Analytical Studies

Analytical studies are observational, they **test hypotheses** (resulting from the results of descriptive studies and thus clarify the cause-and-effect relationship.

Analytical studies are observational studies that are aimed at objective examination and assessment − analysis − of causal relationships between exposure to potential disease determinants (risk factors) and subsequent disease. They are also aimed at testing the hypotheses that emerged from the descriptive phase of the epidemiological investigation.

These studies require working with two qualitatively different sets:

1. **study group** - a selected group of people with the observed characteristic (disease, exposure to a risk factor, biological agent...),
2. **control group** - a selected group of people that is identical to the monitored group in basic epidemiological characteristics. It is used for comparison with the observed group, which enables statistical testing of the obtained data and an objective assessment of the observed causal connections (relationships).

The basis of each investigation is therefore 2 qualitatively different files. For each file, 3 representativeness conditions must be met:

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1. **homogeneity** − all individuals must have the same basic characteristics (this is a relative term),
2. **randomness of selection** − everyone must have the same probability of being selected,
3. **sufficient size of the set** − a sufficient number of observations in the set, which is indirectly dependent on the expected frequency of the monitored phenomenon.

Division of analytical studies by method

Cohort study (prospective)

The incidence of the disease as a consequence of the monitored risk factor is compared here in different groups. We proceed here from the cause (exposure to the suspected factor) to the effect (disease), seeking an answer to the question of whether exposure to the suspected factor (cause) will cause the disease (effect).

For eg.: investigation of the relationship between smoking and cancer of the lungs.

The studied group consists of smokers (exposed group), control non-smokers (unexposed group). So we primarily select the exposed and non-exposed population.

Advantages
: accuracy, reliability, objectivity; they can also assess the multiple consequences of a single exposure.

Disadvantages
: financial and time-consuming, they are not suitable for the study of rare diseases.

Case-Control study (retrospective)

The prevalence of the risk factor (exposure) is compared here. We proceed from the effect to the cause, looking for an answer to the question of whether the observed disease was caused by a suspected factor.

Ex: the relationship between smoking – and lung cancer. Here, we select from a clearly defined source population (e.g. patients of one medical facility) primarily people with lung cancer (monitored group) and people without lung cancer (control group) and investigate the proportion of smokers in both the monitored and control groups.

Advantages

relatively fast, inexpensive, rapidly repeatable; suitable for studying rare diseases; suitable for chronic diseases and diseases with long latency; possibility of monitoring multiple risk factors for one disease.

Disadvantages

necessity to rely on human memory - i.e. problematic retrospective assessment of exposure to the suspected factor; high risk of selection bias (= systematic selection error) - i.e. an unambiguous definition of the source population (from which not only the observed but also the control population is selected) is necessary

Doll's cohort of 40,000 British doctors

Sir William Richard Shaboe Doll (1912–2005), a British physiologist who became one of the best-known epidemiologists of the 20th century as a pioneer in research and finding the relationship between smoking and health problems in smokers, made a huge contribution to epidemiology. Along with **Ernst Wynder, Bradford Hill,**

and Evarts Graham, he is credited with being the first scientist to demonstrate in a prospective study of 40,000 British physicians, whom he had very well lined up and maintained long-term contact with to obtain data important to this study, that smoking increases the likelihood of lung cancer and increases the risk of cardiovascular disease. What is remarkable about his study is that it ran for more than fifty years and Sir Doll also lived to see its completion and evaluation. He also discovered the causality between radioactive radiation and leukemia, asbestosis and lung cancer, alcohol and breast cancer.

"Death in old age is inevitable but death before old age is not." - Richard Doll

Division of analytical studies in terms of the time course of individual observations

Prospective

They start in the present and point to the future, we always proceed from cause to effect, so they are basically **cohort studies.**


William Richard Doll

Retrospective

They examine events that happened in the past, they are essentially **case-control studies**. But the time sequence cannot be taken literally. If we have reliable documentation about exposure (cause) and health consequences (consequence), it is also possible to process a prospective study as a retrospective one, then we are talking about a **prospective study in the past** (cohort retrospective study, historical cohort, retrospective cohort).

Other

Longitudinal studies (long-term follow-up) x **cross-sectional** (prevalence) studies (one-time, may not have a control group).

Analytical studies also include so-called **ecological studies**. It is important to note how ecological studies differ from other types of studies. While in all other studies the basic unit of analysis is the individual, in ecological studies it is a group of persons, e.g. the population of cities or landscapes. The **goal** of ecological studies is the influence of the environment on the health of an individual, which is a very complex issue.

Ethical problems of epidemiological studies

Epidemiological studies face many ethical issues. It is always necessary to consider all the ethical consequences of conducting a study (even the possible consequences of not conducting a study). The authorship or sponsorship of the study should not influence the assessment of the quality of the study, including the decision to publish the results. **If possible, informed consent** must be secured from all study participants and they must be clearly and unambiguously informed about the study. Moreover, it is always necessary to follow the principles of " **primum non nocere** " – that is, to avoid any harm to the individual. The study must respect the **voluntariness** of the participants and allow them to withdraw from the study at any time, the experts must ensure reliable **protection of the personal data of the participants** and the financial reward for the participant should always be only **compensation** – for the time invested in the study, travel expenses, etc.

Usage

	Ecological	Cross-sectional	Case-control	Cohort
Investigation of rare disease	++++	-	+++++	-
Investigation of rare cause	++	-	-	+++++
Examining multiple outcomes	+	++	-	+++++
Studying multiple exposures	++	++	++++	+++
Measurement of time relationship	+	-	+	+++++
Direct measurement of incidence	-	-	+	+++++

Links

Related articles

- Descriptive study
- Experimental study

- Methodology in epidemiology

External links

- On the interpretation of the results of epidemiological studies Bobák M, Moldan B: Epidemiology and the influence of environmental pollution on health status, chapter interpretation of the results of epidemiological studies (http://www.vesmir.cz/clanek/epidemiologie-a-vliv-znecisteni-prostredi-na-zdravotni-stav)

References

- TUČEK, Milan. *Hygiena a epidemiologie.* 1. edition. Karolinum, 2012. ISBN 978-80-246-2025-1.

Bibliography

- BENCKO CHARLES UNIVERSITY, PRAGUE 2004, 270 P, V, et al. *Hygiene and epidemiology. Selected Chapters.* 2nd edition. Prague. 2008. ISBN 9788024607931.

Further reading