ASSESSING DIETARY CHANGE IN A LONGITUDINAL STUDY

J.E. PORTEOUS

INTRODUCTION

The aim of this paper is to highlight some of the difficulties associated with examining complex human behaviours in longitudinal studies. I am particularly interested in assessing changes in human dietary consumption patterns over time.

Difficulties arise not only because of the between-person variability but also because of the inherent day-to-day *within*-person variability associated with dietary consumption practices.

The issue becomes even more complex with the additional qualification of studying dietary *change* as this necessitates a means of determining whether or not a significant change has in fact occurred given the between and within person variability cited above. These issues are often poorly considered in studies of dietary change.

STUDY AIM

The primary aim of the study is to explore factors influencing dietary change in a prospective "naturalistic" (ie *no* intervention is given by the investigator) household based study.

The fundamental implication of this aim is that it requires a means of determining whether or not true "change" has occurred.

METHODOLOGY

As outlined above the study design is prospective and will examine the influences on dietary consumption practices over a 12 month period. Data collection commenced in June 1990.
The study population can be subdivided into two groups:

1. A random sample of the general population of Canberra and Queanbeyan derived from the 1989 electoral rolls using a systematic random sampling procedure (N=443; response rate 71%).

2. A hospital derived sample selected by attempting to recruit all persons admitted to the three coronary care units in Canberra Hospitals with a diagnosis of either acute myocardial infarction or unstable angina pectoris from September to November 1990 (N=42; response rate 66%).

In 1990 subjects were asked to complete questionnaires, including questions on whether or not they intended to change their diet over the next 12 months and a "Food Frequency Checklist" which detailed how often they had usually consumed a list of foods (in terms of the number eaten per day, week or month) over the preceding 3 months.

In 1991 subjects are being asked to complete a second questionnaire, including questions on whether they (subjectively) felt their diet had changed over the previous 12 month period and a second Food Frequency Checklist. This follow-up study is currently being administered.

POSSIBLE OUTCOMES

There are several "sets" of possible outcomes, which have been summarised in Figures 1, 2 and 3.

As shown in Figure 1, an individual may or may not have stated an intention to change their diet at the time of the original (1990) survey and may or may not have felt their diet had changed at the time of the follow-up (1991) survey.

Figure 1

		Subjective assessment of change (1991)	
		Yes	No
Stated intention to change diet (1990)	Yes	++	+-
	No	-+	--

Figure 2 follows on from this, in that although an individual may or may not feel their diet has changed, a more objective assessment (obtained by comparing the two Food Frequency Checklists) may or may not indicate significant change.

Figure 2

		Objective measure of change (1991-1990)*	
		Yes	No
Subjective assessment of change (1991)	Yes	++	+-
	No	-+	--

*in this case 'change' has been measured as a dichotomous variable.

Finally the relationship between an individual's stated intention to change their diet (derived from the 1990 dataset) and whether or not there was objective change (derived from comparing the two Food Frequency Checklists) can be explored as described in Figure 3.

Figure 3

		Objective measure of change (1991-1990)*	
		Yes	No
Stated intention to change diet (1990)	Yes	++	+-
	No	-+	--

*in this case 'change' has been measured as a dichotomous variable.

PLANNED ANALYSES AND THE IMPORTANCE OF THE LEVEL OF ANALYSIS

An accurate assessment of dietary change is critical to the above analyses. But it is not always realised that the phenomena of dietary changes can be defined and therefore analysed at many different levels.

At the micro level I could chose to define dietary change as the difference in the number of grams of fat or fibre being consumed for each individual, or for the sample as a whole. However as I am concerned with changes in food-related behaviour, I am interested in analysing the data at a more macro level.

For example I could chose to look at the differences in consumption patterns of *individual* foods (eg bacon, steak, fried eggs), or in the differences in consumption of food *groups* (eg all dairy foods, meat and meat products). I have also given thought to constructing an overall global *fat score* that would summarise the entire Food Frequency Checklist, and examine differences in this score over time.

Finally I also want to examine dietary change in terms of the number and type of food *substitutions* that occur when an individual modifies their own diet. For example individuals may reduce the amount of high fat milk they drink while concomitantly increasing the amount of low-fat milk they consume; they may eat more vegetables or grains instead of meat. However they may also inadvertently eat more chips, chocolates or biscuits as an consequence of eating less meat, and I want to explore these additional forms of indirect substitutions as well.

THE PROBLEM OF INHERENT DAY-TO-DAY VARIABILITY IN HUMAN DIETARY CONSUMPTION PATTERNS

In order to carry out any of the analyses cited above it is necessary to be sure that the difference observed when comparing consumption

patterns over time is not due solely to within or between-person variability.

A reliability study was carried out amongst 29 University students in an attempt to determine the degree of within and between person variability for the foods and food groups covered in the Food Frequency Checklist. Results were analysed using repeated measures ANOVA on SPSS-X [1].

Because of the small sample size (N=29) and the relative unrepresentativeness of the sample (predominantly female university students aged between 20 to 24 years), a second reliability study has been carried out amongst a random sample of the general population, but has not yet been analysed.

A summary of selected results for some of the food groups is shown in Table 1.

Table 1 - Between and Within Person Variability for selected Food Groups

Food Group	Between person variability	Within person variability
Meat#1	874.56	127.58
Chicken	110.89	34.17
Fish	51.73	5.46
Take-away	54.30	12.68
Cereal	233.31	119.19
Eggs	77.01	11.85
Dairy	1656.46	785.71
Cakes	54.73	35.80
Biscuits	1012.69	204.04

While in all cases the between-person variance is greater than the within-person variance there are clearly differences for different food groups.

There is also the possibility that this variability could be different for different population subgroups, but this hypothesis cannot be tested until the results of the general population reliability study are available.

PROBLEMS ASSOCIATED WITH STUDYING DIETARY CHANGE IN A LONGITUDINAL STUDY

The preceding sections have sought to provide a basis for understanding some of the complexity of food related behaviour and some of the problems associated with examining changes in that behaviour over time.

1. In common with all longitudinal studies there will be problems with missing and incomplete data. Should these cases be excluded from the analyses or included using some mean value derived from the analyses?

2. There will also be problems with outliers which are not uncommon in dietary consumption studies. However as dietary consumption practices are so individualistic and varied, it is often much harder to know when a value is extreme, but still possible, compared to a value that is totally impossible. For example, although you and I may eat between 2 to 4 slices of bread a day, some individuals do eat a loaf of bread a day, and it is still *possible* that someone may eat 60 slices a day. Do we accept *all* values or have some point at which we exclude cases? To what degree do we bias the results if we either exclude or include these cases? Should we view all their food frequency answers as potentially "corrupt", or only the outlying ones?

There are some problems however that are potentially of more significance in studies of dietary change compared to other studies - particularly when the dietary studies are concerned with examining change in terms of the *foods* rather than the amount of individual *nutrients* consumed:

3. Dietary consumption patterns, when examined in terms of individual foods or food groups are not usually normally distributed. As people may frequently *not* eat particular foods, there are often a number of valid zero values. In this situation it is *not* appropriate to

logarithmically transform the data in order to normalise its distribution, a procedure not uncommonly employed to normalise patterns of *nutrient* consumption (which do not have the problem of zero values). Yet at present, the only programs I am aware of that deal with repeated measures all assume the data to be normally distributed. Is it appropriate to assume that the repeated measures ANOVA model will be robust enough to cope with the skewed distribution so pronounced in food consumption studies?

4. Assuming that the repeated measures ANOVA model is capable of handling the data, and having ascertained the within and between-person variance for different foods, should I in some way "correct" any difference I observe in the food consumption patterns over the 12 month period to take into account this within person variability? This "correction factor" if required would need to be different not only for different foods and food groups but also potentially for different population subgroups.

5. Finally, in dietary consumption studies, it is not uncommon to have a high degree of inter-correlation between variables. For example people often eat fish *and* chips, bread *and* butter or meat *and* vegetables. In order to examine food substitutions, first should I take into account the within and between person variability and second, how do I best differentiate between true substitutions between foods and the confounding factor of the high level of inter-correlation between foods?

6. Furthermore, the issue of both direct and indirect food substitution presupposes an interdependence across time between one food with one or several others. For example an individual may seek to decrease their consumption of full fat milk solely by consuming more low fat milk. However they may also seek to do this by additionally increasing their consumption of skim and sour milk. How would I best incorporate this type of consumption behaviour into my analyses?

CONCLUDING COMMENTS

In the introduction to this paper I stated that its aim was to highlight some of the difficulties associated with examining complex human behaviours in longitudinal studies.

I have not been bold enough to presume I know all of the answers to the questions I have asked, nor naive enough to expect that an answer can be found that is suitable for all cases and all circumstances. If the paper serves to stimulate some thought and discussion on the issues raised then I will be happy enough that its aim has been achieved.

REFERENCES

[1] SPSS-X Inc (1986). SPSS-X Users Guide (2nd Edition). McGraw-Hill Book Company. New York.

National Centre for Epidemiology and Population Health
The Australian National University
GPO Box 4
ACT 2601
Australia