

## STUDIJE PRESEKA: PREDNOSTI I NEDOSTACI

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### SAŽETAK

Studija preseka pripada grupi opservacionih studija. Neki autori studiju preseka svrstavaju u analitičke studije, a drugi u deskriptivne studije. Nazivi za ovu studiju su i studija prevalencije i transversalna studija. U okviru ove studije, istovremeno se određuje izloženost faktorima rizika i postojanje bolesti. Ove studije predstavljaju "snimak" trenutne situacije. Najpogodnije su za javnozdravstvena planiranja, etiološka ispitivanja i testiranje dijagnostičkih testova. Ne koriste se za istraživanje bolesti koje kratko traju i za retke poremećaje zdravlja, a glavni njihov nedostatak je što ne može da se odredi smer uzročno-posledične veze. S druge strane, ove studije su jeftinije, brže i jednostavnije se izvode i u okviru njih ne dolazi do osipanja podataka u odnosu na kohortne studije, a u odnosu na studije slučajeva i kontrola izvode se na reprezentativnom uzorku i nije prisutna pristrasnost prisećanja o izloženosti faktorima rizika.

**Ključne reči:** studija preseka, prednosti, nedostaci, unakrsni odnos

### Uvod

Epidemiologija je nauka o učestalosti, rasprostranjenosti i determinantama stanja ili događaja povezanih sa zdravljem u nekoj populaciji, kao i o sprečavanju i suzbijanju zdravstvenih problema. Specifični ciljevi epidemiologije su: identifikacija etiologije ili uzroka bolesti; određivanje opterećenosti društva/zajednice bolestima; ispitivanje prirodnog toka bolesti i prognoze bolesti; evaluacija postojećih i novih preventivnih i terapijskih mera i načina pružanja zdravstvene zaštite; obezbeđivanje osnova za razvoj javne politike u vezi sa ekološkim problemima, genetskim pitanjima i razmatranja vezana za prevenciju bolesti i promociju zdravlja (1-6). Epidemiološke studije (tabela 1) se koriste u cilju realizacije postavljenih epidemioloških ciljeva (3,5). Deskriptivne (engl. *descriptive studies*) i analitičke studije (engl. *analytic studies*) pripadaju opservacionim studijama (engl. *observational studies*), jer se realizuju bez intervencije istraživača. Nazivaju se i neeksperimentalne studije. Nasuprot njima eksperimentalne (engl. *experimental studies*) ili interventne studije (engl. *interventional studies*) sprovode se pod direktnom kontrolom istraživača.

Studija preseka (engl. *cross-sectional study*) pripada grupi analitičkih studija, mada je neki istraživači svrstavaju u deskriptivne studije (1-3). Ova studija ima i sledeće nazive: studija prevalencije (jer se u njoj izračunava prevalencija zbog identifikovanja prevalentnih slučajeva) i transversalna studija (jer se sprovodi u jednom trenutku, tj. predstavlja snimak trenutne situacije) (slika 1). To znači da se u definisanoj populaciji, ili njenom reprezentativnom uzorku, istovremeno određuje izloženost faktorima rizika i postojanje bolesti (slika 2). One predstavljaju "snimak" trenutne situacije. U njima se ispituje povezanost između posmatranih obeležja. Najčešće se koriste za sagledavanje potreba zdravstvene zaštite, postavljanje hipoteze o etiologiji i za evaluaciju dijagnostičkih testova.

### Razlike između studija preseka i longitudinalnih studija

U studijama preseka prikupljaju se podaci o izloženosti određenom faktoru rizika i postojanju bolesti u određenom trenutku, a u longitudinalnim studijama prikupljanje podataka sprovodi se više

## CROSS-SECTION STUDIES: ADVANTAGES AND DISADVANTAGES

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### SUMMARY

The cross-sectional study belongs to the group of observational studies. Some authors classify cross-sectional studies as analytical studies and others as descriptive studies. The names for this study are both the prevalence study and the transversal study. In this study, the exposure to risk factors and the existence of the disease is determined simultaneously. These studies are a “snapshot” of the current situation. They are most suitable for public health planning, etiological testing, and diagnostic testing. They are not used for research on short-term diseases and rare health disorders, and their main drawback is that the direction of the cause-and-effect relationship cannot be determined. On the other hand, these studies are cheaper, faster, and easier to perform and do not scatter data compared to cohort studies, and compared to case studies and controls, they are performed on a representative sample, and there is no recall bias regarding exposure to risk factors.

**Keywords:** cross-sectional study, advantages, disadvantages, odds ratio

### Introduction

Epidemiology is the science of the frequency, prevalence, and determinants of health-related conditions or events in a population and the prevention and suppression of health problems. The specific objectives of epidemiology are: identification of the etiology or cause of the disease; determining the disease burden to society/community; examination of the natural course of the disease and its prognosis; evaluation of existing and new preventive and therapeutic measures and ways of providing health care; providing a basis for policy development related to environmental issues, genetic issues, and considerations related to disease prevention and health promotion (1-6). Epidemiological studies (Table 1) are used in order to achieve the set epidemiological goals (3,5). Descriptive and analytical studies belong to observational studies because they are conducted without researchers' intervention. They are also called non-experimental studies. In contrast, experimental or interventional studies are conducted under the direct control of researchers. The cross-sectional study belongs to the group

of analytical studies, although some researchers classify it as descriptive studies (1-3). This study also has the following names: prevalence study (because it calculates prevalence due to the identification of prevalence cases) and transversal study (because it is conducted at one time, i.e., it is a snapshot of the current situation) (Figure 1). This means that in a defined population or its representative sample, exposure to risk factors and the existence of disease are simultaneously determined (Figure 2). They are a “snapshot” of the current situation. They examine the connection between the observed features. They are most often used to assess health care needs, hypothesize the etiology, and evaluate diagnostic tests.

### Differences between cross-sectional studies and longitudinal studies

Cross-sectional studies collect data on exposure to a certain risk factor and the existence of a disease at a certain time, and in longitudinal

**Tabela 1.** Epidemiološke studije (7)

Opservacione studije
1. deskriptivne studije i
2. analitičke studije:
a) studije slučajeva i kontrola (anamnestičke studije),
b) retrospektivne i prospektivne kohortne studije,
c) studije preseka (studije prevalencije).
Interventne (eksperimentalne) studije:
a) klinički eksperimenti,
b) terenski eksperimenti,
c) eksperimenti u društvenoj zajednici.

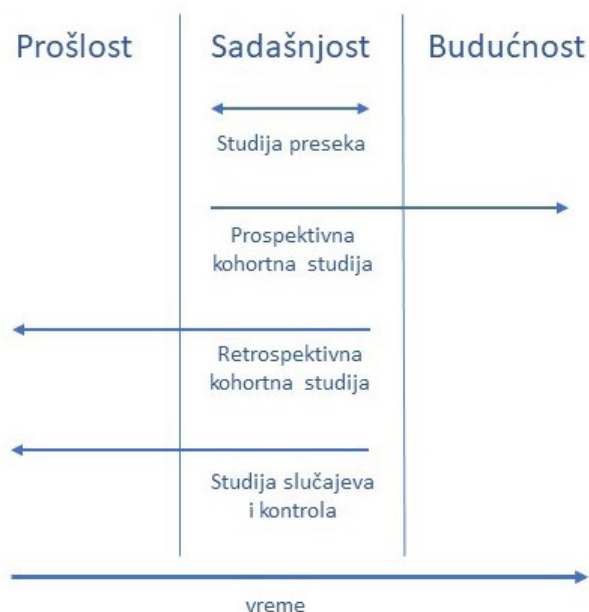
puta iz istog uzorka tokom dužeg vremena (slika 3) (6,8). Studija preseka predstavlja osnov za dalje longitudinalne studije. Ako želimo da ispitamo vezu između gojaznosti i bola u donjem delu leđa, onda je dobro prvo da se sprovede studija preseka. Među svim gojaznim studentima medicinskog fakulteta u trenutku sprovođenja studije preseka možemo ispitati da li neko u trenutku sprovođenja istraživanja (npr. tokom jednog dana) ima bol u donjem delu leđa (trenutna prevalencija)? Ukoliko dobijemo da je gojaznost u vezi sa bolom u donjem delu leđa samo kod muškaraca, onda možemo sprovesti longitudinalnu studiju kako bi

ispitali ovu vezu samo među muškarcima. Bez prethodnog sprovođenja studije preseka ne bi mogli da se fokusiramo samo na mušku populaciju.

### Način izvođenja studije i izračunavanje unakrsnog odnosa

Koraci u izvođenju studije preseka su: definisanje populacije (cela populacija ili njen reprezentativan uzorak), prikupljanje podataka o izloženosti potencijalnim faktorima i prisustvu poremećaja zdravlja, i analiza prikupljenih podataka (3,6,8).

U studijama preseka izračunamo unakrsni odnos (UO) ili odnos šansi tako što šansu da su



**Slika 1.** Studija preseka i ostale analitičke studije u odnosu na vreme izvođenja studije

**Table 1.** Epidemiological studies (7)

<b>Observational studies:</b>
1. descriptive studies and
2. analytical studies:
a) case studies and controls (anamnestic studies)
b) retrospective and prospective cohort studies
c) cross-sectional studies (prevalence studies)
<b>Intervention (experimental) studies:</b>
a) clinical experiments,
b) field experiments,
c) experiments in the social community

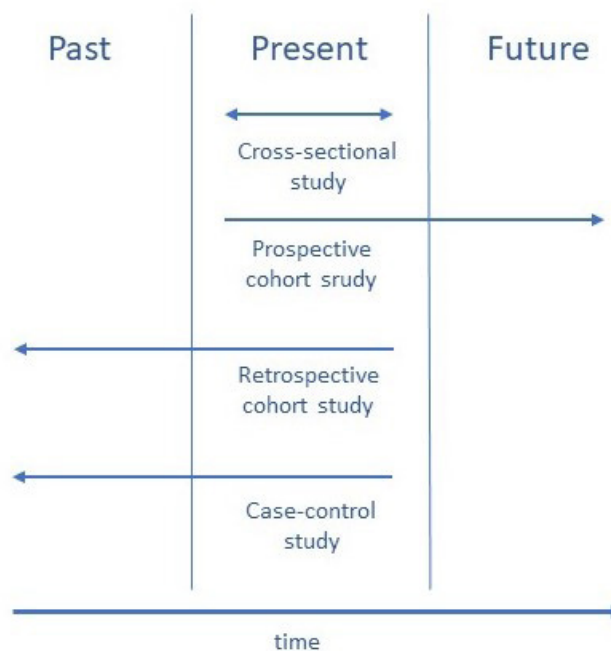
studies, data collection is carried out several times from the same sample over a long time (Figure 3) (6,8). The cross-sectional study is the basis for further longitudinal studies. If we want to examine the connection between obesity and lower back pain, it is good to conduct a cross-sectional study first. Among all obese medical students at the time of the cross-sectional study, we can examine whether someone has lower back pain at the time of the study (e.g., during one day; current prevalence)? If we find that obesity is related to lower back pain only in men, we can conduct a longitudinal study to examine this relationship only among men. Without prior cross-sectional

studies, we would be unable to focus only on the male population.

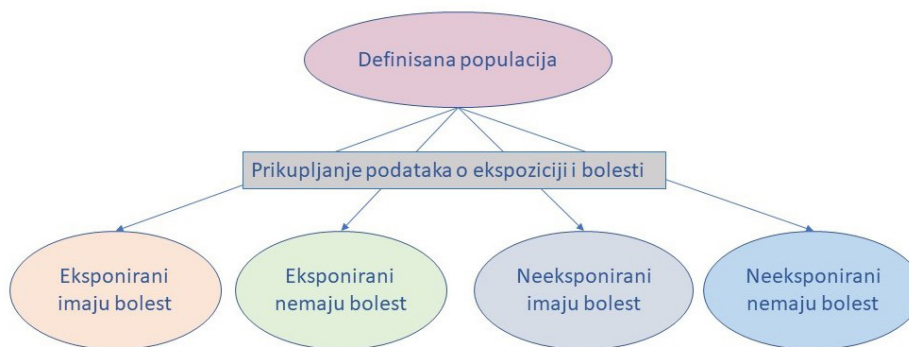
### Study conduction method and cross-relationship calculation

The steps in conducting a cross-sectional study are: defining the population (whole population or its representative sample), collecting data on exposure to potential factors and the presence of health disorders, and analyzing the collected data (3,6,8).

We calculate the cross-ratio (OR) or chance ratio in cross-sectional studies by dividing the



**Figure 1.** Cross-sectional study and other analytical studies in relation to the time of the study



Slika 2. Dizajn studije preseka

oboleli izloženi (a/c) delimo sa šansom da su kontrole bile izložene (b/d). Ukoliko je vrednost UO jednaka 1 to znači da nema veze između ispitivane ekspozicije i bolesti, ako je manja od 1 onda je ekspozicija negativno povezana sa bolešću (protektivni efekat), a ako je veća od 1 onda je ekspozicija pozitivno povezana sa bolešću (faktor rizika).

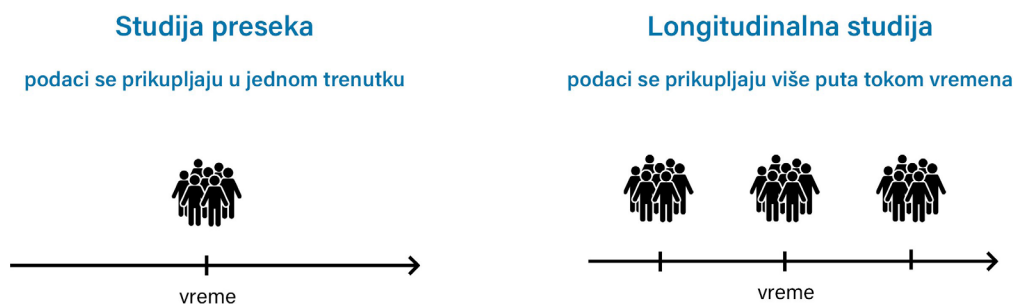
U ovim studijama povezanost između izloženosti nekom faktoru i pojave bolesti može se ispitati određivanjem prevalencije bolesti (bol u donjem delu leđa) u odnosu na izloženost (gojaznost) ili izračunavanjem prevalencije izloženosti (gojaznosti) u odnosu na postojanje bolesti (bol u donjem delu leđa) (5,6).

### Izračunavanje veličine uzorka

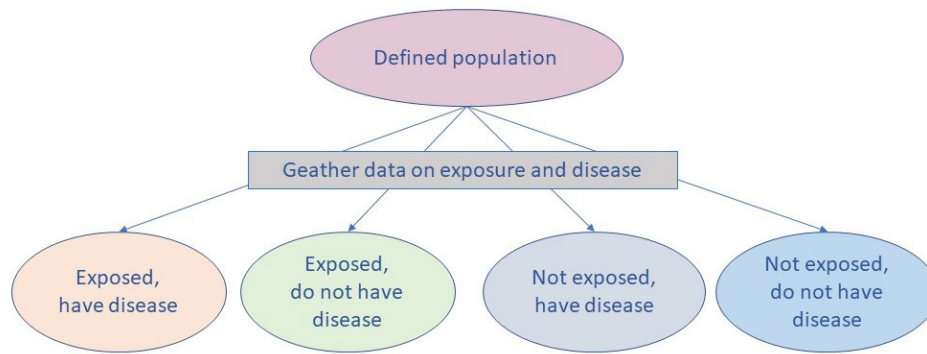
U studijama preseka može da se procenjuje prevalencija neke bolesti u populaciji ili prosečna vrednost neke kvantitativne varijable u populaciji (9).

Dakle, potrebna je adekvatna veličina uzorka da bi se procenila prevalencija u populaciji sa

dobrom preciznošću. Za izračunavanje veličine uzorka koristi se sledeća formula za kvalitativne varijable:  $n = (Z^2 P (1 - P)) / d^2$ . U ovoj formuli  $n$  je veličina uzorka,  $Z$  je koeficijent poverenja (za 5% grešku prve vrste iznosi 1,96, a za 1% grešku prve vrste iznosi 2,58),  $P$  je očekivana prevalencija (koja se može dobiti iz istih studija ili pilot istraživanja sprovedenih od strane istraživača), i  $d$  je preciznost (odgovara veličini efekta). Pretpostavljena vrednost prevalencije je veoma važna, jer se preciznost ( $d$ ) bira prema vrednosti  $P$ . Greška prve vrste (greška I vrste ili alfa greška) zavisi od naše arbitrarne odluke kako ćemo definisati granicu statističke značajnosti. Nema dovoljno smernica za izbor odgovarajuće  $d$  vrednosti. Neki autori preporučuju da se izabere preciznost od 5% ako je prevalencija bolesti između 10% i 90%. Međutim, kada je pretpostavljena prevalencija mala (ispod 10%), preciznost od 5% je neodgovarajuća. Na primer, ako je pretpostavljena prevalencija 1%, preciznost od 5% očigledno može dovesti do odabira neprikladne



Slika 3. Razlika između studije preseka i longitudinalnih studija



**Figure 2.** Cross-sectional study design

chance patients were exposed (a/c) by the chance that controls were exposed (b/d). If the value of the OR is equal to 1, it means that there is no connection between the examined exposure and the disease, if it is less than 1, then the exposure is negatively related to the disease (protective effect), and if it is greater than 1, then the exposure is positively related to the disease (risk factor).

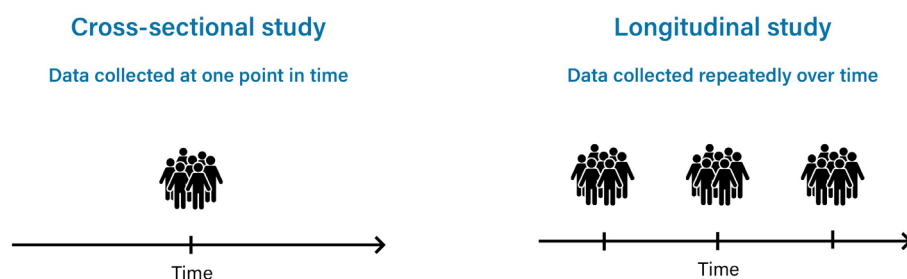
In these studies, the association between exposure to a factor and disease onset could be examined by determining disease prevalence (lower back pain) versus exposure (obesity) or calculating exposure prevalence (obesity) versus disease (lower back pain) (5.6).

### Sample size calculation

Cross-sectional studies can estimate the prevalence of a disease in a population or the average value of a quantitative variable in a population (9).

Therefore, adequate sample size is required to estimate the prevalence in the population

with good precision. The following formula for qualitative variables:  $n = (Z^2 P (1 - P)) / d^2$  is used To calculate the sample size. In this formula, n is the sample size, Z is the confidence coefficient (It is 1.96 for 5% type I error, and 2.58 for 1% type I error), P is the expected prevalence (which can be obtained from the same studies or pilot research conducted by researchers), and d is precision (corresponds to the size of the effect). The assumed value of prevalence is very important because precision (d) is chosen according to the value of P. The error of the first type (type I error or alpha error) depends on our arbitrary decision on how we will define the limit of statistical significance. There are not enough guidelines to select the appropriate d value. Some authors recommend choosing an accuracy of 5% if the prevalence of the disease is between 10% and 90%. However, when the assumed prevalence is low (below 10%), an accuracy of 5% is inadequate. For example, if a prevalence of 1% is assumed, it is obvious that an accuracy of 5% can lead to the selection of an



**Figure 3.** Difference between cross-sectional study and longitudinal studies



veličine uzorka. Konzervativan izbor bi bio jedna četvrtina ili jedna petina prevalencije kao vrednost preciznosti u slučaju male  $P$ .

Na primer, kolika je adekvatna veličina uzorka ako želimo da procenimo proporciju pacijenata sa dijabetesom tip 2 kod školske dece u jednoj opštini. Na osnovu podataka drugih studija prevalencija dijabetesa tip 2 nije veća od 15% kod školske dece. Pored ovog podatka definišemo da ćemo koristiti preciznost od 5% i 5% grešku tipa I. Prema gore navedenoj formuli neophodna veličina uzorka je  $n = (1,96^2 \cdot 15(1 - 0,15)) / 0,05^2 = 196$ .

Kada je u pitanju određivanje prosečne vrednosti neke kvantitativne varijable u populaciji onda koristimo sledeću formulu:  $n = (Z^2 \cdot SD^2) / d^2$  (9). U ovoj formuli SD je standardna devijacija koja može biti preuzeta iz prethodnih istraživanja ili iz sprovedenog pilot istraživanja. Na primer, odrediti neophodnu veličinu uzorka da bi se procenila prosečna vrednost glikemije dece jednog grada. Za izračunavanje opredeljujemo se za preciznost od 5%, 5% grešku tipa I i  $SD = 25$  iz nekog predhodnog istraživanja. Prema gore navedenoj formuli, istraživač treba da meri glikemiju kod najmanje 96 dece da bi odredio prosečnu vrednost glikemije kod dece  $n = (1,96^2 \cdot 25^2) / 5^2 = 96$ .

### Prednosti i nedostaci

Ove studije su najpogodnije za ispitivanje veze između bolesti i stalnih karakteristika ispitanika (npr. genetske karakteristike), kao i za hronične bolesti (1-7). One su jeftine, brzo i jednostavno se izvode, i u okviru njih ne dolazi do osipanja podataka u odnosu na kohortne studije. U odnosu na studije slučajeva i kontrola izvode se na reprezentativnom uzorku populaciji i ne postoji pristrasnost prisećanja (engl. *recall bias*) o izloženosti potencijalnim faktorima. Često se koriste za testiranje efektivnosti dijagnostičkih testova. Nedostaci studije preseka su: ne koriste se za bolesti koje kratko traju i za retke poremećaje zdravlja, u njima se može utvrditi veza, ali ne i vremenski sled između ekspozicije i bolesti (ne zna se šta je uzrok, a šta posledica bolesti), ne obuhvataju sve obolele npr. osobe sa ranim smrtnim ishodom, ne može se razmatrati izloženost koja brzo nestaje, procena incidencije nije moguća, i ispitivane grupe na kraju istraživanja mogu imati različiti broj ispitanika, što doprinosi gubitku statističke efikasnosti (1-6). Ne koriste se za analizu ponašanja tokom određenog

vremenskog perioda ili utvrđivanje dugoročnih trendova. Na primer, sagledavanje koristi od neke psihoterapije na depresiju (9), ne može se sagledati studijom preseka koja se izvodi posle dva dana od primenjene terapije. To znači da bi na osnovu studije preseka došli do pogrešnog zaključka da terapija dovodi do depresije, čak i ako je ona efikasna posle dužeg vremenskog perioda.

### Kada možemo koristiti studije preseka

Studija preseka može se koristiti za populaciona istraživanja (8). U ovim studijama možemo da budemo zainteresovani da saznamo kolika je prevalencija dijabetesa tipa 2 u nekom gradu X. Neophodno je prvo da formiramo reprezentativan uzorak ciljane populacije. Važno je da opišemo tačan način formiranja reprezentativnog uzorka. Zatim je potrebno da kontaktiramo sve članove izabranih domaćinstva koja treba da budu uključena u reprezentativan uzorak. Ako se ukupan ispitivani uzorak sastoji od 7.897 i ako od njih 112 osoba ima dijabetes tip 2, onda će prevalencija dijabetesa u gradu X iznositi:  $112/7897$  ili  $14,2/1000$  stanovnika.

Studije preseka mogu se koristiti za procenu prevalencije u kliničkim istraživanjima (8). Ukoliko želimo da odredimo prevalenciju hipovitaminoze D kod pacijenata sa prelomima koji se sukcesivno hospitalizuju na odeljenju traumatologije. Na primer, ako je u studiju uključeno 250 pacijenata sa traumom iz Klinike za ortopediju i ako od svih uzmemo anamnestičke podatke i uzorak krvi (za određivanje vrednosti vitamina D) onda možemo da procenimo kolika je prevalencija hipovitaminoze kod ljudi sa traumom. Ako 93 pacijenta od 250 hospitalizovanih zbog povreda ima nedostatak vitamina D, onda je prevalencija hipovitaminoze vitamina D 37,2%. Ne treba zaboraviti da je ovo klinička studija i da može imati sva ograničenja koja kliničke studije mogu da imaju. Stoga, generalizacija podataka o prevalenciji iz ovih studija može biti ograničena.

Mogu se koristiti kada se ispituje prevalencija određenog poremećaja zdravlja tokom vremena (serija studija preseka). U Engleskoj je sprovedena serijska studija preseka i to 1994, 1998, 2003, 2006. i 2011. (9). Istraživanje je bilo bazirano na reprezentativnom uzorku populacije uzrasta  $\geq 16$  godina. Rezultati istraživanja su pokazali da se vrednosti srednjeg nivoa krvnog pritiska muškaraca i žena u opštoj populaciji i među pacijentima sa

inappropriate sample size. A conservative choice would be one quarter or one-fifth of the prevalence as a value of precision in the case of small P.

For example, what is the adequate sample size to estimate the proportion of patients with type 2 diabetes in school children in one municipality? According to other studies, the prevalence of type 2 diabetes is no more than 15% in school children. In addition to this data, we define that we will use a precision of 5% and 5% type I error. According to the above formula, the required sample size is 196 subjects  $n=(1,96^2 \cdot 15(1 - 0,15))/0,05^2=196$ .

When it comes to determining the average value of a quantitative variable in the population, then we use the following formula:  $n=(Z^2 \cdot SD^2) / d^2$  (9). In this formula, SD is a standard deviation taken either from previous research or from a conducted pilot study. Take the example of determining the necessary sample size to estimate the average glycemic value of children in a city. For the calculation, we opt for an accuracy of 5%, 5% type I error, and SD = 25 from a previous study. According to the above formula, the researcher should measure glycemia in at least 96 children to determine the average glycemic value in children  $n=(1,96^2 \cdot 25^2) / 5^2=96$ .

### Advantages and disadvantages

These studies are most suitable for examining the relationship between disease and persistent characteristics of subjects (e.g., genetic characteristics), as well as for chronic diseases (1-7). They are cheap, quick, easy to perform, and do not scatter data compared to cohort studies (Table 2). In comparison to case studies and controls, they are performed on a representative population sample, and there is no recall bias regarding the exposure to potential factors. They are often used to test the effectiveness of diagnostic tests. The disadvantages of the cross-sectional study are: they are not used for short-term diseases and rare health disorders, they can establish a relationship, but not the time sequence between exposure and disease (it is not known what the cause is and what the consequence is), they do not include all patients, e.g., individuals with early death, rapidly disappearing exposure cannot be considered, incidence cannot be estimated, and study groups at the end of the study may have different numbers of subjects, contributing to a loss of statistical efficacy

(1-6). They are not used to analyze behavior over a period of time or to identify long-term trends. For example, the benefits of some psychotherapy for depression (9) cannot be seen in a cross-sectional study performed two days after the therapy, this is because a cross-sectional study would lead to the erroneous conclusion that therapy leads to depression, even if it is effective after a long time period.

### Cases when we can use cross-sectional studies

A cross-sectional study can be used for population surveys (8). In these studies, we may be interested to find out the prevalence of type 2 diabetes in city X. First, it is necessary to form a representative sample of the target population. It is important to describe the exact way of forming a representative sample. We then need to contact all members of the selected households for inclusion in the representative sample. If the total sample surveyed consists of 7,897 and 112 have type 2 diabetes, then the prevalence of diabetes in city X will be 112/7897 or 14.2 / 1000 inhabitants.

Cross-sectional studies can be used to assess prevalence in clinical trials (8). If we want to determine the prevalence of hypovitaminosis D in patients with fractures who are successively hospitalized in the trauma department. For example, if 250 patients with trauma from the Orthopedic Clinic were included in the study and if we take anamnestic data and a blood sample (to determine the value of vitamin D) from all of them, we can estimate the prevalence of hypovitaminosis in people with trauma. If 93 patients out of 250 hospitalized due to injuries have vitamin D deficiency, then the prevalence of vitamin D hypovitaminosis is 37.2%. One must not forget that this is a clinical study and that it may have all the limitations that clinical studies may have. Therefore, the generalization of prevalence data from these studies may be limited.

They can be used when examining the prevalence of a particular health disorder over time (a series of cross-sectional studies). A serial cross-sectional study was conducted in England in 1994, 1998, 2003, 2006, and 2011. (9). The study was based on a representative sample of the population aged  $\geq 16$  years. The research results showed that the values of the average blood



lečenom hipertenzijom progresivno poboljšavaju u period od 1994. do 2011. godine.

Studije preseka se mogu koristiti i za određivanje unakrsnog odnosa (OR) (8). Na primer, hoćemo da ispitamo povezanost između pola i deficita vitamina D (iz prethodnog primera). Napravićemo tabelu kontingencije  $2 \times 2$ . Od 250 pacijenata, 175 su žene, a 75 muškarci. Od 50 pacijenata sa deficitom vitamina D, 40 su žene a 10 muškarci (tabela 2). Unakrsni odnos (UO) računa se kao  $a \times b/c \times d$ , odnosno  $40 \times 65/10 \times 135$ , što iznosi 4. Interpretacija ove vrednosti unakrsnog odnosa jeste da žene imaju 4 puta veću šansu da imaju deficit vitamina D nego muškarci. Pošto je OR veći od 1 ishod je verovatniji kod žena nego kod muškaraca. Međutim, potrebni su nam intervali poverenja za dalje tumačenje unakrsnog odnosa.

### Populaciona istraživanja

Cilj studije bio je da se proceni prevalencija povišenog krvnog pritiska i nivo svesti, lečenja i kontrole hipertenzije u populaciji Srbije. Istraživanje je sprovedeno po tipu studije preseka, na teritoriji cele Srbije 2006. godine (11). Ispitivanu populaciju činili su muškarci i žene starosti 20 i više godina. Osobe koje su se nalazile u domovima za penzionere, socijalnim institucijama, zatvorima i psihijatrijskim ustanovama su isključene iz studije. Uzorak je trebalo da predstavlja sva domaćinstva u okviru Popisa stanovništva Srbije 2002. godine. Primenjeno je stratifikovano dvostepeno uzorkovanje. Uključeno je stanovništvo iz 3 regiona: Beograda, Vojvodine i Centralne Srbije. Dalja stratumna analiza bila je na urbano i ruralno stanovništvo. Odabran je reprezentativan uzorak. U studiju je bilo uključeno 6156 domaćinstava, odnosno 14.204 ispitanika. Intervju i merenja krvnog pritiska obavljani su u domovima ispitanika. Krvni pritisak je meren ispitanicima koji su bili u sedećem položaju, nakon što su odmarali najmanje 5 minuta. Urađena su tri merenja, sa intervalom od 1 minuta između merenja. Za vrednost krvnog pritiska uzeta je sred-

nja vrednost prva dva merenja. Međutim, ako je razlika između prvog i drugog čitanja bila veća od 10 mm Hg, korišćena je srednja vrednost 2 najbliža merenja. Hipertenzija (HBP) je definisan kao prosečan sistolni krvni pritisak (SBP) od 140 mm Hg ili više, dijastolni krvni pritisak (DBP) od 90 mm Hg ili više, ili upotreba antihipertenziva. Hipertenzija je klasifikovana kao stadijum 1, kada je SBP od 140 do 159 mm Hg ili DBP od 90 do 99 mm Hg, a kao stadijum 2 kada je SBP od 160 mm Hg ili više ili DBP od 100 mm Hg ili više. Kategorije HBP su definisane kao nelečeni HBP i lečeni HBP. Kontrola HBP je definisana kao farmakološki tretman HBP koji dovodi do SBP manjeg od 140 mm Hg i DBP manjeg od 90 mm Hg. Procena razloga za nelečenje od HBP je bila procenjena upitnikom. Svest o HBP je podrazumevala da je ispitaniku lekar rekao da ima povišen krvni pritisak. Ukupno, 47% odrasle populacije Srbije imalo je hipertenziju: 25,3% je imalo hipertenziju prvog stadijuma, 18,1% je imalo hipertenziju drugog stadijuma. Samo 58,0% osoba se hipertenzijom je bilo svesno da ima bolest, a 60,4% je bilo na lečenju. Među onima koji su bili na lečenju, samo 20,9% je imalo krvni pritisak u granicama normale. Jedan od 10 učesnika sa hipertenzijom nije lečen, između ostalog iz razloga što smatraju da je lečenje nepotrebno (55,3%) ili im nedostaje novac za lekove (19,3%). Prevalencija nedijagnostikovane i nelečene hipertenzije je visoka u odrasloj populaciji Srbije. Potrebne su dalje mere da bi se ubrzalo otkrivanje i lečenje visokog krvnog pritiska. Pažnju treba usmeriti prema programima koji unapređuju znanje, stavove i svest o hipertenziji kod odraslih.

### Panel studija

Panel studija je definisana kao studija koja prikuplja informacije o istim pojedincima u različitim vremenskim periodima. Drugim rečima, panel studiju čine najmanje dve studije preseka sprovedene na istim ispitanicima u dve ili više tačaka u vremenu. To je longitudinalna studija koju treba

**Tabela 2.** Fiktivni primer za izračunavanje unakrsnog odnosa

Pol	Deficit vitamina D	Zadovoljavajući nivo vitamina D	Ukupno
Žene	40 (a)	135 (b)	175
Muškarci	10 (c)	65 (d)	75
<b>Ukupno</b>	50	200	250

pressure level of men and women in the general population and among patients with treated hypertension progressively improved from 1994 to 2011.

Cross-sectional studies can also be used to determine cross-ratio (OR) (8). Take the example that we want to examine the relationship between gender and vitamin D deficiency (previously used). We will make a contingency table of  $2 \times 2$ . Out of 250 patients, 175 are women, and 75 are men. Of the 50 patients with vitamin D deficiency, 40 are women, and 10 are men (Figure 2). Cross-ratio (OR) is calculated as  $a \times b / c \times d$ , or  $40 \times 65 / 10 \times 135$ , which is 4. The interpretation of this value of cross-ratio is that women are four times more likely to have vitamin D deficiency than men. Since the OR is greater than 1, the outcome is more likely in women than in men. However, we need confidence intervals to interpret the cross-relationship further.

### Population research

The study aimed to assess the prevalence of high blood pressure, the level of awareness, the treatment, and control of hypertension in the population of Serbia. The research was conducted as a cross-sectional study encompassing the entire territory of Serbia in 2006 (11). The study's population consisted of men and women aged 20 and over. Individuals in retirement homes, social institutions, prisons, and psychiatric institutions were excluded from the study. The sample was supposed to represent all households within the 2002 Census of Serbia. Stratified two-stage sampling was applied. Population from 3 regions was included: Belgrade, Vojvodina, and Central Serbia. Further stratum analysis differentiated urban and rural populations. A representative sample was selected. The study included 6156 households or 14,204 respondents. Interviews and blood pressure measurements were performed in the respondent's homes. The subjects' blood

pressure was measured in sitting position after at least 5 minutes of rest. Three measurements were made, with an interval of 1 minute between measurements. The mean value of the first two measurements was taken as the blood pressure value. However, if the difference between the first and second readings was greater than 10 mm Hg, the mean value of the two closest measurements was used. Hypertension (HBP) is defined as average systolic blood pressure (SBP) of 140 mm Hg or more, diastolic blood pressure (DBP) of 90 mm Hg or more, or the use of antihypertensives. Hypertension is classified as stage 1 when SBP is 140 to 159 mm Hg or DBP 90 to 99 mm Hg, and as stage 2 when SBP is 160 mm Hg or more or DBP 100 mm Hg or more. Categories of HBP are defined as untreated HBP and treated HBP. Control of HBP is defined as the pharmacological treatment of HBP that results in SBP of less than 140 mm Hg and DBP of less than 90 mm Hg. The reasons for the non-treatment of HBP were assessed by a questionnaire. Awareness of HBP meant that the doctor informed the respondent regarding the respondent's high blood pressure. In total, 47% of the adult population of Serbia had hypertension: 25.3% had first-degree hypertension, 18.1% had second-degree hypertension. Only 58.0% of people with hypertension knew they had the disease, and 60.4% were in treatment. Among those who were treated, only 20.9% had blood pressure within normal limits. One in 10 participants with hypertension was not treated, among other things, because they believe that treatment is unnecessary (55.3%) or they lack money for medicines (19.3%). The prevalence of undiagnosed and untreated hypertension is high in the adult population of Serbia. Further measures are needed to speed up the detection and treatment of high blood pressure. Attention should be directed to programs that promote knowledge, attitudes, and awareness of hypertension in adults.

**Table 2.** Fictitious example for calculating the cross-relationship

Sex	Vitamin D deficiency	Satisfactory vitamin D levels	Total
Women	40 (a)	135 (b)	175
Men	10 (c)	65 (d)	75
Total	50	200	250

razlikovati od drugih studija koje prikupljaju informacije tokom vremena, kao što su vremenske serije i kohortne studije.

### Primer panel studije

Cilj studije je bio da se proceni uticaj zagađenja vazduha na dnevne respiratorne simptome dece osnovne škole u Seulu (12). Koristeći dizajn panel studije, prikupljeni su podaci iz dnevnika za respiratorne simptome dece tokom 1. i 15. dana aprila, jula, oktobra i decembra 2003. godine kod učenika 2. i 3. razreda osnovne škole. Podaci o respiratornim simptomima spojeni su sa podacima o zagađenju ambijentalnog vazduha koje je pratilo Ministarstvo životne sredine. Zatim je procenjen odnos između dnevnih simptoma ispitanika i izloženosti zagađenju vazduha, nakon kontrole na različite potencijalne konfundirajuće faktore. Izloženost azot-dioksidu ( $\text{NO}_2$ ) u toku dana značajno je povećala simptome gornjih disajnih puteva ( $\text{UO}=1,12$ , 95%  $\text{IP}=1,01-1,24$ ) i donjih disajnih puteva ( $\text{UO}=1,18$ , 95%  $\text{IP}=1,06-1,31$ ) u toku istog dana. Izloženost sumpor dioksidu ( $\text{SO}_2$ ) i ugljen monoksidu ( $\text{CO}$ ) u toku dana bila je povezana sa simptomima donjih respiratornih organa ( $\text{UO}=1,12$ , 95%  $\text{IP}=1,01-1,25$  za  $\text{SO}_2$ ;  $\text{UO}=1,16$ , 95%  $\text{IP}=1,02-1,32$  za  $\text{CO}$ ). Može se zaključiti da izloženost zagađenju vazduha utiče na dnevne respiratorne simptome kod dece. Ova studija sugeriše da kratkoročne promene nivoa zagađenja vazduha imaju značajan efekat na zdravlje dece i da ih treba smatrati važnim javnozdravstvenim problemom.

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## Panel study

A panel study is defined as a study that collects information about the same individuals in different time periods. In other words, a panel study consists of at least two cross-sectional studies conducted on the same subjects at two or more points in time. It is a longitudinal study that should be distinguished from other studies that collect information over time, such as time series and cohort studies.

## Panel study example

The study aimed to assess the impact of air pollution on the daily respiratory symptoms of primary school children in Seoul (12). Using the panel study design, data from the diary for children's respiratory symptoms were collected during the 1<sup>st</sup> and 15<sup>th</sup> April, July, October, and December 2003 in students of the 2<sup>nd</sup> and 3<sup>rd</sup> grade of primary school. Data on respiratory symptoms were combined with the data about ambient air pollution monitored by the Ministry of Environment. After controlling for various potential confounding factors, the relationship between the subjects' daily symptoms and exposure to air pollution was then assessed. Exposure to nitrogen dioxide (NO<sub>2</sub>) during the day significantly increased the symptoms of the upper respiratory tract (UO = 1.12, 95% IP = 1.01-1.24) and lower respiratory tract (UO = 1.18, 95% IP) = 1.06-1.31) during the same day. Exposure to sulfur dioxide (SO<sub>2</sub>) and carbon monoxide (CO) during the day was associated with lower respiratory symptoms (UO = 1.12, 95% IP = 1.01-1.25 for SO<sub>2</sub>; UO = 1.16, 95% IP = 1.02-1.32 for CO). It can be concluded that exposure to air pollution affects daily respiratory symptoms in children. This study suggests that short-term changes in air pollution levels significantly affect children's health and should be considered an important public health problem.

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