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# Environmental Burden of Disease on Leisure Noise among Adolescents in Germany

**Master Thesis**

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First Supervisor:
Prof. Dr. Zita Schillmöller

Second Supervisor:
Dr. Michael Schümann

Presented by:

**Reyni Panjaitan**

[redacted]

# Abstract

**Introduction/Background:** Leisure noise exposures become relevant due to increasing cases of hearing disturbance observed among children and adolescents in Germany. The unseen non-fatal Burden of Disease (BoD) due to leisure noise in Germany has not been widely investigated.

**Objectives:** This study attempts to collect, analyze and document data needed for the Disability-Adjusted Life Years (DALYs) calculation as a quantification of the environmental Burden of Disease attributable to leisure noise among adolescents in Germany. It also tries to fill the information gaps which are necessary for this calculation.

**Method:** Data were obtained from German Environmental Survey for Children (GerES) IV 2003/06. For 600 participants aged 11 to 14 years exposure (listening to a Walkman, to a stereo using a headphone, visiting discotheques or attending concerts) and health outcomes (earache, tinnitus and hearing impairment) were analyzed, resulting in the calculation of DALYs for leisure noise. Uncertainty and sensitivity analysis were also evaluated.

**Results:** Around 36.35% of estimated earache cases prevalence took place among German adolescents aged 11 to 14 years are attributable to Walkman use, 13.63% to discotheques visits and 17.6% to concerts attendance. Furthermore, around 9.45% of estimated tinnitus prevalence is attributable to Walkman use, 6.89% to discotheques visits, 6.12% to concerts attendance and 4.88% to stereo hearing using a headphone. DALYs and sensitivity analysis are failed to calculate due to the absence of Dose-Response Function (DRF). Taking into account the qualitatively uncertainty analysis together with the 95% Confidence Interval (CI) of the Relative Risk (RR), this study comprised high level of uncertainty.

**Discussion:** To lessen the level of uncertainty, more detailed and complete questionnaire as well as standardized measurements is required. Future studies seeking for Disability Weights (DW) and DRF for leisure noise and its health outcome are crucial.

**Conclusion:** Even though this study failed to calculate DALYs for leisure noise, it gave novel information as well as direction for future research.

**Keywords:** Leisure noise, Hearing Disturbances, DALYs, adolescents, Germany.

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## List of Abbreviations

| | |
|---|---|
| AF | Attributable Fraction |
| AR | Attributable Risk |
| *BAFU* | *Bundesamt für Umwelt* |
| *BGV* | *Behörde für Gesundheit und Verbraucherschutz* |
| BoD | Burden of Disease |
| CD | Compact Disc |
| CEYLL | Cohort Expected Years of Life Lost |
| CI | Confidence Interval |
| COPD | Chronic Obstructive Pulmonary Disease |
| CRA | Comparative Risk Assessment |
| DALYs | Disability-Adjusted Life Years |
| dB | decibels |
| *DIN* | *Deutsches Institut für Normung* |
| DRF | Dose-Response Function |
| DW | Disability Weight |
| EBD | Environmental Burden of Disease |
| EBoDE | Environmental Burden of Disease in the European |
| ECEH | European Centre for Environment and Health |
| EEA | European Environment Agency |
| EIP/GPE | the Global Program on Evidence for Health Policy |
| EME | the Established Market Economies |
| ENT | Ear, Nose and Throat |
| EU | European Union |
| *F&E-Vorhaben* | *Forschungs- und Entwicklungs-Vorhaben* |
| GBD | Global Burden of Disease |
| GerES | German Environmental Survey for Children |
| *GMK* | *Gesundheitsministerkonferenz* |
| HIV/AIDS | Human Immunodeficiency Virus / Acquired Immunodeficiency Syndrome |
| Hz | Hertz |
| ICD | International Classification of Diseases |
| IPCS | International Programme on Chemical Safety |

| | |
|---|---|
| ISO | International Organization for Standardization |
| ITS | Immediate Threshold Shift |
| *KiGGS* | *Kinder- und Jugend- gesundheitssurvey* |
| *KUS* | *Kinder-Umwelt-Survey* |
| *LIGA.NRW* | *Landesinstitut für Gesundheit und Arbeit des Landes Nordrhein-Westfalen* |
| NCDs | Non Communicable Diseases |
| OECD | Organisation for Economic Co-operation and Development |
| PAF | Population Attributable Fraction |
| PAP | Population Attributable Prevalence (in this study, refers to PAR) |
| PAPF | Population Attributable Prevalence Fraction (in this study, refers to PAF) |
| PAR | Population Attributable Risk |
| PAR% | Population Attributable Risk Percentage |
| PASW | Predictive Analytics SoftWare |
| PCBs | polychlorinated biphenyl |
| PCPs | Personal Cassette Players |
| PEYLL | Period Expected Years of Life Lost |
| PFT | perfluorierte tenside |
| PM | particulate matter |
| PMPs | personal music players |
| PTO | Person Trade Off |
| PTS | Permanent Threshold Shift |
| PYLL | Potential Years of Life Lost |
| *RIVM* | *Rijksinstituut voor Volksgezondheid en Milieu* |
| *RKI* | *Robert Koch-Institut* |
| RR | Relative Risk |
| SCENIHR | Scientific Committee on Emerging and Newly Identified Health Risks |
| SEL | Sound Exposure Level |
| SEYLL | Standard Expected Years of Life |
| SNHL | Sensory Neural Hearing Loss |
| TTO | Time Trade Off |
| TTS | Temporary Threshold Shift |
| *UBA* | *Umweltbundesamt* |

| | |
|---|---|
| *VegAS* | *Verteilungsbasierte Analyse gesundheitlicher Auswirkungen von Umwelt-Stressoren* |
| WHO | World Health Organization |
| YLD | Years of Life with Disability |
| YLL | Years of Life Lost |

# Introduction ─ The Noise Polluted World

The world in which we live today features several pollutants. One of these is noise pollution. Whether desirable or unwanted, pleasant or annoying, it has become part and parcel of our reality. Throughout the day we are surrounded and engaged partially with sounds and noises even while asleep. Such an atmosphere often has effects human health in varied ways. The impact of sound or noise on human life is either positive or negative. It affects the human physical, psychological, cognitive, and behavioural states (SCENIHR 2008). According to the World Health Organization (WHO) Regional Office for Europe it is estimated that environmental noise, particularly due to vehicle traffic and industrial machines, is responsible for 1,629 new cases of non-fatal myocardial infarction in Germany every year (based on data from 1999); 160,859 cases of noise-induced cognitive impairment among children aged 7-19 years in Sweden (based on data from 2004); 1,947,000 people having sleep disturbance in The Netherlands (based on data from 2003), and 17,375,359 cases of tinnitus of different levels of severity among people above the age of 15 years in sub-region EUR-A (based on data from 2001) (WHO Regional Office for Europe 2011). It has also been categorically stated that such an impact will increase the demand for medical visits and assistance as well as increased community spending on medication that will indirectly contribute to the economic burden of a country.

Even though children and adolescents are thought to be free from noise at a workplace, they are exposed to other sources of noise (Maassen et al. 2001, p.2). In the United States in 2001 (Niskar et al. 2001), children and adolescents were reported to have experienced permanent structural or nerve damage in the inner ear due to intense and excessive noise. As many as approximately 12.5% of children and adolescents aged 6 to 19 years, totalling about 5.2 million, suffered from a noise-induced hearing threshold shift due to intense noise. Based on a survey by The German Federal Environment Agency (*Umweltbundesamt* – UBA) in 2003/06 in Germany, about 3% of the children age 8 to 14 years suffer from initial hearing loss and around 14% from slight hearing impairment (UBA 2009a, p.8). As a result, this hearing impairment among children and adolescents will influence not only their performance and achievement at school but will also influence their working and social lives later. This deserves serious attention since it involves children and adolescents who are the future generation of a country.

Sounds generated by items that are meant for leisure are often unrecognized as threats and are overlooked most of the time in comparison to other noises such as noise in the workplace or traffic noise (Williams, Beach & Gilliver 2010, p.155). Recreational activities intended for pleasure and comfort often generate immense sounds. With the introduction of personal music players such as Walkman, mp3 players, and i-Pod, the use of headphones, as well as frequent exposure to high-tech loudspeakers in discotheques and concerts, have become commonplace. Along with these new inventions and the innovation of developing technologies, the noise produced by the great variety of leisure devices and recreational activities has had a severe impact on human health, particularly hearing health.

Disability-Adjusted Life Years (DALYs) which compromises the years of life with disability (YLD) along with years of life lost (YLL) is a new approach that has emerged in national and international discussion in the last 20 years (Murray, Lopez & Jamison 1994; Anand & Hanson 1997; Barendregt, Bonneux & Van der Maas 1996; Murray 1996; Arnesen & Nord 1999; Lopez et al. 2006). It has been used by countries to assess and rank their Burden of Disease (BoD) attributed to risk factors, including environmental risk factors, in the population. Remarkable achievements have been produced by Global Burden of Diseases studies applying this method such as bringing attention to overlooked diseases such as neuropsychiatric disorders and injuries in 1990 (WHO 2003; Lopez et al. 2006; Mathers, Lopez & Murray 2006) as well as on epidemiological transitions worldwide and a growing problem of Human Immunodeficiency Virus / Acquired Immunodeficiency Syndrome (HIV/AIDS) globally in 2000-2002 (Lopez et al. 2006). This new methodology is an attempt to analyze problems attributable to risk factors using easily understood calculations so that the importance of action is clear and priorities can be set by the decision makers.

Until now, the DALYs approach has not been used to assess leisure noise in Germany. The use of this approach will provide an opportunity to present a current picture of noise pollution generated through leisure activities, commonly known as leisure noise, and its impact in Germany. Moreover, it will determine the Burden of Disease caused by leisure noise and the importance of preventive measures or management of leisure noise. It is noted that there may be possible constraints on available data; hence this approach is also expected to come up with novel insights and recommendations for future research. Therefore the study with the theme, *Environmental Burden of Disease on Leisure Noise among Adolescents in Germany,* is conducted.

This study is an evaluative attempt to check the availability of data needed for the DALYs approach. It is a stepwise approach to collect, analyse and document data which would be used for the environmental Burden of Disease calculation. Where lack of data was apparent, secondary analysis of the existing data set was performed to fill the gaps.

This paper is divided into six chapters. The first chapter is about the background of the study. The objective of the study is dealt with in the second chapter. The methodology planned and conducted in this study is presented in the third chapter. The fourth chapter reports the results of the study, followed by a discussion of the findings, assumptions and limitations in the fifth chapter. The conclusion and future recommendations appear in the last chapter.

# 1 Background

Burden of Disease (BoD), which is expressed in Disability-Adjusted Life Years (DALYs), is a concept that has been the subject of discussion in international levels in the last 20 years (Murray, Lopez & Jamison 1994; Barendregt, Bonneux & Van der Maas 1996; Murray 1996; Anand & Hanson 1997; Arnesen & Nord 1999; Lopez et al. 2006). Many countries—such as the United States (McKenna et al. 2005), Australia (Mathers, Vos & Stevenson 1999), India (Mahapatra 2002), Thailand (Thai Working Group on Burden of Disease and Injuries 2002), South Africa (Bradshaw et al. 2003), and others--have adopted this concept as an approach in comparing Burden of Disease from several diseases. The concept also has been employed in setting health research priorities (Lopez et al. 2006). Assessment of disease burden caused by environmental stressors also has begun to take place using this concept (de Hollander et al. 1999; Smith, Corvalán & Kjellström 1999; Melse & de Hollander 2001; Briggs 2003; Prüss-Üstün et al. 2003; WHO European Centre for Environment and Health 2009; EBoDE Report 2011).

This chapter will describe the theoretical framework of the BoD and its application in the first and second Global Burden of Disease (GBD) studies as well as in the Environmental Burden of Disease (EBD) study. It will also describe recent conditions, along with the problems in regard to leisure noise as environmental Burden of Disease particularly in Germany, and the importance of this study.

## 1.1 Theoretical Framework – Burden of Disease (BoD)

The theoretical framework of BoD will be described in this section. Concepts and methodology within this framework have been the focus of several previous discussions and research studies (Rice & Hodgson 1982; CDC 1986; Lewis & Charny 1989; Murray & Chen 1992; Barendregt, Bonneux & Van der Maas 1996; Murray 1996; Anand & Hanson 1998; Arnesen & Nord 1999; Salomon & Murray 2001, 2002, 2004; Essink-Bot & Bonsel 2002; Barendregt et al. 2003; Mathers et al. 2006). This theoretical framework is applied to assess the global and environmental Burden of Disease consecutively in GBD and EBD studies.

DALYs, as one of the tools in summary measures of population health, is used in BoD studies because it allows the combination of premature mortality and non-fatal health outcomes of diseases and injuries to a result of number describing the diseases and injury causes (Mathers, Lopez & Murray 2006). DALYs is a sum of years of life lost because of premature mortality (YLL) and years of healthy life lost as a result of disability (YLD). Such a time-based measurement estimates the loss of expected years of healthy life as a consequence of specific diseases or injuries (Murray, Lopez & Jamison 1994; Murray 1996; Murray & Lopez 1996b, 1996c, 1996d, 1997a; Mathers, Lopez & Murray 2006).

In order to bring the non-fatal health outcomes and premature death together, the idea of using the unit of time on DALYs analysis was adopted (Murray 1996). As cited in Murray (1996, p.8), this idea of a unit of time rather than a unit of rates was proposed initially by Dempsey (1947). First, the years of life with disability of one disease are a function of incidence or prevalence of diseases and expected duration of that disease. Second, the measure of the years of life lost is calculated on the basis of death rates and years lost compared to the life expectancy. Both use a unit of time, i.e. duration, for calculations. Hence the use of time as a unit of measure in analysis, here in year(s), no question give room for calculation using incidence or prevalence. In its development, the use of incidence instead of prevalence is preferred (Murray 1996). Non-fatal health outcomes are calculated by incidence and/or prevalence; premature deaths are calculated solely by incidence. For this reason, the use of incidence will harmonize both aspects: non-fatal health outcomes and premature deaths. Because of the moving population age structure and inconstant incidence of disability, incidence will be the appropriate measure to give the up-to-date picture rather than prevalence. Furthermore, incidence indicates a level of internal consistency and discipline. Murray and Lopez (1996) are of the view that even though the use of prevalence does not produce a significant change in overall global Burden of Disease, they argued against the use of prevalence on analysis in regard to inconsistency between non-fatal health outcomes and premature deaths, where the latter could only be measured by incidence (Murray 1996; Murray & Lopez 1996c).

Three additional values choices are considered in BoD study (Murray 1996; Mathers, Lopez & Murray 2006). They are, firstly, the length of time people are expected to be in state of good health. This will determine the length of years lost due to mortality and health restriction. Secondly, the preference of a healthy life gained in respect of time which determines the length of life with disability. And thirdly, the preference of healthy life gained with regard to individual characteristics that help to determine the grade of disability, or usually named as weighting factor. Other conditions that are being discussed are age weighting and future discounting. Mathematical models in general are needed to fulfil the incompleteness of data.

### 1.1.1 Expected Length of Life: Deciding Time Lost Because of Premature Death

Several studies on deciding the duration of time lost, one component of DALYs, have been done (CDC 1986; Murray 1996). At least four models have been built with regard to this concern (see Table 1). First, the model is Potential Years of Life Lost (PYLL) which selects a random limit of age. As cited in Murray (1996, p.11-13), proponents like Dempsey (1947) defined random limit as life expectancy for a particular population, whereas for Feachem (1992) it is the limit by selecting slightly more than life expectancy for the population. In the United States Centers for Disease Control (CDC) (1986) it is defined by selecting slightly lower. The PYLL model provides a calculation and equal treatment toward all ranges of age until the selected age limit. This model, however, does not favour those in age beyond the selected age limits since all deaths beyond the selected age limit would be considered as zero burden and all programs that would benefit them also were considered as zero benefit.

The second model is the alternative for PYLL. It is Period Expected Years of Life Lost (PEYLL). It calculates duration of time lost by using the local period life expectancy at each age. It solves the problem of age discrimination produced by PYLL, but it discriminates against communities that have a shorter life expectancy. Since DALYs will be used to compare Burden of Diseases between communities or a community over time, PEYLL would not give a fair result.

Third, the Cohort Expected Years of Life Lost (CEYLL) uses the cohort expectation of life at each age in a population. Even though it gives a more egalitarian result compared to PEYLL, this model also discriminates against communities that have shorter life expectancy.

Fourth, the model of the Standard Expected Years of Life Lost (SEYLL) employs an expectation of life at each age based on some ideal standard. The standard used is the highest national life expectancy observed and differs between male and female due to biological differences in survival potential. Even though some criticize this model for gender discrimination toward males, the ages of 82.5 for females and 80 for males are set. This model gives equal weight to death at the same age in all communities as well as considering all death at all ages. In addition, SEYLL establishes a picture closer to reality than PYLL and PEYLL for the potential benefits of an intervention. Therefore, this model is applied in DALYs analysis on BoD study (Murray 1996).

**Table 1 Several Suggested Equations Concerning Calculation for Duration of Time Lost** (Murray 1996)

| | |
|---|---|
| PYLL = $\sum_{x=0}^{L} d_x \, (L - x)$ | Where:<br>PYLL = Potential Years of Life Lost<br>x = age at death<br>L = Last age selected<br>d = number of death in population |
| PEYLL = $\sum_{x=0}^{L} d_x e_x$ | PEYLL = Period Expected Years of Life Lost<br>ex = period life expectancy at each age |
| CEYLL = $\sum_{x=0}^{L} d_x e_x^c$ | CEYLL = Cohort Expected Years of Life Lost<br>ecx = cohort expectation of life at each age |
| SEYLL = $\sum_{x=0}^{L} d_x e_x^*$ | SEYLL = Standard Expected Years of Life Lost<br>e*x = expectation of life at each age x based on standard |

### 1.1.2 Life with Disability: Deciding Weight of Disability

Time lived with non-fatal health outcomes is the other component of DALYs. To arrive at this calculation, one must define the weight of different states of health, i.e. the gap between the desired quality of life and quality of life with diseases. No doubt, some degrees of simplification are needed and therefore should be interpreted within considerations. Some crucial works seek to conceptualize non-fatal health outcomes for assessing quality of life (WHO 1980b; Ware et al. 1981; Verbrugge & Jette 1994). Noticeably, limitations are still at hand. Some reliability and validity studies for these instruments have been developed (Hays, Anderson & Revicki 1993), but there is no criterion for validity that could form a gold standard measure of health-related quality of life. Four domains, however, have been applied in BoD studies, namely procreation, occupation, education and recreation (Murray 1996). Furthermore, every individual has different perceptions and expectations of health that vary over time and across communities. Therefore, the weights of different health states were built using observations, except for pain and suffering (Murray & Chen 1992), which used self reported data (Murray 1996).

To conduct the observations, Murray (1996) had proposed four groups that should be considered as the respondents: (1) those who live in given health states, (2) the families of those who live in given health states, (3) the general public, and (4) health care providers. None of these respondents can give information that is free from flaws. Knowledge of conditions, which is absent or very low in general public, leads to lower utility weights (near to 0, which is death), even though knowledge derived from experiencing a health state (here among those who live in given health states) may lead to higher utility weights compared to the utility weight produced by those who have knowledge derived from seeing someone they know experiencing a health state or those who have knowledge without direct personal effect. Moreover, an adaptation of a health state also will change and drive to a higher value the utility weight assessed by those who live in given health states. Here problems arise on whether to use the pre-adaption or post-adaption utility weight. One could overestimate the burden and the other could underestimate it (Murray 1996).

In the first GBD study, public health practitioners were involved to assess the severity weight of diseases using a rating scale method based on six integrated classes, such as daily living, instrumental activities of daily living and the four domains noted above. This method, however, was criticized for improperly defining disability for children, non-standardized protocol regarding disability weight selection process, the disability weight cut point for mild conditions that will produce insensitive change, and the use of the board of health practitioners as the determinants of the severity weights (Murray 1996). Therefore, at least four revisions were suggested for observation of different health states. They are magnitude estimation, standard gamble, time trade off (TTO), and person trade off (PTO). Magnitude estimation, likewise the rating scale, gives bias towards mild condition of health states since very low utility values for this condition are produced. Standard gamble, similarly, not only gives bias toward very mild condition but also toward very severe states. The TTO gives bias since it is confounded by time preference. Murray (Murray 1996) argued that PTO brings interpersonal comparisons of utility for different groups of individuals. Hence, the content validity produced regarding weights is greater since the study uses the weights to allocate resources between groups (Murray 1996).

The PTO method was developed to fulfil the need of limitation on previously DALYs calculation, to be exact the scale rating method. By this method, the respondents are asked to value the preference on allocating limited resources between some groups of people (conditions). In the first question of PTO (PTO1), the value of extended life in healthy people with that in disabled people was being measured. In the second question (PTO2), the treatments of different chronic conditions with those which may extend life are being compared (Arnesen & Nord 1999). A meeting held in Geneva by the World Health Organization (WHO) in 1995, sponsored by World Bank, had defined disability weight for 22 indicator conditions and then revised them into seven disability classes (see Table 2) (Murray 1996). Yet, Arnesen and Nord (Arnesen & Nord 1999) argued that the PTO method did not provide as an actual picture of preference among respondents. It was more likely the product of forced compromise, which should be seen as artefacts.

**Table 2 Revised Disability Classes Based on Person Trade Off (PTO) Protocol on Disability Weights** (Murray 1996)

| Disability class | Severity weights | Indicator conditions |
|---|---|---|
| 1 | 0.00 – 0.02 | Vitiligo on face, weight-for height less than 2 SDs |
| 2 | 0.02 – 0.12 | Watery diarrhea, severe sore throat, severe anemia |
| 3 | 0.12 – 0.24 | Radius fracture in a stiff cast, infertility, erectile dysfunction, rheumatoid arthritis, angina |
| 4 | 0.24 – 0.36 | Below-the-knee amputation, deafness |
| 5 | 0.36 – 0.50 | Rectovaginal fistula, mild mental retardation, Down syndrome |
| 6 | 0.50 – 0.70 | Unipolar major depression, blindness, paraplegia |
| 7 | 0.70 – 1.00 | Active psychosis, dementia, severe migraine, quadriplegia |

### 1.1.3 Future Discounting: Discount Rate

Discount rates are employed in DALYs calculations because of the presence of uncertainties that increase over time so that the value of a something today will be different, more or less, than the value of the same thing in the future (Murray 1996). Many arguments for and against discounting has been noted (Gold et al. 1996; Murray & Acharya 1997; Kneese 1999). On the one hand, arguments against discount rates focused on the functional form and the level chosen (Fox-Rushby 2002 cited in Mathers et al. 2006, p.400). Moreover, the disease eradication and health research paradox is the main and strongest reason from those who argue for discount rates (Murray & Acharya 1997). Since programs of disease eradication and health research would always give infinite benefits, other programs that focus on current generation would be less prioritized. On the other hand, the sacrifice from current generation will be the most reason for discount (Parfit 1984, pp.356-357). Still, considerations of preventive intervention, where its benefits could be significantly smaller than expected, should be investigated (Murray 1996). The cost of lost opportunity cost and decreasing marginal utility of future consumption also support the arguments. To make sure that the sacrifice of future life years is appropriate, the BoD study uses a three percent discount rate chosen randomly for DALYs calculation (Murray 1996).

### 1.1.4 Age Weighting

Age weighting is a term of giving weight for age points in order to clarify the preference of treatment (Murray 1996). The methods for developing any weight scale vary widely. To take one example, preference is put based on duration of life lost (Murray 1996), which would favour younger age groups such as babies and children. Some argue that young adults or adolescents are more preferred than young children and older adults because of the investment for their previous education and their productivity within society (Lewis & Charny 1989; Nord et al. 1995; Johannesson & Johansson 1997). This often is identified as human capital approach (Murray 1996). Therefore, DALYs calculation on BoD study undertook non-uniform age weighting as much as three percent, which values less for years of life of young and older ages, using a mathematical function for weights at each age to produce discrete weighting schemes (Murray 1996; Lopez et al. 2006). Criticisms raised against age weights include issues of equity in the calculation of YLD and questions about the rankings of diseases and injuries (Barendregt, Bonneux & Van der Maas 1996; Anand & Hanson 1997). Noted, too, is the concern that any unempirical method of building age weights fails to reflect social values (Bobadilla 1996).

Besides age, there are several issues regarding preference in DALYs, such as income and education. On the one hand, Rice and Hodgson (Rice & Hodgson 1982) give preference to those who have higher income or better education since these groups of people add more to the economy. On the other hand, Anand and Hanson (Anand & Hanson 1997) weigh more those who are in disadvantaged compared to the advantaged with the intention of gaps reduction. Due to the large variation of the preferences, laundering preference[1] (Goodin 1986 cited in Murray 1996, pp.3-6) and filtered consensus, as well as the use of minimalist common values instead of majority values, are relevant (Murray 1996). Yet different opinions may remain on the boundary of individual characteristics as values choices such as age, gender and socioeconomic status. The BoD study, however, used values with function for age and sex, but detached from other characteristics such as race, socioeconomic status, or occupation (Murray 1996; Lopez et al. 2006; Mathers et al. 2006).

### 1.1.5 Mathematical Model as Strategy towards Incompleteness Data

Since not every country has complete basic data about diseases and injuries in regard to premature death and non-fatal health outcomes, mathematical models are needed to fill the missing data (Mathers et al. 2006). For information about causes of death patterns, the first GBD study used a model adapted from Preston model (Preston 1976). That model used regression analysis on historical vital registration data to predict the current data. Based on observations of mortality patterns from 67 countries, the model assumed that the log of cause-specific mortality was to be a linear function of the log of total mortality. Furthermore, the missing information on estimating prevalence and incidence of disease was modelled by DisMod (Murray & Lopez 1996b; Barendregt et al. 2003; Mathers et al. 2006).

Later on, a new model called CodMod was developed in order to improve the previous modelling for the cause of mortality (Salomon & Murray 2001). Together with Monte Carlo simulation techniques, CodMod tried to predict probable death distribution using values on all causes of mortality and income per capita. The use of proportion instead of rates which has been used in a previous study established a model of relationship between mortality and the cause of death (Salomon & Murray 2002). The DisMod model was also improved, so called DisMod II, allowing for incorporation of remission, case fatality rates and duration as disease

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[1] Goodin believed that the revealed individual preferences should be laundered because of five internal reasons, e.g. imperfect reflection due to incomplete knowledge and information.

[2] In Bayesian view, a probability is “the degree of belief that a person has that an event will occur, given all the relevant information currently known to that person.” In this view, both the uncertain event

characteristics, which had been taken from studies and research and are believed to show relatively low variation across communities (Mathers et al. 2006).

## 1.2 Reviews of BoD Studies

This section will provide information regarding BoD studies performed by the World Health Organization (WHO). They are Global Burden of Disease (GBD) studies, first in 1990 and second in 2000s, as well as Environmental Burden of Disease (EBD) studies in 2002.

### 1.2.1 Global Burden of Disease (GBD) Studies

In 1992 the World Bank, together with the WHO and the Harvard School of Public Health, assigned the first and initial study, named the 1990 GBD study, addressing a comprehensive assessment of the disease burden in 1990 (Murray 1996; Lopez et al. 2006). Lopez and colleagues (Murray & Lopez 1996a, 1997a, 1997b; Lopez et al. 2006) tried to explain this study as a framework for integrating, validating, analyzing, and disseminating the fragmentary information that is available on a population’s health, along with some understanding of how that population’s health is changing, so that the information is more relevant for health policy and planning purposes. This 1990 GBD study was carried out in eight demographic regions: the Established Market Economies (EME, or largely the Organisation for Economic Co-operation and Development, OECD, countries), the former socialist economies of Europe, the Middle Eastern crescent, sub-Saharan Africa, Latin America and the Caribbean, China, India, and other Asian areas and Islands. Through the study, assessment was provided on the health effects of more than 100 diseases and injuries (World Bank 1993; Murray, Lopez & Jamison 1994; Murray & Lopez 1996a, 1996c, 1996d; Lopez & Murray 1998).

Murray and associates (Murray et al. 2001, p.2) attempted to clarify the aim of the GBD study as follows: “*In relation to international efforts to improve the health of populations, this means assessing the available evidence, and using the best available methods, to quantify the Burden of Disease and injury, its causes in terms of risk factors and broader health determinants, and the likely burden in the future. The Global Burden of Disease (GBD) project was formed to address these objectives*.” The study had at least three principal objectives. First, it was designed to introduce the often unseen burden in community, the non-fatal health outcomes, into epidemiological assessment. Second, the GBD study tried to provide an objective evaluation free from political interest so that decision makers can have prioritization on allocating resources. Third, it attempted to quantify the Burden of Diseases that could be used for cost-effectiveness analysis (Murray 1996; Murray & Lopez 1996c, 1996d).

In assessing the Burden of Diseases, analyzed by five age groups, by sex and by cause, some methods in the 1990 GBD study are noted. It incorporates the DALYs computation, disability weighting factors, three percent future discounting rates, three percent non-uniform age weighting, and a mathematical model to fill in incomplete or fragmented data available in the regions (Murray 1996; Murray & Lopez 1996b, 1996d, 1997b; Barendregt et al. 2003; Lopez et al. 2006; Mathers et al. 2006).

This study produced estimates for 483 sequels of 107 diseases and injuries, with five age groups, eight regions, and both sexes. The results confirmed that 90% of total global Burden of Diseases was suffered by developing regions where only 10% of total health-care financial sources were spent. It revealed a great difference of burden of premature deaths among regions. Contrary to that, however, the burden of non-fatal health outcomes seemed to be evenly distributed. Meanwhile some developing regions such as sub-Saharan Africa and India had the highest burden on the community age-group 0-4 years old. The developed regions, such as the Established Market Economies (EME), had that burden in age-group more than 60 years old. Furthermore, the Group I diseases such as communicable, maternal, perinatal, and nutritional conditions still dominate in developing regions as the health burden, even though the Group II diseases, such as non-communicable diseases (NCDs), began to take over in some regions such as east Asia and the Pacific and became the main problem in developed regions. The burden of Group III diseases (injuries) was a problem in all regions. It also revealed the overlooked diseases, when the health burden only seen from the number of death, such as neuropsychiatric disorders and injuries as major causes of years life with disability (Murray & Lopez 1996c, 1996d; Lopez et al. 2006).

Three leading causes of burden disease worldwide reported in the 1990 GBD study were lower respiratory infections, diarrheal diseases and conditions arising during perinatal period (such as low birth weight and birth asphyxia/birth trauma). Risk factors were also extracted from diseases because some of the diseases, such as hepatitis B, diabetes, and many blinding conditions, gave incredibly different results when analyzed as a disease listed in primary tabulations and as it is with all conditions linked. Ten major risk factors were abstracted from this study giving the highest burden worldwide. They are: Malnutrition, poor water supply, sanitation and personal and domestic hygiene, unsafe sex, tobacco use, alcohol use, occupation hazards, hypertension, physical inactivity, illicit drug use, and air pollution (Murray & Lopez 1996c, 1996d; Lopez et al. 2006).

At the end of this study, uncertainty and sensitivity analyses were done. GBD, which basically is a "meta-synthesis" approach (Murray & Lopez 1996c), is subject to a range of uncertainty. Such uncertainty may arise from measurement errors, the combination of data from several sources, systematic biases as well as from modelling and extrapolation in order to fulfil the missing information. The uncertainty analysis was conducted to list explicitly the limitations that come from data so that policy makers could have objective and complete information for priority setting and action. The sensitivity analysis, different from the uncertainty analysis, shows the output change occurs in regard to input change. The 1990 GBD study conducted sensitivity analysis on the change of discount rate and age weights. The nonzero discount rate showed a significant reduction of importance of burden on children, subsequently on overall distribution of DALYs, especially in low- and middle- income countries, whereas the non-uniform age weights have smaller effects than nonzero discount rates (Mathers et al. 2006).

This study, mainly the methodological part, raised critiques (Anand & Hanson 1998; Hyder, Rotllant & Morrow 1998; Williams 1999; Murray et al. 2002; Salomon & Murray 2002, 2004). The accessible sources of data valuing health states producing weighting factors were using categorical self-reported data. They then brought up challenges in comparing data cross-population, across subgroups within a population, or within the same population over time. The reason is a different cut-point from one to another, influenced by cultural, age, gender, and socioeconomic background as well as education (Murray et al. 2002). Critiques on comparability also turned up when recognizing that each risk factor has its own characteristics, availability, pathways and causality. For that reason, the comparison between Burden of Disease by different risk factors is difficult to make. If it has to be made, it should be within the framework of assumption and limitations (Lopez et al. 2006). Murray and Lopez (Murray & Lopez 1996c), themselves, mentioned several points that should be improvised in this study such as the imperfect analytical tool which helps to increase the internal consistency analysis, the lack of and incomplete data, and the imperfect analysis for the estimation of burden of non-fatal health outcomes, i.e. the methods or instruments to measure preference, incidence and/or prevalence as well as disability and all sequels.

The next GBD study, the GBD 2000-2, was carried out from 1998 to 2003 by the Epidemiology and Burden of Disease team (EBD) within the Global Program on Evidence for Health Policy (EIP/GPE) by the World Health Organization (WHO) to assess an up-to-date global Burden of Disease for 2000 to 2002 with a sharpened and improved methodology of global Burden of Disease (Murray et al. 2001; Mathers, Lopez & Murray 2006). Murray and colleagues (Murray et al. 2001) clearly defined the major focus of this study is to work with WHO disease and injury programs to improve the comparability, validity, and reliability of the descriptive epidemiology for mortality and non-fatal health outcomes attributed to various diseases, injuries, and risk factors.

In order to augment the second GBD study, 136 major causes of diseases and injuries were analyzed by sex and by eight age groups. In addition to eight regions in the world, it incorporated 226 countries and territories of WHO member states which have been clustered as seven groups, and applied different methodological approaches for different growth of health level. They were in the study one group of high-income countries and six of middle-income countries such as East Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean, the Middle East and North Africa, South Asia, and Sub-Saharan Africa. It still used a three percent discount rate but excluded the non-uniform age weights as method. Moreover, the methodological part has been improved to a great extent (Mathers, Lopez & Murray 2006).

The method to weigh diseases has been enhanced to be a population-based survey rather than expert opinion (Murray et al. 2002; Salomon & Murray 2004). Accordingly, this study is expected to deal with comparisons over time, across communities and for cost-effectiveness analysis on intervention comparison (Mathers, Lopez & Murray 2006, p.46). Mathematical models are also improved in the second GBD study to increase reliability and validity (Salomon & Murray 2001, 2002; Mathers, Lopez & Murray 2006). With major improvements in surveillance, calculations of some specific diseases were improved such as Human Immunodeficiency Virus / Acquired Immuno-Deficiency Syndrome (HIV/AIDS), which has an iceberg phenomenon. Some additions were also incorporated into the study. The new framework of assessment--the Comparative Risk Assessment (CRA)--was introduced. Further, the analysis of burden disease attributable to combined hazards of multiple risk factors was brought up and the quantification of uncertainties was analyzed (Lopez et al. 2006). Table 3 shows the risk factors included in the assessment of the study.

**Table 3 Risk Factors Included in the Comparative Risk Assessment (CRA) Component of the GBD 2000** (Murray et al. 2001)

| | |
|---|---|
| 1. Alcohol | 11. Selected occupational risks |
| 2. Blood pressure | 12. Ambient air pollution |
| 3. Cholesterol | 13. Physical inactivity |
| 4. Climate change | 14. Tobacco |
| 5. Illicit drugs | 15. Unsafe injection practices in medical settings |
| 6. Indoor smoke from bio-fuels | 16. Unsafe sex and unplanned pregnancies |
| 7. Lead | 17. Unsafe matter, sanitation, and hygiene |
| 8. Childhood and maternal under nutrition | 18. Non-breast-feeding |
| 9. Obesity and overweight | 19. Childhood sexual abuse |
| 10.Lack of fruit and vegetable intake | 20. Distribution of risk factors by poverty |

The 2001 GBD study delivered several major findings as enhanced results of a global Burden of Disease. The estimate of HIV/AIDS increased significantly, from only 2% in the previous study to 14%, and was cited as the fourth cause of Burden of Diseases globally and as the first cause in sub-Saharan Africa. Worldwide, there is an epidemiological transition from infectious to chronic non-communicable diseases, which should have relevance for health planning. Nevertheless, the developing countries, except south Asia and sub-Saharan Africa, have suffered from a triple Burden of Disease, namely NCDs, communicable disease, and injuries. The unseen burden of nonfatal illnesses--particularly neuropsychiatric disorders, also vision disorders, hearing loss, and alcohol use disorders, and by injuries--becomes clear and requires attention. There was a significant increase of adult male mortality and disability in all regions except south Asia and sub-Saharan Africa. Alcohol use became the major causes resulting the increases of accidents, violence, and cardiovascular disease (WHO 2003; Lopez et al. 2006; Mathers, Lopez & Murray 2006).

One of the fundamental improvements of this GBD study is in producing both described and quantified uncertainty analyses (Mathers et al. 2006). Some sources are estimated as the source of uncertainty. They come from incomplete information, potential bias in information, heterogeneity or from disagreements among information sources, model uncertainty and the data generation process. A quantified uncertainty analysis, using Bayesian interpretation of probability[2] (Morgan & Henrion 1990, pp.49-50; King, Tomz & Wittenberg 2000), was done for at least five concerns: all-cause mortality and life expectancies, regional mortality by cause, disability weights, epidemiological estimation, and burden estimation. One example is uncertainty analysis for life expectancies, which showed that uncertainty ranges around ± 0.07 years for females and ± 0.16 years for males for high-income countries, around ± 0.5 years for Latin America and the Caribbean, and around ± 5.0 years for Sub-Saharan Africa. The range of uncertainty also occurred when estimating all-cause deaths from ± 1 percent for high-income countries to (-15 percent, +21 percent) for Sub-Saharan Africa. This all-cause deaths uncertainty signals not only uncertainty in mortality but also in underlying cause and the coding methods used (Mathers et al. 2006).

### 1.2.2 Environmental Burden of Disease (EBD) Studies

In medical terms, environment takes account of "*the circumstances, objects, or conditions by which one is surrounded*", "*the complex of physical, chemical, and biotic factors (as climate, soil, and living things) that act upon an organism or an ecological community and ultimately determine its form and survival*" or "*the aggregate of social and cultural conditions that influence the life of an individual or community*" (Merriam-Webster 2012). Last (2001) wrote in an epidemiology dictionary that environment is "*All that which is external to the individual human host. Can be divided into physical, biological, social, cultural, etc., any or all of which can influence health status of populations*". Since human is influenced by heredity genetic factors and environments, here the environment is understood as anything exclude genetic factor (Prüss-Üstün & Corvalán 2006). WHO defines environment as "*all the physical, chemical and biological factors external to a person, and all the related behaviors*" (Prüss-Üstün & Corvalán 2006, p.22).

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[2] In Bayesian view, a probability is "the degree of belief that a person has that an event will occur, given all the relevant information currently known to that person." In this view, both the uncertain event and a person's state of information have roles in determining probability. The probability distribution interpretation then is used to analyze uncertainties.

Exposures to various environmental stressors have adverse impacts on population health. The intensity of these effects is varied according to the wide range of level of exposures and human responses to it (Melse & de Hollander 2001; Briggs 2003; Prüss-Üstün & Corvalán 2006; EBoDE Report 2011). Exposures that affected people through various pathways are often very difficult to quantify. The characteristics of the exposure, e.g. the cumulative effect and latency period, also make the measurement of levels of exposure more difficult. A person's susceptibility to exposure is complex in its nature and it all delivers a range of human responses. Nevertheless, studies of such areas are pertinent to assess the effects of environmental factors on health among the overall disease burden in order to bring down preventable burdens by effective and efficient intervention.

Several studies in local (Bluhm & Eriksson 2011; Woodruff et al. 2011; Xiao et al. 2012) and global levels (Smith, Corvalán & Kjellström 1999; Melse & de Hollander 2001; Prüss-Üstün & Corvalán 2007; EBoDE Report 2011) have attempted to answer the issue of how large environmental issues influence population health. For example, Smith and colleagues (Smith, Corvalán & Kjellström 1999) made some effort to estimate the Burden of Diseases attributed to environmental factors. They report that 25-33% of the global Burden of Disease can be attributed to environmental risk factors, represented 23-31% of total world death, with the largest portion (about 43%) suffered by children less than five years of age. They concluded that environmental quality affects both developed countries through NCDs and developing countries through communicable diseases. An urgent need remains for more comprehensive and integrated study of environmental health. Another study used by OECD (Melse & de Hollander 2001) assessed attributable fraction of Burden of Disease on 16 selected diseases and found that within the OECD region, about 2-5% of the total Burden of Disease was attributed to environmental factors.

Therefore, in 2002 WHO conducted an EBD study, known as the Comparative Risk Assessment (CRA), to assess the disease burden that are due to environmental risk factors which also related to individuals Burden of Disease and injuries (Prüss-Üstün et al. 2003). The assessment was focused on six env ronmental factors out of 26 major risk factors (see Table 4) across 14 WHO sub regions, eight age groups, and by gender. These selected factors were chosen due to the clear causal evidence which further on could be applied globally, the availability of the data, and the substantial burden brought by these factors. The results showed that all selected environmental risk factors accounted to only 9.6% of the total disease burden. These results, however, have limitations because of the restricted scope of the risk factors included and ultimately restricted coverage of health impact (WHO 2002; Prüss-Üstün & Corvalán 2006, 2007).

**Table 4 Selected Environmental Risk Factors and Related Diseases Analyzed in the CRA** (WHO 2002)

| Risk factors | Related diseases |
|---|---|
| Outdoor air pollution | Respiratory infections, selected cardiopulmonary diseases, lung cancer |
| Indoor air pollution from solid fuel use | Chronic Obstructive Pulmonary Disease (COPD), lower respiratory infections, lung cancer |
| Lead | Mild mental retardation, cardiovascular diseases |
| Water, sanitation and hygiene | Diarrhoeal disease, trachoma, schistosomiasis, ascariasis, trichuriasi, hookworm disease |
| Climate change | Diarrhoeal disease, malaria, selected unintentional injuries, protein-energy malnutrition |
| Selected occupational factors: | |
| Injuries | Unintentional injuries |
| Noise | Hearing loss |
| Carcinogens | Cancers |
| Airborne particulates | Asthma, COPD |
| Ergonomic stressors | Low back pain |

Prüss-Üstün and Corvalán subsequently (2006; 2007) tried to conduct a more comprehensive work by expanding the scope of risk factors as well as diseases and injuries and involve more than 100 experts for consultation. This systematic literature review used quantitative estimation of diseases due to environment. In order to obtain results that can then be used in reasonable and manageable intervention programs, this study limited the scope of environment to mean "*all the physical, chemical and biological factors external to the human host, and all related behaviours, but excluding those natural environments that cannot reasonably be modified*" (Prüss-Üstün & Corvalán 2006, p. 22). The environmental factors were interpreted to play roles in about 83.3% (85 from 102 diseases) of all preventable diseases evaluated in this study. Approximately 24% of morbidity and 23% of mortality related to the diseases were attributable to environmental risk factors, a significant increase compared with estimates from the previous study by CRA. Children are found to be the group with the highest risk from environmental factors. These factors affected about 34-36% of disease burdens among children, mostly in developing countries. The burden in developing countries due to these factors is higher than in developed countries, e.g. burden of infectious diseases is 15 times higher (Prüss-Üstün & Corvalán 2006, 2007).

The disease burdens attributable to environmental stressors are also present in Europe; however, the results from studies conducted globally by the WHO are not conclusive for European countries. Attempts to assess the EBD in Europe have been started, one of them initially by the National Institute for Public Health and the Environment, the Netherlands (RIVM) (de Hollander et al. 1999), the Netherlands national study assessing the environmental stressors. Therefore, the WHO European Centre for Environment and Health (ECEH) in Bonn, Germany, planned a project to assess systematically the EBD of stressors which are relevant in European countries. This was the Environmental Burden of Disease in the European region (EBoDE) project (WHO European Centre for Environment and Health 2009).

The EBoDE project attempts to update the previous EBD assessments and to bring harmonized assessment of EBD essentially on relevant stressors for the European region, as well as to provide other countries with methodology and databases (WHO European Centre for Environment and Health 2009). Moreover, it is expected to bring comparison of the quantifications and ranking of the EBD between countries, within countries, and between environmental stressors, and gives attention to qualitative assessment of variation and uncertainty throughout the analysis. The project involved six European countries: Belgium, Finland, France, Germany, Italy, and the Netherlands. Nine environmental stressors were examined: benzene, dioxins including furans and dioxin-like polychlorinated biphenyl (PCBs), second-hand smoke, formaldehyde, lead, noise, ozone, particulate matter (PM), and radon. Consideration of this selection was by reason of the public health relevance, potential for high individual risks, public concern, and financial impacts of these environmental stressors (EBoDE Report 2011).

The results, which were analysed for the year 2004 (PM and ozone for year 2005), showed that the selected environmental stressors were responsible for 3-7% (weighted and discounted) of the total Burden of Diseases in the participating countries. Particulate matter (PM) is estimated delivering the highest disease burden (about two-thirds of the total, corresponds to 6,000 to 10,000 non-weighted and non-discounted DALYs per million people), followed by second-hand smoke, traffic noise, and radon. These four factors together give over 90% of the total selected environmental Burden of Disease. Like all studies, however, there are some limitations and flaws. The limitations primarily appeared due to incomplete national data leading to difficulties in producing a reliable trend analysis for all selected stressors in the participating countries (EBoDE Report 2011).

The incomplete national data was also seen in Germany. Even though the works on quantifying Burden of Diseases attributable to environmental risk factors have been started in some settings in this country (Samson et al. 2007; Claßen et al. 2008; Twardella et al. 2011), there is a noticeable need of having the national EBD study. Currently, the first rough EBD calculation was done for single environmental risk factors such as noise and fine particulates by Babisch in 2006 (Babisch 2006) as well as by Claßen (Claßen et al. 2008). Nevertheless, comparisons of the available results for these single environmental risk factors are problematic because these studies used mortality data from different years. In addition, different modeling methods also were applied in different studies. Furthermore, the studies were carried out only in certain regions in Germany, e.g. a study for North Rhine-Westphalia by Samson and colleagues in 2007 (Samson et al. 2007) as well as by Claßen and colleagues in 2008 (Claßen et al. 2008). Hence, it is necessary to have a harmonized and consistent methodology used in a national level study in order to have valid comparisons of burden diseases attributable for environmental in Germany for any international comparisons (Hornberg et al. 2012).

VegAS (*Verteilungsbasierte Analyse gesundheitlicher Auswirkungen von Umwelt-Stressoren*) project, or in English known as “distribution-based analysis of health effects from environmental stressors“ project, is the first national EBD study conducted in Germany. The study, which ran from October 2009 until March 2012, was called for within the environmental research plan by the Research and Developing Project (*Forschungs- und Entwicklungs-Vorhaben*, or *F&E-Vorhaben*) of the German Federal Environment Agency (*Umweltbundesamt*, or UBA) in Berlin, Germany. The main objective was to bring forward the “quantification of the effects of different environmental stressors on the health of the people in Germany which take into account the population-related exposition inquiry”. Led by the University of Bielefeld, the study was conducted in cooperation with four other participants including *Landesinstitut für Gesundheit und Arbeit des Landes Nordrhein-Westfalen* (LIGA.NRW), *Behörde für Gesundheit und Verbraucherschutz* (BGV) Hamburg, and Hamburg University of Applied Science (*Hochschule für Angewandte Wissenschaften Hamburg*) (Hornberg et al. 2012).

The study, which was designed to use the disability weights with stratification on age and gender as long as possible, exclude age weighting and discount rate in DALYs calculation because ethical reason. The transferability of a variety possibility of disability weight such as from GBD, national studies from Netherlands, Estonia and Australia to Germany were also verified. In order to provide missing information, mostly information about morbidity, the DisMod II model was used. The life expectancy of the population in Germany from the DeStatis 2007 / 2009 report (Destatis 2012) was used instead of the standard life expectancy recommended by the WHO. The average population from year 2008 to 2010 by EuroStat (EuroStat 2010) was used as the reference population (Hornberg et al. 2012).

Intending to improve the methodological and empirical basis for regulation of the environmental Burden of Diseases in Germany and to develop the base for a future consistently comparative and coherent methodology for quantification of the environmental Burden of Diseases in the population of Germany, this project selected seven environmental factors. They are: fine particulates (out- and indoor air; $PM_{10}$ and $PM_{2,5}$), ozone (outside air), benzene (out- and indoor air), physical loads by cadmium (from different exposure paths), noise, passive smoker, and per fluorinated surfactants (*Perfluorierte Tenside*, or PFT) (Hornberg et al. 2012). This paper, which raises the theme of environmental Burden of Disease from leisure noise among adolescents in Germany, is a part of the VegAS project, defined more precisely as a part of noise assessment in VegAS project.

## 1.3 Leisure Noise

Noise has been an increasingly common public complaints and become a leading environmental nuisance in Europe (WHO Regional Office for Europe 2010). According to the preliminary results of the multinational Environmental Burden of Disease in Europe pilot project (EBoDE) in 2010 (Opasnet 2010), environmental noise is now the third largest environmental Burden of Disease after ambient air pollution and exposure to second-hand smoke in six European countries, as expressed in DALYs.

Noise has been defined by the European Environment Agency (EEA) in the EEA Technical report 2010 (EEA 2010) as “unwanted sound, or audible sound that causes disturbance, impairment or health damage”. An example showed the magnitude effect of noise can be seen in hearing impairment. The second GBD study in 2000 showed that global level hearing loss among adults has became the second leading cause of YLD after depression, and gives a larger non-fatal burden than alcohol use disorders (Mathers, Smith & Concha 2000). This noise can come from one’s surroundings from various sources such as road traffic, rail traffic and aircraft, construction, neighbourhood, sports activities, leisure activities, and many others.

Currently, noise from recreational and leisure activities, called “leisure noise,” is commonplace in our environment. Noise emanating from activities that initially aim to provide comfort and relaxation has been noted in several studies as creating adverse effects on the health of the ear (Maassen et al. 2001; Jokitulppo & Bjork 2002; Williams, Beach & Gilliver 2010; Twardella et al. 2011). This following section will describe research on leisure noise and the possibility to assess this noise, the groups vulnerable to this noise, and the current situation in Germany concerning this noise in regard to potential risk to hearing health.

### 1.3.1 Definition and Concepts

Leisure noise, as one of the various sources of noise, has not been widely explored. Differing from any other noise, this noise is not unwanted sound. The adverse effects produced by leisure noise are often not recognized because the activities which produce it are intended to give pleasure (Maassen et al. 2001).

The definition of leisure noise differs from one study to another according to the types of activities included. A study by Holgers and Pettersson in 2005 included concerts, discos, fireworks, and weapons as sources of leisure noise (Holgers & Pettersson 2005). Slightly different from that list, Zenner and colleagues included toys instead of weapons (Zenner et al. 1999). A study in Regensburg, Germany, in 2011 called OHRKAN involved discotheques, concerts, and music devices as sources of leisure noise (Twardella et al. 2011). Having a more complete inclusion of leisure noise, Jokitulppo and Bjork covered night clubs and pubs, the use of home tools, playing in a band or orchestra, shooting, and attending or participating in motor sport (Jokitulppo & Bjork 2002). Meanwhile, Streppel and colleagues also listed electronically amplified music, television and computer games, mowing machines, self home improvement, toys, fireworks, toy guns, musical events, as well as sports and restaurants (Streppel et al. 2006). Moreover, the German Federal Environment Agency (UBA) defines leisure noise as noise from recreational equipment or sound that emanates from a facility that can affect or disturb the neighbourhood (UBA 2009b). From this definition, discotheques and personal music players such as mp3 are excluded.

Nowadays it is widely agreed that loud noise has a negative health impact, particularly on the ear, as a result of constant exposure over time (WHO 1980a; International Organisation for Standardisation 1999). Similarly, with exposure to leisure noise at certain levels for particular durations will increase the risk of health problems on ears (Smith et al. 2000; Maassen et al. 2001; Williams, Beach & Gilliver 2010). Several studies have used different methodologies to discover the association between leisure noise and hearing disturbance in various groups or communities such as; the orchestral music players (Emmerich, Rudel & Richter 2008; Schmidt et al. 2011, Qian, Behar & Wong 2011), students (Martínez-Wbaldo et al. 2009; Twardella et al. 2011) or dance and night club visitors (Vogel et al. 2009a; Williams, Beach & Gilliver 2010). The results are often diverse and sometimes contrary to one another.

Difficulties arise regarding exposure assessment, both in terms of duration and exposure levels. Although some studies suggest that levels of leisure noise exposure can be higher than noise in the workplace (Brown & Yearout 1990 cited in Jokitulppo & Bjork 2002, p.53; Williams, Beach & Gilliver 2010; Schmidt et al. 2011), the very large variety of patterns of leisure activities creates uncertainty for any determination of levels (Axelsson et al. 1981; Clark 1991 cited in Jokitulppo & Bjork 2002, p.54) and duration (Jokitulppo & Bjork 2002) of this exposure. Determination of levels of exposure using questionnaires and measurements by dosimeters indeed has limitations. Undoubtedly, questionnaires will give results that are noticeably influenced by subjectivity (Jokitulppo & Bjork 2002; Twardella et al. 2011). Likewise, Qian and colleagues in 2011 found that repeated measurement of exposure to orchestra music means that musicians experience varying vulnerability even when the same player repeatedly play the same song with the same instrument (Qian, Behar & Wong 2011).

Comparable difficulties occur when evaluating health outcomes. Using questionnaires, the methodology contains uncertainty arising from memory bias, which can easily occur, as well as from other factors resulting hearing complaints (Jokitulppo & Bjork 2002; Williams 2005). Another way to assess health outcome is by performing medical examination such as tympanometry and audiometry (Twardella et al. 2011) as well as by calculating the expected outcome based on the exposure measured (Williams, Beach & Gilliver 2010; Qian, Behar & Wong 2011). By measuring or calculating the present hearing capability, there is a possibility of overlooking hearing complaints that occurred in the past.

Thus, assessment of leisure noise with regard to its effect on the health of the ear is a fundamental methodological problem for evaluating the impact of exposures that arise from widely varied and subjective activities. Often, hearing problems as health outcomes are unrecognized and unnoticed.

### 1.3.2 Adolescents as Vulnerable Exposed Group

A great concern exists regarding the increasing prevalence of hearing loss problems among adolescents and young adults (Bistrup et al. 2001; Chung et al. 2005; Martínez-Wbaldo et al. 2009; Vogel et al. 2009a, 2009b). The increased number of cases of hearing impairment in the form of measurable irreversible inner ear damage among children, teenagers, and young adults who have not been exposed to noise at workplace, was noted by Maassen and colleagues (Maassen et al. 2001). The suspicion that leisure noise is the cause of hearing impairment is based on the increased exposure among adolescents and young adults, especially in the terms of visiting discotheques and attending concerts, as well as listening to electronically amplified music (Twardella et al. 2011).

Concern about leisure noise exposure started to emerge in studies in the 1980s when the first portable stereo came on the market (Catalano & Levin 1985; Medical Research Council Institute of Hearing Research 1986). Adolescents and young adults are susceptible to exposure from leisure activities such as hearing electronically amplified music, visiting discotheques, and other recreational activities that produce loud noise. Smith and colleagues in 2000 found that 19% of participants, consisting of young adults aged 18-25 years, were exposed to significant noise from social activities such as night clubs and personal stereos (Smith et al. 2000).

Although several studies found no correlation between leisure time activities and hearing impairment (Axelsson, Rosenhall & Zachau 1994; Mostafapour, Lahargoue & Gates 1998; Tambs et al. 2003), studies conducted among populations in Germany, Australia, Sweden, and the United States--where there is widespread use of personal music players (PMPs)--showed an increasing number (from 5% to 20%) of young people who have audiometric “notches” in line with noise exposure at constant rates in the last 20 years (Axelsson et al. 1981; Wong et al. 1990; Axelsson, Rosenhall & Zachau 1994; Meyer-Bisch 1996; Niskar et al. 2001; Rabinowitz et al. 2006; Peng, Tao & Huang 2007).

Hearing disturbance gives not only auditory problems such as difficulties at work or finding jobs but also non-auditory problems such as difficulties in social and private life (Bistrup et al. 2001; Maassen et al. 2001; SCENIHR 2008). In the future, where working demands good hearing ability in connection with the development of technology for communication and information, problems with hearing will be a weakened point to get, perform, and keep jobs. Non-auditory problems also occur, for example at school in the form of difficulties in cognition and attention.

Although there is no reported research that can prove causality of leisure noise on the psychological effects such as cognition and attention, there are reliable findings of effects of noise from other sources, e.g. in the form of delayed reading acquisition in children and young adults (Bistrup et al. 2001). Disturbance of school performance has also been reported to occur because of loud noise from aircraft and road traffic (Haines et al. 2001; Stansfeld et al. 2005). Moreover, hearing disturbance results in problems not only to individuals but also to families, communities and countries. Unemployment due to hearing impairment, as well as the cost to provide special education, will impose an economic burden on a country (WHO 2010). Therefore, there is indeed a need to conduct environmental Burden of Disease studies on leisure noise among adolescents.

### 1.3.3 Current Discussions in Germany

Some studies on a regional and community basis have tried to analyze the relationship between leisure noise and the hearing health in Germany (Struwe et al. 1996; Maassen et al. 2001; Plontke et al. 2002; Rosanowski, Eysholdt & Hoppe 2006; Emmerich, Rudel & Richter 2008; Twardella et al. 2011). One of the most recent studies is under way, conducted in the area of Regensburg, Bavaria, by Twardella and colleagues in 2009-2011 (Twardella et al.

2011). A prospective study called OHRKAN, to include almost all students grade 9 aged 14-16 years, is expected to avoid the recall bias by its method of data collection.

The increasing number of cases of hearing impairment among adolescents and young adults has also been noted in Germany. Struwe and colleagues (Struwe et al. 1996) found in their survey that about 66.7% of a sample of 1814 young men in Germany experienced "buzzing in the ears," "ear whistling," or "deaf ears" after loud music events. Although there is no empirical relevant evidence on causality (SCENIHR 2008), some risk analysis studies have found an increasing risk of hearing impairment after some sources of leisure noise such as use of fireworks, very loud toys and electronically amplified music from Walkman devices, discotheques, and concerts (Struwe et al. 1996; Maassen et al. 2001; Plontke et al. 2002).

## 1.4 New Approach: Assessing Leisure Noise by BoD

Although many studies in Germany address the current exposure of leisure noise in correlation with hearing impairment as health outcomes and its association (Struwe et al. 1996; Maassen et al. 2001; Plontke et al. 2002; Rosanowski, Eysholdt & Hoppe 2006; Emmerich, Rudel & Richter 2008; Twardella et al. 2011), there is presently no relevant published information on the environmental Burden of Disease concerning leisure noise as exposure and its health outcomes that incorporates DALYs into the analysis. A clear need exists. Therefore it becomes pertinent to assess the environmental burden of leisure noise compared to other sources of noise in particular and to other environmental risk factors in general as strategic action for prioritization at the national level. In other words, evidence must be sought in regard to the importance and necessity of preventive measures and management of leisure noise. Thus this paper is an attempt to assess the environmental Burden of Disease by leisure noise in regard to hearing disturbance, among adolescent in Germany.

# 2 Objectives

Several studies of leisure noise have shown a growing impact on health in the form of hearing disturbances without exception among children and adolescents (Axelsson et al. 1981; Wong et al. 1990; Axelsson, Ringdahl & Zachau 1994; Meyer-Bisch 1996; Smith et al. 2000; Niskar et al. 2001; Rabinowitz et al. 2006; Peng, Tao & Huang 2007). A number of studies in Germany have attempted to answer the question of how big the influence of leisure noise is on health of the ear and how high the leisure noise thresholds must be to cause hearing disturbance (Struwe et al. 1996; Maassen et al. 2001; Plontke et al. 2002; Rosanowski, Eysholdt & Hoppe 2006; Streppel et al. 2006; Emmerich, Rudel & Richter 2008; Twardella et al. 2011). Absent, however, is information on how big the burden of hearing disturbance due to leisure noise among adolescents is nationally in Germany.

Based on previous findings in several studies that were mentioned in the previous chapter (in particular chapter 1.3), this study comes up with the hypothesis that a noteworthy level environmental Burden of Disease attributable to leisure noise is now evident among adolescents in Germany. Therefore, preventive measures and management of leisure noise becomes relevant and necessary, particularly among adolescent population in Germany. Moreover, the possibility of calculating DALY by leisure noise should be explored once the required information is available.

The overall goal of this study is to quantify of environmental Burden of Diseases of hearing disturbance attributable to leisure noise among adolescents in Germany. Concerning the limitations in the availability of data and information from previous research regarding the leisure noise-induced hearing disturbance, this study tried to come up with novel information that is required in order to bring this quantification. This information is expected to provide direction for more complete and comprehensive data needed for further studies. Furthermore, the results of this study are expected to provide an impression of the environmental Burden of Disease of hearing disturbance attributable to leisure noise among adolescents at the national level in Germany. Based on these impressions, recommendations could emerge for the future. At the end of this study, an uncertainty and sensitivity analysis was applied to judge limitations and drive to conclusion within consideration. Gaps in the available data set, as well as in the previous research, prompts appropriate concern.

Given in summary, several objectives are presented by this study as follows:

1. Preparing the required data and parameters for DALYs calculations, e.g. number of population who suffer from hearing disturbance attributable to leisure noise among adolescents in Germany,

2. Discovering limitations and weaknesses that exist in available data as well as in each step of the analysis to have an accurate understanding of Burden of Disease due to leisure noise among adolescents in Germany, and

3. Providing the required new information in the development of further research in regard to this topic.

# 3 Methodology

In this study a meta-synthesis method is adopted in line with GBD and EBD studies' methodology (Murray & Lopez 1996c). This approach was first introduced in China by Qian and colleague (2005) in the early 1990s when dealing with "*open complex giant system problems*". It challenged the traditional reductionism methods and ventured into the "*unstructured messy problems*" which predominantly take places in field of environment, population, socioeconomic, and sustainable development. In other words this method "*emphasizes the synthesis of collected information and knowledge of various kinds of experts, and combining quantitative methods with qualitative knowledge*" (Gu & Tang 2005, p.597).

The study question raises a complex problem encountered in a BoD study. It includes a lot of simplification. The use of assumptions and considerations is inevitable. At the initial stage the main focus of this study is to cite the available information and knowledge from the literature and internet about data sources and studies available in Germany regarding the exposure of leisure noise in relation to hearing disturbance, to be regarded as secondary data use. Accordingly it is followed by a systematic analysis, both quantitatively and qualitatively. The analysis starts from preparation of DALYs calculation, processing the available data in order to calculate DALYs, and making the DALYs calculation itself. The last task of this method is an uncertainty and sensitivity analysis which comes as part of the study (see Table 5).

**Table 5 The Main Steps and Carried out Steps in Methodology (Modified from VegAS study)** (Hornberg et al. 2012)

| The Main Steps in Methodology | Carried out Steps |
|---|---|
| 1. Literature and Available data Research | Sighting data sources and studies available in Germany about the exposure of leisure noise, related to hearing disturbance, for later judgment and analysis concerning the applicability for modelling of the exposure distribution in Germany |
| 2. Preparation of DALYs Calculation | Exposures and Health outcome Assessment:<br>• to calculate the estimated number of adolescents in Germany who get exposed to leisure noise<br>• to calculate the estimated number of adolescents in Germany who suffer from hearing disturbance |

| | |
|---|---|
| | attributable to leisure noise<br>Calculating Population Attributable Risk<br>Modelling data of exposure distribution of leisure noise among adolescents in Germany |
| 3. DALYs Calculation | Modelling data for mortality and morbidity<br>Calculating YLD<br>Calculating YLL<br>Summing YLD and YLL |
| 4. Uncertainty & Sensitivity Analysis | Uncertainty Analysis<br>Sensitivity Analysis |

The flow chart below describes the steps of this study in more detail (see Picture 1). Here, the epidemiological data at the national level in Germany, as well as national data statistics and information on dose-response function (DRF), are searched (I) with the help of all the available literature and data research.

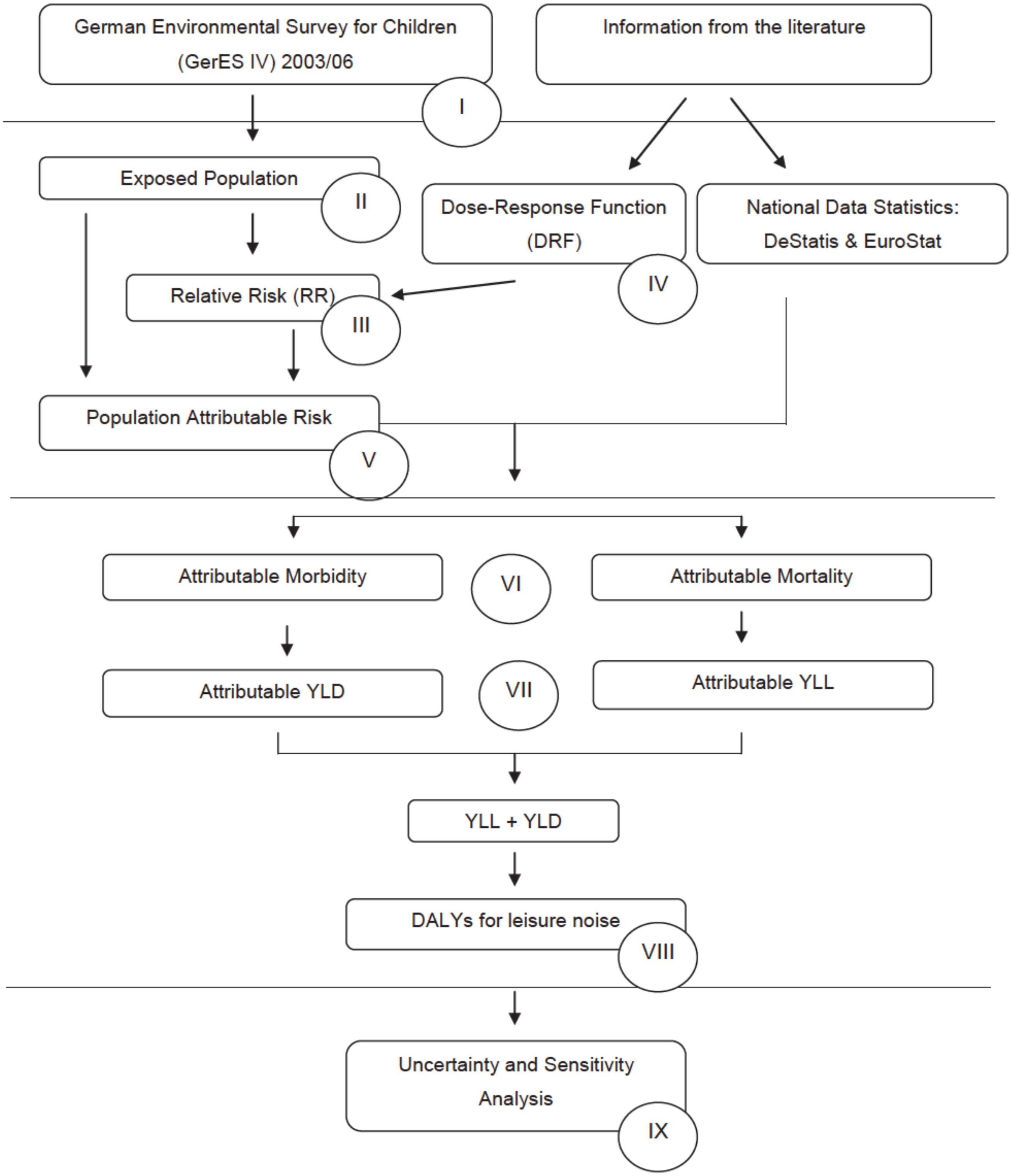
For instance from 2003 to 2006 the German Environmental Survey for Children (GerES IV) conducted the environmental exposures survey, including leisure noise, among children and adolescents in Germany which has become an available source to initiate research. Besides, GerES IV (*Kinder-Umwelt-Survey (KUS), 2003/06*) which was conducted by UBA in cooperation with Robert Koch Institutes (RKI), the Health Interview and Examination Survey for Children and Adolescents (*Kinder- und Jugendgesundheitssurvey*, or KiGGS) was the first environmental survey for children and adolescents that addressed leisure noise. Furthermore, available national data statistics, information from EuroStat, 2010 and DeStatis, 2007/2009 are utilized as sources in this study.

For this study the author decided to include only the 11 to 14 year old age group from participants of GerES IV, based on several reasons: First, the participants in this age group were regarded as able to deliver their own answers without bias from parents. Second, adolescents at this age are regarded as having received a significant amount of the leisure noise exposure being analyzed, which has been independently selected. Third, more complete and comprehensive variables which were missed in two other age groups were investigated in this age group. Thereby, there are 600 participants aged 11 to 14 years included in the analysis. Further, available national data statistics, information from EuroStat, 2010 and DeStatis 2007/2009 are utilized as sources in this study.

The pre-DALYs calculation started by calculating the number of exposed adolescents in the available data and the relative risk (RR) inside the GerES IV. Therefore, the number of exposed adolescents in population (II) can be analyzed. Subsequently, the available Dose-Response Function (DRF) (IV) will express the Relative Risk (RR) (III) in population for every single type of leisure noise with the specific health outcomes. The RR together with the number of exposed population will then produce the Population Attributable Risk (PAR) for every sort of leisure noise (IV).

Attributable Mortality and Attributable Morbidity can be obtained from National mortality and morbidity data together with PAR (VI). The attributable mortality and morbidity data will then generate attributable YLL and YLD (VII) which, when added together, produce DALYs (VIII). At the end, there will be uncertainty and sensitivity analyses that should be done along the process (IX).

**Picture 1 Simplified Schematic Methodology Flow Chart in Assessing DALYs of Hearing Disturbance Attributable to Leisure Noise (Modified from VegAS study)** (Schillmöller et al. 2012)



## 3.1 Literature and Available Leisure Noise Data Research

The explorative step contains from the literature to review available data concerning leisure noise as exposure and hearing disturbance as health end point, as well as to search for the dose-response functions (DRF). PubMed engine, along with Google Scholar, has been utilized as the main portal search system. Internet sites of relevant institutions, such as WHO (www.who.int) and UBA (www.umweltbundesamt.de) were also utilized in order to find original unpublished articles. Keyword combinations were applied in order to find relevant references. These keywords combinations looked for leisure noise, either in the form of single source or multiple sources of leisure noise, as well as specific possible forms of hearing disturbance as health endpoints. Literature and information that show the relationship between leisure noise and hearing disturbance in the form of DRF are also searched for.

Literature both in German and English were included with consideration of the date of publication. Grey literature, such as technical reports and working papers, found in Internet sites of relevant institutions which were original, recent, and highly relevant for this study, were also included. Epidemiological research including meta-analysis and reviews were preferred and primarily evaluated in this study.

In accordance with the purpose of assessing the environmental Burden of Disease for the overall German population, individual clinical case reports and studies on acute exposures were excluded. Quality appraisal regarding the relevancy, applicability, and transferability to this study using questions and selection criteria for the literatures and studies were investigated.

While conducting the literature and available data search, the snowball system -- which investigates literature references from identified articles or reports as well as related articles located by the PubMed engine -- is applied. Afterward, when there was incomplete information or contradictory results, literature research was also conducted to return to specific case-control studies or specific related commentary and opinion on relevant publications.

## 3.2 Preparation of DALYs Calculation

The DALYs calculation, which used an exposure-based approach, requires some sufficient information such as distribution of leisure noise within the population, estimation of hearing disturbance due to leisure noise within the population, the exposure-response relationship described as dose-response function for the specific hearing disturbance, and a disability weight for particular hearing disturbance (WHO Regional Office for Europe 2011). Therefore, data and information collected from the survey are being calculated and analyzed in order to get the number within population. The estimated number who get exposures to leisure noise among adolescents in Germany and the estimated number who suffer from hearing disturbance attributable to leisure noise among adolescents in Germany are calculated. The dose-response function as well as disability weight for particular hearing disturbances are searched and analyzed.

### 3.2.1 Exposure Assessments │Defining Variety of Activities as well as Exposure Distribution of Leisure Noise

Exposures are commonly defined as potential causal characteristics; refer to behaviour, treatment or intervention, trait, exposure in ordinary sense, or disease (Greenland, Rothman & Lash 2008). National Institute of Public Health Denmark proposed a definition of noise as exposure as "*sound with any kind of negative effect on human health and well-being (biological, social, psychological, behavioural and performance outcomes*" (Bistrup et al. 2001). How leisure noise acts as exposure depends on the emission of the noise, its acceptance by the human body, and its setting. The characteristics of leisure noise likewise need to be described, such as the intensity and frequency of the noise as well as the time history of the leisure noise, i.e. its periodicity and duration.

The intensity and frequency of the sound are measurable. The sound intensity is the result of sound pressure levels per unit area to a specific direction. The sound pressure itself is defined as loudness of the sound, expressed in decibels (dB) as a logarithmic ratio, with time function inside (Bistrup et al. 2001; SCENIHR 2008; EEA 2010). The sound frequency, described by the unit of Hertz (Hz), is the number of wave cycles in a second (Bistrup et al. 2001). The human ear is sensitive to sounds within the frequency range from 20 Hz to 20,000

Hz with a declining range over age (SCENIHR 2008). Table 6 shows indicators about sound pressure level, used by European Environmental Agency (EEA) (EEA 2010).

In this study the adolescent age group between 11 to 14 years old who are exposed to the particular leisure noise is calculated. Considering a broad range of activities produced leisure noise and unclear border definition on types of recreation activities included, this study includes all exposures of leisure noise found in selected data which provide sufficient information regarding the noise characteristics needed.

**Table 6 Noise Indicators as used by European Environmental Agency** (EEA 2010)

| Indicator * | Description | Time-constant |
|---|---|---|
| $L_{max}$ | Maximum sound pressure level occurring in an interval, usually the passage of a vehicle | 125 ms ** |
| SEL | Sound exposure level = Sound pressure level over an interval normalised to 1 second. | 1 s |
| $L_{day}$ | Average sound pressure level over 1 day. This day can be chosen so that it is representative of a longer period — for example, $L_{day}$ occurs in the END; if used in that context, a yearly average daytime level is intended. | 12 or 16 hrs |
| $L_{night}$ | Average sound pressure level over 1 night. This night can be chosen so that it is representative of a longer period — $L_{night}$ also occurs in the END; if used in that context, a yearly average night time level is intended. This is the night time indicator defined in EU-directive 2002/49 and used by WHO. | 8 hrs |
| $L_{24h}$ | Average sound pressure level over a whole day. This whole day can be chosen so that it is representative of a longer period. | 24 hrs |
| $L_{dn}$ | Average sound pressure level over a whole day. This whole day can be chosen so that it is representative of a longer period. In this compound indicator the night value gets a penalty of 10 dB. | 24 hrs |
| $L_{den}$ | Average sound pressure level over all days, evenings and nights in a year. In this compound indicator the evening value gets a penalty of 5 dB and the night value of 10 dB. This is the 'general purpose' indicator defined in EU-directive 2002/49. | Year |

**Note:** * Noise levels refer to the outside façade of buildings if not otherwise specified.
** If sound level meter setting 'fast' is used, which is common.

### 3.2.2 Health Outcomes Assessments | Bordering Forms of Hearing Disturbance as Health Outcomes and Assessing the Estimated Number of Hearing Disturbance Attributable to Leisure Noise

Greenland (Greenland, Rothman & Lash 2008) refined a term of effect as "*a change in population characteristics that is caused by the factor being at one level versus another*". Health effects or health outcomes that were attributable to exposures often could not easily and directly be measured.

Health outcomes are considered relevant if they have high damage potential, are lead from chronic exposure, and if there is recent accepted knowledge about association between the stressors and health end point (Hornberg et al. 2012). Desai (2004) as well as Oberg (2010) developed criteria to explain the evidence on relationship / association between stressors and health outcomes (see Table 7). Health outcomes that have strong and moderate evidence, classified as grade I criteria, are being prioritized.

**Table 7 Class of Relationship of Evidence by Desai** (Desai, Mehta & Smith 2004) **as well as by Öberg** (Öberg et al. 2010)

| Relationship of Evidence | Meaning |
|---|---|
| 1. Strong evidence | Numerous studies have indicated a consistent, significant, plausible and uniform connection between stressors and health end point. A causality connection is consensually confirmed and there are no other studies which give contradictive results. The connection was proved in different populations with varied study methods. |
| 2. Moderate evidence | Small numbers of studies have shown a connection between stressors and health end point. |
| a. Moderate evidence grade I | Strong evidence of connection between stressors and health end point exists in studies for single sub-groups (age group, gender), however, not for the whole study population. |
| b. Moderate evidence grade II | Moderate evidence of connection between stressors and health end point exists in studies. For the whole study population, strong evidence could be indicated. |

Noise in general has available significant scientific evidence of a causal association with cardiovascular disease, cognitive impairment, sleep disturbance, tinnitus, and annoyance (WHO Regional Office for Europe 2011). However, for leisure noise there is no adequate information available in previous studies showing supporting evidence of a relationship between leisure noise and hearing disturbance. Therefore, insufficient evidence does not exclude a range of hearing disturbance found in selected data from this study as long as it provides sufficient information about the calculation. A consistent definition of form of hearing disturbance used in data sources, however, is necessary. One form of hearing disturbance is hearing impairment, for which the degree of severity has been classified by the WHO (WHO 2012) and being modified by Zahnert (Zahnert 2011) (see Table 8).

The health outcome assessment started with calculating the prevalence of the listed hearing disturbances included in this study. Using the particular Relative Risk (RR) of each hearing disturbance, the Attributable Fraction (AF), i.e. the fraction of hearing disturbance occurrence due to leisure noise, within the participants is subsequently calculated.

**Table 8 The Severity Classification of Hearing Impairment by WHO** (WHO 2012) **Modified by Zahnert** (Zahnert 2011)

**The WHO classification of the severity of hearing impairment, with general clinical recommendations**[*1]

| Grades of hearing impairment | Mean hearing loss in pure-tone audiogram | Clinical findings | Recommendations |
|---|---|---|---|
| 0 – No impairment | 25 dB or better | No or very slight hearing problems. Able to hear whispers. | Counseling, follow-up examination; if conductive hearing loss is present, evaluate indication for surgery |
| 1 – Slight impairment | 26–40 dB | Able to hear and repeat words spoken in normal voice at 1 meter. | Counseling, hearing aids may be advisable; if conductive hearing loss or combined hearing loss is present, surgical treatment may be indicated |
| 2 – Moderate impairment | 41–60 dB | Able to hear and repeat words spoken in raised voice at 1 meter. | Hearing aids recommended; if conductive hearing loss or combined hearing loss is present, surgical treatment may be indicated |
| 3 – Severe impairment | 61–80 dB | Able to hear some words when shouted into better ear. | Hearing aids needed; if an external hearing aid is not possible, consider an implanted hearing aid or cochlear implant; lip-reading and signing for supportive treatment |
| 4 – Profound impairment including deafness | 81 dB or higher | Unable to hear and understand even a shouted voice. | Failure of a hearing-aid trial is now usually considered an indication for a cochlear or brainstem implant; lip-reading and signing can be taught in addition |

[*1] The mean hearing loss is calculated separately for each ear as the mean value of hearing loss for the four frequencies 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz.
Modified from WHO: Grades of hearing impairment; www.who.int/pbd/deafness/hearing_impairment_grades/en/index.html

### 3.2.3 Population Attributable Risk (PAR) Calculation

The Attributable Fraction (AF) within the participants calculated in health outcome assessment can be transferred afterward into the Attributable Fraction within the population, called Population Attributable Fraction (PAF) and into the Attributable Risk within population, called Population Attributable Risk (PAR). This PAR, which contains an estimated number of cases as well as an estimated number of deaths within the population, is later used in YLD and YLL calculation.

Therefore, before attaining PAR calculation, the Relative Risk (RR) inside the participants is calculated to produce Attributable Fraction (AF) and Attributable Risk (AR) within the participants.

Relative Risk (RR) in this study is the probability of hearing disturbance that occurred in the group exposed to leisure noise compared to the non-exposed group (see Table 9). It can be calculated directly in cohort study by dividing the risk in the exposed group with the risk in the non-exposed group. RR among study participants could later be calculated into RR in population for every single exposure and single health outcome using available DRF. RR is valuable in assessing the strength of association. The larger the RR value obtained means there is a stronger association (Gordis 2009a).

**Table 9 Formula on Relative Risk (RR)** (Gordis 2009a)

| | |
|---|---|
| $\mathbf{RR} = \dfrac{\text{Risk in exposed group}}{\text{Risk in non exposed group}}$ | RR 1 means no association<br>RR > 1 means positive association; possibly causal<br>RR < 1 means negative association; possibly protective |

Attributable Risk can be calculated by determining the RR using the formula below (see Table 10). Once the AR is known, the Attributable Fraction (AF) can be calculated as the proportion between number of hearing disturbance that attributed to a leisure noise and total case number of hearing disturbance (Gordis 2009a; WHO Regional Office for Europe 2011).

**Table 10 Formulas on Attributable Risk (AR) and Attributable Fraction (AF)** (Gordis 2009a; WHO Regional Office for Europe 2011)

| | |
|---|---|
| $\mathbf{AR} = \dfrac{\text{RR} - 1}{\text{RR}}$ | AR Attributable Risk |
| $\mathbf{AF} = \dfrac{\text{AR}}{\text{number of disease}}$ | AF Attributable Fraction |

While Attributable Risk (AR) clarifies the number of events among participants, the Population Attributable Risk (PAR) shows the number of events (which presumably can be prevented by interventions) due to an exposure in the population as a whole. PAR, notable information for policy makers, is the Attributable Risk (AR) for the total population. The PAR can be calculated using the formula below (see Table 11) which requires the number of exposed people in the population, the number of subjects with health outcomes in the population, and the particular relative risk at every level of exposure compared to a reference level (WHO Regional Office for Europe 2011). Therefore, the critical point is to have the precise number of exposed and non-exposed groups in the population as well as to know the incidence of an effect in each group (Gordis 2009d).

**Table 11 Formula on Population Attributable Fraction (PAF), Population Attributable Risk (PAR) and Population Attributable Risk Percentage (PAR%)** (Prüss-Üstün et al. 2003; Gordis 2009d; WHO Regional Office for Europe 2011)

| | |
|---|---|
| $\mathbf{PAF} = \dfrac{p\,(RR - 1)}{1 + (p\,(RR - 1))}$ | PAF Population Attributable Fraction<br>p number of the exposed people in population<br>RR Relative Risk |
| $\mathbf{PAR\%} = \dfrac{\left(\frac{Pe}{100}\right) * (RR - 1)}{\left(\left(\frac{Pe}{100}\right) * (RR - 1)\right) + 1} * 100\%$ | PAR% Population Attributable Risk Percentage<br>Pe percentage of exposed population<br>RR Relative Risk |
| $\mathbf{PAR} = PAF * Nd = \dfrac{PAR\%}{100} * Nd$ | PAR Population Attributable Risk<br>Nd Number of subjects with health outcome in population |

### 3.2.4 Dose-Response Function (DRF) Searching for Leisure Noise

DALYs calculations depend critically on the existence of Dose-Response Function (DRF). This function identifies the exposure-response relationship for particular levels of leisure noise and particular hearing disturbance as well as its severity. Therefore, the level of exposure contained in this relationship should be able to be compared to a reference level of exposure, or at least to those with no exposure. This function could be in a form of regression formula or a relative risk measure (WHO Regional Office for Europe 2011).

DRF is usually derived from epidemiological studies. In the event that several DRF from epidemiological studies are found, the most relevant and transferable DRF form the German population will be chosen. Moreover, if there are several relevant and transferable DRF found from epidemiological studies, a DRF stratified for age, gender, and behaviour with a small Confidence Interval (CI) is selected. The absence of this function, however, results in the impossibility of calculating the particular health outcome resulting from certain sources of leisure noise. Hence, it will be impossible to produce DALYs.

## 3.3 DALYs Calculation

In the following section the DALYs calculation is done by summing YLL and YLD. Here the morbidity and mortality assessment of hearing disturbance attributable to leisure noise becomes essential.

### 3.3.1 Mortality Assessments due to Leisure Noise

There are several quantitative terms that articulate mortality such as mortality rates, case-fatality rates, and proportionate mortality. Gordis (2009) defined (disease-specific) mortality rates, which is a finest information of incidence rate of a disease when its case-fatality rate is high and / or it has short duration, as the number of people who die because of a disease in 1 year divided by the total population at midyear and case-fatality rate, describes the severity of a disease, as the number of individuals dying during a specific period of time after disease onset or diagnosis divided by the number of individuals with a specified disease. The last term does not give information about risk of a disease and it is also actually not a rate since its changes may be the result of mortality from another disease (not as a result of the change of its mortality) (Gordis 2009b).

Most countries use death certificates as the source of mortality data. Death certificates that include the underlying cause of death are influenced by the policy on how cause of death should be defined and the definition of the disease itself. Hence, in interpreting mortality data one should consider whether a change on policy or revision of diagnostic criteria of a disease occurred (Gordis 2009b).

Because until now it is well recognized that hearing disturbance alone does not lead to death, this study excludes mortality assessments from the DALYs calculation. Even though there are reported cases that show suicides resulting from suffering by tinnitus (Johnston & Walker 1996), these cases are taken into account as suicide cases.

### 3.3.2 Morbidity Assessments due to Leisure Noise

There are several measures that are usually used in calculating morbidity such as: Incidence rate, attack rate, and prevalence. Attack rate, often known as proportion, is actually not a rate, therefore it is not used for morbidity. Gordis (2009b) defined the incidence rate of a disease as "*the number of new cases of a disease that occur during a specific period of time in a population at risk for developing the disease*" and prevalence as "*the number of affected persons present in the population at a specific time divided by the number of persons in the population at that time*". In contrary to incidence, prevalence is not a measure of risk since it does not consider the duration of the disease. Indeed, in a steady situation, prevalence is incidence multiplied by duration of disease.

The information about morbidity statistics could be taken from several sources such as surveys of the population (e.g. National Health Survey), disease reporting (e.g. cancer registries), accumulated data by group or party (e.g. by insurance, veterans administration, records in industry or school), hospital and clinics, case-finding programs, or questionnaires and interviews. Sources of data which a study chooses influence the calculation of the frequency of morbidity. Since most of the sources, except the questionnaires or interviews constructed for the survey, are not prepared for research purposes, they may have limitations of completeness, the meaning of the data may be unclear, and there is the possibility of selection bias. Questionnaires or interview surveys themselves have possible flaws regarding the person's understanding and awareness of a disease or condition, their trustworthiness in answering, recall bias, quality of questions (e.g. unclear question), and also selection bias due to incompleteness of responses (Gordis 2009c).

In this study, the disease which contributed to morbidity is systematically defined by ICD-X. Symptoms and medical examinations are described and included.

### 3.3.3 YLL and YLD Calculation due to Leisure Noise

DALYs, in contrast to health expectancies, is a sum of years of life lost because of premature mortality (YLL) and years of healthy life lost as a result of disability (YLD) (see Table 12). 1 DALY means the loss of one year living in healthy condition. It is a time-based measurement which figures the loss of expected years of healthy life as a consequence of specific diseases or injuries (Murray & Lopez 1996d; 1997a; 1997b; Murray et al. 2001; Prüss-Üstün et al. 2003; Lopez et al. 2006; EBoDE Report 2011).

**Table 12 Formulas on DALY, YLL and YLD Calculation** (Murray & Lopez 1996d, 1997a, 1997b; Murray et al. 2001; Prüss-Üstün et al. 2003; Lopez et al. 2006; EBoDE Report 2011)

| | |
|---|---|
| DALYS YLL + YLD | Where:<br>YLL Years of Life Lost to premature mortality,<br>YLD Years Lost due to Disability. |
| YLL N x L | Where:<br>N number of deaths,<br>L standard life expectancy at age of death (in years). |
| YLD I x L x DW | Where:<br>I number of disability cases,<br>L average duration of disability (years),<br>DW disability weight. |

The YLL measures the number of deaths multiplied by the standard life expectancy at the age at which death occurs (Prüss-Üstün et al. 2003; EBoDE Report 2011). Instead of applying the standard life expectancy proposed by WHO, i.e. 82.5 for females and 80 for males, this study uses the standard life expectancy of the German population proposed by the Federal Statistical Office from 2007/2009 (Destatis 2012).

The YLD corresponds to the number of disability cases multiplied by the average duration of the diseases and disability weight which reflects the severity of the disease on a scale from 0 which is perfect health or no disability to 1 which is dead (Prüss-Üstün et al. 2003; Lopez et al. 2006; EBoDE Report 2011).

Although DALYs is subject to adjustment by age weighting and future discounting in other BoD studies (Murray 1996; Mathers et al. 2006; WHO Regional Office for Europe 2011), these two values are not applied in this study for ethical reasons. Where there is missing information on parameters needed for a DALYs calculation, DisMod, the mathematical modelling based on the logical connections between prevalence and incidence and connections between mortality and remission, is used to provide the missing data. The reference population used in this study is the average population of Germany from 2008 to 2010 determined by EuroStat.

## 3.4 Uncertainty & Sensitivity Analysis

Uncertainty Analysis is a tool of analysis that attempts to evaluate a wide range of possible uncertainties coming from many sources during the study. This analysis identifies data gaps from missing, incomplete and/or incorrect information due to ignorance and/or lack of awareness which could be filled to enhance the accuracy of results. Transparency is crucial in this analysis to enable politicians and decision makers to weigh and judge the results and to ensure proper and sufficient consideration for taking action and making interventions (IPCS 2008).

Possible uncertainties come from many sources, beginning with exposure assessment before the DALYs calculation. For example, uncertainties arise in exposure assessment once the dose of exposure is predicted. Broadly speaking, uncertainties come from many sources, such as the process of data generation, incomplete information, potential bias in information such as measurement errors and systematic bias, model uncertainty including uncertainties that arise from extrapolating data in order to complete the missing information (Mathers et al. 2006).

International Programme on Chemical Safety (IPCS) in 2008 listed three basic categories as the sources of uncertainties (IPCS 2008). They are:

- Scenario uncertainty: uncertainty in describing exposure assessment;
- Model uncertainty: uncertainty in modelling associations between exposure as stressors and health outcomes, in line with its causal relations, and
- Parameter uncertainty: uncertainty in determining numerical elements, both as point values and as distributions values, in exposure assessment.

Uncertainty analysis can take the form of qualitative and quantitative analysis. There are two basic steps in performing qualitative uncertainty analysis: Specifying the sources of uncertainties and characterizing the uncertainties qualitatively (IPCS 2008). Computer technologies have been developed to facilitate methods performing quantitative uncertainty analysis (Mathers et al. 2006; IPCS 2008). In this study, qualitative analysis will be done. As far as possible in its time limit and depending on the availability of data, quantitative analysis may also be performed such as by taking into account the 95% Confidence Interval (CI) of the Relative Risk (RR).

Different from uncertainty analysis, sensitivity analysis is a tool of analysis that aims to discover the degree of change bring about by the change of certain parameters and afterward to determine the rank of parameters that have the greatest influence on output (Mathers et al. 2006), in this study the output is the DALYs of hearing disturbance attributable to leisure noise. Saltelli (2000) as well as Mokhtari and Frey (2005) defined sensitivity analysis as "*a tool to identify the inputs of greatest importance by:*

1. *quantifying the impact of changes in values of one or more model inputs on a model output,*
2. *evaluating how variations in model output values can be apportioned among model inputs, and*
3. *identifying which inputs and what values of such input contribute the most to best or worst outcomes of interest*."

Sensitivity analysis cannot only determine what input contributed the most but also the most critical sources of uncertainty in the study. Therefore, this analysis is significant for deciding the importance of additional data collection or research in order to lessen uncertainty.

## 3.5 Software

The feedback from participants aged 11 to 14 years old for GerES IV 2003/06 was put into the data file using PASW Statistics 18. Descriptive statistics calculations such as frequency, descriptive and cross tabulation were done. Moreover, the program of Microsoft Office Excel 17 and EpiCalc 2000 were also utilized.

# 4 Results

## 4.1 German Environmental Survey (GerES) IV 2003/06 as Available Data

GerES IV 2003/06 involved 1,790 children age 3 to 14 years old as participants. In order to ascertain complete and comprehensive information about leisure noise and hearing disturbance, only participants within the age group of 11 to 14 years old (N = 600) are included in this study. These participants have an average age of 12.5 (SD = 1.12) and are evenly distributed across 1-year-age bracket.

Table 13 shows the demographic characteristics of participants included in this study. The sample has an approximately balanced ratio for gender: 51.2% boys and 48.8% girls. Two third of them (68.8%) come from West Germany (including West Berlin), while only one third (31.2%) come from East (including East Berlin). This dis-proportionate sampling towards the East, which comprises of only 20.02% of the total population according to Destatis in 2009, was with intent performed by Health Interview and Examination Survey for Children and Adolescents (*Kinder- und Jugendgesundheitssurvey*, or KiGGS) as the source of GerES IV in order to have representative participants for Germany.

As much as 39.2% of this sample lives in rural areas, and approximately one third (34.4%) live in suburban areas. The rest (26.4%) live in urban areas. Regarding housing, more than half of the sample (53.1%) lives in single family houses, while the others live in apartments (9.3%), multi-family houses (21.4%), double family houses (15.9%), and other types of dwellings (0.3%). Regarding the types of residential streets, more than half of the sample (52%) lives on a street side, while the rest live next to pedestrian zones (35.5%) and on a main road (12.5%). In addition, based on the traffic density of the street, 39.2% of the sample lives next to the street with low traffic density, 33.1% and 12.9% live next to the street with respectively, moderate and high traffic density, and 14.9% to very high traffic density.

**Table 13 Demographic Characteristics of Participants in GerES IV 2003/06 age 11 to 14 years old (N=600), to be Analyzed in this Study**

| Demographic Characteristics | Description |
|---|---|
| Gender | Boys 51.2%<br>Girls 48.8% |
| Origin | West Germany (including west Berlin) 68.8%<br>East Germany (including east Berlin) 31.2% |
| Living area | Rural 39.2%<br>Sub-urban 34.4%<br>Urban 26.4% |
| Housing | Single family house 53.1%<br>Apartment 9.3%<br>Multifamily house 21.4%<br>Double family house 15.9%<br>Others 0.3% |
| Residential street | Street side 52%<br>Pedestrian zone 35.5%<br>Main road 12.5% |
| Traffic density of the street | Street with low traffic density 39.2%<br>Street with moderate traffic density 33.1%<br>Street with high traffic density 12.9%<br>Street/road with very high traffic density 14.9% |

## 4.2 Preparation of DALYs Calculation

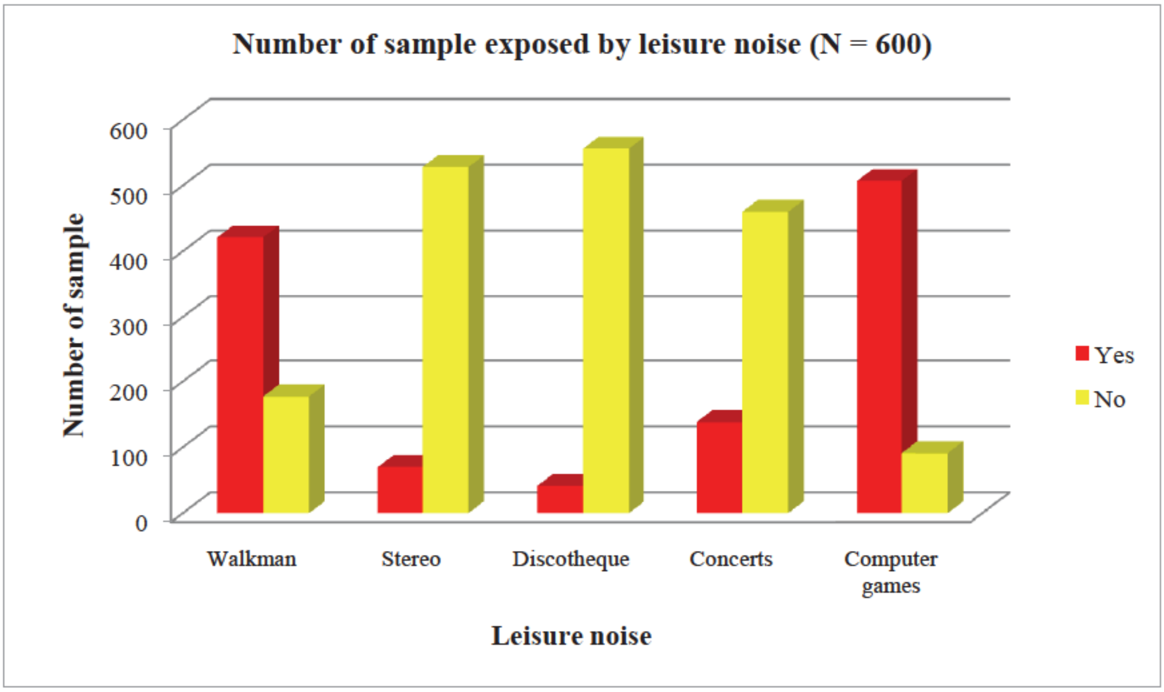
Data and information on distribution exposure of leisure noise, distribution of hearing disturbance, DRF and population attributable risk of hearing disturbance due to leisure noise are collected, calculated and analyzed in this phase. Detailed data can be seen in tabular form in Appendix 2 to 6.

### 4.2.1 Leisure Noise Assessment

In this project, leisure noise, based on the sole source available by GerES IV, is defined as listening to a Walkman, listening to a stereo using a headphone, visiting discotheques, attending concerts, and engaging in playing computer games. The characteristics of the exposure were not quantitatively measured and defined qualitatively as to the loudness. To get information about time history of leisure noise, the questions of frequency and duration were performed. Having no exposure is assumed as duration, frequency, or loudness of zero (0).

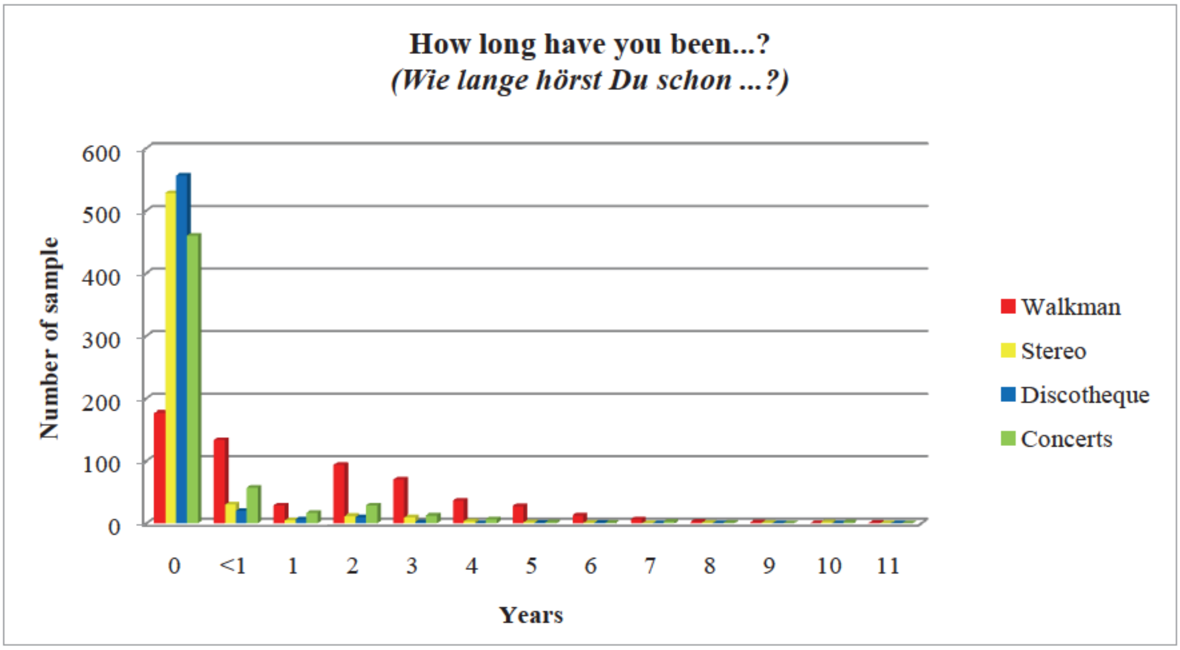
Engaging in playing computer games is the highest ranked exposure, reaching 84.8% of the sample, followed by listening to a Walkman (70.2%), attending concerts (23.1%), listening to a stereo using a headphone (11.7%), and visiting discotheques (6.9%), as shown in picture 2. This most common exposure by the sample, however, could not be analyzed further due to incompleteness information, i.e. no information on the loudness of exposure.

**Picture 2 Bar Chart Shows Number of Sample Exposed by Leisure Noise Addressed in GerES IV (N=600)**



To gather information on duration of exposure, the question “How long have you been doing ... (sort of leisure noise) ...?” was used instead of “How long have you been frequently doing ... (sort of leisure noise) ...?” Graph 2 shows the duration of each exposure among participants, ranging from less than 1 year to 11 years.

**Picture 3 Bar Chart of Duration of Leisure Noise among Sample aged 11 to 14 years in GerES IV (N=600)**




The behaviour leading to the exposure was assumed to be done with regular frequency throughout the year. For instance, 0.5 hour per day of listening to a Walkman means 0.5 hour every day in a year. “Monthly” means at least once a month and “weekly” means at least one a week. “Annually” in this study is valued as once in a year, “6 monthly” as at least twice in a year, “3 monthly” as at least 4 times in a year, and “monthly” as at least 12 times in a year.

Table 14 summarizes information on frequency of exposure for every leisure no se included in the study. Many participants listen to a Walkman most frequently for 30 minutes per day, whereas only a small number of participants listen to a stereo using a headphone or visit discotheques and concerts.

Table 15 shows the loudness of each leisure noise determined as subjective perception of the participants. In the survey, no loudness measurement of exposure was conducted.

**Table 14 The Relative Frequency of Exposure from each Sort of Leisure Noise Among Participants in GerES IV (N=600)**

<table>
<tr><th>Exposure</th><th>Frequency in %</th></tr>
<tr><td>1. Listening to a Walkman</td><td>
<table>
<tr><td colspan="7">Hours / day</td></tr>
<tr><td>0</td><td><0.5</td><td>0.5</td><td>1-1.5</td><td>2-2.5</td><td>>3</td><td>Missing</td></tr>
<tr><td>29.5</td><td>19.2</td><td>32.5</td><td>12.5</td><td>4</td><td>1.7</td><td>0.7</td></tr>
</table>
</td></tr>
<tr><td>2. Listening to a Stereo using a Headphone</td><td>
<table>
<tr><td colspan="7">Hours / day</td></tr>
<tr><td>0</td><td><0.5</td><td>0.5</td><td>1-1.5</td><td>2-2.5</td><td>>3</td><td>Missing</td></tr>
<tr><td>88</td><td>3.7</td><td>4.8</td><td>2.2</td><td>0.8</td><td>0.2</td><td>0.3</td></tr>
</table>
</td></tr>
<tr><td>3. Visiting Discotheques</td><td>
<table>
<tr><td>0</td><td><monthly</td><td>monthly</td><td>bimonthly</td><td>weekly</td><td>Missing</td></tr>
<tr><td>92.7</td><td>1.8</td><td>3</td><td>1.3</td><td>0.5</td><td>0.7</td></tr>
</table>
</td></tr>
<tr><td>4. Attending Concerts</td><td>
<table>
<tr><td>0</td><td>Annually</td><td>6 monthly</td><td>3 monthly</td><td>monthly</td><td>Missing</td></tr>
<tr><td>76.7</td><td>12</td><td>7.2</td><td>1.8</td><td>0.3</td><td>2</td></tr>
</table>
</td></tr>
</table>

**Table 15 The Loudness of Each Leisure Noise Exposure Among Participants in GerES IV (N=600)**

<table>
<tr><th>Exposure</th><th>Loudness in %</th></tr>
<tr><td>1. Listening to a Walkman</td><td>
<table>
<tr><td>0</td><td>Very quiet</td><td>Quiet</td><td>Moderate</td><td>Loud</td><td>Very loud</td><td>Missing</td></tr>
<tr><td>29.5</td><td>0.3</td><td>4.5</td><td>48.8</td><td>12</td><td>4.2</td><td>0.7</td></tr>
</table>
</td></tr>
<tr><td>2. Listening to a</td><td></td></tr>
</table>

| **Stereo using a Headphone** | 0 | Very quiet | Quiet | Moderate | Loud | Very loud | Missing |
|---|---|---|---|---|---|---|---|
| | 88 | 0 | 1.2 | 7.3 | 2.7 | 0.5 | 0.3 |

| **3. Visiting Discotheques** | 0 | Normal voice to chat | Loud voice to chat | Shout to understand | Loud shout, limit understanding | Missing |
|---|---|---|---|---|---|---|
| | 92.7 | 0.7 | 2.8 | 2.3 | 1 | 0.5 |

| **4. Attending Concerts** | 0 | Too quiet | Appropriate | Too loud | Missing |
|---|---|---|---|---|---|
| | 76.7 | 0.3 | 14.3 | 7.8 | 0.8 |

Some other sources of noise were also recorded. Table 16 shows the daytime disturbance made by other sources of noise which have been looked at on this survey.

**Table 16 Daytime Disturbance Reported by Sample Aged 11 to 14 years Caused by other Sources of Noise in GerES IV (N=600)**

| **Sources of Reported Noise** | **% of Daytime Disturbance** | | | |
|---|---|---|---|---|
| | No | Slight | Moderate | Strong |
| Road Traffic | 81.7 | 14.3 | 3.2 | 0.8 |
| Aircraft | 90.3 | 7.9 | 1.5 | 0.3 |
| Rail Traffic | 91.1 | 7.4 | 1.3 | 0.2 |
| Construction | 81 | 13.3 | 4.5 | 1.2 |
| Neighbourhood | 76.8 | 16.8 | 4.4 | 2 |
| Industrial | 95.8 | 2.4 | 1.8 | 0 |
| Public Restaurants/Bars | 98.7 | 1 | 0.3 | 0 |
| Playground | 92.1 | 7 | 0.5 | 0.3 |

| | | | | |
|---|---|---|---|---|
| Nature | 89.6 | 7.4 | 2.5 | 0.5 |
| House Installation | 86.9 | 10.9 | 1.3 | 0.8 |
| Family Members | 59.6 | 26.5 | 10.2 | 3.7 |
| Others | 98.3 | 0.7 | 0.5 | 0.5 |

### 4.2.2 Assessment of Hearing Disturbance as Health Outcomes

This study considers hearing complaints, such as earache, tinnitus, and temporal deafness (*taube Ohren*), as well as the hearing test. However, due to the unclear term of temporal deafness, this hearing complaint was excluded from further analysis.

Each of the hearing complaints contains information about its presence and duration. Analysis shows that 2.3% of the sample had earache. All earache cases lasted for a few minutes. Of the sample, 10.7% had tinnitus; 9.2% of these cases lasted for a few minutes and 1.5% for a few hours (shown in Table 17).

**Table 17 The Existence of the Analyzed Hearing Complaints among Sample Aged 11 to 14 years in GerES IV (N=600)**

| Hearing Complaints | Frequency in % | | | |
|---|---|---|---|---|
| | 0 | Few Minutes | Few Hours | Missing |
| Earache | 97 | 2.3 | 0 | 0.7 |
| Tinnitus | 88.7 | 9.2 | 1.5 | 0.7 |

A hearing test was carried out in a room in the house of the participants. The results are divided into three categories: (1) less than or equal to 20 decibel (dB); (2) between 20 dB and less than or equal to 40 dB; and, (3) more than 40 dB. The grades of hearing impairment, developed by WHO (World Health Organization 2012), were used as a benchmark. Of the 11.5% of the sample who suffer from hearing impairment, 1% experience at least moderate impairment, and 10.5% slight impairment (shown in Table 18).

**Table 18 The Result of Hearing Test among Sample Aged 11 to 14 years in GerES IV (N=600) being Compared to Grades of Hearing Impairment by WHO**

| Hearing Test Results | Frequency in % | Grades of Hearing Impairment by WHO |
|---|---|---|
| ≤ 20 dB | 83.5 | 0 No impairment |
| > 20 40 dB | 10.5 | 0/1 Slight impairment |
| ≥ 40 dB | 1 | 2/3/4 Moderate/severe/profound impairment |
| Missing | 5 | - |

Table 19 summarizes the weighted number of cases of hearing disturbances due to leisure noise among participants in GerES IV in order to assess the hearing disturbances in population. Detailed information can be found in Appendix 2.

**Table 19 Hearing Disturbances among Sample Aged 11 to 14 years in GerES IV being Weighted by Weighting Factor**

| Hearing Disturbances | Weighted Number of Cases N (%) *[95% CI]* | | |
|---|---|---|---|
| | Boys (N total 329) | Girls (N total 312) | Total (N total 641) |
| Earache | 10 (3.04) *[1.55 ; 5.70]* | 6 (1.92) *[0.78 ; 4.35]* | 16 (2.50) *[1.48 ; 4.11]* |
| Tinnitus | 35 (10.64) *[7.62 ; 14.61]* | 36 (11.54) *[8.31 ; 15.74]* | 71 (11.08) *[8.80 ; 13.83]* |
| Hearing impairment | 36 (10.94) *[7.88 ; 14.95]* | 33 (10.58) *[7.49 ; 14.66]* | 69 (10.76) *[8.52 ; 13.49]* |

### 4.2.3 Population Attributable Risk (PAR) for Leisure Noise among Adolescents Aged 11 to 14 Years in Germany

In order to have a representative number in population, the data set is analyzed using weighting factor set by the original study. Some of the steps undertaken in this are detailed below.

### *1. Calculating the Estimated Number of Exposed Adolescents Aged 11 to 14 Years Within Population of Germany*

The percentage of exposures among participants were transposed into estimated numbers of exposed adolescents in a population age group of 11 to 14 years old, using the number of total population of adolescents in this age group reported in EuroStat 2010. For instance, Table 20 shows the estimated number of adolescents in the population age group of 11 to 14 years old exposed by listening to a Walkman. The 70.3% of the sample with this exposure is multiplied by total population aged 11 to 14 years (which is 3,190,940), resulting in 2,243,231 adolescents aged 11 to 14 years in Germany. This means that there are an estimated 2,243,231 adolescents aged 11 to 14 years in Germany who have been exposed by listening to a Walkman.

**Table 20 The Estimated Exposed Number by Walkman among Adolescents Aged 11 to 14 Years in Germany, Calculated Using Number of Total Population by EuroStat 2010**

| **Total Population** | | | |
|---|---|---|---|
| Age | Boys | Girls | Total |
| 11 | 405,875 | 385,436 | 791,311 |
| 12 | 418,950 | 397,892 | 816,842 |
| 13 | 412,504 | 390,828 | 803,332 |
| 14 | 399,788 | 379,667 | 779,455 |
| Total | 1,637,117 | 1,553,823 | 3,190,940 |

| **Exposure** | **Percentage Sample** | | | **Estimated Number Exposed by Walkman** | | |
|---|---|---|---|---|---|---|
| | Boys | Girls | Total | Boys | Girls | Total |
| No | 37.2 | 21.9 | 29.7 | 609,008 | 340,287 | 947,709 |
| Yes | 62.8 | 78.1 | 70.3 | 1,028,109 | 1,213,536 | 2,243,231 |

The calculation is computed for all four exposures, and results in estimated numbers of adolescents aged 11 to 14 years in the German population exposed by listening to a Walkman, listening to a stereo using a headphone, and discotheques and concerts visits. This reveals that there are around 2.2 million adolescents aged 11-14 years using a Walkman, more than 350 thousand using a stereo, and, respectively, about one-quarter and three-quarter million visiting discotheques and concerts within the German population (see Table 21).

**Table 21 The Estimated Exposed Numbers by Leisure Noise Exposures Analyzed in GerES IV among Adolescents Aged 11 to 14 Years in Germany, Calculated Using Number of Total Population by EuroStat 2010**

| Exposures | Percentage Sample | | | Estimated Numbers by Exposures | | |
|---|---|---|---|---|---|---|
| | Boys | Girls | Total | Boys | Girls | Total |
| Walkman | 62.8 | 78.1 | 70.3 | 1,028,109 | 1,213,536 | 2,243,231 |
| Stereo | 13.3 | 8.8 | 11.1 | 217,737 | 136,736 | 354,194 |
| Discotheques | 4.6 | 11.1 | 7.7 | 75,307 | 172,474 | 245,702 |
| Concerts | 18.5 | 29 | 23.6 | 302,867 | 450,609 | 753,062 |

### *2. Calculating the Estimated Number of Hearing Disturbance among Adolescent Aged 11 to 14 Years within Population in Germany*

A similar approach was applied to health outcomes in order to ascertain and calculate the estimated number of adolescents between the age of 11 to 14 years old in the German population who suffered from each sort of hearing disturbance. The calculation shown in Table 22 indicates that 2.5% of adolescents in this age within the participants suffer from earache. This result of 2.5% is then multiplied by the total of 3,190,940 adolescents in the general population with the result that there are an estimated 79,774 adolescents in the German population who suffer from earache.

**Table 22 The Estimated Number who Suffered from Earache among Adolescents Age of 11 to 14 Years old in Germany, Calculated Using Number of Total Population by Eurostat 2010**

| Total Population | | | | | | |
|---|---|---|---|---|---|---|
| Age | Boys | Girls | Total | | | |
| 11 | 405,875 | 385,436 | 791,311 | | | |
| 12 | 418,950 | 397,892 | 816,842 | | | |
| 13 | 412,504 | 390,828 | 803,332 | | | |
| 14 | 399,788 | 379,667 | 779,455 | | | |
| Total | 1,637,117 | 1,553,823 | 3,190,940 | | | |
| | | | | | | |
| **Outcome** | **Percentage Sample** | | | **Estimated Number Suffered from Earache** | | |
| | Boys | Girls | Total | Boys | Girls | Total |
| No | 96.8 | 98.2 | 97.5 | 1,584,729 | 1,525,854 | 3,111,167 |
| Yes | 3.2 | 1.8 | 2.5 | 52,388 | 27,969 | 79,774 |

This calculation was applied to both hearing complaints, as well as to the hearing test results, in order to produce estimated numbers of adolescents aged 11 to 14 years in the German population who suffered from earache, tinnitus, and hearing impairment. The result is that there are about 357,000 and 360,000 adolescents aged 11-14 years in Germany who complain for, respectively, tinnitus and have hearing impairment, and an estimated 80,000 adolescents who have earache (see Table 23).

**Table 23 The Estimated Numbers who Suffered from Hearing Disturbances Analyzed in GerES IV among Adolescents Aged 11 to 14 Years in Germany, Calculated Using Number of Total Population by EuroStat 2010**

| Hearing Disturbances | Percentage Sample | | | Estimated Numbers Suffered from Hearing Disturbances | | |
|---|---|---|---|---|---|---|
| | Boys | Girls | Total | Boys | Girls | Total |
| Earache | 3.2 | 1.8 | 2.5 | 52,388 | 27,969 | 79,774 |
| Tinnitus | 10.7 | 11.6 | 11.2 | 175,172 | 180,243 | 357,385 |
| Hearing impairment | 11.6 | 11.1 | 11.3 | 189,906 | 172,474 | 360,576 |

### *3. Calculating the Estimated Number of Hearing Disturbances Attributable to Leisure Noise among Adolescent Aged 11 to 14 years Within Population in Germany*

After calculating the estimated number of adolescents aged 11 to 14 years in the German population who were exposed to at least one leisure noise and suffered from any sort of hearing disturbance, calculations were made to estimate the number of this group who suffered from hearing disturbances attributable to their exposure to leisure noise. To accomplish this, the relative risk calculation needed to be done.

Cross tabulation on sample data between one exposure and the presence of one hearing disturbance was done. Relative Risks (RR) are the outcome of that tabulation. Table 24 shows this using as an example listening to a Walkman and the presence of earache. The risk of having earache in the group exposed to Walkman use is 2.9%; in the group not exposed to Walkman those with earache is 1.6%. Therefore 2.9% is divided by 1.6% with the resulting RR of 1.81. Calculation to find the RR can also be performed using the EpiCalc 2000. This calculation was done for all combinations of each exposure and each hearing disturbance. Table 25 to 28 show the RR of all four exposures and three hearing disturbances, respectively.

**Table 24** **Cross Tabulation between Listening to a Walkman and Having Earache in Percentage in order to Produce Relative Risk (RR)**

| Cross Tabulation | | | | | |
|---|---|---|---|---|---|
| | | | Earache | | |
| | | | Yes | No | Total |
| **Walkman** | Yes | % within Walkman | 2.9 | 97.1 | 100 |
| | | % within earache | 81.3 | 70.2 | 70.5 |
| | No | % within Walkman | 1.6 | 98.4 | 100 |
| | | % within earache | 18.8 | 29.8 | 29.5 |
| | Total | % within Walkman | 2.5 | 97.5 | 100 |
| | | % within earache | 100 | 100 | 100 |

**Table 25** **Relative Risk (RR) of Hearing Disturbances due to Listening to a Walkman among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| Outcome | Exposed Group (n=449)[a,b] ;(n=431)[c] Number (%) | Non-exposed Group (n=188)[a,b] ;(n=179)[c] Number (%) | Relative Risk (95% CI) |
|---|---|---|---|
| a. Earache | 13 (2.9) | 3 (1.6) | 1.81 (0.52; 6.29) |
| b. Tinnitus | 52 (11.6) | 19 (10.1) | 1.15 (0.70; 1.88) |
| c. Hearing Impairment | 47 (10.9) | 384 (89.1) | 0.89 (0.55; 1,43) |

**Table 26** **Relative Risk (RR) of Hearing Disturbances due to Listening to a Stereo Using a Headphone among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| Outcome | Exposed Group (n=70)[a] ;(n=71)[b];(n=68)[c] Number (%) | Non-exposed Group (n=566)[a,b] ;(n=542)[c] Number (%) | Relative Risk (95% CI) |
|---|---|---|---|
| a. Earache | 1 (1.4) | 14 (2.5) | 0.58 (0.08; 4.33) |
| b. Tinnitus | 11 (15.5) | 60 (10.6) | 1.46 (0.81; 2.65) |
| c. Hearing Impairment | 5 (7.4) | 64 (11.8) | 0.62 (0.26; 1.49) |

**Table 27 Relative Risk (RR) of Hearing Disturbances due to Visiting Discotheques among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| Outcome | Exposed Group (n=49)[a,b] ;(n=48)[c] Number (%) | Non-exposed Group (n=586)[a];(n=587)[b];(n=560)[c] Number (%) | Relative Risk (95% CI) |
|---|---|---|---|
| a. Earache | 3 (6.1) | 12 (2) | 2.99 (0.87; 10.24) |
| b. Tinnitus | 10 (20.4) | 61 (10.4) | 1.96 (1.08; 3.58) |
| c. Hearing Impairment | 4 (8.3) | 65 (11.6) | 0.72 (0.27; 1.89) |

**Table 28 Relative Risk (RR) of Hearing Disturbances due to Attending Concerts among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| Outcome | Exposed Group (n=150)[a] ;(n=149)[b]; (n=141)[c] Number (%) | Non-exposed Group (n=487)[a,b] ;(n=469)[c] Number (%) | Relative Risk (95% CI) |
|---|---|---|---|
| a. Earache | 6 (4) | 10 (2.1) | 1.95 (0.72; 5.27) |
| b. Tinnitus | 20 (13.4) | 51 (10.5) | 1.28 (0.79; 2.08) |
| c. Hearing Impairment | 13 (9.2) | 56 (11.9) | 0.77 (0.44; 1.37) |

Walkman, discotheques, and concerts have positive associations with both earache and tinnitus. Meanwhile, stereo use has a positive association only with tinnitus. All four exposures have negative associations with hearing impairment, and listening to a stereo using a headphone in particular also has a negative association with earache.

The estimated number of this group of the population who suffered from hearing disturbance attributable to the exposure to leisure noise is expressed in Population Attributable Fraction (PAF) or Population Attributable Risk Percentage (PAR%). Population Attributable Fraction (PAF) is calculated using the formula: $PAF \quad (P(RR \quad 1))/[1+(P(RR \quad 1))]$ with P as prevalence of the exposed group in the population divided by the total population and RR as Prevalence Ratio (here as Relative Risk). Population Attributable Risk Percentage (PAR%) is known as the proportion of PAF in total population in percentage. It also can be produced by reducing the number of subjects with health outcomes in the total population (in percentage) by the number of subjects with health outcomes in the non-exposed population (in percentage). Due to the lack of incidence data, the calculation in this study was calculated using prevalence. Therefore, in order to maintain the clarity of the terms, the Population Attributable Risk (PAR) is named as Population Attributable Prevalence (PAP) and Population Attributable Fraction (PAF) is named as Population Attributable Prevalence Fraction (PAPF).

For example, Table 29 is presented in order to calculate the presence of earache which is attributable to listening to a Walkman. The cross tabulation that was conducted using information from the sample data has been transferred into numbers for the general population using the percentage. It is found out that there is a 2.9% prevalence of earache in the exposed group. This number is multiplied by 2,243,231 adolescents aged 11 to 14 years in the general population as estimated number exposed by Walkman (see Table 20), produced 65,054 adolescents age 11 to 14 years in the population who listen to a Walkman and have earache. Using the same computation, the 1.6% prevalence of earache in non-exposed group corresponds to 15,163 adolescents aged 11 to 14 years in the population who do not listen to a Walkman but have earache. Therefore, there is a total of 80,217 adolescent age 11 to 14 years in population who have earache regardless of the use of a Walkman.

**Table 29 The Estimated Number of Cross Tabulation between Listening to a Walkman and the Presence of Earache among Adolescents age 11 to 14 Years in Population, Calculated using Number of Population by EuroStat 2010**

| Cross Tabulation | | | | | |
|---|---|---|---|---|---|
| | | | **Earache** | | |
| | | | Yes | No | Total |
| **Walkman** | Yes | % within Walkman | 2.9 | 97.1 | 100 |
| | | % within earache | 81.3 | 70.2 | 70.5 |
| | No | % within Walkman | 1.6 | 98.4 | 100 |
| | | % within earache | 18.8 | 29.8 | 29.5 |
| | Total | % within Walkman | 2.5 | 97.5 | 100 |
| | | % within earache | 100 | 100 | 100 |

| Cross Tabulation | | | | |
|---|---|---|---|---|
| Population numbers estimated from percent data | | Earache | | |
| | | Yes | No | Total |
| Walkman | Yes | 65,054 | 2,178,177 | 2,243,231 |
| | No | 15,163 | 932,546 | 947,709 |
| | Total | 80,217 | 3,110,723 | 3,190,940 |

From Table 25 the RR between listening to a Walkman and the presence of earache is 1.81 or 181.25%. The prevalence of the exposed group in the population is 2,243,231 and the total population is 3,190,940, P accounts to 70.3%. Therefore, the PAPF of earache due to listening to a Walkman is 0.3635 or as much as 36.35%. This means that a 36.35% earache prevalence among adolescents aged 11 to 14 years in the German population is due to Walkman use.

Afterward, this PAF (or PAPF) is transferred into the number within the population using the formula: $PAR \quad PAF * Nd$ with Nd as the number of subjects with health outcomes in the population. Two different results appeared regarding the estimated number of hearing disturbances among adolescents aged 11 to 14 years within the German population which are 79,774 adolescents (see Table 22) and 80,217 adolescents (see Table 29). The first number resulted from the percentage of the sample suffering from earache multiplied by the total population, and the second number resulted from the sum of the estimated number of people listening to a Walkman and suffering from earache and the estimated number of people not listening to a Walkman and suffering from earache. When the first number is used, it produces 29,001 adolescents who suffer from earache attributable to listening to a Walkman. If the second absolute number of earache is used, it produces 29,162 adolescents who suffer from earache attributable to listening to a Walkman. The first number is preferred because less bias is produced in the estimation calculations.

With PAPF of 29,001 divided by 3,190,940 then multiplied by 100% resulted 0.91% of PAP%. In other words, 2.9% (percentage of subjects with earache in the total population) reduced by 1.6% (percentage of subjects with earache in the non-exposed population) amounts to

0.91%. This means that 0.91% of adolescents aged 11 to 14 years in the German population have earache due to Walkman use.

From this example it is clear that there is 36.35% PAPF or 0.91% PAP% among adolescents aged 11 to 14 years in the German population who have earache due to hearing Walkman, which corresponds to about 29,000 adolescents in this age group.

This calculation was then computed for all four exposures and three health outcomes. The estimated number of subjects with health outcomes in the population was calculated from the percentage of health outcomes multiplied by the total population in this age group. As it is presented in Table 29, there are 29,001 adolescents aged 11 to 14 years in the population who have earache attributable to Walkman use, 10,876 have earache attributable to discotheque visits, and 14,036 have earache attributable to concert attendance. Stereo use gives negative numbers in association with earache. Likewise, the result is 33,786 adolescents aged 11 to 14 years in the population who have tinnitus attributable to Walkman use, 17,443 have tinnitus attributable to stereo use, 24,636 attributable to discotheque visits and 21,869 to concert attendance. The negative absolute numbers in this table are meaningless and will be discussed in the followed chapter.

**Table 30 Population Attributable Prevalence, Population Attributable Prevalence Fraction and Estimated Numbers of Adolescents Aged 11 to 14 Years in Population in Respect to Health Outcomes in Association with Leisure Noise based on Sample aged 11 to 14 years in GerES IV** (EuroStat 2010)

| Health Outcomes in Association with Leisure Noise | Population Attributable Prevalence | Population Attributable Prevalence Fraction | Estimated Numbers of Adolescents Age 11 – 14 years old in Population |
|---|---|---|---|
| **Earache** | | | |
| Walkman | 0.91% | 36.35% | 29,001 |
| Stereo | -0.12% | -5.13% | -4,096 |
| Discotheques | 0.32% | 13.63% | 10,876 |
| Concerts | 0.45% | 17.60% | 14,036 |
| **Tinnitus** | | | |

| | | | |
|---|---|---|---|
| Walkman | 1.05% | 9.45% | 33,786 |
| Stereo | 0.54% | 4.88% | 17,443 |
| Discotheques | 0.77% | 6.89% | 24,636 |
| Concerts | 0.68% | 6.12% | 21,869 |
| **Hearing Test** | | | |
| Walkman | -0.98% | -8.70% | -31,361 |
| Stereo | -0.49% | -4.32% | -15,569 |
| Discotheques | -0.25% | -2.24% | -8,075 |
| Concerts | -0.64% | -5.66% | -20,400 |

### 4.2.4 Dose-Response Function

No available Dose-Response Function (DRF) in regard to hearing disturbance attributable to leisure noise was found in literature research.

## 4.3 DALYs Calculation

Because of the missing information concerning the DRF on hearing disturbance due to leisure noise, the DALYs calculation cannot be made. Therefore, the study comes to an end without producing DALYs. However, the pre-DALYs analysis has produced indicators such as Population Attributable Prevalence (PAP) and Population Attributable Prevalence Fraction (PAPF) that indicate the relevance of leisure noise exposure even without the result of the DALYs calculation.

## 4.4 Uncertainty and Sensitivity Analysis

In exposure assessment, there are three types of uncertainties being quantitatively assessed. They are scenario uncertainties, model uncertainties and parameter uncertainties.

Most scenario uncertainties for the exposure assessment in this study come from possible descriptive errors due to incorrect or incomplete information, such as the absence of information on duration (point of time) and frequency of health outcomes, as well as aggregation errors from rough calculations for loudness and frequency, including the following:

- To characterize the loudness in discotheques without consideration that it will increase during the night-time hours;
- To characterize the loudness in concerts without consideration that it will be different if the concerts takes place indoors or outdoors, loudness is not equally distributed all points in a location and that sound will be different in every performance;
- To assume that the leisure activity behaviour has been done regularly all year; and
- To characterize the loudness of the exposure with subjective judgment.

Due to the absence of information on the required dose-response function, there is no available model used in this study. Thus, the model uncertainty, that is, the uncertainty stemming from the model, was not found.

The sources of parameter uncertainties in this study could be random measurement errors, sample uncertainty and data type uncertainty. These uncertainties are as follows:

- Random measurement error: to conduct the hearing test in unstandardized settings, e.g., inside the room of participants, as well as to have memory recall as the approach in the questionnaire.
- Sample uncertainty: to cover a limited age group (11 to 14 years old) to describe the effect of leisure noise on hearing disturbances among the adolescents in the population in Germany as well as having a small group exposed to any sort of leisure noise.
- Data type uncertainty: to use the survey of GerES IV in 2003/06 together with the population number in 2010.

The study attempted to assess the uncertainty qualitatively by calculating the 95% Confidence Interval (CI) of the Relative Risk (RR) between leisure noise and hearing disturbances. The observed results, except between visiting discotheque and having tinnitus, embrace a RR of one. The observed difference for visiting discotheque and having tinnitus is statistically significant at the 5% level, but has a wide range from 1.08 to 3.58.

Because the DALYs calculation cannot be performed, the sensitivity analysis will also not be assessed in this study.

# 5 Discussion

Table 31 shows the summary of the steps undertaken in this study, along with the main results, discussion and the uncertainty analysis which took place along the process of the study.

**Table 31 Summary of the Results, Discussion and Uncertainty Analysis in "Environmental Burden of Disease on Leisure Noise among Adolescents in Germany" Study**

| Carried out Steps | Main Results & Discussion | Uncertainty Analysis |
|---|---|---|
| Literature & Available Data Research | GerES IV 2003/06: analyze 600 participants aged 11 to 14 years | Put together with 2010 population data by EuroStat.<br>To small sample in exposed group by gender and by the a-year-age group. |
| Exposure Assessment | Exposure:<br>1. Listening to a Walkman<br>2. Listening to a stereo using a headphone<br>3. Visiting discotheques<br>4. Attending concerts<br>Assess:<br>• the time history (the length and frequency) of exposure<br>• the characteristics (subjective loudness) of exposure | No definite time point in question addressing time history lead to recall bias and problems of recall.<br>Detailed information of time history, such as monthly and weekly frequency, was missing.<br>The subjective perception to assess loudness will give more bias than the objective measurement.<br>Other characteristics of exposure was missing such as continuous or impulse noise, the same loudness or grows louder over time, the annoyance due to exposure. |
| Health Outcome Assessment | Hearing Disturbances:<br>1. Hearing complaints: Earache and Tinnitus<br>2. Hearing Impairment by hearing test<br>Assess:<br>Hearing complaints:<br>• the existence of hearing complaints<br>• the duration of hearing complaints | A wide scale and unclear interval to assess the duration of hearing complaints.<br>No investigation for single, intermittent or continuous episodes.<br>No investigation for the temporal duration of the episodes, such as in days, weeks, months or years.<br>No investigation on severity of disturbance due to hearing |

| | | |
|---|---|---|
| | Hearing Impairment:<br>• the hearing test | complaints.<br>Unstandardized hearing test.<br>No gold standard method were applied to assess hearing loss: no otoacoustic emissions examination.<br>No investigation on confounders, predictors and several risk factors for hearing disturbances. |
| Pre-DALYs Calculation | Relative Risk (RR)<br>Positive RR:<br>• Walkman, stereo with a headphone, discotheques and concerts towards tinnitus<br>• Walkman, discotheques and concerts towards earache<br>Negative RR:<br>• Stereo with a headphone towards earache<br>• Walkman, stereo with a headphone, discotheques and concerts towards hearing test | The 95% CI for all RR are not significant, except for discotheques and tinnitus.<br>A wide range of 95% CI of RR for discotheques and tinnitus: 1.08 – 3.58. |
| | PAP & PAPF:<br>Only those with positive RR can be processed | A wide range estimation of PAP, PAPF & therefore the estimated numbers in population due to the range of 95% CI of RR.<br>E.g. The estimated numbers of adolescents aged 11 to 14 years in Germany who suffering from tinnitus due to visiting discotheques: 2188 – 59231 adolescents. |
| DALYs Calculation | DW: No available data | DAYLs cannot be calculated.<br>Sensitivity Analysis cannot be processed. |
| | DRF: No available data | |
| | Mortality Data: Regard as zero (0) | |
| | Morbidity Data<br>• Tinnitus: ICD IX (388.3), ICD X (H 93.1)<br>• Earache: ICD IX (388.7), ICD X (H 92.0)<br>• NIHL: ICD IX (388.12), ICD X (H 83.3) | |

| | | |
|---|---|---|
| | • The possibility to code cases ICD IX into 388.10 and 388.11. | |

The sole available data, GerES IV 2003/06, covered 1,790 children and adolescents. It applied two-step-selection sampling method in order to have a representative and conclusive survey to the children and adolescent population according to age, as well as gender, origin, living area and circumstances of living in Germany. The first selection is choosing the number of community groups in eastern Germany, western Germany and Berlin disproportionately. The second is selecting the children and adolescents per age bracket with a predetermined number. The survey was given to participants aged 3 to 14 years and/or their parents. The participants were classified into three age groups. They are 3 to 7, 8 to 10 and 11 to 14 years old. There were two types of questionnaires used. First is the questionnaire completed by the participants and second is the questionnaire completed by the parents. Only the second questionnaire was available for children aged 3 to 7 years due to their incapacity to fill in the first questionnaire. As has been mentioned in methodology chapter, questionnaires completed by 600 participants aged 11 to 14 years were included in the analysis.

In analysis, however, this data type yields a level of uncertainties in the way of integrating data from different years. This GerES IV 2003/06 was put together with 2010 population data by Eurostat. There is undoubtedly considerable change in both exposure and recipient characteristics over time. The dramatic rise in audio devices sold in the EU from 2004 to 2007, due to the introduction of mp3 in 2004 (SCENIHR 2008, pp.45-48), is one example of the exposure change which occurred between these times among adolescents. Another example is the use of ear bud, which was first introduced in 2000. Together with technological improvement, the lifestyle changes also influence the frequency and duration of exposure for recipients.

Even though the characteristics of the sample represent the characteristics of the population in Germany, the numbers for the exposed group by gender and by the a-year-age group are too small. For example, the study found only one boy who visited the discotheques weekly (see Appendix 3, 4, 5). In the next calculation, if this one boy were suffering from any sort of hearing complaint, it would be regarded as 100% corroboration between visiting discotheques and the presence of the relevant hearing complaint, both in the sample and later in the population. Hence, sample type uncertainty would appear.

There are five leisure noise exposures initially investigated in this study. Eventually, only four of them were analyzed due to incomplete information. They are listening to a Walkman, listening to a stereo using a headphone, visiting discotheques and attending concerts. Among these four exposures, listening to a Walkman was the most common exposure among participants. A previous study (Smith et al. 2000) showed that exposure from nightclubs is more common than from personal stereos among young adults aged 18-25 years. Another study found that the exposure from discotheques increase over time and with the age of a person (Struwe et al. 1996). The average frequency of disco visits increased from 1 to 2 times a month in 1980 to 1 to 2 times per week in 1993 among 12-22 year old adolescents, with the older group having greater exposure (Maassen et al. 2001; Struwe et al. 1996; Plontke & Zenner 2004). This upward trend with age, however, cannot be revealed in this study due to the limited age range of the sample.

The information regarding exposure in the survey consists of 1) the time history of exposure, including the length and frequency of exposure; and 2) the characteristics of the exposure, including the subjectively measured loudness of the referred exposure. Insufficient information, however, took place. Without determining the definite time point for addressing the time history of exposure, it is likely subject, to a great extent, to experience bias, either problems of recall or recall bias. Likewise, using the subjective perspective to assess the loudness of exposure would lead to some extent of bias.

From the analysis, it is found that there is a boy within the sample who has been using a Walkman for 11 years (see Appendix 3, 4, 5). After a check, it was found that this boy is 14 years old. This means that the Walkman listen started when this boy was 3 years old. An adolescent aged 14 years, with 11 years of exposure, will have difficulties with recalling the exposure. This limitation of recall may misclassify the participants into the exposed or non-exposed group. The recall bias also occurred when one had to recall the frequency of doing an activity this month, this year, last year, or 11 years ago. Even though the assumption was made that the activity was done regularly through the years, it is realized that there will be under- or over-estimated data. To avoid this, the time history of exposure should be clearly identified, such as the presence and the length of exposure in the last year, as well as monthly and weekly frequencies.

Another point in regard to the time history of exposure is the issue of choosing one variable from the questionnaire among some which carry the time history of exposure. As stated in a previous chapter (chapter four: result), the answer to the question, “how long have you been doing ... (sort of leisure noise) ...” is used instead of “how long have you been frequently doing ... (sort of leisure noise) ...” This is to avoid under-estimated information, contrary to the actual condition. As a matter of fact, both variables give essential information of duration and frequency which could be clearly investigated through several supporting questions, e.g. “how long have you been doing … (sort of leisure noise)”, “In the last one year, how frequently have you done … (sort of leisure noise)”, “In the last six months …”, “In the last three months ….”, “During last month …”, and “During last week …”.

This study conducted a subjective assessment via questionnaire by investigating the loudness of exposure. There are five gradations of loudness provided in the questionnaire. They are very quiet, quiet, moderate, loud and very loud. However, the subjective perception of loudness on assessing the characteristic of exposure, compared to objective measurement, will surely give room for bias. A habitually loud music listener will most likely regard the loudness at a level less than others due to an adjustment and adaptation process or as compensation of unrealized Temporary Threshold Shift (TTS) (Ising & Babisch 1998 cited in Maassen et al. 2001, p.5). Therefore, a direct measurement or qualitative established and standardized grade of perception is needed to have a more reliable assessment of loudness. Moreover, it is known now that impulse noise causes more severe health effects than continuous noise (Maassen et al. 2001). Therefore, characteristics of exposure should be defined in greater details, e.g., continuous or impulse noise, and whether it gives the same loudness or grows louder over time.

Even though subjective perceptions using a questionnaire remains an option and is still utilized (Jokitulppo & Bjork 2002; Twardella et al. 2011), the objective measurement is preferred to give the real figure for sound level exposure (Williams 2005; Williams, Beach & Gilliver 2010; Schmidt et al. 2011; Qian, Behar & Wong 2011). Madetoja (1998) as cited in Jokitulppo & Bjork (2002) tried to establish regression analysis in the relationship between subjective perception of loudness and the equivalent sound pressure levels of nine musical events and sport games among adults. For this analysis, the assumption has to be taken that the noise is steady. However, Williams and colleagues (2010) in a study in Australia found that the noise exposure through discotheques visit was not constant over time. It increased after 21.00 o’clock until 03.00 in the morning with $L_{Aeq} = 85 + 4T$ dB where T is the time in hours after 21.00. Even though The Health Minister of the Federal States in Germany

(*Gesundheitsministerkonferenz*, GMK), in accordance with DIN 15905-5, has set the threshold value of sound pressure in music events, including discotheques and concerts, which is below 100 dB (Heinecke-Schmitt et al. 2008), there is importance in inquiry into specific information e.g., the time of day for discotheques exposure, besides the frequency and duration of exposure - in order to have more precise loudness of noise exposure.

A national study in Switzerland in 2012 (BAFU 2011) tries to gather the chief characteristics of noise sources and noise recipients in order to assess the annoyance due to various sorts of noise. There are five items addressing the source characteristics. They are point of time of main disturbance (one for noise in the morning, lunch break and night time), the perceptibility of the noise (three for very loud, two for loud, one for middle and zero for slight), frequency (three for continuously, two for high-frequently, one for frequently and zero for seldom) and the type of noise (minus one for children's voices; one for low or high pitch frequency, sound or pulse, adults' voices, music and film; and two for very strong sound or pulse noise). The items regarding noise recipients consist of degree of susceptibility, sensibility, and local circumstances. The first item gives points for the susceptibility of the concerned area. Sick people, small children, adolescents, pregnant women and old people are regarded as sensitive persons and given one point. The local circumstance of an extraordinarily quiet area is also given one point. These points are incorporated into a formula built for this study, which described the predicted annoyance of every sort of noise.

There are 3 hearing complaints, i.e. earache, tinnitus and temporal deafness (*taube Ohren*), together with a hearing test being conducted in this study. Due to an unclear definition of temporal deafness in the community and lacking information on the questionnaire concerning this term, this hearing complaint was excluded from analysis to avoid an ambiguous result. The existence and the duration of hearing complaints were asked with a filter or contingency question. The duration of hearing complaints was asked using *likert scaling*, i.e. never, few minutes and few hours (see Appendix 1). The hearing test was performed among the participants and compared using the grades of hearing impairment from the WHO.

This study found that the most frequent hearing disturbance was slight impairment by hearing test, followed by tinnitus and earache (regardless of the duration), and the least was moderate impairment by hearing test. The result goes along with previous studies which concluded that tinnitus is widely regarded as an early sign of disruption due to noise (Davis 1989; West & Evans 1990; Mitchell & Michael 1991). Noise exposure in significant level will initiate temporary threshold shift (TTS) and/or tinnitus. A fail-to-compensate TTS and/or tinnitus will lead to immediate threshold shift (ITS) and/or chronic tinnitus, which later could be result in permanent threshold shift (PTS) known as permanent inner ear damage. The routine methods of medical checkup by ENT specialist often miss an early PTS to diagnose (Zenner 1994 cited in Maassen et al. 2001, p.2). Therefore, tinnitus, especially during the exposure, has been found the most common hearing disturbance among young adults in previous studies (Axelsson & Ringdahl 1989; Jokitulppo, Bjork & Akaan-Penttilä 1997; Jokitulppo & Bjork 2002).

The scale to assess the duration on hearing complaints, however, has a wide and unclear interval and gives room for a great extent of interpretation. A narrower scale and more clearly defined interval are important points to have a better picture on hearing complaints. The duration of a single episode such as in second or minutes, or whether it was intermittent or continuous, as well as the temporal duration of the episodes, such as in days, weeks, months or years, are worth investigation (WHO Regional Office for Europe 2011). Since almost everyone has experienced tinnitus, Davis (Davis & Refaie 2000) proposed points about tinnitus that should be taken into epidemiological study. It should be tinnitus which lasts for five minutes or more and its impact assessment. However, since the questionnaire include only 2 choices for the duration, i.e., few minutes and few hours, it is difficult to sort out those cases which are considerable.

As said previously, another point regarding hearing complaints which is also important is its severity of disturbance. A soft and gentle tinnitus will give different disturbance in comparison to a long and high pitch of tinnitus. In fact the similar soft and gentle tinnitus in two different persons will give different disturbances. However, this point was not being investigated in the survey. To have clearer information on the characteristics of hearing complaints, another form of questions can be asked such as in what occasion the hearing complaints take place and what kind of activities are being interrupted or cannot be performed when the hearing complaints take place. This information can also be utilized further when the disability weights (DW) are unavailable and therefore need to be built.

It is noted that the WHO grading used in hearing test relates to the remediation after the acquisition of hearing loss and not to the purposes of protection to prevent noise damage. Therefore, even though the grades used by WHO, i.e. 25 dB, is slightly higher than the one used by this study which is 20 dB, it is acceptable to set 20 dB as the limit value of normal hearing in order to prevent hearing impairment from occurring.

However, the hearing test was performed in a room of participants. This unstandardized performance produced great extent bias from other sources of noise and unequal level of background noise in the form of random measurement error as source of parameter uncertainties. Moreover, the participants were not free from certain kinds of interruptions such as door-bell and phone ringing. This unstandardized setting produced unreliable results which can be seen in relative risk between any sort of leisure noise and the hearing test which shows negative numbers, meaning protective association, since there are more cases in the non-exposed population than in the exposed population.

The health outcome assessment in this study, however, was regarded as insufficient. A study in Mexico found and applied a novel method to assess hearing loss due to noise exposure by conducting otoacoustic emissions. This method can reveal interruption even before a clinical audiometry can discover it (Martínez-Wbaldo et al. 2009). Moreover, the OHRKAN study (Twardella et al. 2011) utilizes a more comprehensive method to assess the hearing disturbance experienced among participants exposed to discotheques, concerts, and personal music players. This prospective cohort study assesses the hearing status by medical examinations which consist of tympanometry, audiometry, and distortion-product otoacoustic emissions.

Besides the exposure and health outcomes assessment, it is important to also employ questions which investigate confounders such as traffic noise, predictors such as gender, age, type of residential street, type of house, and type of area, as well as history of several risk factors such as potential ototoxic drugs consumption, history of deafness in family, history of ear infection and head trauma (Martínez-Wbaldo et al. 2009). Ising and Babisch in 1998 (1998) as cited in Maassen (2001, p.5) wrote that one of many reasons people use headphones is to cover up the other background noises such as traffic noise. By this the use of headphone might have a protective effect. Nevertheless, it is oft that people set audio devices louder when the background noise is also higher. It is also noted that these other sources of noise, e.g. traffic noise, have significant positive association towards several health outcome such as annoyance, sleep disturbance, cardiovascular effect and cognitive impairment (EEA 2010; WHO Regional Office for Europe 2011; Lieb, Buffat & Sommer 2012). Thereby, it could potentially be a confounder towards hearing disturbance and produce multicausality. Though some confounders and predictors are being asked in the questionnaire, this study cannot engage them in the analysis. Furthermore, the history of several risk factors is missing in the questionnaire.

The risk of permanent inner ear damage due to noise rises with the increasing intensity and duration of exposure. Even though the focus of this study was not mainly to define a causal relationship, there is a need to investigate the association between leisure noise and its effect, taking account of the relevant confounders. Therefore, a bigger number of participants, especially in the exposed group, are needed, as well as to define a multi-level dose-response function (Maassen et al. 2001).

The result of relative risk (RR) showed positive results on the Walkman towards tinnitus as well as on stereo with a headphone, discotheques and concerts. The positive results were also found on the Walkman towards earache as well as discotheques and concerts, but not on stereo with a headphone. These positive results are in accordance with previous studies (Struwe et al. 1996; Meyer-Bisch 1996; Maassen et al. 2001; Jokitulppo & Bjork 2002). This positive association could be causal but also could be a spurious positive association caused by the presence of confounders.

A positive association found in this study on exposure of Walkman agree with some previous studies which found that there were more frequent subjective hearing complaints and tinnitus among Walkman listeners (Meyer-Bisch 1996; Martínez-Wbaldo et al. 2009). Nevertheless, a more recent study failed to investigate the correlation between the exposures of PMP and self-reported hearing loss and/or tinnitus (Williams 2005). Hence, there is a need in the future to investigate its reproducibility.

The use of stereo with a headphone, in this study, gives positive association with tinnitus but not with earache. This might have happened because there were more cases suffering earache in the group without stereo exposure than in the group with stereo exposure. The reason of this could be due to the clarity of the question which asked about the use of stereo with a headphone. The stereo, excluding personal stereo, was used mostly in cars or at home and it was less likely that people hear stereo using a headphone. In previous study, it was found that the use of home stereo (Jokitulppo & Bjork 2002) increases the likelihood of having hearing disturbance. Using the previous question, the possibility that people expose to a stereo without a headphone in loud volume was not taken into account.

The positive association between discotheques and hearing disturbance found in this study is in accordance with what has been identified in previous studies (Table 32). Additionally, Babisch and Ising in 1989 (Babisch & Ising 1989) found that some hearing loss indicated on average more time spent in discotheques. Furthermore, Dieroff and colleagues in 1991 (Dieroff et al. 1991) found that more than 3 times per week showed a greater loss at very high frequency. Maassen and colleagues (Maassen et al. 2001) reported that about 67% of all discotheques visitors claimed to experience tinnitus and/or TTS.

**Table 32 Relative Risks of Hearing Impairment due to Discotheques Visit in Previous Studies** (UBA et al. 2000)

| Studie | N | Musik-Quelle | Alter [Jahre] | Frequenz [kHz] | Hörverlust | Relatives Risiko |
|---|---|---|---|---|---|---|
| Axelsson, 1981 | 538 | Diskothek+Konzert | 17 - 20 | | > 20 dB | keine Angabe |
| Fearn, 1981 | 153 | Diskothek+Konzert | 10 - 26 | 3 - 6 | > 5 dB | 3.1 |
| Fearn, 1984 | 173 | Diskothek+Konzert | 18 - 25 | 6 | > 10 dB | 1.9 - 3.6 |
| Mori, 1985 | 175 | HiFi+Diskothek | 20 - 29 | 4, 6 | > 20 dB | 4.7, 1.9 |
| Struwe, 1996 | 1811 | Diskothek+Konzert | 16 - 24 | 3 - 6 | > 20 dB | 1.3 |
| Ising, 1998 | 422 | Diskothek | 16 - 24 | 3 - 6 | > 20 dB | 1.4 |
| Mercier, 1998 | 347 | Diskothek+Walkman | 15 - 26 | 3 - 6 | > 20 dB | 1.6 |

To be precise, there are several kinds of concerts based on the type of music such as pop concerts (e.g. rock & roll music festival) or classical concerts (e.g. orchestra), and based on the location used, such as indoor (e.g. in concert halls and amphitheatres) or outdoor concerts (e.g. in parks). Different kind of concerts has different noise characteristics and therefore need different approaches. For example, an outdoor rock & roll music festival where the audience stands and moves around will expose the audience at different levels of noise than an indoor ballet orchestra where all viewers have to sit in a particular location which also means different exposure level. A report by the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) in 2008 (SCENIHR 2008) wrote that classical orchestras produced an average sound level considerably less than pop concerts, although in some performances, the classical orchestra has a long duration, thus, higher sound level. Even though the kind of concerts in this study was not clearly stated, it results in positive association towards tinnitus and earache. However, to facilitate a conclusion, it is preferable to define type of concerts so that results can be utilized.

However, these positive numbers of RR, except between visiting discotheque and having tinnitus, give insignificant results of 95% Confidence Intervals (CI) because they capture the value of no effect (RR = 1). The 95% CI for the estimate of RR between visiting discotheques and having tinnitus, however, shows a wide range and runs from 1.08 to 3.58.

All sources of leisure noise exposure indicated negative RR towards hearing tests. This result, however, is in contrary to some previous studies. Hoffmann (1997 cited in Maassen et al. 2001, p.2) clearly concluded that 10% of young people suffer from irreversible sensory neural hearing loss (SNHL) after 10 years being exposed to personal cassette players (PCPs), discotheques, and concerts. Jian-Hua Peng and colleagues in China (Peng, Tao & Huang 2007) found that long-term use of personal listening devices, i.e. Walkman cassette player, CD player, and mp3 player, raises the risk of hearing function impairment. Additionally, Martinez-Wbaldo and colleagues (Martínez-Wbaldo et al. 2009) found almost 20% of hearing loss in Mexico City schools due to noise exposure, mainly leisure noise such as visiting discotheques and pop music concerts, the use of personal stereos, and noise exposure in school workshops. Nevertheless, the negative results towards hearing test in this study might be considered as unreliable since the test was performed in an unstandardized setting and method.

Subsequently, only positive PARF which were generated by positive RR will give indicatory meaning and could be evaluated. There are about 53,913 adolescents aged 11 to 14 years old who might suffer from earache attributable to exposure by listening to a Walkman, visiting discotheques or attending concerts. There might be about 97,734 adolescents in this age who are suffering from tinnitus attributable to exposure by listening to a Walkman, hearing a stereo using a headphone, visiting discotheques or attending concerts. In this study, however, a wide range of PARF was also produced by wide range of RR. A range of the 95% CI of RR from 1.08 to 3.58 (between visiting discotheques and having tinnitus) produced a range of PARF from 2188 to 59231 adolescents aged 11 to 14 years.

Two others points regarding DALYs calculation for leisure noise that should also be considered in this study are disability weight (DW) and the morbidity data concerning the health outcome. There is no available DW for tinnitus, earache and hearing disturbance in childhood onset. Further studies in regards to searching the DW for health outcomes in different degrees are needed. Previous studies have tried to modify DW for tinnitus (Stouthard, Essink-Bot & Bonsel 2000; Deshaies et al. 2005; McIntosh et al. 2007). All of them need the duration and the severity of tinnitus in order to build the DW. A study by WHO Europe has decided to use DW of 0,01 for slightly disabling tinnitus and 0,11 for moderate to severely disabling tinnitus to assess the DALYs (WHO Regional Office for Europe 2011). This study, however, failed to put the grade of severity into the question concerning tinnitus. Therefore, this DW is not applicable to the study. The same rule applies also to earache and hearing disturbance in childhood onset. The DW should in future study be built by taking duration and severity into consideration.

The morbidity data in population for tinnitus can be taken from ICD IX (388.3) and from ICD X (H 93.1), for earache (medical term is otalgia) from ICD IX (388.7) and from ICD X (H 92.0), for Noise Induced Hearing Loss (NIHL) from ICD IX (388.12) and from ICD X (H 83.3). In addition, there is also the possibility to code cases ICD IX into 388.10 (noise effects on inner ear, unspecified) and 388.11 (acoustic trauma [explosive] to ear). To suit this morbidity data, clear questions and added explanations within the questionnaire for the general population, especially adolescents, are important. For example, tinnitus is defined not only as ringing sound perception not due to external sound source, but it is defined as the inability to perceive silence (Leroux & Lalonde 1993). It includes the roaring, hissing sound perception (WHO Regional Office for Europe 2011). Earache (or otalgia) is an ache in all parts of ear (MedicineNet.com 2012), but when due to leisure noise it is more as a pain located in the middle or inner ear. Missing these added explanations will add the possibility of bias.

Lacking the time point, e.g. in the last one year, and the frequency of disturbance makes it impossible to decide the incidence of hearing complaints. This leads to an ambiguous calculation of Population Attributable Risk (PAR) which should be calculated based on time. Moreover, DRF which consists of multi-level exposure-response assessment rather than dichotomous exposure categorical, as well as classified by gender and age, is needed (WHO Regional Office for Europe 2011). This critical and fundamental descriptive error uncertainty together with the absence of DRF makes the calculation of DALYs and sensitivity analysis impossible to determine. Moreover, great range estimation for the PARF calculation, taking into account the 95% CI of the Relative Risk (RR), together with generalization assumptions, limitation of information and measurements, give a great degree of uncertainty of this study.

Going over these results and observing the technology developments and lifestyle changes, the environmental burden due to leisure noise will increase over time. A study called the Delphy study in Netherlands (Vogel et al. 2009b) has found that regulations from government, besides the responsibility of the adolescents themselves, are effective in preventing mp3-

induced hearing loss among adolescents in that country. Therefore, preventive strategies and intervention which are produced by future research studies should be sought and considered.

# 6 Conclusion and Recommendations

Though leisure noise is difficult to assess due to individual variability when it comes to the type of leisure activities, its frequency and duration, as well as the type of leisure devices, it is feasible to examine leisure noise, obviously, within the border of uncertainties. This study is one of the first attempts to assess the environmental burden of the disease of leisure noise, trying to use DALYs calculation, among adolescents in Germany. It gives new perspectives of what has been done and what should be prepared and be done in the future related to this theme. Constrained by a great degree of uncertainties due to lack of data, the results of this study might give clues and directions which are needed in future studies addressing this theme.

Taking into account the great degree of uncertainty which has been assessed qualitatively as well as quantitatively by calculating 95% CI of relative risks, this study has produced estimation as follows: 1) 36.35% of the earache prevalence in the population is attributable to Walkman listen, 13.63% to discotheques visit and 17.6% to concerts attend; 2) 9.45% of the tinnitus prevalence in the population is attributable to Walkman listen, 6.89% to discotheques visit, 6.12% to concerts attend and 4.88% to stereo hearing using a headphone.

This study estimates that listening to a Walkman attribute to 0.91% of the population to have earache and 1.05% of population to have tinnitus, hearing a stereo using a headphone attribute to 0.54% of the population to have tinnitus, visiting discotheques attribute to 0.32% of the population to have earache and 0.77% of the population to have tinnitus, and attending concerts attribute to 0.45% of the population to have earache and 0.68% of the population to have tinnitus.

GerES IV, as a source of this study, is representative and therefore could be utilized to assess environmental exposure among adolescents in Germany. However, a bigger sample size, especially in the exposed group, and a wider age range of exposure condition is needed in order to have sufficient data for analysis and proper conclusion. Exposure and health outcome assessment by a more detailed and comprehensive questionnaire are needed to lessen possible bias. These qualitative assessments, if possible, should also be supported by standardized quantitative measurements. Confounders from other sources of noise, predictors such as age, gender, type of street, house, and area, as well as information of several risk factors for hearing disturbances should also be included in the analysis. DALYs for leisure noise are not calculated in this study due to the absence of DRF and information of incidence on exposure and health outcome assessments.

Looking at technology improvement and life style change in Germany, the trend of leisure noise exposure will be increasing, especially among adolescents. Hence, studies which aim to target this theme will be urgently needed. Therefore, this study recommends further in-depth studies, especially in establishing standardized questionnaires and measurement regarding exposure and health outcome assessment, as well as in assessing disability weights of health outcomes and dose-response function of leisure noise, as a preparation for future DALYs study.

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# 8 Statutory Declaration

I hereby confirm that I am the author of the thesis presented. I have written the thesis as applied for previously unassisted by others, using only the sources and references stated in the text.

# 9 Appendix

## 9.1 Appendix 1 - Children Questionnaire (GerES IV 2003/06)

UMWELTBUNDESAMT
für Mensch und Umwelt

ROBERT KOCH INSTITUT
Robert Koch-Institut, Seestraße 10, 13353 Berlin

Studie zur Umweltbelastung von Kindern in Deutschland

**Interviewgesteuerter Fragebogen**
**an die 11- bis 14-jährigen Kindern**

| | |
|---|---|
| ID-Nr. Kind/Jugendliche(r) | ☐☐☐☐☐☐ |
| Datum der Erhebung | ☐☐.☐☐.200☐ |
| Begeher-Nr. | ☐☐☐☐☐☐ |

Zunächst interessiert uns, ob Du **Musik** über Walkman, Discman, in Diskotheken, in Musikclubs oder bei Live-Konzerten **hörst**. Weiterhin interessiert uns, **wie oft** Du im Durchschnitt auf diese verschiedenen Arten Musik hörst und **wie lange** Du das jeweils schon so machst.

1. a) Hörst Du Musik mit **Walkman, Discman** und/oder **MP3-Player?**

***Interviewer**: Gemeint sind hier <u>tragbare</u> Musikabspielgeräte.*

Nein ... ☐ **Bitte weiter mit Frage 4!**

Ja ...... ☐

↓

b) **Wie lange** hörst Du schon Musik mit Walkman, Discman und/oder MP3-Player?

Ein Jahr oder länger ... ☐ und seit wie vielen Jahren .. ☐☐ Jahren

oder *(auf ganze Jahre runden)*

Kürzer als ein Jahr .... ☐ <u>Bitte weiter mit Frage 1c und dann mit Frage 2</u>

c) **Wie viele Stunden pro Tag** hörst Du **zur** Zeit Musik mit Walkman, Discman und/oder MP3-Player?

☐☐,☐ Stunden pro Tag

*(auf 0,5 runden)*

d) **Wie lange** machst Du das schon **mit dieser Häufigkeit** pro Tag?

Ein Jahr oder länger ... ☐ und seit wie vielen Jahren .. ☐☐ Jahren

oder *(auf ganze Jahre runden)*

Kürzer als ein Jahr .... ☐

2. Wie **laut** hörst Du im Allgemeinen Musik mit **Walkman, Discman** und/oder **MP3-Player?**

***Interviewer:** Liste A vorlegen!*

| **<u>sehr laut</u>** | **<u>ziemlich laut</u>** | **<u>mittelmäßig</u>** | **<u>ziemlich leise</u>** | **<u>sehr leise</u>** |
|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ |

3. Wie oft **erhöhst** Du im Allgemeinen beim Hören von Musik mit **Walkman, Discman** und/oder **MP3-Player** die Lautstärke oder befindet sich der Lautstärkeregler bereits am Anschlag?

a) Befindet sich der Regler bereits am Anschlag (max. Lautstärke)?

Ja ...... ☐ **Bitte weiter mit Frage 4!**

Nein ... ☐

↓

b) Wie oft **erhöhst** Du im Allgemeinen beim Hören von Musik mit **Walkman, Discman** und/oder **MP3-Player** die Lautstärke?

***Interviewer:*** *Liste B vorlegen!*

| **immer** | **oft** | **gelegentlich** | **selten** | **nie** |
|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ |

4. a) Hörst Du Musik **mit Kopfhörern** über eine **Musik-Anlage** (nicht Walk- oder Discman)?

Nein ... ☐ **Bitte weiter mit Frage 6!**

Ja ...... ☐

↓

b) **Wie lange** hörst Du schon Musik über eine Musik-Anlage **mit** **Kopfhörern**?

Ein Jahr oder länger ... ☐ und seit wie vielen Jahren .. ☐☐ Jahren

oder *(auf ganze Jahre runden)*

Kürzer als ein Jahr .... ☐ Bitte weiter mit Frage 4c und dann mit Frage 5!

c) **Wie viele Stunden pro Tag** hörst Du **zur Zeit** Musik über eine Musik-Anlage **mit Kopfhörern**?

☐☐,☐ Stunden pro Tag

*(auf 0,5 Std. runden)*

d) **Wie lange** machst Du das schon **mit dieser Häufigkeit** pro Tag?

Ein Jahr oder länger ... ☐ und seit wie vielen Jahren .. ☐☐ Jahren

oder *(auf ganze Jahre runden)*

Kürzer als ein Jahr .... ☐

5. Wie **laut** hörst Du im Allgemeinen Musik über eine **Musik-Anlage mit Kopfhörern**?

***Interviewer:*** *Liste C vorlegen!*

| **seht laut** | **ziemlich laut** | **mittelmäßig** | **ziemlich leise** | **sehr leise** |
|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ |

6. a) Besuchst Du **Diskotheken** und/oder **Musikclubs**?

Nein ... ☐ **Bitte weiter mit Frage 9!**

Ja ...... ☐

↓

b) **Wie lange** besuchst Du schon Diskotheken und/oder Musikclubs?

Ein Jahr oder länger ... ☐ und seit wie vielen Jahren .. ☐☐ Jahren

oder *(auf ganze Jahre runden)*

Kürzer als ein Jahr .... ☐ Bitte weiter mit Frage 6c und dann mit Frage 7!

c) **Wie oft im Monat** besuchst Du **zur** Zeit Diskotheken und/oder Musikclubs?

☐☐ mal pro Monat

d) **Wie lange** machst Du das schon **mit dieser Häufigkeit** pro Monat?

Ein Jahr oder länger ... ☐ und seit wie vielen Jahren .. ☐☐ Jahren

oder *(auf ganze Jahre runden)*

Kürzer als ein Jahr .... ☐

7. Wie beurteilst Du im Allgemeinen die **Lautstärke auf der Tanzfläche** in den Diskotheken und/oder Musikclubs?

Zu laut................. ☐

Gerade richtig...... ☐

Zu leise.............. ☐

8. Und **wie laut** ist es **auf der Tanzfläche** in den Diskotheken und/oder Musikclubs, die Du **am häufigsten** besuchst?

*Interviewer: Liste D und **keine** Mehrfachnennungen möglich.*

So laut, ...

A dass man sich mit normaler Stimme unterhalten kann. .................................. ☐

B dass man sich mit lauter Stimme unterhalten kann. .................................... ☐

C dass man schreien muss, um sich zu verständigen. ..................................... ☐

D dass man sich auch durch Schreien kaum noch verständigen kann. ........... ☐

E dass auch durch lautes Schreien eine Verständigung nicht mehr möglich ist. ☐

9. a) Besuchst Du **Konzerte, wo die Musik über Lautsprecher gespielt wird** (z. B. Live-Konzerte im Freien oder in Konzertsälen)?

Nein ... ☐ **Bitte weiter mit Frage 11!**

Ja ...... ☐

↓

b) **Wie lange** besuchst Du schon solche Veranstaltungen?

Ein Jahr oder länger ... ☐ und seit wie vielen Jahren .... ☐☐ Jahren

oder *(auf ganze Jahre runden)*

Kürzer als ein Jahr .... ☐ Bitte weiter mit Frage 9c und dann mit Frage 10!

c) **Wie oft im Jahr** besuchst Du **zur Zeit** solche Veranstaltungen?

☐☐ mal pro Jahr

d) **Wie lange** machst Du das schon **mit dieser Häufigkeit** pro Jahr?

Ein Jahr oder länger ... ☐ und seit wie vielen Jahren .... ☐☐ Jahren

oder *(auf ganze Jahre runden)*

Kürzer als ein Jahr .... ☐

10. Wie beurteilst Du im Allgemeinen die **Lautstärke** bei solchen Konzerten?

Zu laut.................................. ☐

Gerade richtig.......................... ☐

Zu leise................................... ☐

Nun interessiert uns Dein Verhalten bei **Computerspielen**.

11. a) Spielst Du **Computerspiele**?

Nein ... ☐ **Bitte weiter mit Frage 12!**

Ja ...... ☐

↓

b) Setzt Du dabei **Kopfhörer** auf?

Nein, nie ............... ☐ **Bitte weiter mit Frage 12!**

Ja .......................... ☐

↓

c) **Wie oft** spielst Du **zur Zeit** Computerspiele **mit** Kopfhörern?

Täglich ..................... ☐ und zwar etwa.. ☐☐,☐ Stunden pro Tag

oder *(auf 0,5 Std. runden)*

Seltener .................... ☐ und zwar etwa .. ☐☐ mal pro Woche

***Interviewer:*** *Entsprechend der Angabe des Kindes die Häufigkeit bei „Woche" oder „Monat" eintragen.* ☐☐ mal pro Monat

d) **Wie lange** machst Du das schon **mit dieser Häufigkeit**?

Ein Jahr oder länger.. ☐ und seit wie vielen Jahren ............. ☐☐ Jahren

oder *(auf ganze Jahre runden)*

Kürzer als ein Jahr .. ☐

Jetzt haben wir noch einige Fragen zu **Ohrenbeschwerden.**

12. a) Hast Du schon einmal **so laut Musik gehört**, dass Du **Ohrenbeschwerden** wie Ohrenschmerzen, Ohrenpfeifen oder -rauschen (Tinnitus) oder taube Ohren hattest?
b) Wenn ja, **wie lange** dauerten diese Beschwerden im **schlimmsten Fall?**

***Interviewer:*** *Liste E vorlegen und in jede Zeile mindestens ein Kreuz.*

| | Beschwerden gehabt? | | | | Wie lange im schlimmsten Fall? | |
|---|---|---|---|---|---|---|
| | Nein | Weiß nicht | Ja | | Einige Minuten | einige Stunden |
| A Ohrenschmerzen .............................. | ☐ | ☐ | ☐ | ➔ | ☐ | ☐ |
| B Ohrenpfeifen/-rauschen (Tinnitus) .. | ☐ | ☐ | ☐ | ➔ | ☐ | ☐ |
| C Taube Ohren .................................. | ☐ | ☐ | ☐ | ➔ | ☐ | ☐ |

Als nächstes möchten wir uns mit dem Thema **Lärm** beschäftigen.

14. **Fühlst** Du dich im Allgemeinen in dieser **Wohnung** / in diesem **Haus tagsüber** durch **Lärm** gestört oder belästigt? Denke dabei bitte an die **letzten 12 Monate.**

*Interviewer: Liste H vorlegen und in jede Zeile ein Kreuz. Wenn das Kind mit dem Begriff „Lärm" nichts anfangen kann, bitte Erklärung geben: „Mit Lärm sind Geräusche und Krach gemeint".*

| | | dadurch gestört oder belästigt | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Überhaupt nicht** | **Etwas** | **Mittel-mässig** | **Stark** | **Äußerst stark** | **Quelle nicht vor-handen** |
| A | Straßenlärm | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| B | Fluglärm | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| C | Schienenverkehrslärm | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| D | Baulärm | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| E | Nachbarschaftslärm | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| F | Industrie-/Gewerbelärm | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| G | Lärm durch Gaststätten/Diskotheken | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| H | Lärm von Kinderspielplätzen | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I/J | Lärm durch Naturgeräusche (z. B. Bach, Vögel) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| K | Lärm durch Geräusche in der Hausinstallation (z. B. Wasser-/Heizungsrohre) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| L | Lärm durch Familienmitglieder in der Wohnung | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| M | sonstiger Lärm und zwar: ______________ | ☐ | ☐ | ☐ | ☐ | ☐ | |

Nun stelle ich Dir die gleiche Frage noch einmal für die nächtliche Schlafenszeit.

15. **Fühlst** Du dich im Allgemeinen in dieser **Wohnung** nachts durch **Lärm** beim **Einschlafen** oder **Durchschlafen** gestört oder belästigt? Bitte denke dabei wieder an die **letzten 12 Monate!**

***Interviewer:*** *Liste H vorlegen und in jede Zeile ein Kreuz. Wenn das Kind mit dem Begriff „Lärm" nichts anfangen kann, bitte Erklärung geben: „Mit Lärm sind Geräusche und Krach gemeint".*

| | dadurch gestört oder belästigt | | | | | |
|---|---|---|---|---|---|---|
| | Überhaupt nicht | Etwas | Mittel-mässig | Stark | Äußerst stark | Quelle nicht vor-handen |
| A Straßenlärm ........ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| B Fluglärm ........ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| C Schienenverkehrslärm ........ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| D Baulärm ........ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| E Nachbarschaftslärm ........ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| F Industrie-/Gewerbelärm ........ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| G Lärm durch Gaststätten/Diskotheken. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| H Lärm von Kinderspielplätzen ........ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I/J Lärm durch Naturgeräusche (z. B. Bach, Vögel) ........ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| K Lärm durch Geräusche in der Hausinstallation (z. B. Wasser-/Heizungsrohre) ........ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| L Lärm durch Familienmitglieder in der Wohnung ........ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| M sonstiger Lärm und zwar: ________ | ☐ | ☐ | ☐ | ☐ | ☐ | |

## 9.2 Appendix 2 – Relative Risks (RR) Calculation

### 9.2.1 Listening to a Walkman

**Table 33 Relative Risk (RR) of Earache due to Listening to a Walkman among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| | | Earache N (%) | | |
|---|---|---|---|---|
| | | Yes *[95% CI]* | No | Total |
| **Walkman** | Yes | 13 (2.04) *[1.14 ; 3.56]* | 436 (68.45) | 449 (70.49) |
| | No | 3 (0.47) *[0.12 ; 1.49]* | 185 (29.04) | 188 (29.51) |
| | Total | 16 (2.51) *[1.49 ; 4.14]* | 621 (97.49) | 637 (100) |
| | | | | **RR = 1.81** ***[0.52 ; 6.29]*** |

**Table 34 Relative Risk (RR) of Tinnitus due to Listening to a Walkman among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| | | Tinnitus N (%) | | |
|---|---|---|---|---|
| | | Yes *[95% CI]* | No | Total |
| **Walkman** | Yes | 52 (8.16) *[6.21 ; 10.64]* | 397 (62.32) | 449 (70.49) |
| | No | 19 (2.98) *[1.86 ; 4.71]* | 169 (26.53) | 188 (29.51) |
| | Total | 71 (11.15) *[8.86 ; 13.91]* | 566 (88.85) | 637 (100) |
| | | | | **RR = 1.15** ***[0.70 ; 1.88]*** |

**Table 35 Relative Risk (RR) of Hearing Impairment due to Listening to a Walkman among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| | | Hearing Impairment N (%) | | |
|---|---|---|---|---|
| | | Yes *[95% CI]* | No | Total |
| **Walkman** | Yes | 47 (7.7) *[5.77 ; 10.19]* | 384 (62.95) | 431 (70.66) |
| | No | 22 (3.61) *[2.33 ; 5.50]* | 157 (25.74) | 179 (29.34) |
| | Total | 69 (11.31) *[8.96 ; 14.16]* | 541 (88.69) | 610 (100) |
| | | | | **RR = 0.89** ***[0.55 ; 1.43]*** |

### 9.2.2 Listening to a Stereo Using a Headphone

**Table 36 Relative Risk (RR) of Earache due to Listening to a Stereo Using a Headphone among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| | | Earache N (%) | | |
|---|---|---|---|---|
| | | Yes ***[95% CI]*** | No | Total |
| **Stereo** | Yes | 1 (0.16) *[0.01 ; 1.01]* | 69 (10.85) | 70 (11.01) |
| | No | 14 (2.20) *[1.26 ; 3.76]* | 552 (86.79) | 566 (88.99) |
| | Total | 15 (2.36) *[1.37 ; 3.95]* | 621 (97.64) | 636 (100) |
| | | | | **RR = 0.58 *[0.08 ; 4.33]*** |

**Table 37 Relative Risk (RR) of Tinnitus due to Listening to a Stereo Using a Headphone among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| | | Tinnitus N (%) | | |
|---|---|---|---|---|
| | | Yes ***[95% CI]*** | No | Total |
| **Stereo** | Yes | 11 (1.73) *[0.91 ; 3.16]* | 60 (9.42) | 71 (11.15) |
| | No | 60 (9.42) *[7.32 ; 12.02]* | 506 (79.43) | 566 (88.85) |
| | Total | 71 (11.15) *[8.86 ; 13.91]* | 566 (88.85) | 637 (100) |
| | | | | **RR = 1.46 *[0.81 ; 2.65]*** |

**Table 38 Relative Risk (RR) of Hearing Impairment due to Listening to a Stereo Using a Headphone among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| | | Hearing Impairment N (%) | | |
|---|---|---|---|---|
| | | Yes ***[95% CI]*** | No | Total |
| **Stereo** | Yes | 5 (0.82) *[0.30 ; 2.02]* | 63 (10.33) | 68 (11.15) |
| | No | 64 (10.49) *[8.23 ; 13.27]* | 478 (78.36) | 542 (88.85) |
| | Total | 69 (11.31) *[8.96 ; 14.16]* | 541 (88.68) | 610 (100) |
| | | | | **RR = 0.62 *[0.26 ; 1.49]*** |

### 9.2.3 Visiting Discotheques

**Table 39 Relative Risk (RR) of Earache due to Visiting Discotheques among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| | | **Earache N (%)** | | |
|---|---|---|---|---|
| | | Yes *[95% CI]* | No | Total |
| **Discotheques** | Yes | 3 (0.47) *[0.12 ; 1.50]* | 46 (7.24) | 49 (7.72) |
| | No | 12 (1.89) *[1.03 ; 3.37]* | 574 (90.39) | 586 (92.28) |
| | Total | 15 (2.36) *[1.38 ; 3.96]* | 620 (97.64) | 635 (100) |
| | | | | **RR = 2.99 *[0.87 ; 10.24]*** |

**Table 40 Relative Risk (RR) of Tinnitus due to Visiting Discotheques among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| | | **Tinnitus N (%)** | | |
|---|---|---|---|---|
| | | Yes *[95% CI]* | No | Total |
| **Discotheques** | Yes | 10 (1.57) *[0.80 ; 2.97]* | 39 (6.13) | 49 (7.7) |
| | No | 61 (9.59) *[7.47 ; 12.21]* | 526 (82.7) | 587 (92.3) |
| | Total | 71 (11.16) *[8.87 ; 13.93]* | 565 (88.84) | 636 (100) |
| | | | | **RR = 1.96 *[1.08 ; 3.58]*** |

**Table 41 Relative Risk (RR) of Hearing Impairment due to Visiting Discotheques among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| | | **Hearing Impairment N (%)** | | |
|---|---|---|---|---|
| | | Yes *[95% CI]* | No | Total |
| **Discotheques** | Yes | 4 (0.66) *[0.21 ; 1.80]* | 44 (7.24) | 48 (7.89) |
| | No | 65 (10.69) *[8.40 ; 13.49]* | 495 (81.41) | 560 (92.11) |
| | Total | 69 (11.35) *[8.99 ; 14.21]* | 539 (88.65) | 608 (100) |
| | | | | **RR = 0.72 *[0.27 ; 1.89]*** |

### 9.2.4 Attending Concerts

**Table 42 Relative Risk (RR) of Earache due to Attending Concerts among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| | | **Earache N (%)** | | |
|---|---|---|---|---|
| | | Yes *[95% CI]* | No | Total |
| **Concerts** | Yes | 6 (0.94) *[0.38 ; 2.15]* | 144 (22.61) | 150 (23.55) |
| | No | 10 (1.57) *[0.80 ; 2.97]* | 477 (74.88) | 487 (76.45) |

| | | | | |
|---|---|---|---|---|
| | Total | 16 (2.51) *[1.49 ; 4.14]* | 621 (97.49) | 637 (100) |
| | | | | **RR = 1.95 *[0.72 ; 5.27]*** |

**Table 43 Relative Risk (RR) of Tinnitus due to Attending Concerts among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| | | **Tinnitus N (%)** | | |
|---|---|---|---|---|
| | | Yes ***[95% CI]*** | No | Total |
| **Concerts** | Yes | 20 (3.14) *[1.98 ; 4.90]* | 129 (67.45) | 149 (23.43) |
| | No | 51 (8.02) *[6.08 ; 10.48]* | 436 (68.55) | 487 (76.57) |
| | Total | 71 (11.16) *[8.87 ; 13.93]* | 565 (88.8) | 636 (100) |
| | | | | **RR = 1.28 *[0.79 ; 2.08]*** |

**Table 44 Relative Risk (RR) of Hearing Impairment due to Attending Concerts among Sample Aged 11 to 14 Years Based on GerES IV 2003/06 Using a Weighting Factor**

| | | **Hearing Impairment N (%)** | | |
|---|---|---|---|---|
| | | Yes ***[95% CI]*** | No | Total |
| **Concerts** | Yes | 13 (2.13) *[1.19 ; 3.71]* | 128 (20.98) | 141 (23.11) |
| | No | 56 (9.18) *[7.06 ; 11.82]* | 413 (67.7) | 469 (76.88) |
| | Total | 69 (11.31) *[8.96 ; 14.16]* | 541 (88.68) | 610 (100) |
| | | | | **RR = 0.77 *[0.44 ; 1.37]*** |

## 9.3 Appendix 3 – Cross Tabulation Association towards Earache

### 9.3.1 Listening to a Walkman

**Table 45 Cross Tabulation between the Duration of Listening to a Walkman and the Presence of Earache among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Duration of Walkman Listen (years) | The Presence of Earache [n(%)] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | Girls | | | Total | | |
| | 0 | Few minutes | Total | 0 | Few minutes | Total | 0 | Few minutes | Total |
| **0** | 119 (97,5) | 3 (2,5) | 122 (100) | 66 (100) | 0 | 66 (100) | 185 (98,4) | 3 (1,6) | 188 (100) |
| **< 1** | 72 (93,5) | 5 (6,5) | 77 (100) | 67 (100) | 0 | 67 (100) | 139 (96,5) | 5 (3,5) | 144 (100) |
| **1** | 19 (100) | 0 | 19 (100) | 11 (91,7) | 1 (8,3) | 12 (100) | 30 (96,8) | 1 (3,2) | 31 (100) |
| **2** | 47 (97,9) | 1 (2,1) | 48 (100) | 53 (98,1) | 1 (1,9) | 54 (100) | 99 (98) | 2 (2) | 101 (100) |
| **3** | 32 (97) | 1 (3) | 33 (100) | 39 (100) | 0 | 39 (100) | 71 (98,6) | 1 (1,4) | 72 (100) |
| **4** | 9 (100) | 0 | 9 (100) | 35 (92,1) | 3 (7,9) | 38 (100) | 44 (93,6) | 3 (6,4) | 47 (100) |
| **5** | 8 (100) | 0 | 8 (100) | 19 (100) | 0 | 19 (100) | 27 (100) | 0 | 27 (100) |
| **6** | 5 (100) | 0 | 5 (100) | 6 (100) | 0 | 6 (100) | 11 (100) | 0 | 11 (100) |
| **7** | 3 (100) | 0 | 3 (100) | 4 (100) | 0 | 4 (100) | 6 (100) | 0 | 6 (100) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **8** | 2 (100) | 0 | 2 (100) | 2 (100) | 0 | 2 (100) | 3 (100) | 0 | 3 (100) |
| **9** | 1 (100) | 0 | 1 (100) | 2 (100) | 0 | 2 (100) | 3 (100) | 0 | 3 (100) |
| **10** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **11** | 0 | 1 (100) | 1 (100) | 0 | 0 | 0 | 0 | 1 (100) | 1 (100) |
| **Total** | 317 (96,6) | 11 (3,4) | 328 (100) | 304 (98,4) | 5 (1,6) | 309 (100) | 618 (97,5) | 16 (2,5) | 634 (100) |

| **Symmetric Measures** | **Boys** | | **Girls** | | **Total** | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,319 | 0,000 | 0,229 | 0,094 | 0,265 | 0,000 |
| **Cramer's V** | 0,319 | 0,000 | 0,229 | 0,094 | 0,265 | 0,000 |

**Table 46 Cross Tabulation between the Frequency of Listening to a Walkman and the Presence of Earache among Sample Aged 11 to 14 Years Using a Weighting Factor**

| **Frequency of Walkman Listen (hours/day)** | **The Presence of Earache [n(%)]** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Boys** | | | **Girls** | | | **Total** | | |
| | 0 | Few minutes | Total | 0 | Few minutes | Total | 0 | Few minutes | Total |
| **0** | 119 (97,5) | 3 (2,5) | 122 (100) | 66 (100) | 0 | 66 (100) | 185 (98,4) | 3 (1,6) | 188 (100) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **< 0,5** | 56 (98,2) | 1 (1,8) | 57 (100) | 63 (95,5) | 3 (4,5) | 66 (100) | 119 (97,5) | 3 (2,5) | 122 (100) |
| **0,5** | 99 (96,1) | 4 (3,9) | 103 (100) | 102 (97,1) | 3 (2,9) | 105 (100) | 201 (96,6) | 7 (3,4) | 208 (100) |
| **1 – 1,5** | 27 (90) | 3 (10) | 30 (100) | 47 (100) | 0 | 47 (100) | 75 (96,2) | 3 (3,8) | 78 (100) |
| **2 – 2,5** | 9 (100) | 0 | 9 (100) | 18 (100) | 0 | 18 (100) | 27 (100) | 0 | 27 (100) |
| **≥ 3** | 6 (100) | 0 | 6 (100) | 6 (100) | 0 | 6 (100) | 11 (100) | 0 | 11 (100) |
| **Total** | 316 (96,6) | 11 (3,4) | 327 (100) | 302 (98,1) | 6 (1,9) | 308 (100) | 618 (97,5) | 16 (2,5) | 634 (100) |

| **Symmetric Measures** | **Boys** | | **Girls** | | **Total** | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,129 | 0,365 | 0,134 | 0,357 | 0,066 | 0,731 |
| **Cramer's V** | 0,129 | 0,365 | 0,134 | 0,357 | 0,066 | 0,731 |

**Table 47** **Cross Tabulation between the Loudness of Walkman and the Presence of Earache among Sample Aged 11 to 14 years Using a Weighting Factor**

| Loudness of Walkman | The Presence of Earache [n(%)] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | Girls | | | Total | | |
| | 0 | Few minutes | Total | 0 | Few minutes | Total | 0 | Few minutes | Total |
| **0** | 119 (97,5) | 3 (2,5) | 122 (100) | 66 (100) | 0 | 66 (100) | 185 (98,4) | 3 (1,6) | 188 (100) |
| **Very quiet** | 0 | 0 | 0 | 3 (100) | 0 | 3 (100) | 3 (100) | 0 | 3 (100) |
| **Quiet** | 12 (92,3) | 1 (7,7) | 13 8100) | 21 (100) | 0 | 21 (100) | 33 (97,1) | 1(2,9) | 34 (100) |
| **Moderate** | 138 (95,2) | 7 (4,8) | 145 (100) | 155 (96,9) | 5 (3,1) | 160 (100) | 293 (96,1) | 12 (3,9) | 305 (100) |
| **Loud** | 36 (100) | 0 | 36 (100) | 42 (100) | 0 | 42 (100) | 77 (100) | 0 | 77 (100) |
| **Very loud** | 10 (100) | 0 | 10 (100) | 17 (100) | 0 | 17 (100) | 27 (100) | 0 | 27 (100) |
| **Total** | 315 (96,6) | 11 (3,4) | 326 (100) | 304 (98,4) | 5 (1,6) | 309 (100) | 618 (97,5) | 16 (2,5) | 634 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,105 | 0,462 | 0,124 | 0,449 | 0,097 | 0,314 |
| **Cramer's V** | 0,105 | 0,462 | 0,124 | 0,449 | 0,097 | 0,314 |

### 9.3.2 Listening to a Stereo Using a Headphone

**Table 48 Cross Tabulation between the Duration of Listening to a stereo using a Headphone and the Presence of Earache among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Duration of Stereo Listen using a Headphone (years) | The Presence of Earache [n(%)] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | Girls | | | Total | | |
| | 0 | Few minutes | Total | 0 | Few minutes | Total | 0 | Few minutes | Total |
| **0** | 274 (96,8) | 9 (3,2) | 283 (100) | 278 (98,2) | 5 (1,8) | 283 (100) | 552 (97,5) | 14 (2,5) | 566 (100) |
| **< 1** | 20 (95,2) | 1 (4,8) | 21 (100) | 9 (100) | 0 | 9 (100) | 29 (96,7) | 1 (3,3) | 30 (100) |
| **1** | 1 (100) | 0 | 1 (100) | 4 (100) | 0 | 4 (100) | 5 (100) | 0 | 5 (100) |
| **2** | 4 (100) | 0 | 4 (100) | 5 (100) | 0 | 5 (100) | 10 (100) | 0 | 10 (100) |
| **3** | 6 (100) | 0 | 6 (100) | 5 (100) | 0 | 5 (100) | 11 (100) | 0 | 11 (100) |
| **4** | 4 (100) | 0 | 4 (100) | 2 (100) | 0 | 2 (100) | 6 (100) | 0 | 6 (100) |
| **5** | 3 (100) | 0 | 3 (100) | 0 | 0 | 0 | 3 (100) | 0 | 3(100) |
| **6** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **7** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **8** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **9** | 0 | 0 | 0 | 1 (100) | 0 | 1 (100) | 1 (100) | 0 | 1 (100) |
| **10** | 3 (100) | 0 | 3 (100) | 0 | 0 | 0 | 3 (100) | 0 | 3 (100) |
| **Total** | 315 (96,9) | 10 (3,1) | 325 (100) | 304 (98,4) | 5 (1,6) | 309 (100) | 620 (97,6) | 15 (2,4) | 635 (100) |

| **Symmetric Measures** | **Boys** | | **Girls** | | **Total** | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,052 | 0,997 | 0,039 | 1,000 | 0,042 | 1,000 |
| **Cramer's V** | 0,052 | 0,997 | 0,039 | 1,000 | 0,042 | 1,000 |

**Table 49** **Cross Tabulation between the Frequency of Listening to a Stereo Using a Headphone and the Presence of Earache among Sample Aged 11 to 14 Years Using a Weighting Factor**

| **Frequency of Stereo Listen using a Headphone (hours/day)** | **The Presence of Earache [n(%)]** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Boys** | | | **Girls** | | | **Total** | | |
| | 0 | Few minutes | Total | 0 | Few minutes | Total | 0 | Few minutes | Total |
| **0** | 274 (96,8) | 9 (3,2) | 283 (100) | 278 (98,2) | 5 (1,8) | 283 (100) | 552 (97,5) | 14 (2,5) | 566 (100) |
| **< 0,5** | 10 (100) | 0 | 10 (100) | 12 (100) | 0 | 12 (100) | 22 (100) | 0 | 22 (100) |
| **0,5** | 21 (100) | 0 | 21 (100) | 8 (100) | 0 | 8 (100) | 29 (100) | 0 | 29 (100) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1 – 1,5** | 9 (90) | 1 (10) | 10 (100) | 5 (100) | 0 | 5 (100) | 14 (93,3) | 1 (6,7) | 15 (100) |
| **2 – 2,5** | 2 (100) | 0 | 2 (100) | 1 (100) | 0 | 1 (100) | 3 (100) | 0 | 3 (100) |
| **≥ 3** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | 316 (96,9) | 10 (3,1) | 326 (100) | 304 (98,4) | 5 (1,6) | 309 (100) | 620 (97,6) | 15 (2,4) | 635 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,091 | 0,614 | 0,039 | 0,993 | 0,063 | 0,770 |
| **Cramer's V** | 0,091 | 0,614 | 0,039 | 0,993 | 0,063 | 0,770 |

**Table 50 Cross Tabulation between the Loudness of Stereo and the Presence of Earache among Sample Aged 11 to 14 years Using a Weighting Factor**

| Loudness of Stereo | The Presence of Earache [n(%)] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | Girls | | | Total | | |
| | 0 | Few minutes | Total | 0 | Few minutes | Total | 0 | Few minutes | Total |
| **0** | 274 (96,8) | 9 (3,2) | 283 (100) | 278 (98,2) | 5 (1,8) | 283 (100) | 552 (97,5) | 14 (2,5) | 566 (100) |
| **Very quiet** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Quiet** | 5 (100) | 0 | 5 (100) | 3 (100) | 0 | 3 (100) | 8 (100) | 0 | 8 (100) |
| **Moderate** | 21 (95,5) | 1 (4,5) | 22 (100) | 20 (100) | 0 | 20 (100) | 41 (97,6) | 1(2,4) | 42 (100) |
| **Loud** | 15 (100) | 0 | 15 (100) | 3 (100) | 0 | 3 (100) | 17 (100) | 0 | 17 (100) |
| **Very loud** | 2 (100) | 0 | 2 (100) | 2 (100) | 0 | 2 (100) | 4 (100) | 0 | 4 (100) |
| **Total** | 317 (96,9) | 10 (3,1) | 327 (100) | 306 (98,4) | 5 (1,6) | 311 (100) | 622 (97,6) | 15 (2,4) | 637 (100) |

| **Symmetric Measures** | **Boys** | | **Girls** | | **Total** | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,052 | 0,928 | 0,040 | 0,973 | 0,034 | 0,947 |
| **Cramer's V** | 0,052 | 0,928 | 0,040 | 0,973 | 0,034 | 0,947 |

### 9.3.3 Visiting Discotheques

**Table 51 Cross Tabulation between the Duration of Visiting Discotheques and the Presence of Earache among Sample Aged 11 to 14 years Using a Weighting Factor**

| Duration of Discotheques Visits (years) | The Presence of Earache [n(%)] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | Girls | | | Total | | |
| | 0 | Few minutes | Total | 0 | Few minutes | Total | 0 | Few minutes | Total |
| **0** | 302 (97,1) | 9 (2,9) | 311 (100) | 271 (98,9) | 3 (1,1) | 274 (100) | 574 (98) | 12 (2) | 586 (100) |
| **< 1** | 10 (90,9) | 1 (9,1) | 11 (100) | 9 (100) | 0 | 9 (100) | 19 (95) | 1 (5) | 20 (100) |
| **1** | 1 (100) | 0 | 1 (100) | 9 (100) | 0 | 9 (100) | 11 (100) | 0 | 11 (100) |
| **2** | 3 (100) | 0 | 3 (100) | 9 (81,8) | 2 (18,2) | 11 (100) | 12 (85,7) | 2 (14,3) | 14 (100) |
| **3** | 0 | 0 | 0 | 3 (100) | 0 | 3 (100) | 3 (100) | 0 | 3 (100) |
| **4** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **6** | 0 | 0 | 0 | 2 (100) | 0 | 2 (100) | 2 (100) | 0 | 2 (100) |
| **Total** | 316 (96,9) | 10 (3,1) | 326 (100) | 303 (98,4) | 5 (1,6) | 308 (100) | 621 (97,6) | 15 (2,4) | 636 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,068 | 0,827 | 0,253 | 0,001 | 0,125 | 0,130 |
| **Cramer's V** | 0,068 | 0,827 | 0,253 | 0,001 | 0,125 | 0,130 |

**Table 52 Cross Tabulation between the Frequency of Visiting Discotheques and the Presence of Earache among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Frequency of Discotheques Visits | The Presence of Earache [n(%)] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | Girls | | | Total | | |
| | 0 | Few minutes | Total | 0 | Few minutes | Total | 0 | Few minutes | Total |
| **0** | 302 (97,1) | 9 (2,9) | 311 (100) | 271 (98,9) | 3 (1,1) | 274 (100) | 574 (98) | 12 (2) | 586 (100) |
| **< monthly** | 3 (100) | 0 | 3 (100) | 10 (100) | 0 | 10 (100) | 13 (100) | 0 | 13 (100) |
| **Monthly** | 8 (88,9) | 1 (11,1) | 9 (100) | 11 (84,6) | 2 (15,4) | 13 (100) | 19 (86,4) | 3 (13,6) | 22 (100) |
| **Bimonthly** | 2 (100) | 0 | 2 (100) | 7 (100) | 0 | 7 (100) | 9 (100) | 0 | 9 (100) |
| **Weekly** | 1 (100) | 0 | 1 (100) | 4 (100) | 0 | 4 (100) | 4 (100) | 0 | 4 (100) |
| **Total** | 316 (96,9) | 10 (3,1) | 326 (100) | 303 (98,4) | 5 (1,6) | 308 (100) | 619 (97,6) | 15 (2,4) | 634 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,082 | 0,703 | 0,230 | 0,003 | 0,143 | 0,011 |
| **Cramer's V** | 0,082 | 0,703 | 0,230 | 0,003 | 0,143 | 0,011 |

**Table 53 Cross Tabulation between the Loudness of Discotheque and the Presence of Earache among Sample Aged 11 to 14 years Using a Weighting Factor**

| Loudness of Discotheques | The Presence of Earache [n(%)] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | Girls | | | Total | | |
| | 0 | Few minutes | Total | 0 | Few minutes | Total | 0 | Few minutes | Total |
| **0** | 302 (97,1) | 9 (2,9) | 311 (100) | 271 (98,9) | 3 (1,1) | 274 (100) | 574 (98) | 12 (2) | 586 (100) |
| **Normal voice to chat (normale Stimme, Unterhaltung)** | 0 | 0 | 0 | 3 (100) | 0 | 3 (100) | 4 (100) | 0 | 4 (100) |
| **Loud voice to chat (laute Stimme, Unterhaltung)** | 4 (100) | 0 | 4 (100) | 16 (100) | 0 | 16 (100) | 20 (100) | 0 | 20 (100) |
| **Shouting to** | 8 (88,9) | 1 (11,1) | 9 (100) | 6 (75) | 2 (25) | 8 (100) | 14 (82,4) | 3(17,6) | 17 (100) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **understand** **(Schreien zur Verständigung)** | | | | | | | | | |
| **Loud shout, limit understanding** **(Lautes Schreien, kaum noch Verständigung)** | 2 (100) | 0 | 2 (100) | 6 (100) | 0 | 6 (100) | 8 (100) | 0 | 8 (100) |
| **No possible understanding** **(keine Verständigung möglich)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | 316 (96,9) | 10 (3,1) | 326 (100) | 302 (98,4) | 5 (1,6) | 307 (100) | 620 (97,6) | 15 (2,4) | 635 (100) |

| **Symmetric Measures** | **Boys** | | **Girls** | | **Total** | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,082 | 0,703 | 0,303 | 0,000 | 0,170 | 0,001 |
| **Cramer's V** | 0,082 | 0,703 | 0,303 | 0,000 | 0,170 | 0,001 |

### 9.3.4 Attending Concerts

**Table 54** **Cross Tabulation between the Duration of Concerts Attendance and the Presence of Earache among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Duration of Concerts Attendance (years) | The Presence of Earache [n(%)] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | Girls | | | Total | | |
| | 0 | Few minutes | Total | 0 | Few minutes | Total | 0 | Few minutes | Total |
| **0** | 258 (97) | 8 (3) | 266 (100) | 219 (99,1) | 2 (0,9) | 221 (100) | 477 (97,9) | 10 (2,1) | 487 (100) |
| **< 1** | 26 (96,3) | 1 (3,7) | 27 (100) | 34 (91,9) | 3 (8,1) | 37 (100) | 60 (93,8) | 4 (6,3) | 64 (100) |
| **1** | 7 (100) | 0 | 7 (100) | 11 (100) | 0 | 11 (100) | 17 (100) | 0 | 17 (100) |
| **2** | 12 (100) | 0 | 12 (100) | 21 (100) | 0 | 21 (100) | 33 (100) | 0 | 33 (100) |
| **3** | 5 (100) | 0 | 5 (100) | 3 (100) | 0 | 3 (100) | 9 (100) | 0 | 9 (100) |
| **4** | 3 (100) | 0 | 3 (100) | 6 (100) | 0 | 6 (100) | 9 (100) | 0 | 9 (100) |
| **5** | 1 (100) | 0 | 1 (100) | 1 (100) | 0 | 1 (100) | 3 (100) | 0 | 3 (100) |
| **6** | 0 | 1 (100) | 1 (100) | 0 | 0 | 0 | 0 | 1 (100) | 1 (100) |
| **7** | 0 | 0 | 0 | 2 (100) | 0 | 2 (100) | 2 (100) | 0 | 2 (100) |
| **8** | 0 | 0 | 0 | 1 (100) | 0 | 1 (100) | 1 (100) | 0 | 1 (100) |
| **9** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **10** | 0 | 0 | 0 | 3 (100) | 0 | 3 (100) | 3 (100) | 0 | 3 (100) |
| **Total** | 312 (96,9) | 10 (3,1) | 322 (100) | 301 (98,4) | 5 (1,6) | 306 (100) | 614 (97,6) | 15 (2,4) | 629 (100) |

| **Symmetric Measures** | **Boys** | | **Girls** | | **Total** | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,316 | 0,000 | 0,191 | 0,264 | 0,274 | 0,000 |
| **Cramer's V** | 0,316 | 0,000 | 0,191 | 0,264 | 0,274 | 0,000 |

**Table 55** **Cross Tabulation between the Frequency of Concerts Attendance and the Presence of Earache among Sample Aged 11 to 14 Years Using a Weighting Factor**

| **Frequency of Concerts Attendance** | **The Presence of Earache [n(%)]** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Boys** | | | **Girls** | | | **Total** | | |
| | 0 | Few minutes | Total | 0 | Few minutes | Total | 0 | Few minutes | Total |
| **0** | 258 (97) | 8 (3) | 266 (100) | 219 (99,1) | 2 (0,9) | 221 (100) | 477 (97,9) | 10 (2,1) | 487 (100) |
| **Annually** | 29 (100) | 0 | 29 (100) | 47 (97,9) | 1 (2,1) | 48 (100) | 76 (98,7) | 1 (1,3) | 77 (100) |
| **6 Monthly** | 15 (83,3) | 3 (16,7) | 18 (100) | 27 (93,1) | 2 (6,9) | 29 (100) | 42 (91,3) | 4 (8,7) | 46 (100) |
| **3 Monthly** | 6 (100) | 0 | 6 (100) | 6 (100) | 0 | 6 (100) | 13 (100) | 0 | 13 (100) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Monthly** | 2 (100) | 0 | 2 (100) | 1 (100) | 0 | 1 (100) | 2 (100) | 0 | 2 (100) |
| **Total** | 310 (96,6) | 11 (3,4) | 321 (100) | 300 (98,4) | 5 (1,6) | 305 (100) | 610 (97,6) | 15 (2,4) | 625 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| Phi | 0,185 | 0,027 | 0,139 | 0,208 | 0,119 | 0,066 |
| Cramer's V | 0,185 | 0,027 | 0,139 | 0,208 | 0,119 | 0,066 |

**Table 56 Cross Tabulation between the Loudness of Concerts and the Presence of Earache among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Loudness of Concerts | The Presence of Earache [n(%)] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | Girls | | | Total | | |
| | 0 | Few minutes | Total | 0 | Few minutes | Total | 0 | Few minutes | Total |
| **0** | 258 (97) | 8 (3) | 266 (100) | 219 (99,1) | 2 (0,9) | 221 (100) | 477 (97,9) | 10 (2,1) | 487 (100) |
| **Too quiet (zu leise)** | 0 | 0 | 0 | 3 (100) | 0 | 3 (100) | 3 (100) | 0 | 3 (100) |
| **Appriopriate (gerade richtig)** | 40 (93) | 3 (7) | 43 (100) | 51 (96,2) | 2 (3,8) | 53 (100) | 90 (95,7) | 4 (4,3) | 94 (100) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Too loud (zu laut)** | 16 (100) | 0 | 16 (100) | 31 (96,9) | 1 (3,1) | 32 (100) | 47 (97,9) | 1(2,1) | 48 (100) |
| **Total** | 314 (96,6) | 11 (3,4) | 325 (100) | 304 (98,4) | 5 (1,6) | 309 (100) | 617 (97,6) | 15 (2,4) | 632 (100) |

| **Symmetric Measures** | **Boys** | | **Girls** | | **Total** | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| Phi | 0,085 | 0,305 | 0,094 | 0,430 | 0,053 | 0,628 |
| Cramer's V | 0,085 | 0,305 | 0,094 | 0,430 | 0,053 | 0,628 |

## 9.4 Appendix 4 – Cross Tabulation Association towards Tinnitus

### 9.4.1 Listening to a Walkman

**Table 57** **Cross Tabulation between the Duration of Listening to a Walkman and the Presence of Tinnitus among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Duration of Walkman Listen (years) | The Presence of Tinnitus [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total |
| **0** | 108 (89,3) | 12 (9,9) | 1 (0,8) | 121 (100) | 62 (92,5) | 5 (7,5) | 0 | 67 (100) | 169 (90,4) | 17 (9,1) | 1 (0,5) | 187 (100) |
| **< 1** | 64 (84,2) | 9 (11,8) | 3 (3,9) | 76 (100) | 58 (86,6) | 6 (9) | 3 (4,5) | 67 (100) | 123 (85,4) | 16 (11,1) | 5 (3,5) | 144 (100) |
| **1** | 18 (94,7) | 1 (5,3) | 0 | 19 (100) | 12 (100) | 0 | 0 | 12 (100) | 31 (96,9) | 1 (3,1) | 0 | 32 (100) |
| **2** | 43 (89,6) | 5 (10,4) | 0 | 48 (100) | 46 (85,2) | 6 (11,1) | 2 (3,7) | 54 (100) | 89 (87,3) | 11 (10,8) | 2 (2) | 102 (100) |
| **3** | 30 (90,9) | 3 (9,1) | 0 | 33 (100) | 36 (94,7) | 1 (2,6) | 1 (2,6) | 38 (100) | 66 (91,7) | 5 (6,9) | 1 (1,4) | 72 (100) |
| **4** | 9 (100) | 0 | 0 | 9 (100) | 28 (73,7) | 8 (21,1) | 2 (5,3) | 38 (100) | 37 (78,7) | 8 (17) | 2 (4,3) | 47 (100) |
| **5** | 7 (100) | 0 | 0 | 7 (100) | 19 (100) | 0 | 0 | 19 (100) | 26 (96,3) | 1 (3,7) | 0 | 27 (100) |
| **6** | 5 (100) | 0 | 0 | 5 (100) | 6 (100) | 0 | 0 | 6 (100) | 11 (100) | 0 | 0 | 11 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **7** | 3 (100) | 0 | 0 | 3 (100) | 3 (75) | 1 (25) | 0 | 4 (100) | 5 (83,3) | 1 (16,7) | 0 | 6 (100) |
| **8** | 2 (100) | 0 | 0 | 2 (100) | 2 (100) | 0 | 0 | 2 (100) | 3 (100) | 0 | 0 | 3 (100) |
| **9** | 1 (100) | 0 | 0 | 1 (100) | 2 (100) | 0 | 0 | 2 (100) | 3 (100) | 0 | 0 | 3 (100) |
| **10** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **11** | 1 (100) | 0 | 0 | 1 (100) | 0 | 0 | 0 | 0 | 1 (100) | 0 | 0 | 1 (100) |
| **Total** | 291 (89,5) | 30 (9,2) | 4 (1,2) | 325 (100) | 274 (88,7) | 27 (8,7) | 8 (2,6) | 309 (100) | 564 (88,8) | 60 (9,4) | 11 (1,7) | 635 (100) |

| **Symmetric Measures** | **Boys** | | **Girls** | | **Total** | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,180 | 0,981 | 0,258 | 0,419 | 0,164 | 0,755 |
| **Cramer's V** | 0,127 | 0,981 | 0,183 | 0,419 | 0,116 | 0,755 |

**Table 58** **Cross Tabulation between the Frequency of Listening to a Walkman and the Presence of Tinnitus among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Frequency of Walkman Listen (hours/ day) | The Presence of Tinnitus [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total |
| **0** | 108 (89,3) | 12 (9,9) | 1 (0,8) | 121 (100) | 62 (92,5) | 5 (7,5) | 0 | 67 (100) | 169 (90,4) | 17 (9,1) | 1 (0,5) | 187 (100) |
| **< 0,5** | 51 (89,5) | 6 (10,5) | 0 | 57 (100) | 56 (86,2) | 6 (9,2) | 3 (4,6) | 65 (100) | 107 (87,7) | 12 (9,8) | 3 (2,5) | 122 (100) |
| **0,5** | 92 (89,3) | 8 (7,8) | 3 (2,9) | 103 (100) | 94 (88,7) | 10 (9,4) | 2 (1,9) | 106 (100) | 186 (89,4) | 18 (8,7) | 4 (1,9) | 208 (100) |
| **1 – 1,5** | 28 (93,3) | 2 (6,7) | 0 | 30 (100) | 41 (85,4) | 4 (8,3) | 3 (6,3) | 48 (100) | 69 (88,5) | 6 (7,7) | 3 (3,8) | 78 (100) |
| **2 – 2,5** | 9 (100) | 0 | 0 | 9 (100) | 18 (100) | 0 | 0 | 18 (100) | 26 (100) | 0 | 0 | 26 (100) |
| **≥ 3** | 4 (66,7) | 2 (33,3) | 0 | 6 (100) | 2 (33,3) | 4 (66,7) | 0 | 6 (100) | 6 (54,5) | 5 (45,5) | 0 | 11 (100) |
| **Total** | 292 (89,6) | 30 (9,2) | 4 (1,2) | 326 (100) | 273 (88,1) | 29 (9,4) | 8 (2,6) | 310 (100) | 563 (89,1) | 58 (9,2) | 11 (1,7) | 632 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,171 | 0,481 | 0,320 | 0,000 | 0,199 | 0,005 |
| **Cramer's V** | 0,121 | 0,481 | 0,226 | 0,000 | 0,141 | 0,005 |

**Table 59 Cross Tabulation between the Loudness of Walkman and the Presence of Tinnitus among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Loudness of Walkman | The Presence of Tinnitus [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total |
| **0** | 108 (89,3) | 12 (9,9) | 1 (0,8) | 121 (100) | 62 (92,5) | 5 (7,5) | 0 | 67 (100) | 169 (90,4) | 17 (9,1) | 1 (0,5) | 187 (100) |
| **Very quiet (Sehr leise)** | 0 | 0 | 0 | 0 | 3 (100) | 0 | 0 | 3 (100) | 3 (100) | 0 | 0 | 3 (100) |
| **Quiet (Ziemlich leise)** | 13 (100) | 0 | 0 | 13 (100) | 20 (95,2) | 1 (4,8) | 0 | 21 (100) | 33 (97,1) | 1 (2,9) | 0 | 34 (100) |
| **Moderate (Mittelmäßig)** | 131 (90,3) | 11 (7,6) | 3 (2,1) | 145 (100) | 143 (89,4) | 14 (8,8) | 3 (1,9) | 160 (100) | 274 (90,1) | 24 (7,9) | 6 (2) | 304 (100) |
| **Loud (Ziemlich laut)** | 29 (82,9) | 6 (17,1) | 0 | 35 (100) | 30 (71,4) | 7 (16,7) | 5 (11,9) | 42 (100) | 59 (76,6) | 13 (16,9) | 5 (6,5) | 77 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Very loud (Sehr laut)** | 9 (90) | 1 (10) | 0 | 10 (100) | 15 (88,2) | 2 (11,8) | 0 | 17 (100) | 24 (85,7) | 4 (14,3) | 0 | 28 (100) |
| **Total** | 290 (89,5) | 30 (9,3) | 4 (1,2) | 324 (100) | 273 (88,1) | 29 (9,4) | 8 (2,6) | 310 (100) | 562 (88,8) | 59 (9,3) | 12 (1,9) | 633 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,137 | 0,636 | 0,269 | 0,013 | 0,183 | 0,019 |
| **Cramer's V** | 0,097 | 0,636 | 0,190 | 0,013 | 0,130 | 0,019 |

## 9.4.2 Listening to a Stereo Using a Headphone

**Table 60 Cross Tabulation between the Duration of Listening to a Stereo Using a Headphone and the Presence of Tinnitus among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Duration of Stereo Listen using a Headphone (years) | The Presence of Tinnitus [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total |
| **0** | 256 | 23 (8,1) | 4 (1,4) | 283 (100) | 250 | 27 (9,5) | 6 (2,1) | 283 (100) | 506 | 50 (8,8) | 10 (1,8) | 566 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (90,5) | | | | (88,3) | | | | (89,4) | | | |
| **< 1** | 16 (76,2) | 5 (23,8) | 0 | 21 (100) | 9 (100) | 0 | 0 | 9 (100) | 24 (80) | 6 (20) | 0 | 30 (100) |
| **1** | 1 (100) | 0 | 0 | 1 (100) | 2 (50) | 0 | 2 (50) | 4 (100) | 4 (66,7) | 0 | 2 (33,3) | 6 (100) |
| **2** | 4 (100) | 0 | 0 | 4 (100) | 6 (100) | 0 | 0 | 6 (100) | 10 (100) | 0 | 0 | 10 (100) |
| **3** | 4 (80) | 1 (20) | 0 | 5 (100) | 5 (100) | 0 | 0 | 5 (100) | 10 (90,9) | 1 (9,1) | 0 | 11 (100) |
| **4** | 3 (75) | 1 (25) | 0 | 4 (100) | 2 (100) | 0 | 0 | 2 (100) | 4 (80) | 1 (20) | 0 | 5 (100) |
| **5** | 3 (100) | 0 | 0 | 3 (100) | 0 | 0 | 0 | 0 | 3 (100) | 0 | 0 | 3 (100) |
| **6** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **7** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **8** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **9** | 0 | 0 | 0 | 0 | 0 | 1 (100) | 0 | 1 (100) | 0 | 1 (100) | 0 | 1 (100) |
| **10** | 3 (100) | 0 | 0 | 3 (100) | 0 | 0 | 0 | 0 | 3 (100) | 0 | 0 | 3 (100) |
| **11** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | 295 (89,5) | 30 (9,3) | 4 (1,2) | 324 (100) | 274 (88,4) | 28 (9) | 8 (2,6) | 310 (100) | 564 (88,8) | 59 (9,3) | 12 (1,9) | 635 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,169 | 0,817 | 0,398 | 0,000 | 0,280 | 0,000 |
| **Cramer's V** | 0,119 | 0,817 | 0,282 | 0,000 | 0,198 | 0,000 |

**Table 61 Cross Tabulation between the Frequency of Listening to a Stereo Using a Headphone and the Presence of Tinnitus among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Frequency of Stereo Listen using a Headphone (hours/day) | The Presence of Tinnitus [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total |
| **0** | 256 (90,5) | 23 (8,1) | 4 (1,4) | 283 (100) | 250 (88,3) | 27 (9,5) | 6 (2,1) | 283 (100) | 506 (89,4) | 50 (8,8) | 10 (1,8) | 566 (100) |
| **< 0,5** | 8 (72,7) | 3 (27,3) | 0 | 11 (100) | 11 (84,6) | 2 (15,4) | 0 | 13 (100) | 19 (82,6) | 4 (17,4) | 0 | 23 (100) |
| **0,5** | 19 (86,4) | 3 (13,6) | 0 | 22 (100) | 6 (75) | 0 | 2 (25) | 8 (100) | 25 (83,3) | 3 (10) | 2 (6,7) | 30 (100) |
| **1 – 1,5** | 8 (80) | 2 (20) | 0 | 10 (100) | 5 (100) | 0 | 0 | 5 (100) | 13 (86,7) | 2 (13,3) | 0 | 15 (100) |
| **2 – 2,5** | 2 (100) | 0 | 0 | 2 (100) | 1 (100) | 0 | 0 | 1 (100) | 3 (100) | 0 | 0 | 3 (100) |
| **≥ 3** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | 293 | 31 (9,5) | 4 (1,2) | 328 (100) | 273 | 29 (9,4) | 8 (2,6) | 310 (100) | 566 | 59 (9,3) | 12 (1,9) | 637 (100) |

| | | | |
|---|---|---|---|
| | (89,3) | (88,1) | (88,9) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,148 | 0,520 | 0,244 | 0,049 | 0,105 | 0,721 |
| **Cramer's V** | 0,104 | 0,520 | 0,172 | 0,049 | 0,074 | 0,721 |

**Table 62** **Cross Tabulation between the Loudness of Stereo and the Presence of Tinnitus among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Loudness of Stereo | The Presence of Tinnitus [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total |
| **0** | 256 (90,5) | 23 (8,1) | 4 (1,4) | 283 (100) | 250 (88,3) | 27 (9,5) | 6 (2,1) | 283 (100) | 506 (89,4) | 50 (8,8) | 10 (1,8) | 566 (100) |
| **Very quiet (Sehr leise)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Quiet (Ziemlich leise)** | 4 (80) | 1 (20) | 0 | 5 (100) | 3 (100) | 0 | 0 | 3 (100) | 6 (85,7) | 1 (14,3) | 0 | 7 (100) |
| **Moderate** | 18 (81,8) | 4 (18,2) | 0 | 22 (100) | 19 (90,5) | 2 (9,5) | 0 | 21 (100) | 37 (88,1) | 5 (11,9) | 0 | 42 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **(Mittelmäßig)** | | | | | | | | | | | | |
| **Loud (Ziemlich laut)** | 12 (80) | 3 (20) | 0 | 15 (100) | 3 (100) | 0 | 0 | 3 (100) | 14 (82,4) | 3 (17,6) | 0 | 17 (100) |
| **Very loud (Sehr laut)** | 2 (100) | 0 | 0 | 2 (100) | 0 | 0 | 2 (100) | 2 (100) | 2 (50) | 0 | 2 (50) | 4 (100) |
| **Total** | 292 (89,3) | 31 (9,5) | 4 (1,2) | 327 (100) | 275 (88,1) | 29 (9,3) | 8 (2,6) | 312 (100) | 565 (88,8) | 59 (9,3) | 12 (1,9) | 636 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,134 | 0,664 | 0,499 | 0,000 | 0,290 | 0,000 |
| **Cramer's V** | 0,095 | 0,664 | 0,353 | 0,000 | 0,205 | 0,000 |

### 9.4.3 Visiting Discotheques

**Table 63 Cross Tabulation between the Duration of Visiting Discotheques and the Presence of Tinnitus among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Duration of Discotheques Visits (years) | The Presence of Tinnitus [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total |
| **0** | 279 (89,4) | 29 (9,3) | 4 (1,3) | 312 (100) | 247 (89,8) | 25 (9,1) | 3 (1,1) | 275 (100) | 526 (89,8) | 53 (9) | 7 (1,2) | 586 (100) |
| **< 1** | 10 (90,9) | 1 (9,1) | 0 | 11 (100) | 9 (100) | 0 | 0 | 9 (100) | 19 (95) | 1 (5) | 0 | 20 (100) |
| **1** | 1 (100) | 0 | 0 | 1 (100) | 8 (88,9) | 0 | 1 (11,1) | 9 (100) | 9 (90) | 0 | 1 (10) | 10 (100) |
| **2** | 1 (50) | 1 (50) | 0 | 2 (100) | 6 (54,5) | 3 (27,3) | 2 (18,2) | 11 (100) | 8 (53,3) | 5 (33,3) | 2 (13,3) | 15 (100) |
| **3** | 0 | 0 | 0 | 0 | 3 (100) | 0 | 0 | 3 (100) | 3 (100) | 0 | 0 | 3 (100) |
| **4** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **6** | 0 | 0 | 0 | 0 | 0 | 0 | 2 (100) | 2 (100) | 0 | 0 | 2 (100) | 2 (100) |
| **Total** | 291 (89,3) | 31 (9,5) | 4 (1,2) | 326 (100) | 273 (88,3) | 28 (9,1) | 8 (2,6) | 309 (100) | 565 (88,8) | 59 (9,3) | 12 (1,9) | 636 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,112 | 0,848 | 0,564 | 0,000 | 0,458 | 0,000 |
| **Cramer's V** | 0,079 | 0,848 | 0,399 | 0,000 | 0,324 | 0,000 |

**Table 64 Cross Tabulation between the Frequency of Visiting Discotheques and the Presence of Tinnitus among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Frequency of Discotheques Visits (hours/day) | The Presence of Tinnitus [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total |
| **0** | 279 (89,4) | 29 (9,3) | 4 (1,3) | 312 (100) | 247 (89,8) | 25 (9,1) | 3 (1,1) | 275 (100) | 526 (89,8) | 53 (9) | 7 (1,2) | 586 (100) |
| **< Monthly** | 3 (100) | 0 | 0 | 3 (100) | 7 (63,6) | 2 (18,2) | 2 (18,2) | 11 (100) | 10 (71,4) | 2 (14,3) | 2 (14,3) | 14 (100) |
| **Monthly** | 7 (77,8) | 2 (22,2) | 0 | 9 (100) | 10 (76,9) | 0 | 3 (23,1) | 13 (100) | 17 (77,3) | 2 (9,1) | 3 (13,6) | 22 (100) |
| **Bimonthly** | 2 (100) | 0 | 0 | 2 (100) | 7 (100) | 0 | 0 | 7 (100) | 9 (100) | 0 | 0 | 9 (100) |
| **Weekly** | 1 (100) | 0 | 0 | 1 (100) | 2 (50) | 2 (50) | 0 | 4 (100) | 2 (50) | 2 (50) | 0 | 4 (100) |
| **Total** | 292 (89,3) | 31 (9,5) | 4 (1,2) | 327 (100) | 273 (88,1) | 29 (9,4) | 8 (2,6) | 310 (100) | 564 (88,8) | 59 (9,3) | 12 (1,9) | 635 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,088 | 0,961 | 0,385 | 0,000 | 0,249 | 0,000 |
| **Cramer's V** | 0,062 | 0,961 | 0,272 | 0,000 | 0,176 | 0,000 |

**Table 65 Cross Tabulation between the Loudness of Discotheques and the Presence of Tinnitus among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Loudness of Discotheques | The Presence of Tinnitus [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total |
| **0** | 279 (89,4) | 29 (9,3) | 4 (1,3) | 312 (100) | 247 (89,8) | 25 (9,1) | 3 (1,1) | 275 (100) | 526 (89,8) | 53 (9) | 7 (1,2) | 586 (100) |
| **Normal voice to chat (normale Stimme, Unterhaltung)** | 0 | 0 | 0 | 0 | 3 (100) | 0 | 0 | 3 (100) | 4 (100) | 0 | 0 | 4 (100) |
| **Loud voice to chat (laute Stimme, Unterhaltung)** | 4 (100) | 0 | 0 | 4 (100) | 13 (76,5) | 2 (11,8) | 2 (11,8) | 17 (100) | 17 (81) | 2 (9,5) | 2 (9,5) | 21 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shouting to understand (Schreien zur Verständigung)** | 7 (77,8) | 2 (22,2) | 0 | 9 (100) | 7 (87,5) | 0 | 1 (12,5) | 8 (100) | 14 (82,4) | 2 (11,8) | 1 (5,9) | 17 (100) |
| **Loud shout, limit understanding (Lautes Schreien, kaum noch Verständigung)** | 2 (100) | 0 | 0 | 2 (100) | 3 (42,9) | 2 (28,6) | 2 (28,6) | 7 (100) | 5 (55,6) | 2 (22,2) | 2 (22,2) | 9 (100) |
| **No possible understanding (keine Verständigung möglich)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | 292 (89,3) | 31 (9,5) | 4 (1,2) | 327 (100) | 273 (88,1) | 29 (9,4) | 8 (2,6) | 310 (100) | 566 (88,9) | 59 (9,3) | 12 (1,9) | 637 (100) |

| **Symmetric Measures** | **Boys** | | **Girls** | | **Total** | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,088 | 0,961 | 0,338 | 0,000 | 0,227 | 0,000 |
| **Cramer's V** | 0,062 | 0,961 | 0,239 | 0,000 | 0,161 | 0,000 |

### 9.4.4 Attending Concerts

**Table 66 Cross Tabulation between the Duration of Concerts Attendance and the Presence of Tinnitus among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Duration of Concerts Attendance (years) | The presence of tinnitus [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total |
| **0** | 237 (89,1) | 25 (9,4) | 4 (1,5) | 266 (100) | 200 (90,1) | 17 (7,7) | 5 (2,3) | 222 (100) | 436 (89,3) | 43 (8,8) | 9 (1,8) | 488 (100) |
| **< 1** | 25 (92,6) | 2 (7,4) | 0 | 27 (100) | 32 (88,9) | 3 (8,3) | 1 (2,8) | 36 (100) | 57 (90,5) | 5 (7,9) | 1 (1,6) | 63 (100) |
| **1** | 7 (100) | 0 | 0 | 7 (100) | 8 (72,7) | 3 (27,3) | 0 | 11 (100) | 15 (83,3) | 3 (16,7) | 0 | 18 (100) |
| **2** | 10 (83,3) | 2 (16,7) | 0 | 12 (100) | 17 (77,3) | 5 (22,7) | 0 | 22 (100) | 27 (81,8) | 6 (18,2) | 0 | 33 (100) |
| **3** | 5 (83,3) | 1 (16,7) | 0 | 6 (100) | 3 (100) | 0 | 0 | 3 (100) | 8 (88,9) | 1 (11,1) | 0 | 9 (100) |
| **4** | 3 (100) | 0 | 0 | 3 (100) | 6 (100) | 0 | 0 | 6 (100) | 9 (100) | 0 | 0 | 9 (100) |
| **5** | 0 | 1 (100) | 0 | 1 (100) | 1 (100) | 0 | 0 | 1 (100) | 1 (50) | 1 (50) | 0 | 2 (100) |
| **6** | 1 (100) | 0 | 0 | 1 (100) | 0 | 0 | 0 | 0 | 1 (100) | 0 | 0 | 1 (100) |
| **7** | 0 | 0 | 0 | 0 | 2 (100) | 0 | 0 | 2 (100) | 2 (100) | 0 | 0 | 2 (100) |
| **8** | 0 | 0 | 0 | 0 | 1 (100) | 0 | 0 | 1 (100) | 1 (100) | 0 | 0 | 1 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **9** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **10** | 0 | 0 | 0 | 0 | 3 (100) | 0 | 0 | 3 (100) | 3 (100) | 0 | 0 | 3 (100) |
| **Total** | 288 (89,2) | 31 (9,6) | 4 (1,2) | 323 (100) | 273 (88,9) | 28 (9,1) | 6 (2) | 307 (100) | 560 (89) | 59 (9,4) | 10 (1,6) | 629 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,198 | 0,698 | 0,202 | 0,818 | 0,134 | 0,936 |
| **Cramer's V** | 0,140 | 0,698 | 0,143 | 0,818 | 0,095 | 0,936 |

**Table 67** **Cross Tabulation between the Frequency of Concerts Attendance and the Presence of Tinnitus among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Frequency of Concerts Attendance (hours/day) | The Presence of Tinnitus [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total |
| **0** | 237 (89,1) | 25 (9,4) | 4 (1,5) | 266 (100) | 200 (90,1) | 17 (7,7) | 5 (2,3) | 222 (100) | 436 (89,3) | 43 (8,8) | 9 (1,8) | 488 (100) |
| **Annually** | 28 (96,6) | 1 (3,4) | 0 | 29 (100) | 45 (93,8) | 2 (4,2) | 1 (2,1) | 48 (100) | 73 (94,8) | 3 (3,9) | 1 (1,3) | 77 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **6 Monthly** | 17 (94,4) | 1 (5,6) | 0 | 18 (100) | 21 (72,4) | 8 (27,6) | 0 | 29 (100) | 38 (80,9) | 9 (19,1) | 0 | 47 (100) |
| **3 Monthly** | 4 (66,7) | 2 (33,3) | 0 | 6 (100) | 3 (42,9) | 2 (28,6) | 2 (28,6) | 7 (100) | 7 (53,8) | 4 (30,8) | 2 (15,4) | 13 (100) |
| **Monthly** | 0 | 2 (100) | 0 | 2 (100) | 1 (100) | 0 | 0 | 1 (100) | 1 (33,3) | 2 (66,7) | 0 | 3 (100) |
| **Total** | 286 (89,1) | 31 (9,7) | 4 (1,2) | 321 (100) | 270 (87,9) | 29 (9,4) | 8 (2,6) | 307 (100) | 555 (88,4) | 61 (9,7) | 12 (1,9) | 628 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,279 | 0,002 | 0,346 | 0,000 | 0,253 | 0,000 |
| **Cramer's V** | 0,198 | 0,002 | 0,245 | 0,000 | 0,179 | 0,000 |

**Table 68 Cross Tabulation between the Loudness of Concerts and the Presence of Tinnitus among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Loudness of Concerts | The Presence of Tinnitus [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total | 0 | Few minutes | Few hours | Total |
| **0** | 237 (89,1) | 25 (9,4) | 4 (1,5) | 266 (100) | 200 (90,1) | 17 (7,7) | 5 (2,3) | 222 (100) | 436 (89,3) | 43 (8,8) | 9 (1,8) | 488 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Too quiet (zu leise)** | 0 | 0 | 0 | 0 | 3 (100) | 0 | 0 | 3 (100) | 3 (100) | 0 | 0 | 3 (100) |
| **Appriopriate (gerade richtig)** | 37 (88,1) | 5 (11,9) | 0 | 42 (100) | 45 (84,9) | 5 (9,4) | 3 (5,7) | 53 (100) | 82 (87,2) | 9 (9,6) | 3 (3,2) | 94 (100) |
| **Too loud (zu laut)** | 15 (93,8) | 1 (6,3) | 0 | 16 (100) | 26 (81,3) | 6 (18,8) | 0 | 32 (100) | 41 (85,4) | 7 (14,6) | 0 | 48 (100) |
| **Total** | 289 (89,2) | 31 (9,6) | 4 (1,2) | 324 (100) | 274 (88,4) | 28 (9) | 8 (2,6) | 310 (100) | 562 (88,8) | 59 (9,3) | 12 (1,9) | 633 (100) |

| **Symmetric Measures** | **Boys** | | **Girls** | | **Total** | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,064 | 0,853 | 0,155 | 0,285 | 0,077 | 0,704 |
| **Cramer's V** | 0,046 | 0,853 | 0,109 | 0,285 | 0,055 | 0,704 |

## 9.5 Appendix 5 – Cross Tabulation Association towards Hearing Impairment based on Hearing Test Result

### 9.5.1 Listening to a Walkman

**Table 69 Cross Tabulation between the Duration of Listening to a Walkman and the Presence of Hearing Impairment among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Duration of Walkman Listen (years) | The Presence of Hearing Impairment [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total |
| **0** | 103 (84,4) | 10 (8,2) | 3 (2,5) | 122 (100) | 54 (79,4) | 9 (13,2) | 0 | 68 (100) | 157 (82,2) | 20 (10,5) | 3 (1,6) | 191 (100) |
| **< 1** | 67 (88,2) | 4 (5,3) | 2 (2,6) | 76 (100) | 59 (88,1) | 4 (6) | 0 | 67 (100) | 126 (87,5) | 9 (6,3) | 2 (1,4) | 144 (100) |
| **1** | 18 (90) | 2 (10) | 0 | 20 (100) | 10 (83,3) | 2 (16,7) | 0 | 12 (100) | 28 (87,5) | 4 (12,5) | 0 | 32 (100) |
| **2** | 44 (93,6) | 2 (4,3) | 0 | 47 (100) | 46 (85,2) | 8 (14,8) | 0 | 54 (100) | 90 (89,1) | 10 (9,9) | 0 | 101 (100) |
| **3** | 22 (68,8) | 6 (18,8) | 1 (3,1) | 32 (100) | 32 (84,2) | 3 (7,9) | 1 (2,6) | 38 (100) | 54 (75) | 10 (13,9) | 3 (4,2) | 72 (100) |
| **4** | 8 (100) | 0 | 0 | 8 (100) | 34 (89,5) | 1 (2,6) | 0 | 38 (100) | 42 (89,4) | 2 (4,3) | 0 | 47 (100) |
| **5** | 4 (57,1) | 2 (28,6) | 0 | 7 (100) | 17 (89,5) | 1 (5,3) | 0 | 19 (100) | 21 (80,8) | 3 (11,5) | 0 | 26 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **6** | 4 (80) | 1 (20) | 0 | 5 (100) | 6 (100) | 0 | 0 | 6 (100) | 10 (90,9) | 1 (9,1) | 0 | 11 (100) |
| **7** | 2 (100) | 0 | 0 | 2 (100) | 4 (100) | 0 | 0 | 4 (100) | 6 (100) | 0 | 0 | 6 (100) |
| **8** | 2 (100) | 0 | 0 | 2 (100) | 2 (100) | 0 | 0 | 2 (100) | 3 (100) | 0 | 0 | 3 (100) |
| **9** | 1 (100) | 0 | 0 | 1 (100) | 0 | 2 (100) | 0 | 2 (100) | 1 (33,3) | 2 (66,7) | 0 | 3 (100) |
| **10** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **11** | 1 (100) | 0 | 0 | 1 (100) | 0 | 0 | 0 | 0 | 1 (100) | 0 | 0 | 1 (100) |
| **Total** | 276 (85,4) | 27 (8,4) | 6 (1,9) | 323 (100) | 264 (85,2) | 30 (9,7) | 1 (0,3) | 310 (100) | 539 (84,6) | 61 (9,6) | 8 (1,3) | 637 (100) |

| **Symmetric Measures** | **Boys** | | **Girls** | | **Total** | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,263 | 0,921 | 0,358 | 0,110 | 0,233 | 0,387 |
| **Cramer's V** | 0,152 | 0,921 | 0,207 | 0,110 | 0,135 | 0,387 |

**Table 70** **Cross Tabulation between the Frequency of Listening to a Walkman and the Presence of Hearing Impairment among Sample Aged 11 to 14 Years Using a Weighting Factor**

| **Frequency of Walkman Listen** | **The Presence of Hearing Impairment [n (%)]** | | |
|---|---|---|---|
| | **Boys** | **Girls** | **Total** |

| (hours/day) | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 103 (84,4) | 10 (8,2) | 3 (2,5) | 122 (100) | 54 (79,4) | 9 (13,2) | 0 | 68 (100) | 157 (82,2) | 20 (10,5) | 3 (1,6) | 191 (100) |
| **< 0,5** | 44 (78,6) | 8 (14,3) | 0 | 56 (100) | 53 (80,3) | 8 (12,1) | 0 | 66 (100) | 97 (79,5) | 16 (13,1) | 0 | 122 (100) |
| **0,5** | 88 (84,6) | 9 (8,7) | 4 (3,8) | 104 (100) | 90 (85,7) | 10 (9,5) | 1 (1) | 105 (100) | 178 (85,2) | 19 (9,1) | 5 (2,4) | 209 (100) |
| **1 – 1,5** | 27 (93,1) | 2 (6,9) | 0 | 29 (100) | 46 (97,9) | 1 (2,1) | 0 | 47 (100) | 74 (96,1) | 3 (3,9) | 0 | 77 (100) |
| **2 – 2,5** | 9 (100) | 0 | 0 | 9 (100) | 16 (88,9) | 2 (11,1) | 0 | 18 (100) | 24 (92,3) | 2 (7,7) | 0 | 26 (100) |
| **≥ 3** | 4 (80) | 0 | 0 | 5 (100) | 4 (66,7) | 2 (33,3) | 0 | 6 (100) | 8 (72,7) | 2 (18,2) | 0 | 11 (100) |
| **Total** | 275 (84,6) | 29 (8,9) | 7 (2,2) | 325 (100) | 263 (84,8) | 32 (10,3) | 1 (0,3) | 310 (100) | 538 (84,6) | 62 (9,7) | 8 (1,3) | 636 (100) |

| **Symmetric Measures** | **Boys** | | **Girls** | | **Total** | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,205 | 0,547 | 0,230 | 0,353 | 0,184 | 0,124 |
| **Cramer's V** | 0,119 | 0,547 | 0,133 | 0,353 | 0,106 | 0,124 |

**Table 71** **Cross Tabulation between the Loudness of Walkman and the Presence of Hearing Impairment among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Loudness of Walkman | The Presence of Hearing Impairment [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total |
| **0** | 103 (84,4) | 10 (8,2) | 3 (2,5) | 122 (100) | 54 (79,4) | 9 (13,2) | 0 | 68 (100) | 157 (82,2) | 20 (10,5) | 3 (1,6) | 191 (100) |
| **Very quiet (Sehr leise)** | 0 | 0 | 0 | 0 | 3 (100) | 0 | 0 | 3 (100) | 3 (100) | 0 | 0 | 3 (100) |
| **Quiet (Ziemlich leise)** | 12 (92,3) | 1 (7,7) | 0 | 13 (100) | 19 (95) | 1 (5) | 0 | 20 (100) | 31 (93,9) | 2 (6,1) | 0 | 33 (100) |
| **Moderate (Mittelmäßig)** | 121 (84) | 14 (9,7) | 2 (1,4) | 144 (100) | 138 (86,3) | 12 (7,5) | 1 (0,6) | 160 (100) | 259 (84,9) | 26 (8,5) | 4 (1,3) | 305 (100) |
| **Loud (Ziemlich laut)** | 29 (80,6) | 4 (11,1) | 1 (2,8) | 36 (100) | 39 (92,9) | 3 (7,1) | 0 | 42 (100) | 68 (88,3) | 6 (7,8) | 1 (1,3) | 77 (100) |
| **Very loud (Sehr laut)** | 9 (90) | 1 (10) | 0 | 10 (100) | 11 (64,7) | 6 (35,3) | 0 | 17 (100) | 20 (71,4) | 8 (28,6) | 0 | 28 (100) |
| **Total** | 274 (84,3) | 30 (9,2) | 6 (1,8) | 325 (100) | 264 (85,2) | 31 (10) | 1 (0,3) | 310 (100) | 538 (84,5) | 62 (9,7) | 8 (1,3) | 637 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,092 | 0,997 | 0,265 | 0,115 | 0,171 | 0,236 |
| **Cramer's V** | 0,053 | 0,997 | 0,153 | 0,115 | 0,098 | 0,236 |

## 9.5.2 Listening to a Stereo Using a Headphone

**Table 72 Cross Tabulation between the Duration of Listening to a Stereo Using a Headphone and the Presence of Hearing Impairment among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Duration of Stereo Listen using a Headphone (years) | The Presence of Hearing Impairment [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total |
| **0** | 238 (84,1) | 27 (9,5) | 5 (1,8) | 283 (100) | 239 (84,2) | 31 (10,9) | 1 (0,4) | 284 (100) | 478 (84,2) | 58 (10,2) | 6 (1,1) | 568 (100) |
| **< 1** | 17 (85) | 2 (10) | 0 | 20 (100) | 9 (100) | 0 | 0 | 9 (100) | 27 (90) | 2 (6,7) | 0 | 30 (100) |
| **1** | 1 (100) | 0 | 0 | 1 (100) | 3 (100) | 0 | 0 | 3 (100) | 5 (100) | 0 | 0 | 5 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2** | 4 (100) | 0 | 0 | 4 (100) | 6 (100) | 0 | 0 | 6 (100) | 10 (100) | 0 | 0 | 10 (100) |
| **3** | 6 (100) | 0 | 0 | 6 (100) | 5 (100) | 0 | 0 | 5 (100) | 11 (100) | 0 | 0 | 11 (100) |
| **4** | 4 (100) | 0 | 0 | 4 (100) | 0 | 0 | 0 | 2 (100) | 4 (66,7) | 0 | 0 | 6 (100) |
| **5** | 1 (50) | 1 (50) | 0 | 2 (100) | 0 | 0 | 0 | 0 | 1 (50) | 1 (50) | 0 | 2 (100) |
| **6** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **7** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **8** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **9** | 0 | 0 | 0 | 0 | 1 (100) | 0 | 0 | 1 (100) | 1 (100) | 0 | 0 | 1 (100) |
| **10** | 1 (50) | 0 | 1 (50) | 2 (100) | 0 | 0 | 0 | 0 | 1 (50) | 0 | 1 (50) | 2 (100) |
| **11** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | 272 (84,5) | 30 (9,3) | 6 (1,9) | 322 (100) | 263 (84,8) | 31 (10) | 1 (0,3) | 310 (100) | 538 (84,7) | 61 (9,6) | 7 (1,1) | 635 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,318 | 0,051 | 0,376 | 0,008 | 0,321 | 0,000 |
| **Cramer's V** | 0,184 | 0,051 | 0,217 | 0,008 | 0,185 | 0,000 |

**Table 73** **Cross Tabulation between the Frequency of Listening to a Stereo Using a Headphone and the Presence of Hearing Impairment among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Frequency of Stereo Listen using a Headphone (hours/day) | The Presence of Hearing Impairment [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total |
| **0** | 238 (84,1) | 27 (9,5) | 5 (1,8) | 283 (100) | 239 (84,2) | 31 (10,9) | 1 (0,4) | 284 (100) | 478 (84,2) | 58 (10,2) | 6 (1,1) | 568 (100) |
| **< 0,5** | 7 (70) | 2 (20) | 1 (10) | 10 (100) | 11 (84,6) | 0 | 0 | 13 (100) | 17 (77,3) | 2 (9,1) | 1 (4,5) | 22 (100) |
| **0,5** | 21 (100) | 0 | 0 | 21 (100) | 8 (100) | 0 | 0 | 8 (100) | 29 (100) | 0 | 0 | 29 (100) |
| **1 – 1,5** | 9 (90) | 0 | 0 | 10 (100) | 5 (100) | 0 | 0 | 5 (100) | 14 (87,5) | 1 (6,3) | 0 | 16 (100) |
| **2 – 2,5** | 1 (50) | 1 (50) | 0 | 2 (100) | 1 (100) | 0 | 0 | 1 (100) | 2 (66,7) | 1 (33,3) | 0 | 3 (100) |
| **≥ 3** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | 276 (84,7) | 30 (9,2) | 6 (1,8) | 326 (100) | 264 (84,9) | 31 (10) | 1 (0,3) | 311 (100) | 540 (84,6) | 62 (9,7) | 7 (1,1) | 638 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,217 | 0,220 | 0,152 | 0,953 | 0,134 | 0,719 |
| **Cramer's V** | 0,126 | 0,220 | 0,088 | 0,953 | 0,077 | 0,719 |

**Table 74 Cross Tabulation between the Loudness of Stereo and the Presence of Hearing Impairment among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Loudness of Stereo | The Presence of Hearing Impairment [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total |
| **0** | 238 (84,1) | 27 (9,5) | 5 (1,8) | 283 (100) | 239 (84,2) | 31 (10,9) | 1 (0,4) | 284 (100) | 478 (84,2) | 58 (10,2) | 6 (1,1) | 568 (100) |
| **Very quiet (Sehr leise)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Quiet (Ziemlich leise)** | 5 (100) | 0 | 0 | 5 (100) | 3 (100) | 0 | 0 | 3 (100) | 8 (100) | 0 | 0 | 8 (100) |
| **Moderate (Mittelmäßig)** | 18 (81,8) | 3 (13,6) | 0 | 22 (100) | 18 (90) | 0 | 0 | 20 (100) | 37 (86) | 3 (7) | 0 | 43 (100) |
| **Loud (Ziemlich laut)** | 13 (92,9) | 0 | 1 (7,1) | 14 (100) | 3 (100) | 0 | 0 | 3 (100) | 16 (94,1) | 0 | 1 (5,9) | 17 (100) |
| **Very loud (Sehr** | 1 (50) | 1 (50) | 0 | 2 (100) | 2 (100) | 0 | 0 | 2 (100) | 3 (75) | 1 (25) | 0 | 4 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| laut) | | | | | | | | | | | | |
| **Total** | 275 (84,4) | 31 (9,5) | 6 (1,8) | 326 (100) | 265 (84,9) | 31 (9,9) | 1 (0,3) | 312 (100) | 542 (84,7) | 62 (9,7) | 7 (1,1) | 640 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,174 | 0,628 | 0,126 | 0,958 | 0,128 | 0,580 |
| **Cramer's V** | 0,100 | 0,628 | 0,073 | 0,958 | 0,074 | 0,580 |

## 9.5.3 Visiting Discotheques

**Table 75 Cross Tabulation between the Duration of Visiting Discotheques and the Presence of Hearing Impairment among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Duration of Discotheques Visits (years) | The Presence of Hearing Impairment [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total |
| **0** | 261 (83,9) | 30 (9,6) | 6 (1,9) | 311 (100) | 234 (84,8) | 27 (9,8) | 1 (0,4) | 276 (100) | 495 (84,3) | 57 (9,7) | 7 (1,2) | 587 (100) |
| **< 1** | 11 (100) | 0 | 0 | 11 (100) | 6 (66,7) | 2 (22,2) | 0 | 9 (100) | 17 (85) | 2 (10) | 0 | 20 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 1 (100) | 0 | 0 | 1 (100) | 9 (100) | 0 | 0 | 9 (100) | 11 (100) | 0 | 0 | 11 (100) |
| **2** | 3 (100) | 0 | 0 | 3 (100) | 10 (83,3) | 2 (16,7) | 0 | 12 (100) | 12 (85,7) | 2 (14,3) | 0 | 14 (100) |
| **3** | 0 | 0 | 0 | 0 | 3 (100) | 0 | 0 | 3 (100) | 3 (100) | 0 | 0 | 3 (100) |
| **4** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **6** | 0 | 0 | 0 | 0 | 2 (100) | 0 | 0 | 2 (100) | 2 (100) | 0 | 0 | 2 (100) |
| **Total** | 276 (84,7) | 30 (9,2) | 6 (1,8) | 326 (100) | 264 (84,9) | 31 (10) | 1 (0,3) | 311 (100) | 540 (84,8) | 61 (9,6) | 7 (1,1) | 637 (100) |

| **Symmetric Measures** | **Boys** | | **Girls** | | **Total** | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,093 | 0,997 | 0,141 | 0,976 | 0,083 | 1,000 |
| **Cramer's V** | 0,054 | 0,997 | 0,081 | 0,976 | 0,048 | 1,000 |

**Table 76** **Cross Tabulation between the Frequency of Visiting Discotheques and the Presence of Hearing Impairment among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Frequency of Discotheques Visits (hours/day) | The Presence of Hearing Impairment [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total |
| **0** | 261 (83,9) | 30 (9,6) | 6 (1,9) | 311 (100) | 234 (84,8) | 27 (9,8) | 1 (0,4) | 276 (100) | 495 (84,3) | 57 (9,7) | 7 (1,2) | 587 (100) |
| **< monthly** | 3 (100) | 0 | 0 | 3 (100) | 10 (100) | 0 | 0 | 10 (100) | 13 (100) | 0 | 0 | 13 (100) |
| **Monthly** | 9 (100) | 0 | 0 | 9 (100) | 13 (92,9) | 1 (7,1) | 0 | 14 (100) | 22 (95,7) | 1 (4,3) | 0 | 23 (100) |
| **Bimonthly** | 2 (100) | 0 | 0 | 2 (100) | 3 (37,5) | 4 (50) | 0 | 8 (100) | 5 (50) | 4 (40) | 0 | 10 (100) |
| **Weekly** | 1 (100) | 0 | 0 | 1 (100) | 4 (100) | 0 | 0 | 4 (100) | 4 (100) | 0 | 0 | 4 (100) |
| **Total** | 276 (84,7) | 30 (9,2) | 6 (1,8) | 326 (100) | 264 (84,6) | 32 (10,3) | 1 (0,3) | 312 (100) | 539 (84,6) | 62 (9,7) | 7 (1,1) | 637 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,093 | 0,997 | 0,247 | 0,087 | 0,164 | 0,145 |
| **Cramer's V** | 0,054 | 0,997 | 0,143 | 0,087 | 0,095 | 0,145 |

**Table 77** **Cross Tabulation between the Loudness of Discotheques and the Presence of Hearing Impairment among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Loudness of Discotheques | The Presence of Hearing Impairment [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total |
| **0** | 261 (83,9) | 30 (9,6) | 6 (1,9) | 311 (100) | 234 (84,8) | 27 (9,8) | 1 (0,4) | 276 (100) | 495 (84,3) | 57 (9,7) | 7 (1,2) | 587 (100) |
| **Normal voice to chat (normale Stimme, Unterhaltung)** | 0 | 0 | 0 | 0 | 3 (100) | 0 | 0 | 3 (100) | 3 (100) | 0 | 0 | 3 (100) |
| **Loud voice to chat (laute Stimme, Unterhaltung)** | 4 (100) | 0 | 0 | 4 (100) | 13 (76,5) | 3 (17,6) | 0 | 17 (100) | 17 (81) | 3 (14,3) | 0 | 21 (100) |
| **Shouting to understand (Schreien zur Verständigung)** | 9 (100) | 0 | 0 | 9 (100) | 7 (87,5) | 1 (12,5) | 0 | 8 (100) | 16 (94,1) | 1 (5,9) | 0 | 17 (100) |
| **Loud shout, limit understanding (Lautes Schreien, kaum noch** | 2 (100) | 0 | 0 | 2 (100) | 6 (100) | 0 | 0 | 6 (100) | 8 (100) | 0 | 0 | 8 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Verständigung)** | | | | | | | | | | | | |
| **No possible understanding (keine Verständigung möglich)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | 276 (84,7) | 30 (9,2) | 6 (1,8) | 326 (100) | 263 (84,8) | 31 (10) | 1 (0,3) | 310 (100) | 539 (84,7) | 61 (9,6) | 7 (1,1) | 636 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,093 | 0,997 | 0,104 | 0,992 | 0,082 | 0,979 |
| **Cramer's V** | 0,054 | 0,997 | 0,060 | 0,992 | 0,047 | 0,979 |

### 9.5.4 Attending Concerts

**Table 78** **Cross Tabulation between the Duration of Concerts Attendance and the Presence of Hearing Impairment among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Duration of Concerts Attendance (years) | The Presence of Hearing Impairment [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total |
| **0** | 228 (86) | 22 (8,3) | 5 (1,9) | 265 (100) | 184 (83,3) | 27 (12,2) | 1 (0,5) | 221 (100) | 413 (84,6) | 50 (10,2) | 6 (1,2) | 488 (100) |
| **< 1** | 20 (71,4) | 5 (17,9) | 0 | 28 (100) | 30 (85,7) | 2 (5,7) | 0 | 35 (100) | 50 (79,4) | 7 (11,1) | 0 | 63 (100) |
| **1** | 5 (83,3) | 0 | 1 (16,7) | 6 (100) | 11 (100) | 0 | 0 | 11 (100) | 16 (94,1) | 0 | 1 (5,9) | 17 (100) |
| **2** | 12 (100) | 0 | 0 | 12 (100) | 19 (86,4) | 0 | 0 | 22 (100) | 31 (91,2) | 0 | 0 | 34 (100) |
| **3** | 5 (83,3) | 1 (16,7) | 0 | 6 (100) | 5 (100) | 0 | 0 | 5 (100) | 10 (90,9) | 1 (9,1) | 0 | 11 (100) |
| **4** | 3 (75) | 1 (25) | 0 | 4 (100) | 6 (100) | 0 | 0 | 6 (100) | 8 (88,9) | 1 (11,1) | 0 | 9 (100) |
| **5** | 1 (100) | 0 | 0 | 1 (100) | 1 (100) | 0 | 0 | 1 (100) | 3 (100) | 0 | 0 | 3 (100) |
| **6** | 0 | 1 (100) | 0 | 1 (100) | 0 | 0 | 0 | 0 | 0 | 1 (100) | 0 | 1 (100) |
| **7** | 0 | 0 | 0 | 0 | 2 (100) | 0 | 0 | 2 (100) | 2 (100) | 0 | 0 | 2 (100) |
| **8** | 0 | 0 | 0 | 0 | 0 | 1 (100) | 0 | 1 (100) | 0 | 1 (100) | 0 | 1 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **9** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **10** | 0 | 0 | 0 | 0 | 3 (100) | 0 | 0 | 3 (100) | 3 (100) | 0 | 0 | 3 (100) |
| **Total** | 274 (84,8) | 30 (9,3) | 6 (1,9) | 323 (100) | 261 (85) | 30 (9,8) | 1 (0,3) | 307 (100) | 536 (84,8) | 61 (9,7) | 7 (1,1) | 632 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,299 | 0,227 | 0,276 | 0,665 | 0,245 | 0,149 |
| **Cramer's V** | 0,172 | 0,227 | 0,159 | 0,665 | 0,142 | 0,149 |

**Table 79** **Cross Tabulation between the Frequency of Concerts Attendance and the Presence of Hearing Impairment among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Frequency of Concerts Attendance (hours/day) | The Presence of Hearing Impairment [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total |
| **0** | 228 (86) | 22 (8,3) | 5 (1,9) | 265 (100) | 184 (83,3) | 27 (12,2) | 1 (0,5) | 221 (100) | 413 (84,6) | 50 (10,2) | 6 (1,2) | 488 (100) |
| **Annually** | 25 (83,3) | 3 (10) | 0 | 30 (100) | 45 (91,8) | 1 (2) | 0 | 49 (100) | 70 (88,6) | 4 (5,1) | 0 | 79 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **6 Monthly** | 12 (66,7) | 5 (27,8) | 1 (5,6) | 18 (100) | 25 (86,2) | 2 (6,9) | 0 | 29 (100) | 36 (80) | 6 (13,3) | 1 (2,2) | 45 (100) |
| **3 Monthly** | 5 (83,3) | 0 | 0 | 6 (100) | 7 (100) | 0 | 0 | 7 (100) | 12 (92,3) | 0 | 0 | 13 (100) |
| **Monthly** | 2 (100) | 0 | 0 | 2 (100) | 0 | 0 | 0 | 1 (100) | 2 (66,7) | 0 | 0 | 3 (100) |
| **Total** | 272 (84,7) | 30 (9,3) | 6 (1,9) | 321 (100) | 261 (85) | 30 (9,8) | 1 (0,3) | 307 (100) | 533 (84,9) | 60 (9,6) | 7 (1,1) | 628 (100) |

| Symmetric Measures | Boys | | Girls | | Total | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,210 | 0,290 | 0,295 | 0,009 | 0,144 | 0,364 |
| **Cramer's V** | 0,121 | 0,290 | 0,170 | 0,009 | 0,083 | 0,364 |

**Table 80** **Cross Tabulation between the Loudness of Concerts and the Presence of Hearing Impairment among Sample Aged 11 to 14 Years Using a Weighting Factor**

| Loudness of Concerts | The Presence of Hearing Impairment [n (%)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | | | | Girls | | | | Total | | | |
| | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total | Normal | Slight | Moderate | Total |
| **0** | 228 (86) | 22 (8,3) | 5 (1,9) | 265 (100) | 184 (83,3) | 27 (12,2) | 1 (0,5) | 221 (100) | 413 (84,6) | 50 (10,2) | 6 (1,2) | 488 (100) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Too quiet (zu leise)** | 0 | 0 | 0 | 0 | 3 (100) | 0 | 0 | 3 (100) | 3 (100) | 0 | 0 | 3 (100) |
| **Appriopriate (gerade richtig)** | 32 (76,2) | 7 (16,7) | 0 | 42 (100) | 45 (84,9) | 4 (7,5) | 0 | 53 (100) | 77 (81,1) | 12 (12,6) | 0 | 95 (100) |
| **Too loud (zu laut)** | 14 (93,3) | 0 | 0 | 15 (100) | 31 (93,9) | 0 | 0 | 33 (100) | 46 (92) | 0 | 0 | 50 (100) |
| **Total** | 274 (85,1) | 29 (9) | 5 (1,6) | 322 (100) | 263 (84,8) | 31 (10) | 1 (0,3) | 310 (100) | 539 (84,7) | 62 (9,7) | 6 (0,9) | 636 (100) |

| **Symmetric Measures** | **Boys** | | **Girls** | | **Total** | |
|---|---|---|---|---|---|---|
| | Value | Sign. | Value | Sign. | Value | Sign. |
| **Phi** | 0,147 | 0,322 | 0,152 | 0,617 | 0,132 | 0,274 |
| **Cramer's V** | 0,104 | 0,322 | 0,088 | 0,617 | 0,076 | 0,274 |

## 9.6 Appendix 6 - PAP, PAPF and Estimated Numbers in Population

### 9.6.1 Earache due to Listening to a Walkman

**Picture 4 Population Attributable Prevalence, Population Attributable Prevalence Fraction and Estimated Numbers of Earache among Adolescents Aged 11 to 14 Years in Population due to Listening to a Walkman**

| | |
|---|---|
| Source | Eurostat; KUS Daten |
| Short Descr pt on | Between L sten ng to a Wa kman and Hav ng Earache |
| GEO | Germany |
| T ME | 2010 |

**Population**

| Age | Boys | Girls | Total |
|---|---|---|---|
| 11 | 405875 | 385436 | 791311 |
| 12 | 418950 | 397892 | 816842 |
| 13 | 412504 | 390828 | 803332 |
| 14 | 399788 | 379667 | 779455 |
| Tota | 1637117 | 1553823 | 3190940 |

**Exposure : Walkman**

| Exposure | % boys | % girls | % total | Boys | Girls | Total |
|---|---|---|---|---|---|---|
| No | 37,2 | 21,9 | 29,7 | 609008 | 340287 | 947709 |
| Yes | 62,8 | 78,1 | 70,3 | 1028109 | 1213536 | 2243231 |

**Outcome: Earache**

| Outcome | % boys | % girls | % total | Boys | Girls | Total |
|---|---|---|---|---|---|---|
| No | 96,8 | 98,2 | 97,5 | 1584729 | 1525854 | 3111167 |
| Yes | 3,2 | 1,8 | 2,5 | 52388 | 27969 | 79774 |

**Crosstabulation**

| | | | Earache | | |
|---|---|---|---|---|---|
| | | | Yes | No | Tota |
| Wa kman | Yes | % w th n wa kman | 2,9 | 97,1 | 100 |
| | | % w th n earache | 81,3 | 70,2 | 70,5 |
| | No | % w th n wa kman | 1,6 | 98,4 | 100 |
| | | % w th n earache | 18,8 | 29,8 | 29,5 |
| | Tota | % w th n wa kman | 2,5 | 97,5 | 100 |
| | | % w th n earache | 100 | 100 | 100 |

**Crosstabulation**

| Popu at on numbers est mated from percent data | | | Earache | | |
|---|---|---|---|---|---|
| | | | Yes | No | Tota |
| Wa kman | Yes | % w th n wa kman | 65054 | 2178177 | 2243231 |
| | | % w th n earache | 64856 | 2184039 | 2248895 |
| | No | % w th n wa kman | 15163 | 932546 | 947709 |
| | | % w th n earache | 14997 | 927128 | 942125 |
| | Tota | % w th n wa kman | 80217 | 3110723 | 3190940 |
| | | % w th n earache | 79774 | 3111167 | 3190940 |

| | | |
|---|---|---|
| PAR = (P (RR - 1)) / (1 + (P (RR - 1))) | | |
| P | 0,705 | |
| % outcome w th exposure | 2,9 | |
| % outcome w thout exposure | 1,6 | |
| RR | 1,8125 | |
| RR - 1 | 0,8125 | |
| P (RR-1) | 0,5728125 | |
| 1 + (P (RR-1)) | 1,5728125 | |
| PAR | 0,3641963 | |
| PAR % | 36,42 | |
| PAR N | 29053,21 | 29053 |

| | |
|---|---|
| PAR = (Preva ence of earache - preva ence of earache among non-exposed popu at on) / preva ence of earache | |
| Est mated cases of earache n tota popu at on | 80217 |
| Non exposed popu at on | 947709 |
| Et mated cases of earache n non exposed popu at on | 15163 |
| PAR | 0,36353872 |
| PAR % | 36,35 |
| PAR N | 29000,76 |
| Popu at on Attr butab e Preva ence | 0,91% |

| | |
|---|---|
| Preva ence n exposed popu at on | 2,90% |
| Preva ence n non exposed popu at on | 1,60% |
| Preva ence n tota popu at on | 2,51% |
| | 2,50% |
| Popu at on Attr butab e Preva ence | 0,91% |
| Popu at on Attr butab e Preva ence Fract on | 36,35% |

| | |
|---|---|
| Preva ence of Exposure (P) | 70,30% |
| Preva ence Rat o: | 181,25% |
| PARF= (P(PR-1)) / (1+(P(PR-1))) | 36,35% |

| | |
|---|---|
| from PAPF | 29001 |

### 9.6.2 Tinnitus due to Listening to a Walkman

**Picture 5 Population Attributable Prevalence, Population Attributable Prevalence Fraction and Estimated Numbers of Tinnitus among Adolescents Aged 11 to 14 Years in Population due to Listening to a Walkman**

| | |
|---|---|
| Source | EuroStat; KUS Daten |
| Short Descr pt on | Between L sten ng to a Wa kman and Hav ng T nn tus |
| GEO | Germany |
| T ME | 2010 |

**Population**

| Age | Boys | Girls | Total |
|---|---|---|---|
| 11 | 405875 | 385436 | 791311 |
| 12 | 418950 | 397892 | 816842 |
| 13 | 412504 | 390828 | 803332 |
| 14 | 399788 | 379667 | 779455 |
| Tota | 1637117 | 1553823 | 3190940 |

**Exposure : Walkman**

| Exposure | % boys | % girls | % total | Boys | Girls | Total |
|---|---|---|---|---|---|---|
| No | 37,2 | 21,9 | 29,7 | 609008 | 340287 | 947709 |
| Yes | 62,8 | 78,1 | 70,3 | 1028109 | 1213536 | 2243231 |

**Outcome: Tinnitus**

| Duration | % boys | % girls | % total | Boys | Girls | Total |
|---|---|---|---|---|---|---|
| No | 89,3 | 88,4 | 88,8 | 1461945 | 1373580 | 2833555 |
| Yes | 10,7 | 11,6 | 11,2 | 175172 | 180243 | 357385 |

**Crosstabulation**

| | | | T nn tus | | |
|---|---|---|---|---|---|
| | | | Yes | No | Tota |
| Wa kman | Yes | % w th n wa kman | 11,6 | 88,4 | 100 |
| | | % w th n t nn tus | 73,2 | 70,1 | 70,5 |
| | No | % w th n wa kman | 10,1 | 89,9 | 100 |
| | | % w th n t nn tus | 26,8 | 29,9 | 29,5 |
| | Tota | % w th n wa kman | 11,1 | 88,9 | 100 |
| | | % w th n t nn tus | 100 | 100 | 100 |

**Crosstabulation**

| Popu at on numbers est mated from percent data | | | T nn tus | | |
|---|---|---|---|---|---|
| | | | Yes | No | Tota |
| Wa kman | Yes | % w th n wa kman | 260215 | 1983016 | 2243231 |
| | | % w th n t nn tus | 261606 | 1986322 | 2247928 |
| | No | % w th n wa kman | 95719 | 851991 | 947709 |
| | | % w th n t nn tus | 95779 | 847233 | 943012 |
| | Tota | % w th n wa kman | 355933 | 2835007 | 3190940 |
| | | % w th n t nn tus | 357385 | 2833555 | 3190940 |

| | | |
|---|---|---|
| PAR = (P (RR - 1)) / (1 + (P (RR - 1))) | | |
| P | 0,705 | |
| % outcome w th exposure | 11,6 | |
| % outcome w thout exposure | 10,1 | |
| RR | 1,14851485 | |
| RR - 1 | 0,14851485 | |
| P (RR-1) | 0,10470297 | |
| 1 + (P (RR-1)) | 1,10470297 | |
| PAR | 0,0947793 | |
| PAR % | 9,48 | |
| PAR N | 33872,73 | 33873 |

| | |
|---|---|
| PAR = (Preva ence of t nn tus - preva ence of t nn tus among non-exposed popu at on) / preva ence of t nn tus | |
| Est mated cases of t nn tus n tota popu at on | 355933 |
| Non exposed popu at on | 947709 |
| Et mated cases of t nn tus n non exposed popu at on | 95719 |
| PAR | 0,09453584 |
| PAR % | 9,45 |
| PAR N | 33785,72 |
| Popu at on Attr butab e Preva ence | 1,06% |

| | |
|---|---|
| Preva ence n exposed popu at on | 11,60% |
| Preva ence n non exposed popu at on | 10,10% |
| Preva ence n tota popu at on | 11,15% |
| | 11,20% |
| Popu at on Attr butab e Preva ence | 1,05% |
| Popu at on Attr butab e Preva ence Fract on | 9,45% |

| | |
|---|---|
| Preva ence of Exposure (P) | 70,30% |
| Preva ence Rat o: | 114,85% |
| PARF= (P(PR-1)) / (1+(P(PR-1))) | 9,45% |

| | |
|---|---|
| from PAPF | 33786 |

### 9.6.3 Tinnitus due to Listening to a Stereo Using a Headphone

**Picture 6 Population Attributable Prevalence, Population Attributable Prevalence Fraction and Estimated Numbers of Tinnitus among Adolescents Aged 11 to 14 Years in Population due to Listening to a Stereo Using a Headphone**

| | |
|---|---|
| Source | EuroStat; KUS Daten |
| Short Descr pt on | Between L sten ng to a stereo us ng a headphone and Hav ng T nn tus |
| GEO | Germany |
| T ME | 2010 |

**Population**

| Age | Boys | Girls | Total |
|---|---|---|---|
| 11 | 405875 | 385436 | 791311 |
| 12 | 418950 | 397892 | 816842 |
| 13 | 412504 | 390828 | 803332 |
| 14 | 399788 | 379667 | 779455 |
| Tota | 1637117 | 1553823 | 3190940 |

**Exposure : Stereo**

| Exposure | % boys | % girls | % total | Boys | Girls | Total |
|---|---|---|---|---|---|---|
| No | 86,7 | 91,2 | 88,9 | 1419380 | 1417087 | 2836746 |
| Yes | 13,3 | 8,8 | 11,1 | 217737 | 136736 | 354194 |

**Outcome: Tinnitus**

| Duration | % boys | % girls | % total | Boys | Girls | Total |
|---|---|---|---|---|---|---|
| No | 89,3 | 88,4 | 88,8 | 1461945 | 1373580 | 2833555 |
| Yes | 10,7 | 11,6 | 11,2 | 175172 | 180243 | 357385 |

**Crosstabulation**

| | | | T nn tus | | |
|---|---|---|---|---|---|
| | | | Yes | No | Tota |
| Stereo | Yes | % w th n stereo | 15,5 | 84,5 | 100 |
| | | % w th n t nn tus | 15,5 | 10,6 | 11,1 |
| | No | % w th n stereo | 10,6 | 89,4 | 100 |
| | | % w th n t nn tus | 84,5 | 89,4 | 88,9 |
| | Tota | % w th n stereo | 11,1 | 88,9 | 100 |
| | | % w th n t nn tus | 100 | 100 | 100 |

**Crosstabulation**

| Popu at on numbers est mated from percent data | | | T nn tus | | |
|---|---|---|---|---|---|
| | | | Yes | No | Tota |
| Stereo | Yes | % w th n stereo | 54900 | 299294 | 354194 |
| | | % w th n t nn tus | 55395 | 300357 | 355752 |
| | No | % w th n stereo | 300695 | 2536051 | 2836746 |
| | | % w th n t nn tus | 301991 | 2533198 | 2835188 |
| | Tota | % w th n stereo | 355595 | 2835345 | 3190940 |
| | | % w th n t nn tus | 357385 | 2833555 | 3190940 |

| | | |
|---|---|---|
| PAR = (P (RR - 1)) / (1 + (P (RR - 1))) | | |
| P | 0,111 | |
| % outcome w th exposure | 15,5 | |
| % outcome w thout exposure | 10,6 | |
| RR | 1,46226415 | |
| RR - 1 | 0,46226415 | |
| P (RR-1) | 0,05131132 | |
| 1 + (P (RR-1)) | 1,05131132 | |
| PAR | 0,04880697 | |
| PAR % | 4,88 | |
| PAR N | 17442,89 | 17443 |

| | |
|---|---|
| PAR = (Preva ence of t nn tus - preva ence of t nn tus among non-exposed popu at on) / preva ence of t nn tus | |
| Est mated cases of t nn tus n tota popu at on | 355595 |
| Non exposed popu at on | 2836746 |
| Et mated cases of t nn tus n non exposed popu at on | 300695 |
| PAR | 0,04880697 |
| PAR % | 4,88 |
| PAR N | 17442,89 |
| Popu at on Attr butab e Preva ence | 0,55% |

| | |
|---|---|
| Preva ence n exposed popu at on | 15,50% |
| Preva ence n non exposed popu at on | 10,60% |
| Preva ence n tota popu at on | 11,14% |
| | 11,20% |
| Popu at on Attr butab e Preva ence | 0,54% |
| Popu at on Attr butab e Preva ence Fract on | 4,88% |

| | |
|---|---|
| Preva ence of Exposure (P) | 11,10% |
| Preva ence Rat o: | 146,23% |
| PARF= (P(PR-1)) / (1+(P(PR-1))) | 4,88% |

| | |
|---|---|
| from PAPF | 17443 |

### 9.6.4 Earache due to Discotheques Visits

**Picture 7 Population Attributable Prevalence, Population Attributable Prevalence Fraction and Estimated Numbers of Earache among Adolescents Aged 11 to 14 Years in Population due to Visiting Discotheques**

| | |
|---|---|
| Source | EuroStat; KUS Daten |
| Short Descr pt on | Between V s t ng D scotheques and Hav ng Earache |
| GEO | Germany |
| T ME | 2010 |

**Population**

| Age | Boys | Girls | Total |
|---|---|---|---|
| 11 | 405875 | 385436 | 791311 |
| 12 | 418950 | 397892 | 816842 |
| 13 | 412504 | 390828 | 803332 |
| 14 | 399788 | 379667 | 779455 |
| Tota | 1637117 | 1553823 | 3190940 |

**Exposure : Discotheque**

| Exposure | % boys | % girls | % total | Boys | Girls | Total |
|---|---|---|---|---|---|---|
| No | 95,4 | 88,9 | 92,3 | 1561810 | 1381349 | 2945238 |
| Yes | 4,6 | 11,1 | 7,7 | 75307 | 172474 | 245702 |

**Outcome: Earache**

| Outcome | % boys | % girls | % total | Boys | Girls | Total |
|---|---|---|---|---|---|---|
| No | 96,8 | 98,2 | 97,5 | 1584729 | 1525854 | 3111167 |
| Yes | 3,2 | 1,8 | 2,5 | 52388 | 27969 | 79774 |

**Crosstabulation**

| | | | Earache | | |
|---|---|---|---|---|---|
| | | | Yes | No | Tota |
| D sco | Yes | % w th n d sco | 6,1 | 93,9 | 100 |
| | | % w th n earache | 20 | 7,4 | 7,7 |
| | No | % w th n d sco | 2 | 98 | 100 |
| | | % w th n earache | 80 | 92,6 | 92,3 |
| | Tota | % w th n d sco | 2,4 | 97,6 | 100 |
| | | % w th n earache | 100 | 100 | 100 |

**Crosstabulation**

| Popu at on numbers est mated from percent data | | | Earache | | |
|---|---|---|---|---|---|
| | | | Yes | No | Tota |
| D sco | Yes | % w th n d sco | 14988 | 230715 | 245702 |
| | | % w th n earache | 15955 | 230226 | 246181 |
| | No | % w th n d sco | 58905 | 2886333 | 2945238 |
| | | % w th n earache | 63819 | 2880940 | 2944759 |
| | Tota | % w th n d sco | 73893 | 3117047 | 3190940 |
| | | % w th n earache | 79774 | 3111167 | 3190940 |

| | | |
|---|---|---|
| PAR = (P (RR - 1)) / (1 + (P (RR - 1))) | | |
| P | 0,077 | |
| % outcome w th exposure | 6,1 | |
| % outcome w thout exposure | 2 | |
| RR | 3,05 | |
| RR - 1 | 2,05 | |
| P (RR-1) | 0,15785 | |
| 1 + (P (RR-1)) | 1,15785 | |
| PAR | 0,13633027 | |
| PAR % | 13,63 | |
| PAR N | 10875,54 | 10876 |

| | |
|---|---|
| PAR = (Preva ence of earache - preva ence of earache among non-exposed popu at on) / preva ence of earache | |
| Est mated cases of earache n tota popu at on | 73893 |
| Non exposed popu at on | 2945238 |
| Et mated cases of earache n non exposed popu at on | 58905 |
| PAR | 0,13633027 |
| PAR % | 13,63 |
| PAR N | 10875,54 |
| Popu at on Attr butab e Preva ence | 0,34% |

| | |
|---|---|
| Preva ence n exposed popu at on | 6,10% |
| Preva ence n non exposed popu at on | 2,00% |
| Preva ence n tota popu at on | 2,32% |
| | 2,50% |
| Popu at on Attr butab e Preva ence | 0,32% |
| Popu at on Attr butab e Preva ence Fract on | 13,63% |

| | |
|---|---|
| Preva ence of Exposure (P) | 7,70% |
| Preva ence Rat o: | 305,00% |
| PARF= (P(PR-1)) / (1+(P(PR-1))) | 13,63% |

| | |
|---|---|
| from PAPF | 10876 |

### 9.6.5 Tinnitus due to Discotheques Visits

**Picture 8 Population Attributable Prevalence, Population Attributable Prevalence Fraction and Estimated Numbers of Tinnitus among Adolescents Aged 11 to 14 Years in Population due to Visiting Discotheques**

| | |
|---|---|
| Source | EuroStat; KUS Daten |
| Short Descr pt on | Between V s t ng D scotheques and Hav ng T nn tus |
| GEO | Germany |
| T ME | 2010 |

**Population**

| Age | Boys | Girls | Total |
|---|---|---|---|
| 11 | 405875 | 385436 | 791311 |
| 12 | 418950 | 397892 | 816842 |
| 13 | 412504 | 390828 | 803332 |
| 14 | 399788 | 379667 | 779455 |
| Tota | 1637117 | 1553823 | 3190940 |

**Exposure : Disco**

| Exposure | % boys | % girls | % total | Boys | Girls | Total |
|---|---|---|---|---|---|---|
| No | 95,4 | 88,9 | 92,3 | 1561810 | 1381349 | 2945238 |
| Yes | 4,6 | 11,1 | 7,7 | 75307 | 172474 | 245702 |

**Outcome: Tinnitus**

| Duration | % boys | % girls | % total | Boys | Girls | Total |
|---|---|---|---|---|---|---|
| No | 89,3 | 88,4 | 88,8 | 1461945 | 1373580 | 2833555 |
| Yes | 10,7 | 11,6 | 11,2 | 175172 | 180243 | 357385 |

**Crosstabulation**

| | | | T nn tus | | |
|---|---|---|---|---|---|
| | | | Yes | No | Tota |
| D sco | Yes | % w th n d sco | 20,4 | 79,6 | 100 |
| | | % w th n t nn tus | 14,1 | 6,9 | 7,7 |
| | No | % w th n d sco | 10,4 | 89,6 | 100 |
| | | % w th n t nn tus | 85,9 | 93,1 | 92,3 |
| | Tota | % w th n d sco | 11,2 | 88,8 | 100 |
| | | % w th n t nn tus | 100 | 100 | 100 |

**Crosstabulation**

| Popu at on numbers est mated from percent data | | | T nn tus | | |
|---|---|---|---|---|---|
| | | | Yes | No | Tota |
| D sco | Yes | % w th n d sco | 50123 | 195579 | 245702 |
| | | % w th n t nn tus | 50391 | 195515 | 245907 |
| | No | % w th n d sco | 306305 | 2638933 | 2945238 |
| | | % w th n t nn tus | 306994 | 2638039 | 2945033 |
| | Tota | % w th n d sco | 356428 | 2834512 | 3190940 |
| | | % w th n t nn tus | 357385 | 2833555 | 3190940 |

| | | |
|---|---|---|
| PAR = (P (RR - 1)) / (1 + (P (RR - 1))) | | |
| P | 0,077 | |
| % outcome w th exposure | 20,4 | |
| % outcome w thout exposure | 10,4 | |
| RR | 1,96153846 | |
| RR - 1 | 0,96153846 | |
| P (RR-1) | 0,07403846 | |
| 1 + (P (RR-1)) | 1,07403846 | |
| PAR | 0,06893465 | |
| PAR % | 6,89 | |
| PAR N | 24636,23 | 24636 |

| | |
|---|---|
| PAR = (Preva ence of t nn tus - preva ence of t nn tus among non-exposed popu at on) / preva ence of t nn tus | |
| Est mated cases of t nn tus n tota popu at on | 356428 |
| Non exposed popu at on | 2945238 |
| Et mated cases of t nn tus n non exposed popu at on | 306305 |
| PAR | 0,06893465 |
| PAR % | 6,89 |
| PAR N | 24636,23 |
| Popu at on Attr butab e Preva ence | 0,77% |

| | |
|---|---|
| Preva ence n exposed popu at on | 20,40% |
| Preva ence n non exposed popu at on | 10,40% |
| Preva ence n tota popu at on | 11,17% |
| | 11,20% |
| Popu at on Attr butab e Preva ence | 0,77% |
| Popu at on Attr butab e Preva ence Fract on | 6,89% |

| | |
|---|---|
| Preva ence of Exposure (P) | 7,70% |
| Preva ence Rat o: | 196,15% |
| PARF= (P(PR-1)) / (1+(P(PR-1))) | 6,89% |

| | |
|---|---|
| from PAPF | 24636 |

### 9.6.6 Earache due Concerts Attendance

**Picture 9 Population Attributable Prevalence, Population Attributable Prevalence Fraction and Estimated Numbers of Earache among Adolescents Aged 11 to 14 Years in Population due to Attending Concerts**

| | |
|---|---|
| Source | EuroStat; KUS Daten |
| Short Descr pt on | Between Attend ng Concerts and Hav ng Earache |
| GEO | Germany |
| T ME | 2010 |

**Population**

| Age | Boys | Girls | Total |
|---|---|---|---|
| 11 | 405875 | 385436 | 791311 |
| 12 | 418950 | 397892 | 816842 |
| 13 | 412504 | 390828 | 803332 |
| 14 | 399788 | 379667 | 779455 |
| Tota | 1637117 | 1553823 | 3190940 |

**Exposure : Concerts**

| Exposure | % boys | % girls | % total | Boys | Girls | Total |
|---|---|---|---|---|---|---|
| No | 81,5 | 71 | 76,4 | 1334250 | 1103214 | 2437878 |
| Yes | 18,5 | 29 | 23,6 | 302867 | 450609 | 753062 |

**Outcome: Earache**

| Outcome | % boys | % girls | % total | Boys | Girls | Total |
|---|---|---|---|---|---|---|
| No | 96,8 | 98,2 | 97,5 | 1584729 | 1525854 | 3111167 |
| Yes | 3,2 | 1,8 | 2,5 | 52388 | 27969 | 79774 |

**Crosstabulation**

| | | | Earache | | |
|---|---|---|---|---|---|
| | | | Yes | No | Tota |
| Concerts | Yes | % w th n concerts | 4 | 96 | 100 |
| | | % w th n earache | 37,5 | 23,2 | 23,5 |
| | No | % w th n concerts | 2,1 | 97,9 | 100 |
| | | % w th n earache | 62,5 | 76,8 | 76,5 |
| | Tota | % w th n concerts | 2,5 | 97,5 | 100 |
| | | % w th n earache | 100 | 100 | 100 |

**Crosstabulation**

| Popu at on numbers est mated from percent data | | | Earache | | |
|---|---|---|---|---|---|
| | | | Yes | No | Tota |
| Concerts | Yes | % w th n concerts | 30122 | 722939 | 753062 |
| | | % w th n earache | 29915 | 721791 | 751706 |
| | No | % w th n concerts | 51195 | 2386683 | 2437878 |
| | | % w th n earache | 49858 | 2389376 | 2439234 |
| | Tota | % w th n concerts | 81318 | 3109622 | 3190940 |
| | | % w th n earache | 79774 | 3111167 | 3190940 |

| | | |
|---|---|---|
| PAR = (P (RR - 1)) / (1 + (P (RR - 1))) | | |
| P | 0,235 | |
| % outcome w th exposure | 4 | |
| % outcome w thout exposure | 2,1 | |
| RR | 1,9047619 | |
| RR - 1 | 0,9047619 | |
| P (RR-1) | 0,21261905 | |
| 1 + (P (RR-1)) | 1,21261905 | |
| PAR | 0,1753387 | |
| PAR % | 17,53 | |
| PAR N | 13987,38 | 13987 |

| | |
|---|---|
| PAR = (Preva ence of earache - preva ence of earache among non-exposed popu at on) / preva ence of earache | |
| Est mated cases of earache n tota popu at on | 81318 |
| Non exposed popu at on | 2437878 |
| Et mated cases of earache n non exposed popu at on | 51195 |
| PAR | 0,17595354 |
| PAR % | 17,60 |
| PAR N | 14036,43 |
| Popu at on Attr butab e Preva ence | 0,44% |

| | |
|---|---|
| Preva ence n exposed popu at on | 4,00% |
| Preva ence n non exposed popu at on | 2,10% |
| Preva ence n tota popu at on | 2,55% |
| | 2,50% |
| Popu at on Attr butab e Preva ence | 0,45% |
| Popu at on Attr butab e Preva ence Fract on | 17,60% |

| | |
|---|---|
| Preva ence of Exposure (P) | 23,60% |
| Preva ence Rat o: | 190,48% |
| PARF= (P(PR-1)) / (1+(P(PR-1))) | 17,60% |

| | |
|---|---|
| from PAPF | 14036 |

## 9.6.7 Tinnitus due to Concerts Attendance

**Picture 10 Population Attributable Prevalence, Population Attributable Prevalence Fraction and Estimated Numbers of Tinnitus among Adolescents Aged 11 to 14 Years in Population due to Attending Concerts**

| | |
|---|---|
| Source | EuroStat; KUS Daten |
| Short Descr pt on | Between Attend ng Concerts and Hav ng T nn tus |
| GEO | Germany |
| T ME | 2010 |

**Population**

| Age | Boys | Girls | Total |
|---|---|---|---|
| 11 | 405875 | 385436 | 791311 |
| 12 | 418950 | 397892 | 816842 |
| 13 | 412504 | 390828 | 803332 |
| 14 | 399788 | 379667 | 779455 |
| Tota | 1637117 | 1553823 | 3190940 |

**Exposure : Concerts**

| Exposure | % boys | % girls | % total | Boys | Girls | Total |
|---|---|---|---|---|---|---|
| No | 81,5 | 71 | 76,4 | 1334250 | 1103214 | 2437878 |
| Yes | 18,5 | 29 | 23,6 | 302867 | 450609 | 753062 |

**Outcome: Tinnitus**

| Duration | % boys | % girls | % total | Boys | Girls | Total |
|---|---|---|---|---|---|---|
| No | 89,3 | 88,4 | 88,8 | 1461945 | 1373580 | 2833555 |
| Yes | 10,7 | 11,6 | 11,2 | 175172 | 180243 | 357385 |

**Crosstabulation**

| | | | T nn tus | | |
|---|---|---|---|---|---|
| | | | Yes | No | Tota |
| Concerts | Yes | % w th n concerts | 13,4 | 86,6 | 100 |
| | | % w th n t nn tus | 28,2 | 22,8 | 23,4 |
| | No | % w th n concerts | 10,5 | 89,5 | 100 |
| | | % w th n t nn tus | 71,8 | 77,2 | 76,6 |
| | Tota | % w th n concerts | 11,2 | 88,8 | 100 |
| | | % w th n t nn tus | 100 | 100 | 100 |

**Crosstabulation**

| Popu at on numbers est mated from percent data | | | T nn tus | | |
|---|---|---|---|---|---|
| | | | Yes | No | Tota |
| Concerts | Yes | % w th n concerts | 100910 | 652152 | 753062 |
| | | % w th n t nn tus | 100783 | 646050 | 746833 |
| | No | % w th n concerts | 255977 | 2181901 | 2437878 |
| | | % w th n t nn tus | 256603 | 2187504 | 2444107 |
| | Tota | % w th n concerts | 356887 | 2834053 | 3190940 |
| | | % w th n t nn tus | 357385 | 2833555 | 3190940 |

| | | |
|---|---|---|
| PAR = (P (RR - 1)) / (1 + (P (RR - 1))) | | |
| P | 0,234 | |
| % outcome w th exposure | 13,4 | |
| % outcome w thout exposure | 10,5 | |
| RR | 1,27619048 | |
| RR - 1 | 0,27619048 | |
| P (RR-1) | 0,06462857 | |
| 1 + (P (RR-1)) | 1,06462857 | |
| PAR | 0,06070528 | |
| PAR % | 6,07 | |
| PAR N | 21695,17 | 21695 |

| | |
|---|---|
| PAR = (Preva ence of t nn tus - preva ence of t nn tus among non-exposed popu at on) / preva ence of t nn tus | |
| Est mated cases of t nn tus n tota popu at on | 356887 |
| Non exposed popu at on | 2437878 |
| Et mated cases of t nn tus n non exposed popu at on | 255977 |
| PAR | 0,06119238 |
| PAR % | 6,12 |
| PAR N | 21869,25 |
| Popu at on Attr butab e Preva ence | 0,69% |

| | |
|---|---|
| Preva ence n exposed popu at on | 13,40% |
| Preva ence n non exposed popu at on | 10,50% |
| Preva ence n tota popu at on | 11,18% |
| | 11,20% |
| Popu at on Attr butab e Preva ence | 0,68% |
| Popu at on Attr butab e Preva ence Fract on | 6,12% |

| | |
|---|---|
| Preva ence of Exposure (P) | 23,60% |
| Preva ence Rat o: | 127,62% |
| PARF= (P(PR-1)) / (1+(P(PR-1))) | 6,12% |

| | |
|---|---|
| from PAPF | 21869 |