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Assessing health in children: National surveys and the role of the laboratory

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The first representative German Health Interview and Examination Survey for Children and Adolescents (KiGGS) was conducted from May 2003 to May 2006. In total, 17,641 participants, aged 0 to 17 years have been questioned and examined. Four highly trained and standardized teams, each headed by a physician, visited 167 sample points throughout Germany. The survey covered a broad range of exposures, conditions and health determinants. Blood and urine samples were collected from over 14,000 individuals aged from 1 to just less than 18 years.

To describe the health status of a population with the use of laboratory analyses and to establish reference or cut-off values in large population studies, it is absolutely necessary that pre-analytical conditions are highly standardized and adapted to the needs of the specific measurement methods. The measurements have to be performed at higher quality standards than required by statutory regulations. Extensive internal and external quality control is indispensible. For longitudinal aspects or the detection of trends in the population, it is important to measure with the same methods over long periods of time and, if changes are inevitable, cross-calibrations have to be performed with large enough sample sizes in order to compare results and calculate regression equations to calibrate the methods.

Ethical considerations also played a major role in the planning and conduct of the study since the majority of the study participants were not legally able to give informed consent. In these cases, informed consent was obtained from the parents or other legal representatives.

In total, 70 different analytes were measured in each individual. One of the focal points was the measurement of 20 different specific IgE antibodies to determine allergic sensitization against common allergens. Other areas of particular public health interest were micronutrient deficiency, seroepidemiology of infectious diseases and immunization status, and risk indicators or risk factors for chronic non-communicable diseases.

The rationale for these extensive laboratory analyses was to increase knowledge about the prevalence of diseases and risk factors in children and adolescents, but also to establish valid reference or cut-off levels for a number of measures. Clinicians as well as lab experts know how poorly many of these values have been established in the past. In many cases, the numbers were very small so that it was not possible to differentiate between sex and/or age groups. Very often, the source of the biological samples were hospitals, sometimes just from one region. So there was clearly a need for new reference or cut-off values based on a large population of healthy volunteers distributed across Germany.

Besides the determination of the prevalence of diseases or conditions with public health or clinical relevance, the KiGGS study serves as the basis for the establishment of three different types of reference or cut-off values:

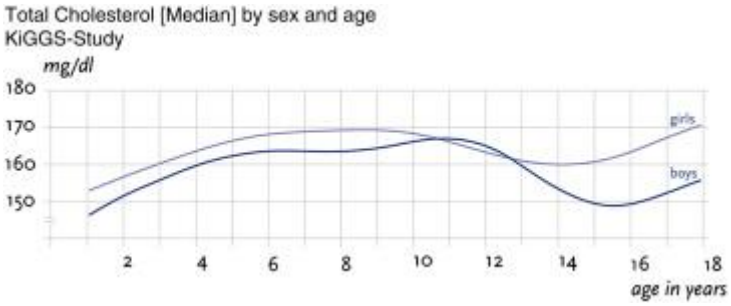
- based purely on distributions,
- calculated using additional measurements for interpretation,
- or based on health outcomes in the longitudinal arm of the study.

As expected, different characteristics between the particular distribution curves were detected, depending on sex, age, state of maturation or season. Typical examples for rather complicated curves are thyroid-stimulating hormone (TSH), cholesterol (total, HDL and LDL). For TSH, girls start from a lower level than boys. Between 8 and 11 years both sexes reach the same level, just to be lower in girls than in boys again thereafter. In total and in LDL cholesterol, girls have higher levels than boys,

but the curves look different and are substantially affected by puberty in both sexes. The level of HDL cholesterol is higher in boys until the age of 13 years, then girls reach higher levels with an increasing spread until the age of 18 years. Other parameters are so closely regulated that none of the influencing factors mentioned show any influence, such as magnesium or potassium. An example for using additional laboratory information to determine cut-off levels is vitamin D. As shown in a laboratory comparison study, intact parathormone (iPTH) can be used to establish a clear cut-off level for vitamin D. Depending on the method used for measurement, the cut-off level for iPTH ranges from 14.4 µg/L (luminescence assay, DiaSorin) to 22.9 µg/L (HPLC). Vitamin D is also a good example for seasonality. Lowest levels were observed in December and January, highest levels in July. This observation has to be kept in mind when calculating reference values.

Within the framework of the continuous health monitoring of the Robert Koch Institute, which includes regular population based representative health examination surveys in children as well as in adults, Germany is in the position to track the health status of the population not just based on questionnaires, but supported by laboratory analyses and physical tests. New laboratory tests can be included and validated if appropriate. Longitudinal analyses will show endpoints for which cut-off levels of health relevance can be calculated, even for children and adolescents. These levels can be lower than the levels calculated on the basis of distributions within a population, such as cholesterol or homocysteine in adults.

Health policy depends on up to date and relevant information on the health status of the population. Among other information systems, health surveys using laboratory analyses play a major role in serving this need.



Further reading

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