11: what kinds of electronic devices were utilized, time of using, type of earphone (external, internal and occlusive), volume utilized and places of using. The questionnaire utilized in this study was based principally in the study sponsored by American Speech Language Hearing Association (ASHA) of 2006 [5].

The data has been analyzed with the help of the Statistical Package for the Social Science Program (SPSS Inc., Chicago, USA) version

18.0. In the description of the proportions, it is preceded to an approaching of the binomial distribution to the normal distribution by the interval of 95% of confidence (IC 95%). In the comparison of the proportions, it will be utilized the Pearson chi-square test, where the level of significance adopted was  $p < 0,05$ .

## Results

Table 1 shows the genders and ages of the study population. About 55.4% of the boys evaluated are in the age range of 10 to 12 years of age and 63.3% of the girls are in the age range of 10 to 12 years of age.

Age Group (Years Old)	10-12 Years Old	13-17 Years Old	Total
Male gender	61	49	110
Female gender	88	51	139

**Table 1:** Gender and age group of population studied.

Table 2 shows the frequency (f) and percentage (%) of the use of electronic devices by students according to gender and age group.

Age Group (Years Old)	iPod f (%)	MP3 Player f (%)	PC f (%)	Cell Phone f (%)
<b>Male gender</b>				
10-12 (n=61)	8 (13.1)	23 (37.7)	53 (86.8)	48 (78.6)
13-17 (n=49)	8 (16.3)	17 (34.6)	47 (95.9)	47 (91.8)
Total (n=110)	16	40	100	95
<b>Female gender</b>				
10-12 (n=88)	17(19.3)	36(40.9)	82 (93.1)	78 (88.6)
13-17 (n=51)	12(23.5)	27(52.9)	49 (96.0)	44(88.2)
Total (n=139)	29	63	131	122

**Table 2:** Frequency (f) and percentage (%) of electronic devices usage by students according to gender and age group.

In table 3: Frequency (f) and percentage (%) of use of electronic devices by students according to gender, age and time of use in hours. For the group of boys 10 to 12 years old, 24.5% use MP3/iPod for 30 minutes to an hour and 29.5% use the cell phone for 30 minutes to an hour. For the age group of 13 to 17 years, 18.3% use MP3/iPod for 30 minutes to an hour and 32.0% use the cell phone for 30 minutes to an hour. For the female group, from 10 to 12 years of age, 14.7% use MP3/iPod from one to 4 hours and 23.8% use the cell phone for more than 4 hours. For the 13-17 age group, 23.5% use MP3/iPod for 30 minutes at a time and 35.2% use the cell phone for more than 4 hours.

Table 4 shows the frequency (f) and percentage (%) of use of headphones by students according to gender. 74.3% of boys and 91.2% of girls use earphones.

Table 5 shows the frequency (f) and percentage (%) of use by type of headphones by the students according to the genre. The occlusion headphones are used by 39.4% of the boys and 64.9% of the girls.

Table 6 shows the Frequency (f) and Percentage (%) of time of use by students according to gender. 28.1% of boys use their cell phones for more than an hour a day. In addition, in 41.0% of cases girls use the cell phone for more than an hour a day.

Table 7 shows the frequency (f) and percentage (%) of the time of iPod use by the students according to the genre. Only 13.6% of boys and 23.0% of girls use iPods.

Time of utilization	Male		10-12 Years Old (n=61)		13-17 Years Old (n=49)	
			MP3/iPod	Cell phone	MP3/iPod	Cell phone
			f (%)	f (%)	f (%)	f (%)
>4 hours			4 (6.5)	6 (9.8)	4 (8.1)	10 (20.4)
1-4 hours			1 (1.6)	6 (9.8)	6 (12.2)	9 (18.3)
30 minutes to 1 hour			15 (24.5)	18(29.5)	9 (18.3)	16 (32.6)
15-30 minutes			4 (6.5)	6 (9.8)	1 (2.0)	5 (10.2)
<15 minutes			3 (4.9)	11 (18.0)	0 (0)	7 (14.2)
Not utilized			34 (55.7)	14 (22.9)	29 (59.1)	2 (4.0)
Time of utilization	Female		10-12 Years Old (n=88)		13-17 Years Old (n=51)	
			MP3/iPod	Cell phone	MP3/iPod	Cell phone
			f (%)	f (%)	f (%)	f (%)
>4 hours			5 (5.6)	21 (23.8)	6 (11.7)	18 (35.2)
1-4 hours			13 (14.7)	7 (7.9)	8 (15.6)	11 (21.5)
30 minutes to 1 hour			9 (10.2)	21 (23.8)	12 (23.5)	5 (9.8)
15-30 minutes			9 (10.2)	19 (21.5)	2 (3.9)	7 (13.7)
<15 minutes			7 (7.9)	9 (10.2)	1 (1.9)	2 (3.9)
Not utilized			45 (51.1)	11 (12.5)	22 (43.1)	8 (15.6)

**Table 3:** Frequency (f) and percentage (%) of electronic devices usage by students according to gender, age and time of utilization in hours.

Earphones Utilized	
Gender	Total f (%)
Male (n=109)	81 (74.3)
Female (n=137)	125 (91.2)
Total (n=246)	206 (83.8)

**Table 4:** Frequency (f) and percentage (%) of utilization of earphones by students according to gender.

Gender	Type of Earphone			
	External f (%)	Internal f (%)	Occlusive f (%)	Notutilized f (%)
Male (n=109)	21 (19.2)	17 (15.5)	43 (39.4)	28 (25.6)
Female (n=137)	14 (10.2)	22 (16.0)	89 (64.9)	12 (08.7)
Total (n=246)	35 (14.2)	39 (15.8)	132 (53.6)	40 (16.2)

**Table 5:** Frequency (f) and percentage (%) of utilization by type of earphones by students according to gender.

Cell Phone Usage	Utilization time $\geq 1$ hour	
	Gender	Utilized f (%)
Male (n=110)	79 (71.8)	31(28.1)
Female (n=139)	82 (58.9)	57 (41.0)
Total (n=249)	161 (64.6)	88 (53.3)

**Table 6:** Frequency (f) and percentage (%) of utilization time by students according to gender.

Table 8 shows the frequency (f) and percentage (%) of volume used in the device of the cell phone by the students according to the genre. 26.3% of the boys and 25.1% of the girls use the cell phone with the increased volume.

Table 9 shows the frequency (f) and percentage (%) of volume used in the iPod device by the students according to the genre. Only

19.0% of boys and 15.1% of girls use iPods with increased volume.

iPod Usage	Utilization $\geq 1$ Hour	
	Not Utilized f (%)	Utilized f (%)
Gender		
Male (n=110)	95 (86.3)	15 (13.6)
Female (n=139)	107 (76.9)	32 (23.0)
Total (n=249)	161 (64.6)	88 (53.3)

**Table 7:** Frequency (f) and percentage (%) of utilization time of iPod by students according to gender.

Cell Phone Volume	
Gender	Total f (%)
Male (n=110)	29 (26.3)
Female (n=139)	35 (25.1)
Total (n=249)	64 (25.7)

**Table 8:** Frequency (f) and percentage (%) of loud volume utilized in cell phone device by students according to gender.

iPod Volume	
Gender	Total f (%)
Male (n=110)	21 (19.0)
Female (n=139)	21 (15.1)
Total (n=249)	42 (16.8)

**Table 9:** Frequency (f) and percentage (%) of loud volume utilized in iPod device by students according to gender.

p= 0.06

Table 10 shows the preferential places where children and teenagers utilize the earphones. The most frequent sites were at home (87%) and on the streets (50%).

Preferential Places	
Home	87%
Streets	50%
Bus	47%
Car	45%
Subway	31%
Parks	21%

**Table 10:** Preferential places where children and teenagers utilize the earphones.

## Discussion

249 children and teenagers have been evaluated; 44.2% male gender and 55.8% female gender, with average age of 12.6 years old ( $\pm 1.42$ ). More than 90% have cell phones and from 40% to 60% use iPod or MP3 players.

The impact of exposition to noise in the hearing may be affected by several factors. For example, the individual susceptibility, including here the differences between left and right ears and time of the day, suggesting that the lesion in the internal ear may result from genetically variable responses to noise exposure [6].

In the study of Kim and collaborators [7] it was found that students of male gender presented hearing thresholds significantly higher than the female gender ones and the hearing thresholds of the right ear were significantly higher than the left ear ones.

In other study, the participants of male gender listened to music in significantly more elevated levels than the participants of female gender in silence environment ( $p>0.05$ ). There was no difference when the measurements were done in the presence of background noise [8]. In the study of Vogel and collaborators, 2009, the difference in the sound level in the favorite earphone between individuals of male gender to female gender was approximately 5 dB louder to male gender [1,9].

In the study of Hodgetts, Rieger and Szarko, 2007, the girls heard music more frequently in portable electronic devices than boys did and also utilized more the insertion earphones. On the other hand, the boys heard more frequently in louder volume than the girls did. This means that both genders were susceptible to hearing loss [10].

In the present study, the usage of cell phone for more than one hour/day occurred to 26.4% of girls and 38.3% to the boys ( $p=0.03$ ); for iPod/MP3 player the usage for more than one hour/day occurred to 26.4% of girls and 18.5% to boys ( $p=0.06$ ). The utilization of cell phones in increased volume occurred in 28% to girls and 35.8% to boys; the utilization of iPod and MP3 players in increased volume occurred to 16.7% of girls and 25.9% to boys ( $p=0.06$ ).

Most of the portable electronic devices are capable to generate sounds in intensity of 91 to 121 decibels (dB) [11]. The American scientific committee of emergent and recently identified health risks estimates that 5 to 10% of individuals that listen to portable electronic devices are in risk to develop permanent hearing loss after 5 years or more due to music exposure during one hour a day, 7 hours a week, in sound levels superior to 89 dB [2].

In the study of Vogel and collaborators, 2010, this estimative may be overly low to teenagers: 32.2% of participants listened to music for one hour a day in sound levels superior to 89 dB [12]. To Kageyama, 1999, the typical listener utilizes the volume in between 75 to 100 dB [13].

The individual who listens to music with earphones in 100 dB for 15 minutes may be exposed to the same level of sound intensity such as industrial workers exposed to 85 dB in an 8 hours journey workday [14]. The levels of sound intensity utilized by listeners are among 79 and 125 dB [15].

The types of earphones may also be more or less harmful. Blocking the external acoustic duct, the insertion earphones may elevate the output power in 7 to 9 dB compared to the ones which cover the entire ear. This means to increase in two or three times the sound intensity of sounds and music [11]. Furthermore, the intra-auricular earphone users tend to elevate the volume of the sound to deal with environment noise.

The usage of intra-auricular earphones increases the level of sound intensity in more than 5.5 dB due to the small volume of the external acoustic duct [2,16]. Furthermore, the recordings nowadays are made with stronger compression, what allows a middle sound level closer to the maximum output level.

On the other hand, the earphones which utilize noise attenuation may reduce the level in which listeners listen to music in the presence

of competitive background noise [17]. In the present study, 89.9% of the girls use earphones while 73.6% of the boys use them ( $p=0.01$ ). The type of earphone which predominated in the study was the occlusive model (64.1%) followed by the internal (18.9%) and external (17%).

The preferential places where children and teenagers utilize the earphones, in this study, were: at home (87%), on the streets (50%), in the car (45%), in the bus (47%), in the subway (31%) and at the parks (21%). On the streets, the usage of earphones increases the risk of accidents. In the presence of louder external noise, the person tends to listen in louder volume, higher risk of hearing loss.

The measurement of sound intensity levels sampled randomly based on individuals who passed in a public street utilizing portable electronic devices reveal hearing levels of 73.7 to 110.2 dB (average: 86.1; pattern-detour: 7.9) [9].

As a matter of fact, there is a consensus that the exposure effects to noise are accumulative. Thus, in a short term, the effects of overstimulation to noise may not be obvious, but the accumulative effects shall eventually lead to significant hearing losses [9].

## Conclusion

The teenagers of female gender utilize the earphones and the electronic devices for a longer time than the male gender ones; the teenagers of male gender utilize the electronic devices in a louder volume than the female ones; among the types of earphones, the teenagers choose principally the occlusive one (more harmful); half utilize on the streets and a huge part utilize in competitive background noise situation such as in buses, cars and subway (worse situations: louder outside noise, tends to listen in louder volume, higher risk of hearing loss). It is made necessary an awareness policy for our children and teenagers about the correct usage of earphones and electronic devices and the risk of irreversible hearing loss due to inadequate usage.

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## Questionnaire



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How teenagers utilize electronic devices in a daily basis – cell phones, iPods, MP3 players and PC's.

Age:

Gender-Male ( )-Female ( )

Schooling:

### 1. You use (check as many as necessary)

Cell phone	Yes ( )	No ( )
iPod	Yes ( )	No ( )
MP3 player	Yes ( )	No ( )
PC	Yes ( )	No ( )
None	( )	

## 2. Who chooses your: cell phone-iPod-MP3 player-PC

Parent (s)      
Relative (s)      
Yourself

## 3 .The choice has been made because the device is

Cheap   
Modern   
Brand   
Resources   
Benefits

## 4. Duration of utilizing time of cell phone per day

4 hours or more  Fifteen to thirty minutes   
Within 4 and 1 hour  Less than fifteen minutes   
Half an hour to 1 hour  Do not use

## 5. Do you listen to music/play video games in the cell phone using earphones?

No  Yes  Loud   
Medium   
Low   
Do not know

## 6. Duration of utilizing time of iPods/MP3 players during the day

4 hours or more  Fifteen to thirty minutes   
Within 4 and 1 hour  Less than fifteen minutes   
Half an hour to 1 hour  Do not use

## 7. Volume utilized in iPods/MP3 players

Loud   
Medium   
Low   
Do not know

## 8. Type of earphone

External (headset/headfone)   
Internal (plug-in type)   
Occlusive (insertion inside the conduct)

## 9. In which place(s) you are used to listening to music (check as many as necessary)

Streets  Car   
Bus  Home   
Subway  Parks

Others: \_\_\_\_\_

## 10. Use earphones with PC

Yes   
No   
Do not know

## 11. Volume utilized

Loud   
Medium   
Low   
Do not know