OPERATIONAL CONTEXT:HEALTH INDICATORS

Sub- ACTION A1.4

Annex 4 of Abacus on operational context on Noise Low Emission Zone

Life MONZA
Methodologies fOr Noise low emission Zones introduction And management

LIFE15 ENV/IT/000586

LIFE MONZA
Methodologies fOr Noise low emission Zones introduction And management

Technical Report - A1.4 Operational context: Health indicators

Deliverable	**Operational context: Health indicators** **Annex 4 of Abacus on operational context on Noise Low Emission Zone**
Action/Sub-action	Action A1: Operational context for Noise Low Emission Zones (LEZ) detection and management Sub-action A1.4: Operational Context: Health Indicators
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1. Introduction

Action A1 consists in a state-of-the art review about the legislative and technical requirements on noise LEZ as well as the most up-to-date noise and air quality monitoring systems.
The necessity is to update the current state of knowledge about the improvements concerning the technological and normative framework of the above-mentioned items of the Project, including a scientific review on the suitable health indicators of the effects due to noise and air pollution.
The action is divided in 5 sub-actions, each one coordinated by one associated beneficiary:
A1.1 Legal and Environmental framework for Noise LEZ introduction - MONZA
A1.2 Operational context: Noise Monitoring Systems - ISPRA
A1.3 Operational context: Air Quality Monitoring Systems - ISPRA
A1.4 Operational context: Health indicators - UNIFI
A1.5 Operational context: interventions and expected effects on air quality, noise and health – VIENROSE
In the sub-action A1.4 the analysis of the state of the art about health indicators have been performed. This sub-action collects a review of the most recent available scientific literature regarding the evaluation of quality of life and of annoyance.
In particular, a deep analysis of research methodologies inherent in the object of the sub-action has been carried out, with particular attention to the choice of tools that can be employed for the study of large populations.
The survey has been mainly focused on the characteristics of three authoritative and validated questionnaires: SF 36, SF12, and WHOQOL-BREF.

2. Technical part

2.1. Instruments for the evaluation of quality of life

Scientific evidence shows that environmental risk factors have a negative impact on health status. Based on an estimate made in six European countries, including Italy, between 3% and 7% of the annual burden of disease is attributable to such factors. Specifically, airborne particulate (PM 2,5) is the main environmental risk factors related to 6.000-10.000 DALYs/year/million persons, while second-hand smoke, traffic noise (road, air and rail) and radon exposure cause 600-1.200 DALYs/year/million persons each one. Estimates of the burden of disease attributable to dioxin and formaldehyde still have uncertainties, so they can only be partially quantified. The health outcomes used to realize the estimates of disease burden are cardiopulmonary diseases, lung cancer, chronic bronchitis and restrictions in activities of daily life for the exposure to PM2.5 and severe sleep disorders and ischemic heart disease for the effects of aircraft, road and rail noise[1]. Other diseases that have been associated with exposure to environmental noise are cognitive impairment, annoyance and hearing disorders such as tinnitus. The methodology for calculating the burden of disease attributable to environmental noise was recently published by the World Health Organization, along with specific estimates of impact[2,3]. Although no systematic and conclusive analysis about the effect of noise-control interventions on the health of the exposed population has

[1] Hanninen O., Knol AB., Jantunen M. et al. Environmental Burden of Disease in Europe: assessing nine risk factors in six countries. Environ Health Perspect 2014; 122:439-446.
[2] WHO, JRC European Commission. Burden of disease from environmental noise. Quantification of healthy life years lost in Europe. WHO, 2011.
[3] WHO, JRC European Commission. Methodological guidance for estimating the burden of disease from environmental noise. WHO, 2012.

been yet realized, the assumption of a clear link between exposure and related diseases makes appropriate the use of intermediate outcomes - and related actions, as in the case of the project - for the evaluation of impact, represented by the exposure changes[4]. The use of indicators of burden of disease to assess the effect of the measures implemented in the LIFE project, i.e. a synthetic indicator such as DALYs, is problematic and poorly informative because the diseases associated with environmental risk factors modify their occurrence in a long time, longer than that of the post-intervention follow-up. We believe, therefore, more appropriate to rely on proxy indicators of health status, modifiable in the study timepoints, related to measurements of the quality of life (QOL).

The assessment of QOL in social and health sciences has assumed increasing importance, as testified by the many studies published on the development and validation of accurate and reproducible methods for the overall assessment of health status to be used in association or instead of classic indicators, such as mortality or morbidity. QOL, measured by validated instruments, has become an area of investigation in some ways of even more impact respect of "hard" indicators of health, since it involves the direct participation/perception of each person both on his/her own current health status and on the kind of interventions that are or are not perceived as useful to the improvement of their living conditions. Therefore, since the second half of the 80s, many tools have been created that, with different purposes and research areas, have tried to measure the QOL in different conditions. These tools consider different aspects, such as: impact of illness and disability on daily activities or behavior of sick person (e.g. Sickness Impact Profile); subjective perception of health status (e.g. Nottingham Health Profile); general aspects of disability and individual's functional status (e.g. SF-36). Many tools are "disease-based" and therefore not completely suitable to the environmental impact assessment and to evaluate the effect of the interventions on the determinants of the research project (changes in environmental noise, air quality , mobility and traffic ...). Many of these tools are not useful in the WHO's perspective of the QOL, defined as: "*QOL is represented by the perception that each person has about his position in life, in the context of culture and value system in which is included and in relation to his goals, expectations, priorities and concerns*". From this definition on, the conceptual framework addresses many subjective determinants such as physical health, psychological state, level of independence, social relationships, personal beliefs and the relationship that the individual establishes with the living environment. These determinants, not easy to detect, are also affected by cultural, social and environmental context in which individuals live, significantly influencing the efforts to enhance the overall QOL. Taking into account the intended use and the content, the numerous instruments measuring QOL can be divided into two main categories: specific and generic tools. While the specific instruments focus the assessment of QOL on specific areas and therefore are disease-specific, population-specific, function-specific and problem or condition-specific, the generic tools are built to evaluate all the main dimensions of QOL. The generic tools can be applied in different contexts, especially when there are no specific tools to investigate a peculiar problem, as in the case of the impact that noise and air quality have on the QOL of residents in the considered district of Monza. The choice of one of these tools to assess the effect that a change of the environment may have on health status is extremely complex: although some studies document the separate effects of air pollution and environmental noise on the overall QOL or on certain well identified diseases (e.g., cardiovascular diseases, respiratory diseases, allergic disorders, sleep disorders, etc.) there are no works that evaluate the simultaneous (synergistic?) exposure effect to both risk factors on QOL. To identify the best tool to answering the purpose of the study, we have examined the different questionnaires used in the scientific literature, taking into account some useful features: the ability to be self-administered; the potential to detect, through a subjective opinion expressed by the participants, the difference in QOL related to the structural interventions proposed and developed in

[4] Brown AL. Effects of road traffic noise on health: from Burden of Disease to effectiveness of interventions. Procedia Environmental Sciences 2015; 30:3-9.

the study. In the table below we summarize some of the instruments measuring QOL most cited in the literature related to the research objectives, so justifying the subsequent choice of the WHO questionnaire WHOQOL-Bref.

QOL questionnaire	N° of items	Domains	Key literature references
SF-36	36	physical functioning (PF), role limitation physical (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role limitation emotional (RE) and mental health (MH)	**Dratva**, J., Zemp, E., Dietrich, D. F., Bridevaux, P. O., Rochat, T., Schindler, C., & Gerbase, M. W. (2010). *Impact of road traffic noise annoyance on health-related quality of life: Results from a population-based study*. Quality of life research, 19(1), 37-46. **Héritier,** H., Vienneau, D., Frei, P., Eze, I. C., Brink, M., Probst-Hensch, N., & Röösli, M. (2014). *The association between road traffic noise exposure, annoyance and health-related quality of life (HRQOL)*. International journal of environmental research and public health, 11(12), 12652-12667. **Roswall, N., Høgh, V., Envold-Bidstrup, P., Raaschou-Nielsen**, O., Ketzel, M., Overvad, K., ... & Sørensen, M. (2015). Residential exposure to traffic noise and health-related quality of life—a population-based study. *PloS one*, *10*(3), e0120199. **Nitschke**, M., Tucker, G., Simon, D. L., Hansen, A. L., & Pisaniello, D. L. (2014). The link between noise perception and quality of life in South Australia. Noise and Health, 16(70), 137.
SF-12	12		**Oiamo**, T. H., Luginaah, I. N., & Baxter, J. (2015). *Cumulative effects of noise and odour annoyances on environmental and health related quality of life*. Social Science & Medicine, 146, 191-203. **Gundersen**, H., Magerøy, N., Moen, B. E., & Bråtveit, M. (2013). Traffic density in area of residence is associated with health-related quality of life in women, the community-based Hordaland Health Study. Archives of environmental & occupational health, 68(3), 153-160. **Jalali**, L., Bigelow, P., McColl, S., Majowicz, S., Gohari, M., & Waterhouse, R. (2016). Changes in quality of life and perceptions of general health before and after operation of wind turbines. Environmental Pollution, 216, 608-615.
WHOQOL-BREF	26	physical, psychological, social and	**Feder**, K., Michaud, D. S., Keith, S. E., Voicescu, S. A., Marro, L., Than, J., ... & Whelan, C. (2015). *An assessment of quality of*

		environmental domains	*life using the WHOQOL-BREF among participants living in the vicinity of wind turbines*. Environmental research, 142, 227-238. **Shepherd**, D., Welch, D., Dirks, K. N., & Mathews, R. (2010). Exploring the relationship between noise sensitivity, annoyance and health-related quality of life in a sample of adults exposed to environmental noise. International journal of environmental research and public health, 7(10), 3579-3594. **Shepherd**, D., McBride, D., Dirks, K. N., & Welch, D. (2014). Annoyance and health-related quality of life: a cross-sectional study involving two noise sources. Journal of Environmental Protection, 2014. **Shepherd**, D., Dirks, K., Welch, D., McBride, D., & Landon, J. (2016). The Covariance between Air Pollution Annoyance and Noise Annoyance, and Its Relationship with Health-Related Quality of Life. International Journal of Environmental Research and Public Health, 13(8), 792. **Welch**, D., Shepherd, D., Dirks, K. N., McBride, D., & Marsh, S. (2013). Road traffic noise and health-related quality of life: A cross-sectional study. Noise and health, 15(65), 224.

Based on the analysis of the studies identified in the literature, therefore, we propose the use of the WHOQOL-Bref questionnaire that, although less used than the SF36 questionnaire, is the only tool that has a specific environmental domain. Moreover, it can be of immediate use because already validated in Italian language. The administration pre-post (before and after the structural, environmental interventions) of WHOQOL-Bref would provide a comparable objective score of the residents' QOL and an estimate of the potential role of the structural changes on it. The 26-item tool requires a compilation time - min 5, max 10 mins – that we submit to the evaluation of the steering committee: if on the one hand the complete administration of all the items enables comparisons with similar scientific studies, the limit of the physical space available in the general LIFE questionnaire, as well as a possible negative effect on the participants due to the excessive length of the compilation, has led us to select a minimum of five main questions to be administered, that we propose as an enlarged general assessment, bearing in mind that the results obtained would have only an internal validity and representativeness. That is, in case the steering committee will decide to adopt the "minimum" approach, the results will be valid only for the sample of the study, but not generalizable nor comparable to other similar researches. Alternatively, we propose the full administration of the WHOQOL - Bref questionnaire in two different ways, below reported, which could warrant a greater representativeness but which need a greater commitment of those citizens who will join the research . The possible "outputs" of the analysis of QOL, by administering it before/after structural intervention, can therefore be declined in three different modalities:

1. administration of only 5 selected questions;
2. administration of the complete WHOQOL-Bref questionnaire to the entire sample of Monza citizens, attaching it in the overall questionnaire;

3. administration of the 5 selected questions in the overall questionnaire and enclose the entire WHOQOL-Bref as a separate module, letting the participants the willingness/ability to respond to it.

The 5 selected questions by the WHOQOL-Bref proposed as minimum dataset are the following:

1. **How would you rate your quality of life?**
   1 Very poor
   2 Poor
   3 Neither poor nor good
   4 Good
   5 Very Good

2. **How well are you able to concentrate?**
   1 Not at all
   2 Slightly
   3 A moderate amount
   4 Very much
   5 Extremely

3. **How healthy is your physical environment?**
   1 Not at all
   2 Slightly
   3 A moderate amount
   4 Very much
   5 Extremely

4. **How satisfied are you with your sleep?**
   1 Very dissatisfied
   2 Dissatisfied
   3 Neither satisfied nor dissatisfied
   4 Satisfied
   5 Very satisfied

5. **How satisfied are you with your mode of transportation?**
   1 Very dissatisfied
   2 Dissatisfied
   3 Neither satisfied nor dissatisfied
   4 Satisfied
   5 Very satisfied

In order to better understand the rationale of choice of the instruments for the evaluation of quality of life, a full extract of WHOQOL – Bref Questionnaire is given in the following pages.

WHOQOL-BREF

June 1997

U.S. Version

University of Washington

Seattle, Washington

United States of America

Emblem...Soul Catcher: a Northwest Coast Indian symbol of physical and mental well-being. Artist: Marvin Oliver

WHOQOL-BREF

About You

Before you begin we would like to ask you to answer a few general questions about yourself by circling the correct answer or by filling in the space provided.

1. What is your gender — Male — Female

2. What is your date of birth? _____ / _____ / _____ (Day / Month / Year)

3. What is the highest education you received?
   - None at all
   - Elementary School
   - High School
   - College

4. What is your marital status?
   - Single
   - Married
   - Living as Married
   - Separated
   - Divorced
   - Widowed

5. Are you currently ill? — Yes — No

6. If something is wrong with your health, what do you think it is? _____ illness/problem

Instructions

This questionnaire asks how you feel about your quality of life, health, or other areas of your life. Please answer all the questions. If you are unsure about which response to give to a question, please choose the one that appears most appropriate. This can often be your first response.

Please keep in mind your standards, hopes, pleasures and concerns. We ask that you think about your life in the last two weeks. For example, thinking about the last two weeks, a question might ask:

For office use		*(Please circle the number)*				
		Not at all	**A little**	**Moderately**	**Mostly**	**Completely**
	Do you get the kind of support from others that you need?	**1**	**2**	**3**	**4**	**5**

You should circle the number that best fits how much support you got from others over the last two weeks. So you would circle the number 4 if you got a great deal of support from others. o

For office use		*(Please circle the number)*				
		Not at all	**A little**	**Moderately**	**Mostly**	**Completely**
	Do you get the kind of support from others that you need?	**1**	**2**	**3**	**④**	**5**

You would circle number 1 if you did not get any of the support that you needed from others in the last two weeks. o

For office use		*(Please circle the number)*				
		Not at all	**A little**	**Moderately**	**Mostly**	**Completely**
	Do you get the kind of support from others that you need?	**①**	**2**	**3**	**4**	**5**

Please read each question, assess your feelings, and circle the number on the scale that gives the best answer for you for each question.

For office use			*(Please circle the number)*				
			Very poor	Poor	Neither poor nor good	Good	Very Good
G1 / G1.1	1.	How would you rate your quality of life?	**1**	**2**	**3**	**4**	**5**

For office use			*(Please circle the number)*				
			Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
G4 / G2.3	2.	How satisfied are you with your health?	**1**	**2**	**3**	**4**	**5**

The following questions ask about **how much** you have experienced certain things in the last two weeks.

For office use			*(Please circle the number)*				
			Not at all	A little	A moderate amount	Very much	An extreme amount
F1.4 / F1.2.5	3.	To what extent do you feel that physical pain prevents you from doing what you need to do?	**1**	**2**	**3**	**4**	**5**
F11.3 / F13.1.4	4.	How much do you need any medical treatment to function in your daily life?	**1**	**2**	**3**	**4**	**5**
F4.1 / F6.1.2	5.	How much do you enjoy life?	**1**	**2**	**3**	**4**	**5**

For office use			(Please circle the number)				
			Not at all	A little	A moderate amount	Very much	An extreme amount
F24.2 / F29.1.3	6.	To what extent do you feel your life to be meaningful?	1	2	3	4	5

For office use			(Please circle the number)				
			Not at all	Slightly	A Moderate amount	Very much	Extremely
F5.2 / F7.1.6	7.	How well are you able to concentrate?	1	2	3	4	5
F16.1 / F20.1.2	8.	How safe do you feel in your daily life?	1	2	3	4	5
F22.1 / F27.1.2	9.	How healthy is your physical environment?	1	2	3	4	5

The following questions ask about **how completely** you experience or were able to do certain things in the last two weeks.

For office use			(Please circle the number)				
			Not at all	A little	Moderately	Mostly	Completely
F2.1 / F2.1.1	10.	Do you have enough energy for everyday life?	1	2	3	4	5
F7.1 / F9.1.2	11.	Are you able to accept your bodily appearance?	1	2	3	4	5
F18.1 / F23.1.1	12.	Have you enough money to meet your needs?	1	2	3	4	5

For office use		(Please circle the number) Not at all	A little	Moderately	Mostly	Completely
F20.1 / F25.1.1	13. How available to you is the information that you need in your day-to-day life?	**1**	**2**	**3**	**4**	**5**
F21.1 / F26.1.2	14. To what extent do you have the opportunity for leisure activities?	**1**	**2**	**3**	**4**	**5**

For office use		(Please circle the number) Very poor	Poor	Neither poor nor well	Well	Very well
F9.1 / F11.1.1	15. How well are you able to get around?	**1**	**2**	**3**	**4**	**5**

The following questions ask you to say how **good** or **satisfied** you have felt about various aspects of your life over the last two weeks.

For office use		(Please circle the number) Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
F3.3 / F4.2.2	16. How satisfied are you with your sleep?	**1**	**2**	**3**	**4**	**5**
F10.3 / F12.2.3	17. How satisfied are you with your ability to perform your daily living activities?	**1**	**2**	**3**	**4**	**5**
F12.4 / F16.2.1	18. How satisfied are you with your capacity for work?	**1**	**2**	**3**	**4**	**5**

For office use			(Please circle the number)				
			Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
F6.4 / F8.2.2	19.	How satisfied are you with yourself?	**1**	**2**	**3**	**4**	**5**
F13.3 / F17.2.3	20.	How satisfied are you with your personal relationships?	**1**	**2**	**3**	**4**	**5**
F15.3 / F3.2.1	21.	How satisfied are you with your sex life?	**1**	**2**	**3**	**4**	**5**
F14.4 / F18.2.5	22.	How satisfied are you with the support you get from your friends?	**1**	**2**	**3**	**4**	**5**
F17.3 / F21.2.2	23.	How satisfied are you with the conditions of your living place?	**1**	**2**	**3**	**4**	**5**
F19.3 / F24.2.1	24.	How satisfied are you with your access to health services?	**1**	**2**	**3**	**4**	**5**
F.23.3 / F28.2.2	25.	How satisfied are you with your mode of transportation?	**1**	**2**	**3**	**4**	**5**

The follow question refers to **how often** you have felt or experienced certain things in the last two weeks.

For office use		(Please circle the number)				
		Never	Seldom	Quite often	Very often	Always
F8.1 / F10.1.2	26. How often do you have negative feelings, such as blue mood, despair, anxiety, depression?	**1**	**2**	**3**	**4**	**5**

Did someone help you to fill out this form? *(Please circle Yes or No)* Yes No

How long did it take to fill out this form? _____

THANK YOU FOR YOUR HELP

WHOQOL-BREF Scoring

The WHOQOL-Bref, still in field trials, is a subset of 26 items taken from the WHOQOL-100. The same steps for the scoring WHOQOL-100 should be followed to achieve scores for the Bref. Although scoring the Bref is identical to scoring the WHOQOL-100, there are some differences that need to be addressed:

- The WHOQOL-Bref does not have facet scores
- Mean substitutions are recommended for Domain 1 *Physical Health* and Domain 4 *Environment* if no more than one item is coded missing
- Only three items need to be reversed before scoring

The WHOQOL-Bref (Field Trial Version) produces a profile with four domain scores and two individually scored items about an individual's overall perception of quality of life and health. The four domain scores are scaled in a positive direction with higher scores indicating a higher quality of life. Three items of the Bref must be reversed before scoring. They can be seen in Table 9, indicated by the "- (reverse)" denotation in the *Direction of scaling* column.

TABLE 9. Scoring Domains of the WHOQOL-BREF

Domains and questions 236/BREF		Direction of scaling	Raw domain score	Raw item score
Overall Quality of Life and General Health			....(2-10)	
G1.1/B1	How would you rate your quality of life?	+		....(1-5)
G2.3/B2	How satisfied are you with your health?	+		....(1-5)
Domain 1	**Physical Health**		....(7-35)	
F1.2.5/B3	To what extent do you feel that physical pain prevents you from doing what you need to do?	-(reverse)		....(1-5)
F13.1.4/B4	How much do you need any medical treatment to function in your daily life?	-(reverse)		....(1-5)
F2.1.1/B10	Do you have enough energy for everyday life?	+		....(1-5)
F11.1.1/B15	How well are you able to get around?	+		....(1-5)
F4.1.1/B16	How satisfied are you with your sleep	+		....(1-5)
F12.2.3/B17	How satisfied are you with your ability to perform your daily living activities?	+		....(1-5)
F16.2.1/B18	How satisfied are you with your capacity for work?	+		....(1-5)
Domain 2	**Psychological**		....(6-30)	
F6.1.2/B5	How much do you enjoy life?	+		....(1-5)
F29.1.3/B6	To what extent do you feel your life to be meaningful?	+		....(1-5)
F7.1.6/B7	How well are you able to concentrate?	+		....(1-5)
F9.1.2/B11	Are you able to accept your bodily appearance?	+		....(1-5)
F8.2.1/B19	How satisfied are you with yourself?	+		....(1-5)
F10.1.2/B26	How often do you have negative feelings such as blue mood, despair, anxiety, depression?	- (reverse)		....(1-5)
Domain 3	**Social relationships**		....(3-15)	
F17.1.3/B20	How satisfied are you with your personal relationships?	+		....(1-5)
F3.2.1/B21	How satisfied are you with your sex life?	+		....(1-5)
F18.2.5/B22	How satisfied are with the support you get from your friends?	+		....(1-5)

Domains and questions 236/BREF		Direction of scaling	Raw domain score	Raw item score
Domain 4	**Environment**		....(8-40)	
F20.1.2/B8	How safe do you feel in your daily life?	+		....(1-5)
F27.1.2/B9	How healthy is your physical environment?	+		....(1-5)
F23.1.1/B12	Have you enough money to meet your needs?	+		....(1-5)
F25.1.1/B13	How available to you is the information that you need in your daily-to-day life?	+		....(1-5)
F26.1.2/B14	To what extent do you have the opportunity for leisure activities?	+		....(1-5)
F21.2.2/B23	How satisfied are you with the condition of your living place?	+		....(1-5)
F24.2.1/B24	How satisfied are you with your access to health services?	+		....(1-5)
F28.2.2/B25	How satisfied are you with your transport?	+		....(1-5)

If no more than one item from the *Physical Health* or *Environment* domains has been coded as missing, we recommend that a domain score be calculated by substituting a person-specific average across the completed items in the same scale. For example, if a respondent does not have a value for item B16 *How satisfied are you with your sleep?* in the Physical Health domain, but has answered all of the other items in that domain, then the value for item B16 would be the average of the remaining 6 items. If two or more items are coded missing in these two domains, the domain score should not be calculated, likewise if any items are coded missing in the *Psychological* and *Social Relationships* domains, a domain score for that respondent would not be calculated.

After item recoding and handling of missing data, a raw score is computed by a simple algebraic sum of each item in each of the four domains. Once complete, check the frequencies of each domain to be sure that the scores are within the correct range indicated in Table 9 *Raw domain score* column. The next step is to transform each raw scale score using the formula on page 31. The possible raw score ranges for each domain are as follows: *Physical Health*=28, *Psychological*=24, *Social Relationships*=12, and *Environment*=32.

SCORING EXERCISE AND TEST DATASET FOR THE WHOQOL-BREF INSTRUMENT

The purpose of this scoring exercise is to help WHOQOL-Bref users to evaluate results from each step in the process of calculating the Domain summary scores of the instrument. This exercise was created for SPSS users, but with minor modifications, can be adapted for other computer programs or can be useful for those scoring the survey manually.

A test dataset and SPSS code for scoring the WHOQOL-Bref a computer diskette in this packet. The test dataset, which is called "**WQ_BREF.TXT**" on the diskette, contains data from 64 administrations of the WHOQOL-BREF. The data can be seen in *Appendix F*. The enclosed diskette also provides the user with the SPSS syntax used to:

- import raw data into SPSS format [**WQ_B_DL.SPS**]
- derive the WHOQOL-BREF domain summaries [**WQ_BREF.SPS**]

The SPSS code (called "**WQ_BREF.SPS**") on the diskette begins by labeling all items and checking for out-or-range values. It then recodes the 3 negatively stated items so that a

higher score indicates better health. The 4 domains are then scored, labeled, and transformed to a 0 to 100 scale used to interpret and compare to other validated instrument tools such as the WHOQOL-100. A copy of the SPSS syntax is reproduced in Appendix F.

Table 10 presents statistics for the transformed domains for the WHOQOL-Bref. After scoring the test dataset, the means, standard deviations, and minimum and maximum observed values should agree with those presented in Table 10

TABLE 10. Test Dataset Descriptive Statistics: WHOQOL-BREF

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Physical (TRANSFORMED)	64	32.14	92.86	66.7969	14.5480
Psychological (TRANSFORMED)	64	37.50	95.83	73.5026	13.7165
Social Relations (TRANSFORMED)	64	25.00	100.00	73.1771	17.0891
Environment (TRANSFORMED)	64	28.13	100.00	72.8027	14.1592
Valid N (listwise)	64				

After all necessary items have been recoded, a raw score is calculated for each facet and each domain. Both facets and domains are scored through a simple algebraic summation of each item in that scale. As stated earlier, each question contributes equally to the facet score and each facet contributes equally to the domain score. Since each facet has four items with response values of 1 through 5, the raw score for any facet must have a minimum value of 4 and a maximum value of 20 (see Table 7 on the following pages).

TRANSFORMATION OF SCALE SCORES

The next step involves transforming each raw scale score to a 0-100 scale using the formula shown below:

$$\text{Transformed Scale} = \left[\frac{(\text{Actual raw score} - \text{lowest possible raw score})}{\text{Possible raw score range}}\right] \times 100$$

where "Actual raw score" is the values achieved through summation, "lowest possible raw score" is the lowest possible value that could occur through summation (this value would be 4 for all facets), and "Possible raw score range" is the difference between the maximum possible raw score and the lowest possible raw score (this value would be 16 for all facets: 20 minus 4).

This transformation converts the lowest and highest possible scores to zero and 100, respectively. Scores between these values represent the percentage of the total possible score achieved. The WHOQOL-100 scores from other Centers may not be transformed to the 0-100 scale. The U.S.WHOQOL instruments and scoring programs have used this transformation to provide comparative data for interpretation.

Example: A Facet 1 "Pain and discomfort" raw score of 15 would be transformed as follows:

$$\text{Transformed Scale} = \left[\frac{(15 - 4)}{16}\right] \times 100 = 68.75$$

2.2. Instruments for the evaluation of annoyance

Noise pollution is caused by excessive exposure to sounds and loud noises. This can take place both in cities and in natural environments.
Noise pollution is so defined when it comes to annoying or disturbing to rest and to human activities or health hazard.
The noise may be due to factories, construction sites, airports, highways, motor racing circuits, etc.
The effect of noise on humans are varied and can be divided into:

- damage effects (non-reversible alteration or only partially reversible of an organ or a system, seen from a clinical and /or an anatomo-pathological point of view);
- disturbing effects (temporary alteration of an organ or a system, verifiable through clinical or instrumental procedures);
- annoyance (perception of unhappiness or general discomfort, often influenced by factors of exposure and not only by the specific sensitivity of the individual).

The urban noise pollution, and in particular that due to the traffic of vehicles on the surface, determines the prevalence of annoyance and effects of disturbance. Very rarely can one speak of damage.
Noise pollution is fought within the home with the use of particular materials for construction, such as cork or the use of fabrics for the interiors.
Noisy environments may produce in exposed people several behavioral and social effects, affecting for example[5]:

- Daily behavioral patterns (inability to use outdoor areas and balconies, difficulty in listening of radio and television, presentation of complaints to the authorities);
- Performance related to specific activities (i.e. school learning);
- Social behavior (aggression, rudeness, etc.);
- Social indicators (residential mobility, hospitalizations, consumption of drugs, road accidents, etc.);
- Mood changes (i.e. sadness).

The effects of environmental noise on these behavioral and social variables are often complex and indirect; many of these effects must also be considered as the result of the interaction with a number of non-acoustic variables.
Socio-acoustic studies indicate that behavioral effects may be considered as a consequence of exposure to noise. The most frequently studied effects are the following:

- shuttered windows, in particular to perform certain activities such as chat, sleep, read, watch television, etc.;
- changes in the use of the rooms inside the home;
- home sound insulation;
- transfer towards less noisy areas, both for short periods (i.e. weekends), both in a definitive manner (residential mobility).

Therefore, an acoustically unfavorable environment constitutes a bias factor for a good quality of life. This is a condition that can manifest itself through a series of extra-auditory effects, including sleep disturbance, interference with speech communication, psychophysiological effects, disturbances of performance and learning, and annoyance.
Annoyance may be defined as a feeling of displeasure related to the noise (as well as to any agent or condition) that the individual knows or suspects, and that affects him/her in a negative way[6]. It is

[5] Berglund B, Lindvall T. 1995. Community Noise. Archives of the Center for Sensory Research Vol 2, No. 1. Stockholm:Center for Sensory Research.

not just a result of a non-optimal sleep or an interference with communication, but it also depends on less well defined feelings as the perception of being disturbed and affected during all the activities and the rest. In other words, annoyance, for years considered as the most obvious and immediate effect of exposure to noise, is a general term used to summarize all the negative feelings as disturbance, dissatisfaction, displeasure, and irritation tried by the person exposed.
Annoyance, intended as a parameter for the noise disturbance quantification, can become an excellent indicator in order to study and improve, from an acoustic point of view, the quality of life. The study of this phenomenon in urban areas has developed over the last 30-40 years and, consequently, the knowledge on this subject is, to a large extent, recent. Nonetheless, in recent years, several research experiences were conducted, which are a few recent examples.
Zytoon MA (2016)[7], in a research performed in the Kingdom of Saudi Arabia , has promoted the role of noise mapping as a helpful approach against adverse health and other impacts related to traffic and other environmental noise. Annoyance analysis revealed that high percentages of the Al-Fayha District in Jeddah City inhabitants were highly annoyed, depending on the type of planning zone and period of interest.
In an European experience, Licitra et al. (2016)[8] have characterized the noise impact of the whole railway infrastructure in the urban environment of Pisa, Italy. The ordinary train transits were considered, nevertheless it was given particular attention also to the noise sources referable to railway operations like maneuvering, loading and unloading, truck movements, braking, squeals and whistles. These kinds of noise are usually neglected in the noise modeling and are hereafter called "unconventional noises". The results showed the limitations of traditional noise mapping for railway epidemiological studies based exclusively on ordinary transits and confirm the role of vibrations as enhancing factor for disturbance.
De Paiva Vianna KM et al. (2015)[9], in a cross-sectional study, evaluated the effects of noise exposure in six urban soundscapes: areas with high and low levels of noise in scenarios of leisure, work, and home. The study was conducted in two steps: evaluation of noise levels, with the development of noise maps, and health related inquiries. 70% of the interviewees reported noticing some source of noise in the selected scenarios and it was observed an association between exposure and perception of some source of noise ($p < 0.001$). 41.7% of the interviewees reported some degree of annoyance, being that this was associated with exposure ($p < 0.001$). There was also an association between exposure in different scenarios and reports of poor quality of sleep ($p < 0.001$).
Paunović K et al. (2014)[10], investigated the association between noise annoyance and public transport in the city center of Belgrade, Serbia. The presence, the type and the number of public transport vehicles were assessed using official transport maps and matched with residential addresses. Noise annoyance was assessed by a questionnaire including a self-report five-graded scale. “High noise annoyance” was defined by merging “very” and “extremely” annoyed answers. The study has identified the presence of public transport at daytime and at night as a significant and independent predictor of high noise annoyance. Future intervention measures should concern the presence, the type and the number of public transport vehicles in order to reduce noise annoyance reactions in urban areas.

[6] M. Cosa e M. Nicoli, “Valutazione e controllo del rumore e delle vibrazioni”, Edizioni Scientifiche Associate,. Roma, 1989
[7] Zytoon MA. Opportunities for Environmental Noise Mapping in Saudi Arabia: A Case of Traffic Noise Annoyance in an Urban Area in Jeddah City. Int J Environ Res Public Health 2016; 13(5): pii: E496. doi: 10.3390/ijerph13050496
[8] Licitra G, Fredianelli L, Petri D, Vigotti MA. Annoyance evaluation due to overall railway noise and vibration in Pisa urban areas. Sci Total Environ 2016 ; 568: 1315-25. doi: 10.1016/j.scitotenv.2015.11.071
[9] de Paiva Vianna KM, Alves Cardoso MR, Rodrigues RM. Noise pollution and annoyance: an urban soundscapes study.
Noise Health 2015; 17(76): 125-33. doi: 10.4103/1463-1741.155833.
[10] Paunović K, Belojević G, Jakovljević B. Noise annoyance is related to the presence of urban public transport. Sci Total Environ 2014; 481: 479-87. doi: 10.1016/j.scitotenv.2014.02.092

Since this is a set of subjective feelings, the detection of annoyance is normally carried out through questionnaires administered to large groups of people. However, to date, in the literature we have analyzed (MEDLINE, Scopus, Web of Sciences), we did not find the existence of an authoritative and validated questionnaire for the detection of this disturbance. Consequently, we have developed the following survey instrument, made up of 4 questions, to complement the minimum dataset of 5 selected questions by the WHOQOL-Bref above mentioned:

1. How would you rate – on a scale from 0 (none) to 10 (extremely important) – your perception of the annoyance due to noise pollution in the area where you live? (You must specify only one option)
   0 1 2 3 4 5 6 7 8 9 10

2. In your opinion what are the main sources of noise pollution in the area where you live? (*you can specify more than one option*)
   - Traffic
   - Work activities
   - Domestic activities
   - Schools
   - Hospitals
   - Shopping areas
   - Animals
   - Religious buildings
   - Construction sites

3. What are the times of day in which you sense a greater nuisance due to noise pollution in the area where you live? (*you can specify more than one option*)
   - 06-10
   - 10-14
   - 14-18
   - 18-22
   - 22-02
   - 02-06

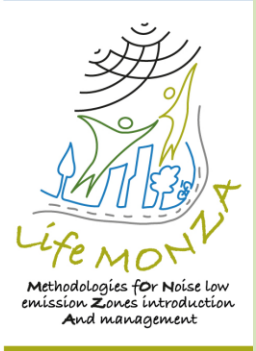
4. Have you experienced one or more of the following phenomena due to noise pollution in the area where you live? (*you can specify more than one option*)
   - Headache
   - Irritability
   - Difficulty sleeping
   - Stress

3. Conclusions

This report shows the state of the art about the evaluation of quality of life and annoyance and their relative instruments of analysis. There is abundant scientific production, for many years now, regarding the issue of quality of life evaluation and, in this context, authors have developed several specific tools of investigation. Instead, regarding the urban annoyance, the literature is limited and there is no authoritative assessment tools. However, the recent increasing of publications about this issue underlines its topicality as well as the need for further researches.
Starting from an analysis of the literature, we have proposed nine multiple-choice questions that allow us to fully investigate the health indicators that we set and, then, that fully meet the objectives

of this sub-action. This type of questions allows an easy administration and a rigorous collective data analysis and can be properly employed for studies on large populations.


Life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Methodologies fOr Noise low
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