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Relevance of sampling techniques in medical research



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ABSTRACT

It is the era of developments and technologies in Southeast Asian countries including Nepal. Medical practice is growing to its supreme level. There is several funded and clinically relevant research works from this region. But it is questionable whether the data is collected scientifically and the inferred evidence is useful to the medical sciences. Improper sampling methods will result with biased evidence, which will make the researcher misleading. This article will discuss the basic sampling techniques required for a good research.

Keywords:

Sampling errors, simple random sampling, stratified random sampling, systematic random sampling.

Introduction:

Inferential statistics is a branch of statistics which use a small sample's statistic to estimate a big population's parameter. Most of the common tools used for this prediction required a random sample. Researcher use sample because of its main three properties viz. greater accuracy, less time to collect data and less expensive [1]. Sampling is the procedure to take a representative sample from a population under study [2]. Sampling terminology start with the theoretical population which is needed to generalize and practically not able to obtain as an intact [Population of Nepal]. Secondly the study population which is accessible [Population of Kaski District]. Sampling frame which is the access to the study population [VDCs of Kaski District of Nepal]. Finally the sample who are the people in the study [Selected members of the VDCs of Kaski District].

Sample mean and proportion will never be equivalent to the population mean or proportion this error is called survey errors. It can be classified into two, sampling errors and non sampling errors.

Sampling errors are occurred because when the researcher is taking a small subset of a big population. Each small subset will have different characteristics. More precisely each sample will have different means. It can be abridged by raising the sample size and selecting a random sample [1-3].

Non Sampling errors mainly arises because of coverage error [excluded from sampling frame], non response error [follow up on non responses] and measurement error [Bad question, untrained interviewers, malfunctioning instruments or poor procedures] [1-3].

In figure 1 Sampling techniques are classified into two categories Probability and non probability sampling. Non probability sampling is not preferred to use in medical research except the research is very basic level, no sampling frame, exploratory research and population homogeneity. It is purposive and subjective so the researcher will get a result according to his decision. In probability sampling, each unit will have equal probability to be selected so it will give a reliable representative of the population. Most commonly used probability sampling techniques are simple random sampling, stratified random sampling, systematic random sampling and cluster random sampling [1-5].

Simple Random Sampling (SRS)

Each unit has equal chance of being selected in the sample. It is easy to carry out if the list frame is available or small population. Conventional statistics will be valid in the sample and perform complex statistical analysis. Disadvantage is complete list of units is required and units may be scattered.

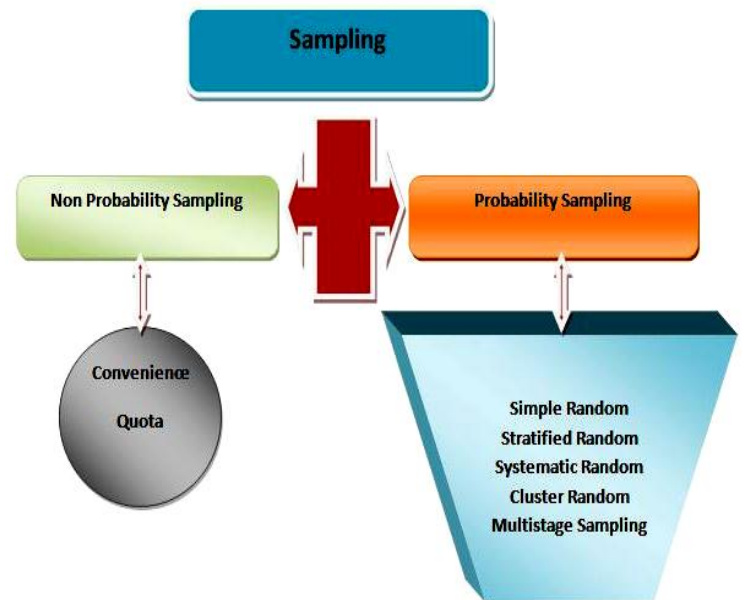


Figure 1- Sampling techniques

There are two types of random sampling, simple random sampling with replacement and simple random sampling without replacement. In SRS with replacement, the selected unit is replaced back to the population and again has the chance of getting selected. In SRS without replacement, which is the usual method in medical research, the selected unit is not put back in the population and hence the population size reduces by one at each selection. Random samples can be drawn by lottery method or by using random number tables. In Lottery method, we make small chits of paper for each unit in the population which are folded and then mixed together. From this the required number are picked blindly.

Example: Select a random sample of size 100 to evaluate the prevalence of obesity among the 800 students of Manipal College Of Medical Sciences, Pokhara, Nepal.

First prepare a register with a given number to the first semester students to ninth semester students starting from 1 to end with 800. Close the eyes and put finger on one of the number in the random number table given in figure 2. Suppose the number was the first entry 57172. Then check the last 3 digit because the population size was 800 which is a 3 digit number. Last three digits are 172, so the student numbered 172 will be selected in the sample then for the next units go though the other numbers till the end of the column. Once the last entry of the column 60557 is also selected then again select a number by closing eye and repeat the process.

57172	42088	70098	11333	26902	29959	43909	49607
33883	87680	28923	15659	09839	45817	89405	70743
77950	67344	10609	87119	15859	74577	42791	75889
11607	11596	01796	24498	17009	67119	00614	49529
56149	55678	38169	47228	49931	94303	67448	31286
80719	65101	77729	83949	83358	75230	56624	27549
93809	19505	82000	79068	45552	86776	48980	56684
40950	86216	48161	17646	24164	35513	94057	51834
12182	59744	65695	83710	41125	14291	74773	66391
13382	48076	73151	48724	35670	38453	63154	58116
38629	94576	48859	75654	17152	66516	78796	73099
60728	32063	12431	23898	23683	10853	04038	75246
01881	99056	46747	08846	01331	88163	74462	14551
23094	29831	95387	23917	07421	97869	88092	72201
15243	21100	48125	05243	16181	39641	36970	99522
53501	58431	68149	25405	23463	49168	02048	31522
07698	24181	01161	01527	17046	31460	91507	16050
22921	25930	79579	43488	13211	71120	91715	49881
68127	00501	37484	99278	28751	80855	02035	10910
55309	10713	36439	65660	72554	77021	46279	22705
92034	90892	69853	06175	61221	76825	18239	47687
50612	84077	41387	54107	09190	74305	68196	75634
81415	98504	32168	17822	49946	37545	47201	85224
38461	44528	30953	08633	08049	68698	08759	45611
07556	24587	88753	71626	64864	54986	38964	83534
60557	50031	75829	05622	30237	77795	41870	26300

Figure 2 - Random number table

It can also be done by writing the names on paper chits and pick the chits after well shuffled as lottery method. There are several random number tables available in internet. Also it can be done easily in excel using the command =RANDBETWEEN (bottom, top). For the above mentioned example type the command =RANDBETWEEN (1,800) in one cell and click and drag till 100th cell. Simple random sampling is very scientific but the practical problem is that it is quite difficult; sometimes it is impossible to make a whole list of units in the population under study.

Stratified Random Sampling

Simple random sampling is used in the homogenous population. If it is heterogeneous population then researcher has to make it homogenous groups which called stratum and perform simple random sampling in each group to get the required sample.

Example: Select a stratified random sample of size 100 to evaluate the prevalence of obesity among 450 male students and 350 female students of Manipal College Of Medical Sciences, Pokhara, Nepal.

In this case make two list one is with 450 male students and another is with 350 female students. Perform the simple random sampling in both groups to get a sample size of 50 male students and 50 female students. If the researcher will do the simple random sampling in this situation then there can be a sample of 100 male student only or 100 female students only. stratified random sampling is used when group comparison is needed, few subgroups are more homogenous than others so fewer numbers are needed for those groups to obtain the same level of precision, few elements are more important in determining outcome of research interest than are others.

Systematic Random Sampling

Whenever entire and recent list of sampling units are available then Systematic sampling is the most commonly used method. In this method first unit is selected by simple random sampling and the remaining units are obtained by adding a constant [Sampling Interval = Population size / Sample size] to the first unit till the required sample size achieved.

Example: Select a systematic random sample of size 100 to evaluate the prevalence of obesity among the 800 students of Manipal College Of Medical Sciences, Pokhara, Nepal.

Population size is $N=800$, sample size is $n=100$. Divide population size by sample size which is called "sampling interval" = $800/100 = 8$. Then randomly select a number from 1 to 8 [sampling interval]. Suppose the number was 6 then the first unit is 6. Second is $6+ 8[\text{sampling interval}] = 14$. Third are 22 so on by adding the 8 [sampling interval].

The merits of systematic sampling are that it is convenient to conduct, but the demerit is that the sample may demonstrate a pattern or periodicity.

Cluster Sampling

Cluster sampling is commonly used in a population which is heterogeneous. According to geographical locations units are grouped and create the clusters. Then the clusters are selected using simple random sampling. From the selected clusters each and every unit is included for study. Cluster sampling is one of the most popular techniques for the field epidemiological research. In cluster sampling, sampling frame is not required and also in practice when entire lists are seldom available, cluster sampling is appropriate.

Multistage Sampling

Multi stage sampling is done in stage wise. The entire population is divided into the first stage sampling units and the random sample is selected among them. The first stage sample is further divided into second stage units and another random sample will be obtained. Additional stages can be made in this similar procedure. For example, in Nepal, a sample of districts may be taken first and then in each of the selected districts, a second stage sample of wards may be taken. Further from each of the selected wards, a third stage sample of households is selected. Since the samples are selected at each stage the method is called 'Multi stage sampling'.

Conclusion

A scientifically designed relevant research can be an asset to the medical science. It will provide high quality evidence. Researcher should carefully choose the sampling techniques to avoid the misleading evidences.

Abbreviations

Simple Random Sampling (SRS).

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Competing interests

Authors declare that they don't have any competing interest.

Authors' contribution

BS and JS planned the concept and wrote the first draft. BR, IB and SHS has performed the review and literature and revised the first draft. All authors contributed to the interpretation and writing the manuscript. Final manuscript is accepted by all authors for publication.

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