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Reducing attrition in panel studies in developing countries

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Background Panel studies offer repeated observations of individuals over time, but the mobility of populations in the developing world often causes attrition in panel studies. Such attrition can cause bias if it is selective but can be reduced by tracking respondents. Tracking in developing countries can be costly and difficult as populations are often highly mobile, infrastructure is poor, structures frequently change, and formal address systems or population records rarely exist.

Method In this paper, the attrition and tracking experiences of panel studies in developing countries are reviewed and recommendations made for ensuring effective tracking.

Comments Tracking can reduce attrition by up to 45% and is feasible if procedures are locally appropriate, well planned, involve the community, collect as much locating data as possible, and have explicit criteria, and if tracking is done at regular intervals, and interviewers are well trained, supervised, and motivated.

Conclusion Attrition is an important issue in panel studies, whilst tracking can be costly it can reduce attrition if effective procedures are used.

Panel studies offer repeated observations of individuals over time, which facilitates causal explanations of relationships between variables. Attrition in panel studies results in a diminishing number of study respondents; it occurs when respondents die, decide to drop out of the study, or are not relocated. Because the loss is cumulative a small loss in each survey round can add up to a significant loss over time. This loss can reduce the statistical power of the study (through a reduction in sample size) and, if selective, can cause bias as the remaining sample may not be representative of the population it was originally selected from. The importance of attrition depends on the study aims and study population; loss of respondents through moves is for example particularly significant for studies investigating transition and change linked to migration. This paper reviews the literature from longitudinal studies in developing countries exploring the importance of attrition, the importance of tracking respondents (following and relocating respondents as they move out of their house or migrate) for reducing attrition, and makes recommendations for setting up tracking systems.

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The studies

The selection criteria for inclusion in the review were that the studies had a sample size of at least 1000 and lasted for at least 2 years. Studies were located through an electronic search of *Bath Information and Data Services (BIDS), Health Star, Medline* and *Popline* data bases and the Internet. Once the studies were identified, articles and project materials relating to attrition and tracking were used to develop the tracking guidelines. Much of the literature regarding tracking and attrition is not formally published and was hard to locate and it is likely that studies have been missed in the review. No studies that rigorously evaluated different tracking techniques were located and these guidelines are based on reports of effective techniques. The 13 studies that are referred to in this review are outlined in Table 1; the sample sizes range from 1262 to 9774 and include hospital, city, district, and national samples. Studies lasted for between 2 and 12 years and their aims included evaluating interventions and exploring poverty, fertility, and child health and development. The efforts the surveys made to track respondents varied greatly; efforts were either non-existent, pre-planned, or unplanned, centrally or fieldworker organized, and respondents were either tracked only if they moved within a study site, if they moved between sites, and in some cases wherever they moved.

Table 1 Survey description

Study name and year	Sample size	Sample characteristics	Study length (years)	No. of survey rounds	Main research questions
Kenyan Ideational Change survey Cited in ref. 1 (Kenya 1994)	900 women and their partners	Ever married women aged 15–49 and their husbands in four rural sites	2	1 at 2-year interval	Role of informal networks on contraception and AIDS prevention
IFORD Yaounde survey[2] (Cameroon 1978)	9774	All hospital births to residents of Yaounde in 1978	2	7 at 4-month intervals	Levels and determinants of infant mortality and morbidity
El Proyecto Integral de Desarrollo Infantil Cited in ref. 1 (Bolivia 1996)	2047 households	Urban pre-school children attending child care centers	2	1 at 2-year interval	Evaluation of an early child development intervention
Peru Living Standard Measurement Survey[3] (Peru 1985)	1280 households	Households in Lima	5	1 at 5-year interval	Understanding household welfare
Peru Living Standard Measurement Survey[4] (Peru 1990)	2522 households	National sample of households	3	1 at 3-year interval	Understanding household welfare
1982 Birth Cohort Study in Pelotas[5] (Brazil 1982)	6011	All hospital births in Pelotas urban area in 1982	2	3 at varying intervals	Understanding mortality, morbidity, growth & development & health care utilization
Birth to Ten[6] (South Africa 1990)	3275	Births in Soweto-Johannesberg between March and April 1990	10	6 at varying intervals	Understanding child development within the urban context
Cebu Longitudinal Health and Nutrition Survey[7] (Philippines 1983)	3085	Births in metropolitan Cebu between 1983 and 1984	11	14 in first 2 years, 2 other at varying intervals	Issues relating to health, demographic, and nutritional outcomes
KwaZulu-Natal Income Dynamics Study[8] (South Africa 1993)	1393	Africans and Indians living in KwaZulu-Natal	5	1 at 5-year interval	Impact of political, social, and economic change on households
Malaysian Family Life Study[9] (Malaysia 1976)	1262	National sample of households containing ever married women <50 years of age	12	1 at 12-year interval	Understanding fertility/demographic events
China Health and Nutrition Survey[10] (China 1989)	3795 households	Households in nine provinces	4	4	Evaluation of health nutrition & family planning policies
Indonesia Family Life Study[11] (Indonesia 1993)	7224 households	Households in 13 provinces	5	2 at varying intervals	Explore correlates and consequences of social and economic change
Vietnam Longitudinal Survey (Vietnam 1995)[12]	4464	Resident adults aged 15–65 years in two provinces	2	2 at 1-year interval	Impact of changing household economy on demographic phenomena
C-Bird Evaluation Project: Migrant follow up[13] (Thailand 1994)	Unavailable	Households in Nang Rong province. Second round was an out migrant subset	1	1 at 1-year interval	Monitoring and understanding demographic and social change

The importance of attrition

Six of the 13 panel studies located provided information about the impact of attrition on bias. In Cameroon[2] the probability of children being lost through attrition was associated with the mother's marital status and education level, however the attrition of 40% was not found to affect the outcome measure of infant mortality. In Malaysia[9] selective attrition of 30% meant that younger, better educated, urban and ethnic Chinese were under-represented in the sample but it was concluded that meaningful analysis could be conducted for the outcome variables by re-weighting the sample and using other corrective statistical methods. In a Brazilian panel attrition was 13% but there was no marked variation in birthweight or income by whether follow-up was successful or not.[5] In a review of three panel studies in Kenya, Bolivia, and South Africa[1] attrition was 41%, 35%, and 15% respectively and was found to be associated with several background variables including education, age, and assets, and with some outcome variables in multivariate models. The review concluded that, despite suggestions of selective attrition from univariate comparisons between those lost and those re-interviewed, the attrition did not significantly affect most estimates (i.e. estimates of the associations between family background variables and child development, nutrition and fertility/social network outcomes). A further evaluation of the South African data drew similar conclusions.[14]

These developing country studies, and similar studies from developed countries[15–20] illustrate that whilst attrition can be a major problem in longitudinal studies it is not always selective, that even selective attrition does not always affect estimates, and that attrition can sometimes be effectively corrected using statistical techniques. These encouraging findings cannot be used to justify relaxed efforts to reduce attrition; however, studies with high attrition should not assume their results are invalid.

The importance of tracking

In developed countries attrition is mostly due to refusals which are often situational[21] whilst in developing countries attrition is mostly due to moves.[1,2,5,9,11] Respondents who move can either be excluded from the sample, replaced, or tracked; the appropriate strategy depends on the aim of the study. Reductions in statistical power can be overcome by recruiting more participants or replacing those who are lost with respondents of similar socio-demographic characteristics, but in many cases tracking respondents is the most appropriate strategy to minimize bias. Table 2 shows attrition and the impact of tracking on reducing attrition for the 13 identified studies. Studies with no tracking had 9–21% attrition per year compared with only 1–8% for those with tracking. The number of respondents located by tracking who would have otherwise been lost ranged from 5% to 45% of the sample.

Practical advice for setting up tracking systems

Keeping track of panel members involves considerable effort and valuable lessons can be learnt from previous large-scale panel studies in developing countries. First, studies should collect as much information about the respondent as possible. Second, studies must consider all of the different options for tracking and use those that are locally appropriate. Third, protocols need to include rules and tracking limits. Fourth, the shorter the gap between contacts the better. Fifth, respondents should feel part of the study, and sixth, choice, training, supervision, and motivation of interviewers are essential considerations. Tracking procedures may evolve over the life of a study, but each of the tracking issues identified in this review are best considered and extensively discussed early in the study design phase and, where possible, made an explicit part of the study protocol.

Studies should collect as much information about the respondent as possible

Although tracking strategies must be context specific there are several basic principles appropriate for all settings. A good strategy is to try and identify a network of people who are likely to know the whereabouts of the respondent and collect as much information about the respondent and their network as possible. Respondents with limited networks are often difficult to track and making special tracking arrangements may be appropriate for such cases. The network should include household members, external family members and other people who respondents think will know their whereabouts (e.g. boyfriends/girlfriends). Whoever the appropriate tracking contacts are, respondents should be informed that they will be tracked and who may be contacted for this purpose. Without this information the respondents and their tracking contacts may be surprised, suspicious, and upset by tracking efforts. Tact and discretion must be used in tracking especially when the respondent has left the study area because of difficult circumstances, such as owing money. Gate keepers can also be important, in the Nang Rong project in Thailand (Table 1) permission from employers was often needed to conduct interviews and a good relationship between interviewers and migrant employers and/or co-workers was key to successful follow up.[13]

Formal names and nicknames of each network member should be recorded in full, along with the address and their relationship to the respondent. It is also useful to record place of

Table 2 Attrition and the impact of tracking in panel studies in developing countries

Study site	% attrition per year	% study respondents found through tracking	Survey length (years)	% attrition at end of survey
Kenya Cited in ref. 1	21(couples)	No tracking	2	41
Cameroon[2]	20	No tracking	2	40
Peru[4]	18	No tracking	3	52
Bolivia Cited in ref. 1	17	No tracking	2	35
Peru[3]	9	No tracking	5	43
Brazil[5]	8	45	2	13
South Africa[6]	4	Unavailable	8	30
Philippines[7]	3	Unavailable	11	29
South Africa[8]	3	5	5	15
Malaysia[9]	3	26	12	30
Indonesia[11]	1	10	5	5
Vietnam[12]	1	Unavailable	3	3
China[10]	Unavailable	Unavailable	Unavailable	Unavailable
Thailand[13]	Unavailable	Unavailable	Unavailable	Unavailable

work, ethnicity, date of birth, place of origin, the location of any property owned, and migration plans. All information must be recorded accurately, completely, and meaningfully. In Peru, initial experiences from the Young Lives Study (an international study of child poverty for which data collection has just begun) are that respondents can rarely give formal addresses or telephone numbers of tracking contacts but can describe how to get to the contact address. Studies in such settings need to make sure they can utilize these informal directions; in the Nang Rong project this was done by asking informants to draw maps if they were able.[13] A lack of a formal address system can make it difficult for interviewers to relocate the respondent's house, even if they have not moved. Relocation can be facilitated by fieldworkers drawing maps as in the Malaysian Family Life Survey,[9] by using Geographical Positioning Systems to obtain co-ordinates as is being considered in the Young Lives Study in Peru, or by recording detailed descriptions of permanent landmarks and directions to the house.

Tracking can produce a lot of information and plans need to be made for data handling. Some useful tracking data may be collected in the survey questionnaire which will need to be extracted. In the Indonesian Family Life Study[11] a relocation sheet was produced for each respondent, which was updated at each round and issued to the relevant interviewer.

Studies must consider all of the different options for tracking and use those that are locally appropriate

It is best to start tracking with the simplest and cheapest tracking options that will locate the most respondents. Studies should, however, consider all tracking options; what sounds expensive or unfeasible at first may save time and money in the long run. The Pelotas study successfully relocated respondents by performing the huge task of conducting a census of the 68 590 households in urban Pelotas,[5] and in the Birth to Ten study interviewers were given mobile phones so they could make easy contact with participants (personal communication).

Tracking protocols must be context specific taking into account the quantity and nature of migration, the best time for tracking, the resources available, and the infrastructure and geography of the area. In the Malaysian Family Life Study the tracking protocol utilized the predictable nature of migration by starting the follow-up rounds in rural areas and working towards urban areas reducing the need to return to study areas for tracking.[9] In some settings circular migration is common and researchers should not assume that respondents lost in one round are lost for all future rounds. In the Birth to Ten Study[6] between one-third and half of all cases lost in one round were found in the study area in later rounds. Similarly in the Indonesian Family Life Study[11] 60% of households that were lost in the first follow-up round were relocated in the second round. In the Cebu health and nutrition study[7] 8% of women classified as lost were later found at their original address.

Households should be visited when respondents are most likely to be home and tracking should be conducted in the most appropriate season. Seasons associated with difficult weather conditions and when seasonal migration is common should be avoided. In the Nang Rong project researchers utilized the fact that migrants often return to their home villages for important festivals such as Thai New Year and timed their fieldwork accordingly. Whilst successful the approach had some downfalls; migrants were often drunk, interviews were interrupted by friends and family and some visiting migrants did not have time to answer the questions.[13]

Whilst formal registration and documentation are rare in many developing countries, and where they exist may be difficult to access, they can be a useful resource in some settings. They include: birth, marriage or medical records, health or welfare registers, city or municipal records, voter or census lists, adoption records, phone books or postal records, land titles, tax or driving license records, school or church records, prison or labour union records, and organization membership lists. Unofficial records/sources have also been used to track respondents; these have included department store credit records, electricity meter readers, postmen, village headmen/local leaders, employers, and neighbours.[5,9,11,13] The Nang Rong project also found that migrants from the same village in the same destination tended to know one another and used the located movers as a tracking resource by asking if they knew any one else from the study site living in their location.[13]

Infrastructure varies greatly between developing countries. The Birth to Ten setting (urban South Africa) had the advantage of good infrastructure and tracking by telephone was feasible,[6] in fact many respondents had mobile phones and the study collected these numbers and used them to make contact (personal communication). In the Indonesian Family Life Study only 20% of households could provide a contact telephone number;[11] for such settings other more appropriate means of contact must be used. This usually consists of visiting the dwelling of last contact. Infrastructure, tracking resources, and mobility also vary within countries and tracking protocols need to take this into account. Panel studies can reduce attrition by identifying areas with high mobility or with special tracking needs. Once these areas are identified special tracking arrangements can be made such as more frequent visits by interviewers or employing a community member to help with tracking. In both the Malaysian and Indonesian Family Life Studies shantytowns were a problem area for tracking and their redevelopment or demolition eliminated entire clusters.[9,11] Where demolition is frequent, studies could make checks on redevelopment plans and visit the study respondents prior to their removal. Other examples of highly transient respondents or places where communities are not closely knit include people living in government staff quarters, agricultural estate workers,[9] and people living in areas around training schools, universities, or markets.[11] In some countries mobility is higher in urban areas[9,11] and in others rural areas[1] and tracking plans need to reflect this.

One of the best ways to identify mobile groups and other tracking problems is to conduct qualitative formative research or a pilot study. This should include working with the community to explore how people are commonly identified and the best tracking approach. Qualitative formative research can also be used to identify any tracking or linking information (such as names, addresses, and dates of birth) that may be reported incorrectly or inconsistently by respondents. The Pelotas study[5] enrolled children in maternity wards and found that follow-up rounds were hindered because mothers had given false social security numbers and incorrect dates of birth to qualify for a higher quality of care and to avoid fines for the late registration of births. In South Africa names can be spelt

using two spelling systems; in the Birth to Ten study linking children on the data base was difficult because names were not recorded consistently.[22] In both of these examples well conducted formative research could have prevented these problems, as could issuing each respondent with a unique ID card and number. In studies that have more than one follow-up round getting fieldworkers to record details of their tracking procedures, as in the Nang Rong project,[13] provides useful information for improving tracking in subsequent rounds.

Tracking protocols need to include rules and tracking limits

Studies need to set criteria and limits on the time, money, and resources they will be put aside for tracking. Some respondents cannot be tracked and for others tracking will be exceedingly costly. The cost of tracking increases dramatically for hard to reach cases; in the Indonesian Family Life Study[11] tracking outside the local enumeration areas cost 20% more than local tracking. Generally the studies reviewed tracked respondents within their study areas. The studies that covered whole regions or the entire country had the advantage of having a network of interviewers in several locations and could track respondents who moved from one study area to another. This requires that studies make provisions for keeping information updated and getting it to those who need it. A successful approach in several studies[9,11,13] has been to have central tracking co-ordination. In the Indonesian Family Life Study[11] the 'tracking shop' used to locate respondents who had moved outside their study area allowed interviewers to plan the most efficient visit route, prioritize tracking, and determine when tracking should end.

When deciding the tracking limits studies need to consider where people move. In the Indonesian Family Life Study[11] 40% of respondents found by tracking were located within their study area and in the Malaysian Family Life Study 28% of respondents were located by tracking in the same district, 4% in a different district in the same state, and 5% in different states.[9] In the Pelotas study[5] 6% of respondents moved outside the study area. The Indonesian Family Life Study[11] set a limit for local tracking of half an hour by public transport whilst the Nang Rong project[13] limited tracking to destinations selected because they had high in-migration and were logistically feasible.

The shorter the gap between contacts the better

Tracking respondents who have moved becomes more difficult the longer the length of time that has elapsed since the move. Contacting respondents at regular intervals allows records to be regularly updated and respondents to be tracked as quickly as possible after they have moved. These contacts can either be survey rounds themselves or contacts solely for tracking purposes.

Respondents should feel part of the study

Respondents who feel part of the study are more likely to make an effort to inform the project they have moved or leave an address with neighbours. A good respondent–study relationship starts with informed consent, which itself can be difficult to achieve[23,24] and can then be fostered by keeping respondents informed about the study and by using tangible reminders such as radio publicity,[5] stickers, fridge magnets, news letters, birthday cards, photos, ID cards, toll free numbers, and change of address cards.[6]

Choice, training, supervision, and motivation of interviewers

Studies have found that a careful choice of interviewer is essential to ensure successful tracking.[11,13] The Indonesian Family Life Study[11] found that success in tracking was associated with interviewer quality (as measured by mathematics scores and salary in their previous job) and contact with the supervisor.

Interviewers should have certain personal characteristics: enthusiasm, flexibility, ingenuity, and perseverance. Tracking is made easier if interviewers know the community, as this will help them locate households and tracking contacts. It is also desirable, although often difficult, to use the same interviewers in each survey round as they are familiar with the study area and a good relationship is fostered between the interviewers and the respondents.

Studies need to equip interviewers with all the skills they need for successful tracking. Interviewers must be well trained, motivated, and supported, and their workload kept realistic. Interviewer training should include techniques of tracking and the legal and ethical implications of tracking (these will vary depending on the context). Facilitating communication between interviewers can be both motivational and an opportunity for interviewers to learn from each other, and should be encouraged. Methods of motivation used in the Indonesian Family Life Study[11] include interviewers working in pairs when tracking respondents who had moved far afield and giving rewards per respondent located. The dangers of tracking must also be considered. The Nang Rong project found that during tracking some interviewers were put in dangerous situations such as having to conduct interviews on construction sites and in remote houses.[13]

Conclusion

Attrition causes a reduction in effective sample size that can potentially result in information bias. Tracking in panel studies in developing countries can significantly reduce attrition but can be difficult because populations are highly mobile and infrastructures are often poor. Whilst all of the studies reviewed faced various problems (including cost, accessibility, safety, and lack of information), well-organized tracking protocols meant problems were dealt with effectively and this shows that studies in developing countries can successfully relocate respondents. Although tracking procedures need to be context specific there is much to learn from these studies: studies must collect as much information about respondents as possible, consider all of the different options for tracking and use those which are locally appropriate, have a well defined tracking protocol with rules and limits of tracking, make the gap between respondent contact as short as possible, make respondents feel part of the study, and select, train, supervise, and motivate the interviewers well.

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KEY MESSAGES

- Attrition is an important issue in panel studies as it can cause bias.
- The most appropriate method of dealing with attrition depends on the aims of the study.
- Tracking is one way of reducing attrition.
- Tracking can be costly and difficult in developing countries where mobility is high and infrastructure is poor.
- The cost of tracking can be decreased and feasibility increased if procedures are locally appropriate, well planned, involve the community, collect as much locating data as possible, and have explicit criteria, and if tracking is done at regular intervals, and interviewers are well trained, supervised, and motivated.

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