

Vital Rates in East and West Pakistan Tentative Results from the PGE Experiment

by

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Readers of this journal were introduced to the Population Growth Estimation (PGE) experiment in the issue of Spring 1962 [5]. Since then five mimeographed interim reports¹ have appeared and two papers have been presented to international conferences [23;4]. The experiment is now in its third year and the time has come to report more comprehensively on the findings and experiences of the first two years. We feel the importance of the findings to be so great for the future of this country (and the confidence in their reliability to be sufficiently high) that they should be disclosed. Even if not immediately accepted, the findings will provoke continued enquiries, resulting in eventual acceptance of more generally agreed upon vital rates. Simultaneously, a more comprehensive report in the form of a monograph is being prepared [3]. Opinions of an assertive nature in this article will — it is hoped — be justified more convincingly in the monograph. The monograph will thus enable both the authors and the readers to subject the PGE experiment and its findings to a much more penetrating criticism than the current article.

Although this article is a report on the first two years of the experiment, it repeats in broad strokes some of the introductory material available elsewhere. Readers familiar with the experiment will excuse this tendency to ensure that the present article is self-contained. Besides discussing certain natural developments arising from the experiment, this paper indicates briefly some evolutionary shifts in our thinking and the consequent changes in the organization and administration of the experiment.

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¹ Persons interested in receiving these reports should request Lt.Col. Nazir Ahmed, Director-General, Central Statistical Office, 63 Muslimabad, Karachi, West Pakistan, to include their names in the distribution list given in Appendix M to PGE Manual 4. Please quote exact and complete addresses.

The Idea Behind the Experiment

The underlying technique is that the given population is investigated twice independently. The content of each enquiry is similar (though not identical, to ensure independence), so that the information obtained can be compared (matched) *individually*, that is to say on an event-by-event basis. In the PGE experiment the two independent investigations are called longitudinal registration (LR) and cross-sectional surveys (CS). The most important part of the two investigations is to collect information on births and deaths. The results are *not* compared in their totality between the two investigations. A similar rate from both could give a false feeling of confidence in both, false inasmuch as the events which went to contribute to similar rates might have been in part different events, even though they added up to similar totals. The most essential feature in the PGE experiment is the matching of individual events one by one.

From such a comparison three groups of events are obtained: those caught by both investigations, those caught by LR but missed by CS, and those caught by CS but missed by LR. From these three quantities an estimate can be made of the "fourth category", namely events missed by both LR and CS. The estimate of all events will then be:

$$N = \frac{(C + N)^2}{C} = C + Nr + Ne + \frac{Nr \cdot Ne}{C}$$

where C = events caught by both LR and CS,

Nr = events caught by LR but missed by CS,

Ne = events caught by CS but missed by LR,

$\frac{Nr \cdot Ne}{C}$ = events missed by both LR and CS, and

N = estimate of all events.

The validity of this formula rests on a stringent requirement of independence between the two investigations and on the basic belief that it is possible to match information adequately about events collected by two different methods. These two conditions have been argued in greater detail in the literature already cited. The very question of the applicability of this formula to the Pakistan population and to an experiment like the PGE is of course an interesting one, but its theoretical significance is not matched by its practical importance. As indicated in the section on "Crude Vital Rates Obtained" (p. 751 below), the contribution of the category $\frac{Nr \cdot Ne}{C}$ is relatively small.

Outstanding Features of the PGE Experiment

Twenty-four areas of about 5,000 people each were selected at random, twelve in each of the two provinces. Sixteen of them are subject to both LR

and CS. Four are subject to "LR only" and four to "CS only". Of the twenty-four areas, four are urban, two in each province. The total population in the sample is 120,000. The total population under LR is 100,000 and that under CS is also 100,000. Similarly, while there are 24 areas, it is more meaningful to say that there are 20 areas in LR and 20 in CS, of which 16 are common to both. The same areas have been in the experiment since its formal inception early in 1962². In these areas, during the years 1962 and 1963, some 11,000 vital events were registered, some 40,000 events were enumerated³ and some 160,000 household interviews were conducted and recorded. Work at this rate continues. The success of the operation depends on the goodwill of respondents. A number of formal arrangements have taken place to ensure confidentiality of the information collected, including solemn warning to analysis personnel.

We have discussed elsewhere the unique features of this approach in comparison with the more orthodox types of investigations in which only totals are compared. There are also several features of PGE distinguishing it from the one example known to us which used the same approach [7]. The most important are these:

i) The sample is a whole country sample, intended to give adequate estimates at the whole country level and for each province, *i.e.*, not a case study of an isolated district.

ii) Each vital event has, in theory, a chance to be enumerated four times, because of the quarterly enumeration by CS, with the resulting possibility of watching changes in response.

iii) Still births are registered and enumerated. Pregnancies cannot be registered, but are enumerated. The hope is that in this way even marginal cases will be brought into the net.

iv) The quarterly survey provides a source of current demographic data for the country as a whole, including data on population mobility. The definitions employed are such that totals can be struck both on a *de facto* and *de jure* basis.

v) Each dwelling in each sample area has been provided with a unique dwelling number—unique for the given sample area—to facilitate identification in circumstances where addresses are unknown and personal names are variable.

vi) No specific steps in the form of direct instructions or exhortations have been taken to secure independence between the two field operations as these

² The question arises whether our respondents after years of intensive registering and frequent enumerations remain the representative respondents they presumably were at the beginning of the experiment. It is not suggested that our respondents changed demographically under the influence of PGE investigations, but they may have become more careful (or less attentive) in their responses.

³ Each event is enumerated as many as four times, but registered only once.

would only draw attention to the possibility of collusion between the registrar and the enumerator. The system of operations as a whole has been designed in such a way that neither the LR registrar nor the CS enumerator sees any advantage in collusion.

Significance of the Experiment for Pakistan and the Underdeveloped World

In less than ten years the rate of population growth in terms of which the Pakistan public was thinking, and its planners planning, grew gradually from 1.4 through 1.8 and 2.2 until recently it has reached 2.6 per cent per annum [20]. There is every indication that before the ten years are over since 1.4 per cent was first suggested, we shall be thinking in terms of a rate more than twice that high. While the high rate is no less than a national disaster, the uncertainty surrounding it must be exasperating to planners and to all foreign-aid agencies. The point need not be laboured. The references pointing out the crucial role of population growth for Pakistan's future are almost too numerous to be quoted [21]. They all suggest that population growth is the one variable which can affect the success of development plans more than any other single variable. To know the level of this growth is obviously important. PGE hopes to provide this information.

Apart from this main function, PGE is likely to make a contribution in Pakistan in a variety of other ways. Census results may be confirmed in totals and in such important characteristics as sex and age distribution. Laboratory-like controls may be provided for other experiments, particularly in the field of family planning [27, p. 3]. Information over the years will be built up covering 120,000 people in a representative sample, disclosing hopefully not only their fertility and mortality, but also a host of variables of socio-economic significance, such as migratory habits. Finally, light may be thrown on a variety of methods suitable or unsuitable for sponsoring a nation-wide system of registration of vital events.

These findings and experiences may be of interest to other countries. At the policy level, Pakistan's future is of vital interest to other countries and its success in tackling its population problem of immediate concern to the whole world. At the technical level the findings can be used directly and/or further improved methodologically. Among the recommendations of the Asian Population Conference, New Delhi, December 1963, there is a plea for work to be done on life tables for Asia [6, p. 4, paragraph (2)], life tables stemming directly from Asian sources rather than derived indirectly. PGE is providing the necessary data on age specific mortality. The Executive Secretary of ECAFE has stressed the importance of the accuracy of vital rates [29].

Finally, the results should be of interest to that part of the demographic profession which is interested in survey techniques [35]. The attempt to match two documents is not novel. Previous studies, however, had somewhat limited purposes, such as measuring variation in response to the same item on different records [19, p. 264], underenumeration of infants [39], underregistration of vital events [7], social and economic differentials in mortality⁴. PGE hopes to be other milestone in this progressive development of ideas about the meaning and reliability of survey results.

THE WORKINGS OF THE EXPERIMENT

Longitudinal Registration (LR)

Under this part of the experiment all births and deaths in the sample areas are registered by specially appointed full-time registrars who are required to ensure as complete a coverage as possible by following all useful informational leads. While they are to keep their eyes open for all possibilities and have one day a week (Friday) reserved for special enquiries their activities during the remaining five working days are strictly determined by their instructions. It is only necessary to know which is the current week in the *routine round* to know what is the *daily ration* allotted to the given day of the week and what *sectors* (homogeneous groups of not more than nine dwellings) the registrar was supposed to go to [5, p. 53].

Formerly special emphasis was laid on keeping CS and LR supervisory responsibilities independent. As a result of experience it was decided that Regional Survey Officers (RSOs) of the Central Statistical Office (CSO), who were hitherto responsible for supervising only CS operations through their Field Co-ordinators and Enumerators, could be entrusted, without doing violence to the basic independence of the two operations, with the overall responsibility for the day-to-day administrative control over the LR Field staff as well. This change took effect from May first, 1964.

The number of Field Inspectors was increased at the same time from four to six (three in each province), not only to provide each of the six RSOs concerned with one Field Inspector, but mainly to increase the junior inspecting personnel so that apart from their standard responsibility for LR inspections

⁴ [19]. This is a very ambitious study, which is likely to transform our methodological approaches and substantive understanding when its results become available in 1966. Its main point is the comparison of recent death registrations with documents from a census taken previously. Twenty per cent of the deaths cannot be traced to census documents. It is interesting to note that the authors do not stop to consider the possibility that these may have been caused by migrationally or otherwise induced matching difficulties. They thus assume away the very problem which PGE was designed to solve. The disregard for this possibility by at least one of the authors referred to is by now of long standing. See Hauser's article [15].

they could also carry out a number of *ad hoc* enquiries for the headquarters arising mainly in the various analysis sections. These will be described in parts of this paper dealing with the analysis experience⁵.

Cross-Sectional Surveys (CS)

In CS enumeration there are two types of visits: a) full enumeration visit; and b) fill-up visit. During the full enumeration visit, a form (CS1) is completed in duplicate showing the composition of each household in the sample area. Vital events which have occurred during the preceding twelve months are recorded on another form (CS2). Each full enumeration visit is followed, as a rule, by three fill-up visits. During three fill-up visits the duplicate copy of form CS1 (the top copy having been sent to headquarters) is brought up to date. Any changes that may have occurred since the last visit are reported to headquarters on form CS3. Also, during fill-up visits, a form CS2 is completed for any vital event which may be reported in respect of the "last twelve months". New forms CS1 are also made out in respect of households, not enumerated (new arrivals or omissions) during previous enumeration visits. There is a complete break in the information between the last fill-up visit of a series and the following full enumeration, inasmuch as the enumerator's copies of form CS1 are sent to headquarters before the beginning of the next full enumeration⁶.

Field Co-ordinators send schedules of enumeration visits to headquarters for approval. Enumerators work in sample areas according to the approved programmes. The fact that these schedules are arranged in terms of small chunks of territory of each PGE area helps inspecting officers to locate the enumerator in the PGE area⁷. The enumerator moves in his sample area from dwelling to dwelling in each block irrespective of whether a certain dwelling bears a PGE number or not. The enumerators are explicitly instructed not to follow the numerical sequence of dwelling numbers. This ensures that if a dwelling was missed inadvertently during the original placarding with numbers by the regis-

⁵ Two enquiries have already been entrusted to the RSOs. One will collect (on a comprehensive questionnaire in all 24 PGE areas, selected at random over the whole country) information on prevailing practices in the field of official vital events registration. The findings will be reported in Manual 9 [12]. The purpose of the other inquiry is to check all unmatched registrations and all unmatched enumerations in the hope that some will match and that the others will be confirmed or otherwise as true vital events (*de facto*) in the field. The Field Inspectors do not know whether they are checking a registration or an enumeration. The results and procedure will be reported in Manual 10 [36]. Finally, it is possible that some of the more esoteric enquiries suggested in the first article [5] will be entrusted to the Field Inspectors, such as the enquiry into "walk at one year of age".

⁶ This "complete break in information" occurs only in the field. It is patiently and laboriously repaired at headquarters, where households and their individual members are allotted the same identifying numbers in the new year as they had in the previous year.

⁷ There are about eight chunks in a PGE area, or just over one hundred households in a chunk. The smallness of the size of the chunk makes it easy for the inspecting official to find the enumerator.

trar, it may be picked up during the subsequent visits and reported by the enumerator.

A "complete" census was carried out at the end of 1963 by non-PGE enumerators in order to establish a fresh base population for each PGE area, including those which are "LR only" areas. This census has disclosed in some areas disturbing variations since the earlier census. It has also shown disagreements with the summaries available from forms CS1. The causes of both variations are being investigated.

Field Inspections

Field inspections are carried out regularly, although in some cases more inspection visits seem to be called for than it has actually been possible to make. CS work is checked in the field by Field Co-ordinators and Regional Survey Officers. Sometimes members of the Managing Committee also visit PGE areas when CS work is in progress. In the case of LR registrations we have six Field Inspectors to carry out periodical inspections. Members of the Managing Committee have also paid occasional inspection visits. The intensity of inspection visits can be seen by the fact that registration operations were visited 464 times and enumeration operations 77 times by the various officials mentioned above from December 1961 to May 1964.

Besides keeping the field staff alert, these inspections have helped to bring out several field difficulties. In suitable cases remedial action was taken.

The details of the rather disquieting findings of these various inspections will be reported in greater detail at a later time [3]. It is also hoped that a special publication will bring together in a systematic form the findings of all inspection reports [34]. Several hundred pages of systematic notes on forms with a high degree of comparability are being analyzed.

MATCHING⁸

Matching Principles

The matching procedure is designed to separate the reported events into three groups: those caught by both parts of the experiment, those caught by one but not by the other, and those caught by the other but not by the first.

⁸ An extensive report on matching experience at the Social Science Research Centre, University of the Panjab, Lahore, has been received through the kind service of Dr. John F. Kantner, Professor of Demography at the University of the Panjab, in April 1962. Information on the principles employed at the United States Bureau of the Census was received from Mr. W. Parker Mauldin of the Population Council [38]. Dr. Leon Pritzker, Chief of the Research Branch, Statistical Research Division, U.S. Bureau of the Census, provided a number of publications. Our early thoughts and ideas in this field were vetted on a number of occasions by Dr. John F. Kantner and Dr. Rowland Rider, Professor of Statistics at the Johns Hopkins University. We are very conscious of the fact that only in small part has it been possible — so far — to take full advantage of the voluminous advice received.

A good matching procedure will guard against two errors. It will avoid mismatches when insufficient items are compared. It will not fall into the opposite error of disregarding true matches by insisting on too rigorous a match, when differences between documents to be matched may be merely formal or may be due to faulty information. For matching of births, there are 13 items of information common to the registration and enumeration documents. There are 15 common items for deaths. The first two in each case (PGE area code and type of PGE area) are not used, because since matching is done within each PGE area separately, the need to distinguish mechanically between the PGE areas does not arise. This reduces the number of common items to 11 and 13 respectively. None of the items can be treated as irrelevant but some are more useful than others in obtaining a match with confidence. Agreement need not be obtained on all 11 or 13 items. A match can be declared on the strength of a smaller number of items, if sufficiently firm conclusions can be drawn from fewer items. Some items may be missing from one set of the records (registration or enumeration), or entered incorrectly, or coded wrongly, or punched wrongly, or the factual situation may have changed. For example, a registered grandchild (of the head of a household) might be correctly enumerated at a later time as a child because of the death of the previous head of household at some time after the registration. It would obviously be a mistake to declare a non-match for any such reasons. Provided strong enough corroborative evidence is forthcoming from other items a match can be declared in spite of the non-match of some items.

The single most significant item used in matching the two sets of information is residence. The PGE dwelling number (assigned to place of residence) is given on both the LR and CS forms. The PGE household number (assigned to the household group) is not given on LR forms because the registrar has means of ascertaining it. Household numbers cannot, therefore, be used for matching. A certain amount of mobility, even within the PGE area, can be expected and therefore the dwelling number, while the most important criterion, is not sufficient for a match. Suppose that a vital event takes place in a household which changed dwellings between registration and enumeration. The fixed dwelling number of the dwelling inhabited by the mobile household at the time of the interview is to be recorded by field staff and the number registered will be different from the one enumerated. Furthermore, apart from mobility within the PGE area, the same vital event may have a dwelling number on the registration document different from that on the enumeration documents, because of a mistake in recording or in mapping or in reading the dwelling number. This is particularly so in East Pakistan, where dwellings have been allotted by registrars rather loosely to groups of dwellings. In such a situation a dwelling

on the edge of one group of dwellings with a given dwelling number could fall, in the opinion of the enumerator, under a neighbouring dwelling number. Finally, more than one vital event of the same type may take place in a dwelling with a given dwelling number.

In view of the fact that the dwelling number alone may not be a sufficient criterion for matching and because it may at times have to be disregarded, combinations of other items have been adopted. Out of eleven combinations tried, only four have been found empirically to give satisfactory matches. The actual items used in any one of the four mechanical matchings and the probabilities which can be allocated to each will be reported later [3]. These probabilities are so high that a match on any one of the combination of items is accepted as a match, even if there are non-matches on other combinations.

Some of our advisers have criticised, and some readers no doubt also will criticise, the substitution of one set of matching criteria by another and then another and so on until all possibilities are exhausted. To these critics it looks like choosing the evidence to fit the case. In fact the argument is quite simple. If one could assume invariance of response and absolute validity and completeness with regard to a given set of criteria then failure to match would be disqualifying in an absolute sense. Inasmuch, however, as we cannot rely on any of these three requirements, we cannot take "no" for an answer, because "no" does not mean "no", it means "no" or "maybe". We go on until we collect enough "yeses".

Failure of Mechanical Matchings

The registered information having been put on one set of punch cards and the enumerated information on another set, the two packs of punch cards are sorted in the order of matching-items and then compared mechanically on a collator (sometimes called interpolator). Machine operators have no discretion in determining a match. The machines will either indicate identity between matching items on the two cards (one from each pack) or they will not. Unfortunately, the mechanical criteria chosen were not always conclusive. The readers might have suspected such a result during the preceding discussion of the procedure according to which one set of criteria is substituted for another in the process of matching. This result had two consequences: mechanical matches could not be trusted completely and had to be checked manually; non-matches could not be accepted as conclusive and an elaborate system of manual matching, office checking, and field checking had to be set up. It would be beyond the scope of this paper to describe the method by which the mechanical criteria have been selected and the characteristics of the criteria. Instead, we offer a brief description of the manual matching and the office and field investigations which the

failure of the mechanical matchings necessitated. Basically, failures in mechanical matchings are due to the difficulties with coding names unambiguously. A separate section is devoted below to this group of difficulties. With regard to mechanical matches as such, it will be enough to say that no set of criteria could be found which would on the one hand be conclusive enough to do away with manual matches and on the other would be liberal enough to provide a sufficiently large number of matches to be worthwhile undertaking.

The causes of the failure of machines to match events matched manually can be arranged in the following order of descending order of importance:

i) names inconsistently reported either by respondents or interviewers or both;

ii) scrutinizers unreasonable or inconsistent in the application of the name codes, mainly due to inadequate scrutinizing instructions;

iii) relationship to head of household misreported as relationship of head of household; or misreported due to a faulty understanding of the household definition by at least one party; or the relationship changed between the two recording times;

iv) mechanical failure;

v) sex misreported⁹. It is hoped to support the above list with numerical details in the proposed monograph.

In the earlier section on matching principles the four criteria with very high matching probabilities have been mentioned. It must be appreciated that these probabilities are solid, assuming no mistakes in reporting. As we could not rely on the information as punched, all the mechanical matches had to be checked manually¹⁰. The manual check was the final step in the determination of matches from the mechanical matchings.

⁹ The population of Pakistan (or perhaps its enumerators) is not unique in getting reports of sex wrong occasionally. For similar misreporting in the case of the population of Canada, see [11]. Numerical results for that study are given in [11a].

¹⁰ In view of the high number of non-matches reported for 1962 and 1963, it may appear that there would be no harm if a few untrue matches slipped through the mechanical matchings. However, it must be realized that such non-matches are withdrawn from further matchings and their corresponding potential partners (left behind in the non-matched pack of cards) are deprived of the opportunity to match. It is true that with, say, three untrue matches both the N_r and N_e have been each cut by three (a total of minus six) and the C increased by three, but the disappointed partners (assuming one for each of the untrue matches) have increased the N_e by three and the N_r by three (a total of plus six), decreased the C by three and in this wiped out the work of the untrue matches. In addition, they made a contribution to the "fourth category". If properly matched they would have decreased N_r and N_e by six, increased C by six, and made no contribution to the "fourth category". Thus, when tolerating untrue matches, instead of being generous to the need to cut down the vital rates, we are actually increasing them.

Having checked the mechanical matches manually, scrutinizers undertake two more matchings: "common dwelling numbers" and "characteristics sorting". Under the first, events (or rather their punched cards) are arranged in dwelling number order. Scrutinizers examine listings of these cards in the hope that they will spot similarities between events with the same dwelling number. In addition, events with dwellings with similar or close numbers, say, 176, 178 and 117 in the case of an unmatched event with dwelling number 177 are examined. Under the second method of manual matching, all remaining unmatched cards are tabulated three times, having been previously sorted on the following characteristics in the case of births:

1. sex, parity (order of birth), mother's name;
2. sex, parity, father's name;
3. month of event, grandfather's name, father's name; and in the case of deaths:

1. sex, age group, own name;
2. sex, age group, father's name;
3. month of event, own name, father's name.

The above characteristics sortings hopefully give another chance of picking out matches of events which have been given the wrong dwelling number. (The first chance was one of the mechanical matchings). The LR and CS listing for each characteristic sorting are compared manually and suspected matches marked. "Suspensions" are raised by comparison of the characteristics sorted upon. These potential matches are confirmed by looking at the original documents for any additional items which may agree. The following are examples of agreement reached:

Characteristics sorting 1 in the case of births:

	<i>sex</i>	<i>parity</i>	<i>mother's name</i>	<i>(dwelling number)</i>	<i>month of event</i>
LR	2	06	129	352	4
CS	2	06	129	353	5

Characteristics sorting 3 in the case of deaths:

	<i>month of event</i>	<i>own name</i>	<i>father's name</i>	<i>(dwelling number)</i>
LR	5	053	180	484
CS	5	053	180	483

In the above examples all the three items in the characteristics sorting agree and the additional information (in parentheses), although not identical, is at least very close. The suspected matches are checked manually against the

original documents and the reasons for making a decision that the given pair of documents are a match are recorded in a special form (AN 23). Through a study of such leaks in mechanical matches and reasons for confirming manual matches we may be able to suggest improvements in the matching procedures.

It will be seen above that the reported month of occurrence plays an important role in manual matchings. (It was not possible to instruct the available machines to exercise the necessary degree of flexibility with mechanical matchings). If there is only one or two months' difference between the LR month of event and the CS month of event then there is obviously no real difference. If the difference is twelve months or eleven or thirteen, then the year comes under suspicion and there is again probably no difference. If the difference is six months or so then there is probably a difference.

On completion of the four mechanical matchings and the two manual matchings the remaining non-matched events are compared with household composition documents and with enumerations from other visits.

During this matching, which is entirely manual, the original documents are compared, using the "long tables" method. This method is so called because it requires two long tables on which the registration documents and the enumeration documents can be spread respectively and compared optically with each other. The actual technique has with practice evolved differently, but the stage is still called "long tables". The purpose of this comparison is twofold: to obtain further matches *or* to obtain confirmation about the correctness from the point of view of *de jure—de facto* definitions of any given unmatched registration or any given unmatched enumeration with a view to eliminating it from further enquiries. The risk to be guarded against while obtaining such "confirmations" is that they may have an undiscovered partner, in which case both sides would remain unmatched (*see* note 10). Getting such an event then "confirmed" on one side, or even on both, would be cold comfort. Finally, a check is undertaken by Field Inspectors in the field with the same twofold purpose, the Field Inspectors not knowing whether they are checking unmatched registrations or unmatched enumerations.

The results of these numerous steps are recorded on a special form (AN 20) which at the time of this writing (June 1964), consists of eight pages with well over 350 documented items. This is a carefully documented system, easily checkable by outsiders and by now as near to fool-proof as it can be made within the general framework of current PGE possibilities, but without doubt it is a mediaeval way of operating. It is a far cry from the early vision of a mechanical collator (or interpolator) with two packs of cards (registrations and

enumerations) throwing all C's in one heap and a few Nr's and even few Ne's into two smaller heaps, all at the press of a button.

Disappointment with Names

The difficulty of matching names was always anticipated, but our disastrous experiences are worse than even the most pessimistic anticipations. Four different sources of the difficulties can be isolated for analytical purposes.

The difficulty arise firstly and mainly because of people's vagueness and changeability in the way they report their own names and those of their kith and kin. An additional difficulty under this heading is the uncertain way in which most of the names are spelled. Spelling in the various vernacular scripts would not help (at least not immediately), because spelling mistakes arise in the vernacular too, though it would probably avoid some of the difficulties of spelling in English. On the other hand, it would require a coding system capable of dealing with more than one script.

Neither the registrars nor the enumerators are consistent in writing names. Some of the varieties could have arisen only in the most fertile imaginations, such as, *e.g.*, KOWNISS, the spelling used in some Bengali PGE areas, for KANIZ or KANIS. The inconsistency in entering names is enhanced by the inadequate space allowed for names on LR and CS forms. At a late stage an LR Field Instruction and a CS Field Instruction were issued, the purpose of which was to ensure that registrars' and enumerators' entries met the needs of the Analysis Section more fully than they did at the time, but the 1962 matchings did not benefit from this belated intervention and the 1963 matchings benefitted only at the very end.

Up till late 1963 the scrutinizers' instructions on how to deal with names were singularly unhelpful. The instructions specifically aimed in cases of doubt and in cases of abbreviations made in the field at ensuring that no matches would take place. For example, if ABDUL GADIR was abridged as A. GADIR or GHULAM MOHAMMED was abridged as GH. MOHAMMED, the abbreviation was disregarded and only the fully written-out name was coded. If in such cases on the other document ABDUL GADIR or GHULAM MOHAMMAD were written out fully, ABDUL and GHULAM were coded, making certain in this way that no match would be achieved.

Codes for names were allotted somewhat haphazardly so that the same name but with different spellings may have been allotted more than one different code. There is no objection in principle to having more than one name under the same code. In fact, in view of the limitation imposed by the three digits

devoted to the name code, more than one different name must be placed under the same code once all the 999 codes have been taken up. Less frequently occurring names have been grouped together. Names occurring frequently have not been grouped with other names and have been left alone, each under its own code. This procedure lessened the disparities between the contributions made by name codes to the probability of a match based partly on names and will make it easier to calculate the averages probability that a match from any given matching is a true match.

This disappointing section need be closed with only two more remarks. Names are coded to facilitate matching. The purpose is not to produce a document with legal or any other significance to the individual. To make a minimum contribution to coding it would be enough to have two codes: one for, say, all Abduls, Ahmeds and Mohammeds, and the other one for all neither-Abduls-nor-Ahmeds-nor-Mohammeds. By increasing the number of alternative codes, however, it is possible to make a more effective contribution to matching than only two alternative codes could.

Sundry Matching Experience and Discussion

During the work special cases have arisen such as conflicts between the registrar's report and the enumerator's report, one party's reporting a still birth and the other's classifying the same birth as a live birth, or one party's allocating an event to December of one year and the other party to January of the next year. Special rules have been evolved for all such cases.

As already explained, by the time this article had been completed, 1962 and 1963 registrations had been matched, each with enumerations from one visit only, namely the one held early in 1963 and in 1964 respectively. Enumeration documents from visits covering the years partly, *i.e.*, both the three earlier visits and the three later visits were consulted only optically to obtain a few more matches, or, more frequently, to have unmatched registrations "confirmed" by reference to other visits when it was apparently impossible to match them with given visit, presumably because they were not enumerated during the given visit. In order to fit the unevenly proceeding fieldwork with a calendar year a number of assumptions about matches "on the edges" of the field work had to be made. Apart from such *unavoidable* assumptions there was also another group of assumed matches called *safeguards*. These were assumed in anticipation of further matches which may arise as a result of further office and field checks. A few more matches were assumed in other cases, if for example, the work of an enumerator was obviously and particularly careless. There is a considerable analytical difference between the two kinds of assumed matches. The *unavoid-*

ables decreased the calculated N's and increased the calculated C for good, but the *safeguards* will be removed when the detailed field checks have been completed. Table I gives the various categories of matches in 1962 and 1963 respectively.

TABLE I

	EAST PAKISTAN		WEST PAKISTAN	
	Births	Deaths	Births	Deaths
Categories of 1962 Matches				
<i>All Matches</i>	1678	498	1306	434
Mechanical	948	276	912	292
Manual	499	152	241	64
Assumed:				
Unavoidable	131	37	105	37
Safeguards	53	22	47	21
Categories of 1963 Matches				
<i>All Matches</i>	1628	486	1253	347
Mechanical	1052	329	899	220
Manual	403	103	220	76
Assumed:				
Unavoidables	111	28	72	21
Safeguards	62	26	62	30

It is possible that vital events which actually took place outside the PGE area and which were not, therefore, registered may have been enumerated, if they occurred to a member of household enumerated while the person concerned was temporarily away during the occurrence of the vital event, or if the household moved into the PGE area after the occurrence of the event. The understanding of the *de facto* basis of the registration and enumeration of vital events is stressed in all manuals and generally understood throughout the organization. Nevertheless, the possibility of some mistakes cannot be excluded, particularly when the whole household (as distinct from an individual member) was outside the PGE area at the time the vital event took place in the household. We hope that such cases have been or will be unearthed during the final field enquiry.

At the time of writing this report the relevant tables of the intended volume 14 in the PGE series of reports, in which substantive findings will be made available, have not yet been fully checked, but it is already apparent that there is some, though hardly perceptible, decrease in the number of unmatched enum-

erations. There is an increase, and quite a noticeable one at that, in the case of unmatched registrations. The following possibility suggests itself. If we assume correct *de facto* registrations, the unmatched early registrations may have been due to movements away from the area before the given enumeration and/or due to respondents' forgetfulness about more distant events.

The criteria used in the four mechanical matchings will at times seem inadequate in view of the fact that it is easy to think of instances where a match could be made on all the items, yet not be a true match. For example, the multiple births to a woman could not be adequately matched unless we add a fifth criterion, *viz.*, the name of the child. However, this required no special action because it is unlikely that in the case of multiple births not all births would be registered and/or enumerated once one at least has been recorded. Once they were *all* registered and enumerated it does not matter whether they were correctly or incorrectly matched. The numbers going into the estimating formula would be the correct one, irrespective of whether the matches were correct or not.

SUBSTANTIVE FINDINGS

Base Populations

A vital rate depends as much on the denominator as on the numerator. The fathers of the formula on which the PGE experiment is based [7] did not realize this; nor did the Managing Committee of the PGE until a very late stage in the experiment. It may seem incredible that 5,000 people living in a relatively congested area, with presumably well defined boundaries, cannot be enumerated exactly to the very last person, but for that matter the few hundred births and deaths happening to this well-observed population cannot be got hold of either.

During the first two years we relied on figures provided by the National Sample Survey Division of the CSO. Comparison with the first information available from the PGE household composition data suggests that the NSS information is erratic. While most NSS estimates seem to be lower than the PGE counts, those few which are on the high side in comparison with the PGE record, may be so merely due to NSS's covering also villages outside a PGE area. Although the present base populations are largely discredited, we are reluctant to change our base until more final base populations can be adopted. The vital rates reported in the article already benefit somewhat from more accurate base populations, but it will not be until the monograph referred to above has been prepared that the more nearly final base populations will become available.

A Novel Application of the Chandra-Deming Formula

The usual fill-up enumeration visit (2.3) was carried out in all the 20 CS areas in October 1963. At the end of November non-PGE enumerators were sent to all 24 areas (*i.e.*, including the four "LR only" areas). They were given the ordinary PGE maps, but no other PGE documents. They were instructed to visit all the households in each PGE area, irrespective of whether in a numbered dwelling or in an unnumbered dwelling. The information to be collected by them on a simple form (CS13) consisted of dwelling number, if any, name of head of household, number of *de facto* and *de jure* members of household broken down into men, women, boys and girls¹¹.

Forms CS13 were then compared in the Base Population Section with up-to-date forms CS1. The comparison was of course made not between the totals but in the true PGE tradition, individual household by individual household. Within each household the comparison was made between the totals of each of the four groups: men, women, boys and girls. If CS13 enumerators omitted man A, but included man B previously omitted by PGE enumerators, then such omissions could not be determined. Similarly, the departure of man C and the arrival of man D between the visit 2.3 enumeration and the CS13 enumeration would not be detected. Changes involving sexes or the two broad age groups were caught in the comparison carried out in the offices.

From this exercise various categories of households will be obtained: households enumerated by both exercises, households caught only by PGE enumerators, while the first category will be further divided into three categories: households with no differences in composition, households with more members caught by the PGE enumerator and households with more members caught by the non-PGE enumerator. We hope to report at a later stage on the success or otherwise of the application of the Chandra-Deming formula to the denominator of the vital rates.

¹¹ When we say "*de facto* and *de jure*", we mean in this case one figure without differentiating between the two categories. This had the result of facilitating a direct comparison with the total number of members of each household, but provided meaningless totals otherwise.

Crude Vital Rates Obtained

Crude birth rates (CBR) and crude death rates (CDR) for the two provinces of Pakistan from various sources are summarized in Table II.

TABLE II
VARIOUS VITAL RATES IN PAKISTAN

Source	Year	CBR	CDR	CBR	CDR
		Muslims (All Pakistan)		Non-Muslims (All Pakistan)	
Demographic Analysis I [2]	1951	62	49	49	37
		Muslims (East Pakistan)			
Demographic Analysis II [1] ^d	1951	62	49		
		East Pakistan		West Pakistan	
Demographic Analysis III [24]	1961	58	32	51	25
Planning Commission [32]	1961	57	31	52	26
MESOREP [28] ^e	1963	NA	NA	52 ^a	NA
Housing Census [31, p. II-114]	1960	28	11	24	7
PGE 1962 ^f	1962	57	20	52	19
PGE 1963 ^f	1963	56	19	53	19
Demographic Analysis IV [17]	1951	NA	NA	43 ^b	25 ^b
Demographic Analysis V [18]	1956	NA	NA	48 ^c	21 ^c

CBR=Crude Birth Rate

CDR=Crude Death Rate

NA=Not applicable or not available.

a) The town of Lulliani.

b) Based largely on the Punjab part of West Pakistan.

c) Six "sample" villages of Lahore district.

d) The author does not explain how the muslims of East Pakistan can have rates identical with muslims of *all* Pakistan in spite of their marked differences in age distribution and intercensal growth.

e) The rate quoted in the table has been read approximately from Appendix E and fig. 1 to which 10 per cent has been added in accordance with p. 4, where it has been reported that "the check survey [the equivalent of PGE CS enumeration] has also recorded and verified additional births which constitute over ten per cent of the births registered". Elsewhere and a year earlier this rate has been quoted as "about 50" [9, p. 233].

f) These rates will be reported upon in detail in the forthcoming monograph. The rates tentatively suggested for 1962 are likely to be very close to the rates in a forthcoming PGE Interim Report. The rates suggested for 1963 move away from "official" PGE release in two respects: they anticipate results of a matching operation in the field and they do not accept fully results from some of the more erratic PGE areas. The monograph is likely to suggest for both years rates which will—hopefully—approximate reality somewhat more closely.

Except for the CBR from the Housing Census and the last two series of rates given in Table II, the other estimates of the CBR are in reasonable agreement as to its astronomical level. This is not surprising in view of the power of the analytical techniques available to demographers in the case of births and the high quality of field work of both the PGE and the Medical Social Research Project on Population. The Census Commissioner was right to publish the Housing Census figures (as he was wrong in 1951 in concealing anomalies in the age distributions by presenting them in broad age groups [22]), but the rates show the futility of using so-called official figures, whatever that phrase may mean in this context. This futility carries over into the analytical field, as witnessed by the lowness of the estimates suggested by the last two estimates in table 3, both based substantially on official or semi-official registrations. The actual level of the PGE CBRs can only be determined with greater certainty when more confidence accumulates in the base populations.

The CDRs show a greater dispersion than the CBRs. The tools of demographic analysis are here much weaker. Furthermore, poorer results from field work are typically expected with deaths than with births. However, greater certainty about base population will not only increase the confidence in the denominator, but will also be accompanied by improvements in the numerator, because of improvements in field and matching techniques.

When studying the PGE data by individual areas (not given in this article) it is interesting to note that low numbers of vital events in any one PGE area are paralleled by high numbers of unmatched events and consequently a high 'fourth category'. It is interesting to speculate whether these are natural compensations through the Chandra-Deming formula in a country with uniform vital rates or whether poor field work and consequent difficulties of matching obtain a gratuitous compensation in the form of a large "fourth category" particularly in urban areas, where with the mobile population the difficulties of matching may be greater and may create the possibly erroneous impression that urban rates are as high as rural rates¹².

In other words, we are left wondering whether the remarkable evening out of vital rates between the PGE areas once the Chandra-Deming formula has been applied is a reflection of the true demographic situation or merely the accidental outcome of the lower vital rates being counterbalanced by our failures in matching.

¹² Mobility of persons and households compounds the difficulties of matching in several ways: the *de facto* definitions are more difficult to apply, the usefulness of dwelling numbers is lessened, and the knowledge of mobile respondents about the vital events of mobile individuals is likely to be inaccurate. More generally, responses obtained by registrar and enumerator are likely to differ more than with a settled population.

The comparison of preliminary results for 1962 and 1963 results accords a measure of confidence in the usefulness of the Chandra-Deming formula to the Pakistan populations and in the relative success of our matching procedures. The absolute number of deaths registered in East Pakistan did not change between the two years. There has been an increase in West Pakistan of some 7 or 8 per cent, while births registered increased by a quarter and a fifth in East and West Pakistan respectively. In spite of this, the CBR and CDR for the two years remain similar. On the assumption that there has been no improvement in the matching during the more recent year (1963 as against 1962), the lower "fourth category" suggests improved field work of each of the two parts of the experiment and not a rise in the vital rates, particularly the birth rates.

The general increase in the number of vital events caught in 1963 as compared with 1962 draws attention for more reasons than one¹³. This increase took place in spite of certain biases built into the PGE procedure, which should have favoured 1962. These biases will be discussed in the forthcoming monograph. On the whole, the higher level in 1963 seems to have been reached in spite of a certain increase in what may be called the greater disorderliness of the rates in 1963. It is as if after the first enthusiasm of 1962 the discipline slackened in some PGE areas resulting in unevenness and unsteadiness of data collection¹⁴. Yet the sheer force of habit has apparently secured more reporting as time went on.

The rates stand or fall by the second and third category (Nr and Ne). Relative to their size, the importance of the fourth category dwindles. It will be seen from appendices in the forthcoming monograph that about 80 per cent of events are matched when registrations or enumerations are considered separately. It is understood that this is also the percentage achieved by another survey in Pakistan¹⁵ as well as a survey in the United States [19, p. 254]. Match-

¹³ However, it is interesting to note that another survey shows a fall in the number of births from 465 in 1962/63 to 442 in 1963; but this survey was part of an action programme in family planning [28, Appendix E].

¹⁴ This aspect as well as all other aspects of the PGE work have been thrown open, at our instance, to a special Subcommittee of Demographers and Social Surveyors appointed by the Planning Commission. The hope is that, after an investigation by an independent body, the PGE results will become more generally acceptable. Another group from the Population Council and the National Center for Health Statistics surveyed the PGE operation in November 1964. See [26] for their generally favourable report, which suggests a number of improvements to PGE procedures. See [19a] for Krotki's reply.

¹⁵ This survey, which insists on remaining nameless until the results are published in the future, cut its non-matches from 20 per cent to 10 per cent after a field enquiry. It also had the advantage of a presumably very exact base population because of its registration system, which covered not only births and deaths, but also in-migrants and out-migrants. Its differences from PGE were: *de jure* registration, high proportion of senior personnel and foreign advisers, six-monthly enumeration.

ings of such proportions add to the total estimate of births or deaths less than 5 per cent by virtue of the fourth category.

Age-Specific Vital Rates

Births are available by age of mother and deaths and age of deceased, but no reliable age-specific rates can be calculated until doubts about the age distribution described below are resolved. As a temporary measure age-specific death rates have been worked out manually from a non-probabilistic sample of PGE 1962 results [13, pp. 131-132]. These rates when plotted produce four U-shaped mortality curves for males and females of East and West Pakistan. They are remarkably regular in their shape. Even the small hump at ages 60-64, which they all display, is confidence-inspiring. It is just what one would expect with more dead being heaped at 60 by the respondents left behind, than live respondents heaping themselves at age 60. The female selectiveness starts cruelly in West Pakistan, even earlier than in East Pakistan, but the reported masculinity ratio of the overall death rate (115) is higher in West Pakistan than in East Pakistan (108). Consistently there is also evidence from elsewhere of higher female selective under-enumeration in West Pakistan. The age-specific birth rates worked out at the same time do not depend on PGE information for the distribution of births between mothers of different ages¹⁶. This PGE information is not yet available. However, while demographically not significant, these age-specific rates increase further our confidence in the overall standards of the PGE field work and office analysis because of the fact that these rates are remarkably stable and otherwise reasonable in spite of the fact that they come from a combination of two small samples. It is gratifying to be able to derive on this account a measure of confidence in the quality of the field work of the two surveys.

Age Distribution

Modern demographic analysis is able to draw reasonably confident conclusions about birth rates from age distributions for the simple reason that the proportion at young ages (and conversely at old ages) is most directly related to fertility. The effect of mortality is much less noticeable on the age distribution because it affects all ages in a pronounced way at high levels of mortality and little at low levels of mortality. The census-derived age distributions suffer from severe anomalies both in 1951 and 1961, caused either by enumeration freaks or the aftermath of the 1947 Partition or both. It is, therefore, of prime importance for Pakistan demography, and for that matter for the future of Pakistan, to obtain confirmation or refutation of the various estimates of age

¹⁶ They use as a model rates obtained from another survey [14].

distributions which can be made from the census age distributions. As a temporary measure age distributions have been worked out manually from a sample of PGE 1962 enumerations [13, p. 57]. It is difficult to draw firm conclusions from this fragmentary information, but the general impression appears to be that the PGE population is somewhat less young than the census population, *i.e.*, with a lower birth rate. So is the NSS population [30] and the NSS rounds were perhaps not conspicuous for the adequacy of their demographic interests¹⁷. Also it is a safe rule to live by that a poor enumeration will have fewer children aged 0-4 than aged 5-9. The girls of the preliminary PGE population pass this formal test, though only just, but the boys do badly. In a primitive society when male children are protected due to the fear of the evil eye, an under-enumeration of male children has been observed, resulting, consequently, in a lower masculinity ratio at young ages [33]. The variety of that type of explanation is great and the explanations remain largely conclusive because of the large number possible. We can only look with hope and impatience towards the first PGE age distributions coming off the machines.

CONCLUSION

The fragmentary PGE age distributions mentioned above have been taken seriously by the Office of Population Research at Princeton University and analysed with the thoroughness and imagination characteristic of this office¹⁸. A technique not yet available in published form (to the best of our knowledge) has been applied¹⁹. The outcome seems to suggest rates close (in the case of births) to the results of demographic analysis carried out in Pakistan and to the PGE results—though for different reasons and with a somewhat greater spread between the provinces. In the case of deaths the analysis comes out somewhere between the low PGE death rates and the higher rates obtained by demographic analysis in Pakistan.

For a number of reasons it is not possible to adopt a firm attitude about any one rate of births, but the evidence both of demographic analysis and field surveys comes out more and more in favour of the high fifties for East Pakistan and low fifties for West Pakistan. Whether the death rate is as low

¹⁷ In particular, they came out with a masculinity ratio higher in both provinces of Pakistan than the already high masculinity ratio obtained by the 1961 Census.

¹⁸ Krotki is grateful to Professor Ansley J. Coale, Director of the Office of Population Research, Princeton, for an opportunity to read in September 1964 the first drafts of papers [40] and [18].

¹⁹ Some indications of it have been given by Frank Lorimer in [25]. See also [8] and [10].

as twenty is less certain²⁰, but in some ways the question is immaterial, because even if it is not, it is bound to get to this level soon, even if only temporarily. It is difficult to quote any one figure in such a situation, but a rate of population growth of 3 per cent for West Pakistan and somewhat over 3 per cent for East Pakistan must from now on be reckoned with as a clear possibility. No doubt the work to narrow the areas of uncertainty around the birth rate and the death rate will continue.

²⁰ The Chandra-Deming formula looked after the underreporting of deaths traditionally larger than that of births. The only alternative left to doubt deaths more than births is the possibility that the independence of the two field methods was somehow vitiated in the case of deaths, resulting in a lower death rate.

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