

Collecting standardized urban health indicator data at an individual level for school-aged children living in urban areas: methods from EURO-URHIS 2

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Background: Measuring health and its determinants in urban populations is essential to effectively develop public health policies maximizing health gain within this context. Adolescents are important in this regard given the origins of leading causes of morbidity and mortality develop pre-adulthood. Comprehensive, accurate and comparable information on adolescent urban health indicators from heterogeneous urban contexts is an important challenge. EURO-URHIS 2 aimed to develop standardized tools and methodologies collecting data from adolescents across heterogeneous European urban contexts. **Methods:** Questionnaires were developed including (i) comprehensive assessment of urban health indicators from 7 pre-defined domains, (ii) use of previously validated questions from a literature review and other European surveys, (iii) translation/back-translation into European languages and (iv) piloting. Urban area-specific data collection methodologies were established through literature review, consultation and piloting. School-based surveys of 14–16-year olds (400–800 per urban area) were conducted in 13 European countries (33 urban areas). **Results:** Participation rates were high (80–100%) for students from schools taking part in the surveys from all urban areas, and data quality was generally good (low rates of missing/spoiled data). Overall, 13 850 questionnaires were collected, coded and entered for EURO-URHIS 2. Dissemination included production of urban area health profiles (allowing benchmarking for a number of important public health indicators in young people) and use of visualization tools as part of the EURO-URHIS 2 project. **Conclusion:** EURO-URHIS 2 has developed standardized survey tools and methodologies for assessing key measures of health and its determinants in adolescents from heterogeneous urban contexts and demonstrated the utility of this data to public health practitioners and policy makers.

Introduction

Currently, more than 3 billion people reside in urban areas—more than half the world's population.¹ This urban population density is set to increase to more than two-thirds of the global population within the next 25 years.^{2,3} In Europe, approximately 70% of people live in urban areas,⁴ a rapid and dramatic demographic shift in population from only 10–15% in the 1800s.⁴ With urban living being the dominant social context, an essential public health priority is to understand how such a context affects (both directly and indirectly) health and the social determinants of health.³

Urban health research has been defined as 'explicit investigation of the relation between the urban context and population distribution of health and disease'.³ To understand this relationship, it is important to obtain reliable data on the determinants of health and disease at an urban level, repeatable across a variety of urban contexts.

The European Urban Health Indicators System (EURO-URHIS) project was launched in 2006⁵ to investigate the potential to develop an urban health indicator (UHI) system, which could be used to describe urban population health across the European Union. A list of 45 UHIs was identified as essential for describing 'the urban context and population distribution of health and disease'; however, many of these were not supported by routinely available data.^{6–7} To obtain this information and get a representation of priority urban health issues, a principal recommendation from the project was the necessity to obtain population-based survey data in a

standardized way across heterogeneous urban contexts. The second phase of the project, EURO-URHIS 2, started in January 2009 and, as one of its objectives, set out to action this recommendation with the development of survey tools and methodologies to collect UHI information in adult and youth populations. The tools were validated, piloted and used across a number of European urban contexts to demonstrate the utility and application of these components of the UHI System (UHIS). We report here the development, distribution and dissemination of the UHIS to describe the health and determinants of health of adolescents living in urban areas as part of EURO-URHIS 2.

Background

Adolescents have been identified as an important population group for studying health and health determinants, with many of the diseases carrying the greatest mortality and morbidity having their origins from risk factors present and/or developed in childhood.⁹ For example, childhood obesity has been associated with the incidence of type 2 diabetes among adolescents and neurologic, endocrine, cardiovascular, pulmonary, gastrointestinal, renal, musculoskeletal and psychosocial complications.⁸ Research has shown that being overweight or obese after 10 years of age has a significant relationship with risk for a fatal or nonfatal coronary heart disease event in adulthood.⁸ Poor nutrition, lack of physical activity and sedentary behaviour have been identified as important risk factors for childhood obesity. Other important risk-related behaviours and

health issues particularly relevant for the adolescent population group include smoking,⁹ substance and alcohol abuse,^{10,11} risky sexual behaviour,¹² bullying and aggression¹³ and depression.¹⁴ The Health Behaviour in School-aged Children (HBSC) study was among the first international surveys on adolescent health with stated aims of establishing a monitoring tool for policy development and developing adolescent health research across a variety of international settings.¹⁵ The challenge of producing valid and reliable data with practical issues, such as heterogeneous school systems in which fieldwork was conducted, compliance with a common research protocol, issues around language and translation and the differing research capabilities within countries, was well documented within the HBSC methodology.¹⁵ The HBSC study is now conducted in more than 40 countries and regions and its profile has increased dramatically with HBSC data highly valued in (i) informing policy makers and international agencies focused on adolescent health and (ii) providing research data for academics exploring current health issues and predictors of health in adolescents.¹⁵ The HBSC methodology (including the data collection instrument) was of direct relevance to the EURO-URHIS 2 project and largely informed the approach taken to data collection of UHI data in adolescents. However, important considerations for the project were (i) ensuring that all UHI data were collected at an urban level (representative data for defined urban areas within EURO-URHIS 2), (ii) ensuring that all UHIs identified as relevant to adolescents living in urban areas were covered with the survey tool and (iii) ensuring that data could be related to similar UHI information collected in the adult component of EURO-URHIS 2. For this reason, important distinctions were made between HBSC and EURO-URHIS 2 methodologies.

This article describes (i) development of the EURO-URHIS 2 adolescent survey tool including translation and validation, (ii) development of the EURO-URHIS 2 adolescent survey methodology including standardization and training and (iii) conduct of the EURO-URHIS 2 adolescent survey across 33 urban areas from 13 European Union countries.

Methods

EURO-URHIS 2 consortium

The EURO-URHIS 2 consortium consists of research partners from the 13 countries participating in EURO-URHIS 2 (steering group) and an oversight and project management group (PMG) consisting of three core members. Standardized research protocols were developed through discussion with the steering group and signed off by the PMG providing a theoretical framework for the research content, data collection and analysis procedures. The EURO-URHIS 2 adolescent survey protocol was developed to ensure comparable, reliable UHI data. Three members of the EURO-URHIS 2 Consortium collaborated on the production of the protocol and the full Consortium received structured training on the survey methodology at a number of events held within the EURO-URHIS 2 project (detailed later). The EURO-URHIS 2 adolescent survey protocol included detailed information and instructions covering (i) the study aims and objectives and conceptual framework for the survey, (ii) study settings (urban areas), (iii) development of the survey tool, (iv) the ideal survey methodology proposed for standardized collection of data including sampling, data collection procedures, translation and piloting of tools and (v) standardized data collection, entry and treatment [via a centralized EURO-URHIS 2 database—Sequin database (www.urhis.eu)]. Other research protocols relevant to the EURO-URHIS 2 adolescent survey included (i) standardized data cleaning and analysis instruction manual, (ii) urban area specific methodological proformas (to address locally specific issues in relation to carrying out the adolescent surveys) and (iii) publication and dissemination instruction manual and guidelines (overseen by the PMG).¹⁶

Study settings

Details of the 33 urban areas taking part in the EURO-URHIS 2 adolescent survey are shown in table 1. To define ‘urban area’ for each city, two approaches were used. For urban areas that are also included in data collection for the Urban Audit project,¹⁷ the city administrative boundary was used—an Urban Audit ‘city’ level definition. Where the city’s urban area was beyond the scope of Urban Audit, the public health administration area was used (PHA). Details of the approach used to define urban area boundaries have been published elsewhere.¹⁷

Survey instrument

The approach used for the EURO-URHIS 2 adolescent survey was a school-based survey with data collected through self-completion questionnaires administered in a classroom setting. The questionnaire was developed to represent all UHIs, pertinent to the adolescent population, identified as important to defining health in the urban context but that were not available routinely.^{6–7} The UHIs represented a number of domains relevant to health and the determinants of health. These included core domains identified in the HBSC study¹⁵ (demographic characteristics, social background, social context, health outcomes, health behaviours and risk behaviours) and physical environment felt to be directly relevant to the urban context.

Standardized, previously validated questions were selected from a number of sources to represent UHIs under the seven domains. A hierarchy of question selection was employed to ensure all relevant UHIs were represented in the questionnaire. First, questions were sourced from externally and internally validated, widely used instruments across heterogeneous European populations with translated variants of the questions (e.g. the Strengths and Difficulties Questionnaire¹⁸). Second, where previously validated sources were not available, questions were sourced from established, multi-centre and quality assured routine European surveys, ideally with translated variants available (e.g. the HBSC survey¹⁵). Third, questions were sourced from routine European Health surveys, with translated options for the questions (e.g. European Health Interview Survey¹⁹). Finally, questions were sourced from previously validated research instruments used regularly in UK Health Surveys (e.g. the South Manchester Pain Studies²⁰). The UHIs with source are listed by domain in table 2.

It was felt that information pertaining to height and weight was particularly important given current health priorities around overweight and obesity²¹ and that self-reported height and weight were often subject to inaccuracies or missing data.²² For this reason, for UK urban areas, accurate height and weight measurements were taken using calibrated electronic scales (weight) and stadiometry (height). This information was to be used to assess the accuracy of self-reported heights and weights from the survey data and, if necessary, to adjust variables for height and weight.

Sampling

The population selected for the EURO-URHIS 2 adolescent survey (aged 14–16 years) was the upper age of the HBSC survey population (15 years). As with the HBSC, this age group was selected ‘to represent the onset of adolescence, the challenge of physical and emotional changes, and the middle years when important life and career decisions are beginning to be made’ but in addition, for EURO-URHIS 2, it was felt that the UHIs were more relevant to this age group than younger ages. For some urban areas, this age group represented a single school year/grade, whereas for others, the target age group spanned years/grades due to students being advanced or held back. Because of variable intake for school years/grades the range of ages was 14–16 years.

The ideal EURO-URHIS 2 methodology proposed stratification to obtain representative samples of school sectors (e.g. private, public,

Table 1 Details of participating urban areas for the EURO-URHIS 2 adolescent survey

Country	Urban area	Urban boundary definition	Language
France	Bordeaux	City Administrative Boundary	French
Lithuania	Kaunas	City Administrative Boundary	Lithuanian
	Siauliai	City Administrative Boundary	Lithuanian
Macedonia	Skopje	Public Health Administration Area	Albanian and Macedonian
	Tetovo	Public Health Administration Area	Albanian and Macedonian
Norway	Oslo	City Administrative Boundary	Norwegian
Romania	Bistrita	Public Health Administration Area	Romanian
	Craiova	Public Health Administration Area	Romanian
	Iasi	Public Health Administration Area	Romanian
Slovenia	Ljubljana	City Administrative Boundary	Slovenian
	Maribor	City Administrative Boundary	Slovenian
Slovakia	Bratislava	City Administrative Boundary	Slovakian
	Kosice	City Administrative Boundary	Slovakian
The Netherlands	Amsterdam	City Administrative Boundary	Dutch
	Utrecht	City Administrative Boundary	Dutch
United Kingdom	Birmingham	City Administrative Boundary	English
	Cardiff	City Administrative Boundary	English
	Glasgow	City Administrative Boundary	English
	Manchester	City Administrative Boundary	English
	Bury	City Administrative Boundary	English
	Bolton	City Administrative Boundary	English
	Oldham	City Administrative Boundary	English
	Wigan	City Administrative Boundary	English
	Tameside	City Administrative Boundary	English
	Trafford	City Administrative Boundary	English
	Salford	City Administrative Boundary	English
	Rochdale	City Administrative Boundary	English
	Stockport	City Administrative Boundary	English
	Liverpool	City Administrative Boundary	English
	Halton and St Helens	City Administrative Boundary	English
	Wirral	City Administrative Boundary	English
	Knowsley	City Administrative Boundary	English
	Sefton	City Administrative Boundary	English

religious and academies) within the defined urban area boundary; however, this was not always possible where sampling frames of all schools within the boundary were not available. Cluster sampling was used with the primary sampling unit being school class (or school in the absence of a sampling frame of classes). The recommended sample size was 400 adolescents for each urban area, set by the main EURO-URHIS 2 project [sufficient to detect a prevalence for a given UHI as low as 10% ($\pm 3\%$) with 95% confidence]. Ideally, sampling was recommended to be proportional to the size of the school year (with the number of classrooms sampled for each school reflecting school size). For some urban areas, sampling had to be carried out pragmatically due to limitations including sampling frames not being available and problems with recruitment of schools. Adolescents attending schools from outside the urban area represented by the school were excluded.

Piloting and translation

Piloting was carried out in one of the UK urban areas, Sefton in Merseyside. Suitable schools were identified by an official of Sefton Metropolitan Borough Council in Merseyside and two were selected for the piloting exercise—one from a relatively affluent area (Crosby) and one which draws from a deprived population in Knowsley (Maghull). One class of Year 11 students (mean age 15 years) was identified from each of the schools by the head teachers who wrote to parents of the selected pupils to obtain informed consent to take part in the pilot. Piloting involved two researchers who administered the survey questionnaire and measured the heights and weights of pupils. Piloting was used to improve the study questionnaire and inform the survey methodology.

Upon completion of piloting, the questionnaires were translated into the languages used for each urban area (table 1) and then back

translated into English. This was done using a standardized translation protocol developed by the EURO-URHIS 2 steering group. The questionnaires were then piloted in each urban area (although not necessarily using school pupils—sometimes piloting involved discussion of the translated questionnaire content with experts from the participating urban area).

Data collection and treatment

For the majority of urban areas, questionnaires were delivered by a named researcher, or researchers, who had received governmental clearance to work with children (where required) and who enlisted the help of teachers on the day of the survey. The survey was conducted during a 1-h lesson period and involved all pupils who had given consent (written by parents or verbally on the day of the survey). For UK urban areas, an additional researcher was employed to record height and weight measurements from the pupils.

Data quality and data entry procedures were standardized using operations manuals developed by lead members of the EURO-URHIS 2 Steering Group. For some urban areas, questionnaires were quality checked on the day of the survey and obvious completion issues addressed. For others, quality appraisal was carried out initially by the lead researcher for the urban area prior to data entry to identify missing data/incomplete questionnaires. Data entry was carried out for each urban area directly onto a secure and centralized database [Sequin database via the EURO-URHIS 2 website (www.urhis.eu)]. Upon completion of data entry, data cleaning and quality assurance protocols were engaged, with errors and inconsistencies in data being addressed directly with data managers from each urban area.

Data collection was carried out during September to December 2010. Data entry took place during December 2010 to May 2011

Table 2 Question selection for UHIs for the EURO-URHIS 2 adolescent survey

Domain	UHI	Source ^a
Demographics	Sex	General
	Age	General
	Residence (and duration at residence)	General
Social background	Family affluence scale	HBSC
	Quality of residence	EU SILC
Social context	Communication	HBSC
	Relationship and quality of friendships	HBSC
Health outcomes	Attributes of school life	HBSC
	General health status	General
	Asthma—complaints	ISAAC—child questions
	Rhinitis—complaints	ISAAC—child questions
	Eczema—complaints	ISAAC—child questions
	Injuries	EHIS
	Low back pain	Manchester pain studies
Health behaviours	Mental health	SDQ—child version
	Somatic health complaints	Manchester pain studies
	Height and weight	HBSC
	Physical activity	HBSC
	Nutrition	HRBQ
	Oral health	HBSC
	Weight reduction behaviour	HBSC
Risk behaviours	Sedentary behaviour—TV	Manchester pain studies
	Sedentary behaviour—PC	Manchester pain studies
	Smoking	HBSC
	Alcohol use	HBSC
	Drug use	HBSC/ESPAD
Physical environment	Sexual behaviour	HBSC/YRBSS
	Bullying	HBSC
	Noise	EU SILC
	Pollution	EU SILC
	Crime	EU SILC

a: General (represented by a number of sources); EU SILC, European Union Statistics on Income and Living Conditions; ISAAC, International Study of Asthma and Allergies in Childhood; EHIS, European Health Interview Survey; HRBQ, Health-Related Behaviour Questionnaire; Manchester pain studies²¹; ESPAD, European School Survey Project on Alcohol and Other Drugs; YRBSS, Youth Risk Behaviour Surveillance System.

when database was closed for cleaning and quality assurance of data. Data collection continued for some urban areas beyond the database closure date due to ethical and research governance approval delays and problems with recruitment (these were primarily UK urban areas). The additional survey data were entered and appended onto the Sequin database and flagged to differentiate between the different time periods of the surveys.

Training/standardizing the methodology

One important aspect of the EURO-URHIS 2 project was to ensure the standardization of UHI data collected through the adult and adolescent surveys using robust and reliable methods to allow direct comparison between heterogeneous urban areas across Europe. For the EURO-URHIS 2 adolescent survey, the UHI questionnaire and survey methodology evolved over the duration of the project, through a number of development/training workshops attended by the EURO-URHIS 2 partners involved in data collection. With facilitation from the project management committee, partners were involved in (i) questionnaire development, (ii) specification of the survey methodology, (iii) identification of specific urban area difficulties, (iv) interpretation of piloting results and (v) understanding data treatment and quality issues. Three training workshops ensured that each urban area representative was fluent in the questionnaire content, sampling for the survey, survey methodology and data entry/cleaning, with potential problems being identified and addressed prior to data collection. The products of these training workshops were urban area specific operations manuals detailing the exact survey procedure and data treatment protocol for each urban area.

Results

Piloting

Altogether 82 students took part in the pilot: 38 pupils from Maghull and 44 students from Crosby. The questionnaire was found to have both face and content validity and took between 20 and 40 min to complete, easily accommodated during the course of a 1-h lesson. Among minor changes made to the questionnaire as a result of the piloting were clarity of ordering of the questions (clear signposting for skipping sub-sections of questions that were not relevant) and inclusion of metric/imperial conversion charts to aid with height and weight estimation. Suggested comments on delivery of the questionnaire included (i) clearly introducing the background to the survey prior to questionnaire completion, (ii) enlisting help of teachers to engage pupils during questionnaire completion and (iii) provision of entertainment (health related quiz) for pupils completing their questionnaires early. This feedback was incorporated into the youth survey protocol highlighting the optimum survey methodology.

Study dataset

EURO-URHIS 2 data collection for the adolescent survey was completed in 2012 with data having been entered, cleaned and analysed. Table 3 lists the crude numbers of completed questionnaires for each of the urban areas [note that urban areas within Greater Manchester ($n=10$) and Merseyside ($n=5$) were combined due to delays in data collection for some of the UK urban areas].

Table 3 Number of completed questionnaires by urban area taking part in the EURO-URHIS 2 adolescent surveys

Country	Urban area	Urban boundary definition	Crude number of questionnaires
France	Bordeaux	City Administrative Boundary	565
Lithuania	Kaunas	City Administrative Boundary	503
	Siauliai	City Administrative Boundary	559
Macedonia	Skopje	Public Health Administration Area	400
	Tetovo	Public Health Administration Area	421
Norway	Oslo	City Administrative Boundary	541
Romania	Bistrita	Public Health Administration Area	415
	Craiova	Public Health Administration Area	489
	Iasi	Public Health Administration Area	450
Slovenia	Ljubljana	City Administrative Boundary	501
	Maribor	City Administrative Boundary	483
Slovakia	Bratislava	City Administrative Boundary	603
	Kosice	City Administrative Boundary	562
The Netherlands	Amsterdam	City Administrative Boundary	408
	Utrecht	City Administrative Boundary	565
The United Kingdom	Greater Manchester (<i>n</i> = 10) ^a	LUA Administrative Boundary	4095
	Merseyside (<i>n</i> = 5) ^a	LUA Administrative Boundary	1239
Total			13850

a: Not all data had been entered by the initial closure of the database.

Data from 13 850 adolescent survey questionnaires have been entered and cleaned for the 33 urban areas taking part in EURO-URHIS 2.

Dissemination

One of the aims of EURO-URHIS 2 was to inform health-related policy to maximize health gain and to promote health and health education in schools and among young people in general. Therefore, wide dissemination of EURO-URHIS 2 data was a key priority within the project to reach as large an audience as possible, including stakeholders, policy makers and researchers involved in health.

Dissemination of the EURO-URHIS 2 adolescent survey data involved the following *a priori* strategies:

- (1) Descriptive summaries of UHIs in the form of written reports with commentaries to all schools taking part in EURO-URHIS 2 (anonymized and given to head teachers for circulation).
- (2) Key indicators (representing adolescent health) selected to contribute to urban area health profiles, produced and disseminated to (i) urban area research partners and (ii) wider distribution to health related policy makers and researchers.
- (3) Interactive, web tools including mapping and tabulation of UHI data analysed at different levels (country, urban area, user-defined criteria).
- (4) Summary of first analysis of adolescent UHI data presented at an International Conference (final EURO-URHIS 2 conference)—including a training workshop demonstrating use of health profiles and web tools.
- (5) Analysis of specified research questions for adolescent health and determinants of health by approved research organizations.
- (6) Publication of peer-reviewed manuscripts summarizing health issues and determinants of health relevant to adolescents living in an urban context.

The adolescent data collected for EURO-URHIS 2 have been summarized and disseminated in urban area specific health profiles available from the study website (www.urhis.eu). In addition, visualization tools have been created for a number of the adolescent health indicators allowing a comparison between the study urban areas (www.results.urhis.eu).

Discussion

The EURO-URHIS 2 project began in January 2009, and in its first 3 years, a standardized set of UHIs relevant to adolescents living in urban areas has been effectively collected cross-sectionally across heterogeneous settings across the European Union. Through the use of participatory methods early on in the development of the survey instrument and methodology, it has been possible to address potential problems specific to countries and urban areas taking part in the project to ensure standardized and comparable data.

Originally, it was planned to use a two-stage sampling approach (i) selecting a stratified random sample of schools (by denomination and sector) and (ii) random sampling of classrooms from the year groups of selected schools. The ability to adopt this approach varied across the participating urban areas and, in practice, it was not possible for the majority of the urban areas to conduct stratified random sampling of schools due to refusals by selected schools. In the UK urban areas, recruitment of schools was a particular problem, and random sampling of classrooms was often not possible (only 2 of the 18 urban areas randomly selected classrooms for participating schools) with all classrooms for the relevant year group being selected from participating schools. Reasons given for the high refusal rates of the UK schools included 'having no space within the curriculum' and 'currently being over burdened with paperwork' as well 'no time' or 'too busy'. The impact on the external validity of the UHI data from participating schools was assessed in Merseyside by comparing participating schools with all schools within the sampling frame for the urban areas for (i) denomination and sector and (ii) socio-economic status based on the postcode of the schools. There were no significant differences between the participating schools and the wider sample of all schools within the urban area. Although recruitment of schools was sometimes found to be problematic the participation rates of pupils from selected classrooms was very high (for all urban areas, the completion rate of the questionnaires on the day of the survey was above 80%). The collected data are therefore a good representation of the year groups for the selected schools for all participating urban areas.

In terms of the quality of the collected data (and completion rates of the UHI questions within the questionnaire), there were very few spoiled questionnaires and consistency checking revealed very few errors/answered items—quality appraisal of all the data was

undertaken centrally for the project. This was the situation for all the participating urban areas making it possible to carry out direct comparisons of UHI data and bench marking between urban areas through health profiling.

In summary, within a public health perspective, young people are an important focus for promotion of health and healthy behaviours. EURO-URHIS 2 has provided a unique opportunity to investigate health and the determinants of health in adolescents residing in an urban context. This is of particular relevance given the predominant and expanding population residing in urban areas both within Europe and globally, and the unique health attributes and behaviours relevant to living within an urban environment that directly affect adolescents living in this context. The instruments and methodology developed by the EURO-URHIS 2 project provide a valuable resource to future studies of UHIs in the younger population.

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Conflicts of interest: None declared.

Key points

- EURO-URHIS 2 has developed standardized instruments to collect comprehensive UHI information in adolescents from heterogeneous urban settings (Appendix—questionnaire).
- EURO-URHIS 2 has identified optimal methodologies for the collection of UHI data in adolescents from heterogeneous urban settings (Appendix—Youth protocol).
- EURO-URHIS 2 questionnaires and data collection methodologies allow comprehensive health profiling of adolescents, important for public health policy makers and practitioners working and legislating in urban areas.

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