Iranian J.Publ. Health
1989, Vol. 18, Nos.1-4

CLUSTER SAMPLING FOR DETERMINATION OF IMMUNIZATION COVERAGE;A LIMITATION

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Key Words: Cluster sampling; Immunization coverage surveys; Rapid epidemiological methods

ABSTRACT

Evidence provided from studies in Iran points to a possible bias in application of the standard EPI cluster sampling procedure in large metropolitan areas of the developing countries. The standard EPI cluster sampling procedure,when carried out in populations with highly variant birth rates, tends to over-represent the low birth rate, i.e. higher socio-economic , strata,and if the entity under study shows significant socio- economic gradient, then the estimates arrived at by this method might be highly biased. Some alternatives have been mentioned.

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INTRODUCTION

Since formulation of the Expanded Programme on Immunization (EPI), a version of the cluster sampling procedure with probability proportionate to size (PPS) has been adapted and advocated by the World Health Organization (WHO) for determination of immunization coverage. Details of this procedure, which uses the general population census as its sampling frame , as well as its statistical basis, have been explained elsewhere (4,9). Moreover, the efficiency of the method has been proved by various computer simulations to be within the stated limitations, i.e, precision of 10 percentage point of p and confidence limit of 95% (2,8,10). In the light of such proofs , and due to its practicability, this method of sampling has been widely used not only in international comparison of immunization coverage (3), but for other purposes such as determination of disease incidence (14), and assessment of growth and nutritional status (1).

The main assumption implicit in this survey method is that the proportion of target population, e.g. children of 12-23 months of age, is equal across the various sections of the population under study so that the PPS which is based on general population , holds for the target population too. An important factor influencing the distribution of children in a population is the birth rate, and because the birth rate in the rural areas and most small urban populations of the developing

countries is basically uniform, no problem arises by using this standard sampling procedure.

However , in the large metropolitan areas of the developing countries, where population is a conglomerate of subgroups with highly variant birth rates, the standard EPI cluster sampling tends to over-represent the children of the lower birth rate subgroups,i.e.,the higher socio-economic strata , and because these children usually have better immunization coverage the estimates arrived at by this method might be biased.

Observations pointing to such effect came to our attention from various sources: a) during routine surveys in large metropolitan areas of Iran, it was repeatedly noticed that clusters located in the "well to do" areas constantly needed more time and larger number of households to be covered before the seven target children could be identified(13), and b) during a study to measure the immunization status of patients attending the governmental health services in Mashhad, a large metropolitan area in the northeast Iran. In the latter study the coverage of patients who are basically from the low socio- economic strata, was found to be substantially lower than that arrived at for the same city during the same year using the standard EPI cluster sampling method (Table 1). As a part of explanation for this observation ,it was concluded that it might show the impact of private physicians on the progress of EPI in Iran (12).

The purpose of this communication is to report further evidence for such possible bias in application of standard EPI Sampling procedure in large metropolitan areas of developing countries.

MATERIALS AND METHODS

Two cluster samples which were drawn for different purposes in the city of Teheran, the capital of Iran with over six million population, are used. Both samples were to cover the total population of the city and both were taken inthe first half of 1986 with a few months interval.

1- Standard EPI cluster Sample Proportionate to general population size (CGP): For this sampling procedure, which is routinely done to monitor the progress of EPI in Teheran, the city which has already been divided into 20 municipality areas, was further divided into over 1000 goegraphical blocks of approximately similar population. Thirty of these blocks were randomly selected in proportion to the population of each municipality as determined by the 1986 general census. Selection of the starting points and continuation untill the 7 needed children were obtained were carried out according to the standard procedures (15). The age limit for this study was 12-23 months and altogether, 211 children were selected. For 205 children, immunization cards were available and exact data were recorded on standard EPI survey forms.

2- Cluster sample proportionate to target population size (CTP): For this sampling,which was done as a part of a study to identify the growth pattern of children under

five years of age in Teheran, all hospital births in the city proper were recorded and used as sampling frame. The rational for this procedure was the previous knowledge that close to 98% of children of Teheran are born in hospitals(5), and also that this would provide a more appropriate sampling frame for a study on child growth and development. Altogether, 550 births (over a 24 hours period) were recorded, of which 55 were randomly selected as starting Points. Details of this Procedure have been explained elsewhere(11). Of the children selected at each starting point two, one boy and one girl of one year of age, were considered for the present comparison. For 93 Of the 110 children thus identified, immunization cards were available and exact data were recorded from them.

RESULTS AND DISCUSSION

Table 2 shows the immunization coverage of children of Teheran at 12 months of age as determined by the two sampling methods. Statistical analysis shows that the differences observed between the two methods are significant at $P<.05$ for DPT (Diphtheria, Pertissis, Tetanus) and OPV (Oral Polio Vaccine), but not for BCG and Measles, similar to the pattern observed previously (table 1). This Pattern is believed to reveal the impact of private physicians on immunization activities and conforms with the fact that private health services of Iran are not provided with the BGC vaccine, are generaly not in favor of recommending it, and prefer to postpone measles immunization till after the first birth day. Since the private physicians charge for

vaccination services,as opposed to the free governemntal services, their utilization is limited to a certain group that can afford that, i.e. the "well to do", and if this pattern emerges as the overall result of immunization coverage study, it clearly shows that the sample has favored that group. This observation was possible only because immunization has a socio-economic gradient; otherwise, such bias could not be detected.

The importance of this possible bias becomes crucial when it is realized that WHO has selected 25 large metropolitan areas of the developing world to monitor the progress of EPI by using various indicatros,including Local Area Monitoring(LAM) and immunization coverage surveys(6). Moreover, this method is gaining popularity for rapid epidemiological surveys in developing countries for entities other than immunization, many of which might have strong socio-economic gradient.

One way to reduce or abolish such bias is to identify different birth rate strata and draw individual samples for each one of them, a process that is virtually impossible in most developing countries. Another solution would be to utilize a frame other than general population census for cluster identification. In the Present study a list of hospital deliveries were used. In other situations for reasons completely different, school attendance list has been proposed and used(7). Due to the uniqueness of the social conditions of each community, a universal solution might not be available,but each community has to study the extent of this bias under its specific conditions and

identify the most suitable sampling frame for its future use.

Table 1- Immunization coverage of children 12-23 months of age, Mashhad,Iran 1984.

	EPI Cluster Method	Health Services Patients
Number of children examined	211	214
Percent with DPT I	77.2	71.5
Percent with DPT III	58.3	36.4
Percent with OPV I	79.1	72.0
Percent with OPV III	61.6	37.8
Percent with measles vaccine	59.2	22.9
Percent with BCG	17.5	20.6

Table 2- Immunization coverage of children 12 months of age, Teheran, Iran 1986

	CGP*	CTP**
Number of children examined	211	110
Percent with immunization card	97.2	84.5
Percent with DPT I	98.0	86.0
Percent with DPT III	81.5	69.9
Percent with OPV I	98.0	87.1
Percent with OPV III	81.9	69.9
Percent with measles vaccine	68.8	59.1
Percent with BCG	41.5	40.9

* CGP: Cluster Proportionate to General Population

** CTP:Cluster Proportionate to Target Population

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