

**Impacts of Individual/Household Socio-Economic  
Conditions and Area Environment on Health in Australia,  
Using Five-Wave Panel Data of HILDA Surveys**

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A paper presented at the 2007 HILDA Survey Research Conference,  
University of Melbourne, Melbourne, Australia

## Abstract

**Purpose:** This paper uses 5-year longitudinal data to study impacts of changes in individual's socio-economic condition and the area living environment on personal health status in Australia.

**Data and methods:** This study uses five waves (from 2001 to 2005) of yearly panel survey data of HILDA to study the above research questions. Two-stage random effect panel estimations are performed on 19 regression models. These models are applied to eight specific health dimensions and a total health score (adding the scores of eight health dimensions). The explanatory variables are individual demographic characteristics, individual/household socio-economic conditions and the area environment an individual/household has been living from 2001 to 2005.

**Results:** Firstly, last year's health condition is highly associated with this year's health condition. Secondly, aging produces a negative impact on physical health for both aboriginal and non-aboriginal Australians, but it produces a positive impact on mental health for non-aboriginal Australians. Thirdly, personal annual income is insignificant in this panel analysis, after the correction of endogeneity problem (by the 2-stage panel estimation process) due to mutually reinforcing each other between income and health. Fourthly, for most of the dimensions of personal health, most of the individual-level demographic or socio-economic variables (such as age, gender, income, working status and dwelling condition) don't have a significant impact on the health of aboriginal Australians. A significant factor to aboriginal Australians' health is at the level of state, i.e., aboriginal Australians living in Victoria reported having better health than aboriginal Australians living in most of other states. Such inequality of health between states does not exist among non-aboriginal Australians. Finally, the cases living in Northern Territory was automatically dropped

from the multi-variate longitudinal analysis due to the total number of good-quality aboriginal cases in Northern Territory being too small. Thus, it is necessary to draw an over representative sample for aboriginal Australians, especially for aboriginal Australians living in Northern Territory in future HILDA surveys so that further meaningful analysis regarding aboriginals' health can be studied.

## **Introduction**

In addition to human's biological factors, health is a result of interaction of individual's micro-level socio-economic factors and area - environmental factors. Studies show that individual's socio-economic factors (particularly employment status, income and wealth) are key factors in determining personal health. Individuals with better socio-economic condition tend to have better nutrition and are more affordable with health care, leading to better health (Chirikos, 1993; Pickett and Pearl, 2001; Philip, Clarke and Ryan, 2006; Cai and Kalb, 2006). Studies also find that the wider living environment in an area impacts on individual health status. That is, people's health geography matters. People living in an environment which has clean water, clean air, easy access to health care, or even easy access to the space or facilities for exercising, may also lead to a better health (Cutchin, 2006; DeChello and Sheehan, 2007; Rodriguez, et al., 2007).

However, most previous research in economics, health care or other social sciences has been the reliance on cross-sectional survey data. Cross-sectional data provides point-in-time snapshots but cannot tell us about the change occurring within the same individuals over time. This study aims to use longitudinal data of Household Income and Labour Dynamics in Australia (HILDA) to further explore how the individual socio-economic conditions and the area-level condition and impact on Australians' health status. The five-wave HILDA data are particularly valuable in terms of being the first Australian nation-wide representative longitudinal panel data. This paper thus can use this data set to investigate whether individual's health being varies by different areas/states across the five waves of surveys.

This study has important policy implication because its findings can help policy makers to decide the priorities in allocating limited public resources between

different areas or states. This study can also examine whether using 5-year longitudinal data can provide further elaboration on the relationship between individual socio-economic condition and its health well being.

## **Data and methods**

### ***Data***

This study uses five waves (i.e., from 2001 to 2005) yearly panel survey data of Household Income and Labour Dynamics in Australia (HILDA) to study the above research questions. HILDA is Australian's first large-scale nation-wide representative household panel survey. The first wave of HILD survey started in 2001 and continued each year since then.

The first wave of HILDA survey has randomly selected 11,693 households nation-wide in Australia. Among those households, all of the individual household members were interviewed. At the end of wave 1 survey, 6,872 households had fully responded (i.e., all household members in the households responded) and 810 households partially responded (i.e., at least one member in the household responded). In total, 7,682 households had responded and the response rate of all the households selected was 66%. Within the 7,682 households interviewed, there were 15,127 eligible adults and 13,969 had completed interviews. The person-level (completed Person Questionnaire) response rate was 92.3%. Additionally, 13,159 of the 13,969 persons (94%) had completed and returned the Self-Completion Questionnaire. The responding sample was slightly under-represented for residents of Sydney, men, unmarried persons, and immigrants from a non-English-speaking background. Although the non-response was not totally random, the size of these discrepancies was not large enough to seriously discredit the representation of the HILDA data (Watson

and Wooden, 2002). Detailed description of the sampling methods used in HILDA survey and assessment of the quality of HILDA data can be referred to Butterworth and Crosier (2004), and Clarke and Ryan (2006).

The content of HILDA includes the following household and the individual level information: household composition, dwelling characteristics, child care, housing/household finances, person's country of birth and language, family background, education, employment history and status, persons in paid employment and not in paid employment, income, family formation, parenting, life situation, interview situation, general health and well-being, lifestyle and living situation, personal and household finances, attitudes and values about work and gender roles, and job/workplace. HILDA is especially valuable for research in sociology, economics, and health care.

However, attrition is a potential factor affecting the representativeness of panel data across time. Fortunately, HILDA has low attrition rates between the five waves from 2001 to 2005. There were 10,392 same individuals interviewed in the wave of 2005, which was 74.4% of the 13,969 individuals interviewed in 2001.

### ***Sample selection***

Due to one of the purposes of this study is to examine the environmental impact of a specific location on individuals' health in Australia, this paper has conducted statistical analysis among individuals who were born in Australia and had not changed their residential places during 2001 to 2005.

### ***The Model:***

#### 1. Dependent variables:

The outcome variables of this study are the self-reported SF-36 measurements of health status. There are eight specific dimensions: physical function, social function,

mental health, general health, bodily pain, vitality, role-physical and role-emotional. The dimension of 'physical function' includes questions such as being able to lift or carry groceries, climb flights of stairs, walk for a certain distance etc. The dimension of 'social function' includes questions such as 'to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours or groups?' The dimension of 'mental health' includes questions such as whether the respondents has felt calm and peaceful, or felt down. General health includes questions such as 'I am as healthy as anybody I know' and 'I expect my health to get worse'. The dimension of 'bodily pain' includes questions such as 'how much bodily pain had you have during the past 4 weeks', 'how much did pain interfere with your normal work'. The dimension of 'vitality' includes questions such as 'did you feel full of life?', 'Did you have a lot of energy?' The 'role-physical' dimension includes questions such as whether the respondent 'cutdown the amount of time you spent on work' or 'accomplished less than you would like' due to his/her physical condition. The 'role-emotional' dimension includes questions such as whether the respondent 'cutdown the amount of time you spent on work' or 'didn't do work or other activities as carefully as usual' due to his/her emotional condition.

SF-36 is well developed and is one of the most widely used personal health measurement tools around the world. SF-36 in HILDA has demonstrated convergent and divergent validity through the principle components analysis (Butterworth and Crosier, 2004). SF-36 in the HILDA has also been found to be reasonably reliable in terms of a high level of consistency in data collected by the same SF-36 questions for the 1995 Australian National Health Survey (NHS) and for the 2001 HILDA survey (Clarke and Ryan, 2006). Another outcome variable of an individual's overall health condition is a total health score constructed by adding scores of all the eight health

dimensions. As a result, there are nine health outcome variables examined in this study.

## 2. Independent variables:

This study has three sets of independent variables developed from the review of literature and available data in HILDA. These independent variables indicate personal demographic characteristics, individual or household socio-economic conditions, and the area an individual or household lives. These variables are defined as below.

### 1) *Personal demographic characteristics*, including

- a. Age
- b. Gender: a dummy variable – male (female is the base of comparison)
- c. Ethnicity: a dummy variable (non-aboriginal Australian is the base of comparison)
- c. Pre-existing health status: health score of last year (the higher score the healthier)

### 2) *Individual/household socio-economic conditions*, including

- a. Working status, including being employed, unemployed, or not in labour force in the last four weeks (not to look for work due to disability, retirement, study, child care etc). There are two dummy variables, i.e., ‘being unemployed’ and ‘not in labour force’, and for both dummy variables, ‘being employed’ is the base of comparison.
- b. Personal income: last financial year gross wages and salary
- c. Number of bed rooms: an indicator of the size of dwelling
- d. Physical condition of dwelling (judged by the interviewer): being recoded as the higher the score, the better the physical condition of the house



e. Household weekly grocery expenditures: an indicator of the level of household living expenses

f. Household weekly expenditures of meals eating outside: an indicator of the level of household wealth

3) *Area environment condition*, including

- a. State of residency: seven dummy variables – New South Wales, Queensland, South Australia, West Australia , Tasmania , Northern Territory, Australian Capital Territory (Victoria is the base of comparison).
- b. Remoteness in the state: four level of remoteness defined by the size of population. There are dummy variables: ‘other-urban’, ‘bounded-locality’, ‘rural-balance’ (major urban is the base of comparison)

3. Comparing aboriginal and non-aboriginal Australians:

In order to understand the specific impacts of socio-economic and area environment factors on aboriginal Australians versus non-Australian, statistical modelling are conducted separately for aboriginal Australians, and non-aboriginal Australians.

4. Method of estimation:

In order to account for possible cross-section heteroskedasticity and time-wise autocorrelation when conducting econometric analysis with panel data, panel-corrected standard errors are used in analysis by employing STATA econometrics software version 9. A random-effect model is employed because it allows the variability of beta coefficient of each geographic location, thus is suitable to explore the effect of the changes of the quality of area living environment on people’s health overtime.

5. The generic model

The generic model is specified as below:

$$Y_{it} = \alpha_{it} + \beta X_{it} + \theta Q_{IT} v_{it}$$

Where  $Y_{it}$  is the self reported health score of  $i^{\text{th}}$  respondent in year (wave)  $t$

$\alpha_{it}$  is the intercept of  $i^{\text{th}}$  respondent in year (wave)  $t$

$\beta$  is the coefficient of  $X_{it}$

$X_{it}$  is a vector of independent (explanatory) variables of  $i^{\text{th}}$  respondent in year (wave)  $t$

$\theta$  is the coefficient of  $Q_{it}$

$Q_{it}$  is a vector of interaction terms of wave and socio-economic factors or regional factors of  $i^{\text{th}}$  respondent in year (wave)  $t$

$v_{it}$  is the random error of  $i^{\text{th}}$  respondent in year (wave)  $t$

Better socio-economic condition of individuals is likely associated with better health, which results in more work capacity, productivity and income. Health and personal income are likely to reinforce each other, causing endogeneity in specifying the regression model. Therefore, this study uses an instrumental variable 2-stage estimation procedure, i.e., the personal income is instrumented in the model using observed values. At the second stage, the predicted value of personal income is used to replace the observed value for estimation.

6. The specific models are as the following

1). Model 1~8 (and Model 9~16): Aboriginal (and Non-Aboriginal) Australian panel estimation

$$\begin{aligned} \text{Derived Health Score}_{ij} = & \alpha_{ij} + \beta_{1ij} \text{Age} + \beta_{2ij} \text{Male} + \beta_{3ij} \text{Unemployed} + \beta_{4ij} \\ & \text{NotInLabourforce} + \beta_{5ij} \text{annual wages and salary} + \beta_{6ij} \text{BedRooms} + \\ & \beta_{7ij} \text{HouseCondition} + \beta_{8ij} \text{LastYearHealthScore} + \beta_{9ij} \\ & \text{GroceryExpense} + \beta_{10ij} \text{EatOutExpense} + \beta_{11ij} \text{NSW} + \beta_{12ij} \text{QLD} + \\ & \beta_{13ij} \text{SA} + \beta_{14ij} \text{WA} + \beta_{15ij} \text{TAS} + \beta_{16ij} \text{NT} + \beta_{17ij} \text{ACT} + \beta_{18ij} \end{aligned}$$

$$OtherUrban + \beta_{19ij} BoundLocal + \beta_{20ij} RuraBalancel + \varepsilon_{ij}$$

$$Annual\ wages\ and\ salary_{ij} = \alpha_{ij} + \beta_{1ij} Age + \beta_{2ij} Male + \beta_{3ij} Unemployed + \beta_{4ij} \\ NotInLabourforce + \beta_{5ij} Derived\ Health\ Score + \varepsilon_{ij}$$

Where dependent variables for Aboriginal Australians are derived health scores of: Bodily Pain (model 1), Physical Function (model 2), Social Function (model 3), Mental Health (model 4), General Health (model 5), Role-Physical (model 6), Role-Emotional (model 7), Vitality (model 8); annual wages and salary is instrumented in the second equation which is explained by health score and other related variables.

Where dependent variables for Non-Aboriginal Australians (model 9 to 16) are the same as those of Aboriginal (model 1 to 8)

Where independent variables include:

1. Personal characteristics: age and male (a dummy variable, female is the base of comparison)
2. Working status: being unemployed and not in labour force (dummy variables, being employed is the base of comparison)
3. Wealth: household income band, the number of bed rooms, physical condition of dwelling, household weekly grocery expenditures, household expenditures of meals eating outside.
4. Pre-existing health status: health score of last year

2) Model 17: All sample panel estimation

$$Total\ Health\ Score_{ij} = \alpha_{ij} + \beta_{1ij} Aboriginal + \beta_{2ij} Age + \beta_{3ij} Male + \beta_{4ij} \\ Unemployed + \beta_{5ij} NotInLabourforce + \beta_{6ij} Annual\ wages\ and\ salary + \\ \beta_{7ij} BedRooms + \beta_{8ij} HouseCondition + \beta_{9ij} LastYearHealthScore +$$

$$\begin{aligned}
& \beta_{10ij} \text{ GroceryExpense} + \beta_{11ij} \text{ EatOutExpense} + \beta_{12ij} \text{ NSW} + \beta_{13ij} \text{ QLD} \\
& + \beta_{14ij} \text{ SA} + \beta_{15ij} \text{ WA} + \beta_{16ij} \text{ TAS} + \beta_{17ij} \text{ NT} + \beta_{18ij} \text{ ACT} + \beta_{19ij} \\
& \text{OtherUrban} + \beta_{20ij} \text{ BoundLocal} + \beta_{21ij} \text{ RuraBalancel} + \varepsilon_{ij} \\
\text{Annual wages and salary}_{ij} = & \alpha_{ij} + \beta_{1ij} \text{ Age} + \beta_{2ij} \text{ Male} + \beta_{3ij} \text{ Unemployed} + \beta_{4ij} \\
& \text{NotInLabourforce} + \beta_{5ij} \text{ Derived Health Score} + \varepsilon_{ij}
\end{aligned}$$

Where total health score is the sum of the eight derived scores; annual wages and salary is instrumented in the second equation which is explained by health score and other related variables.

Where independent variables are the same as Model 1 to 16, with one additional independent dummy variable Aboriginal (non-aboriginal Australian is the base of comparison)

3) Model 18 (and Model 19): Aboriginal (and Non-Aboriginal) Australian

$$\begin{aligned}
\text{Total Health Score}_{ij} = & \alpha_{ij} + \beta_{2ij} \text{ Age} + \beta_{2ij} \text{ Male} + \beta_{3ij} \text{ Unemployed} + \beta_{4ij} \\
& \text{NotInLabourforce} + \beta_{5ij} \text{ Annual wages and salary} + \beta_{6ij} \text{ BedRooms} + \\
& \beta_{7ij} \text{ HouseCondition} + \beta_{8ij} \text{ LastYearHealthScore} + \beta_{9ij} \\
& \text{GroceryExpense} + \beta_{10ij} \text{ EatOutExpense} + \beta_{11ij} \text{ NSW} + \beta_{12ij} \text{ QLD} + \\
& \beta_{13ij} \text{ SA} + \beta_{14ij} \text{ WA} + \beta_{15ij} \text{ TAS} + \beta_{16ij} \text{ NT} + \beta_{17ij} \text{ ACT} + \beta_{18ij} \\
& \text{OtherUrban} + \beta_{19ij} \text{ BoundLocal} + \beta_{20ij} \text{ RuralBalance} + \varepsilon_{ij} \\
\text{Annual wages and salary}_{ij} = & \alpha_{ij} + \beta_{1ij} \text{ Age} + \beta_{2ij} \text{ Male} + \beta_{3ij} \text{ Unemployed} + \\
& \beta_{4ij} \text{ NotInLabourforce} + \beta_{5ij} \text{ Derived Health Score} + \varepsilon_{ij}
\end{aligned}$$

Where dependent variable is the same as Model 17; annual wages and salary is instrumented in the second equation which is explained by health score and other related variables.

Where independent variables are the same as those in Model 1 to 16.

## 7. Data selection:

To ensure validity and reliability of the data, only those who were judged by the interviewers as understanding well the survey questions and showing no suspicious about the survey were included in the analysis. Also, cases with invalid value in their answers of related variables were excluded (e.g., income or health scores less than zero).

### **Results of 2-Stage Panel Estimation:**

This section will present the results of 2-stage panel estimation separately for aboriginal versus non-aboriginal Australians. Given the majority of the cases are non-aboriginal Australians (9985 out of 10130 observations); the results of modelling of the whole sample are very similar to those of non-aboriginal Australians. It will be redundant to present the results of whole sample after the results of non-aboriginal Australians have already been presented. I will also present the overall contrasts in explanatory factors in explaining variation regarding aboriginal versus non-aboriginal Australians' health.

#### ***Aboriginal Australians***

Table 1 presents the results of panel estimation of all eight derived individual health scores and total health score (the sum of the eight individual health scores) of aboriginal Australians. The individual derived health scores explained by the random effect model vary from 17% to 38%, with the dimension of 'vitality' (38%) the highest and the 'bodily pain' and 'role-physical' dimensions (17%) the lowest. According to literature, the r-squares of regression models based on cross-sectional survey data tend to be low in general, around 0.01 (1%) to 0.2 (20%). Therefore, this

model based on the five-waves of HILDA panel data is quite powerful by identifying factors to explain variation of aboriginal Australians' health conditions.

Comparing with r-squares in models using derived health scores in specific health dimensions as dependent variables, the models using the total health score as the dependent variable have produced the highest r-squares. As presented in Table 1, the overall r-square is as high as 0.46 (46%). Among those significant explanatory variables, the higher the last year health score, the higher the total health score. Compared to aboriginal Australians living in Victoria, aboriginal Australians living in other states have lower total health scores. The respective  $\beta$  coefficients across these states are listed as the following and the order of the listing is from the state with the worst impact on aboriginals' health relative to impact of the state of Victoria: Australian Capital Territory ( $\beta=-97.72$ ), West Australia ( $\beta=-82.11$ ), Queensland ( $\beta=-76.25$ ), South Australia ( $\beta=-76.25$ ), and New South Wales ( $\beta=-71.74$ ). This reveals the state where aboriginal Australians live has detectable differential impacts on aboriginal Australians' overall health. Table 1 also shows that personal characteristics (such as age and gender), and individual socio-economic factors (such as employment status and income) make no significant difference in overall health among aboriginal Australians.

When modelling using itemised/specific health dimensions as dependent variables, overall, the r-squares are still quite high (from 17% to 38%) as mentioned before. The significant explanatory variables are different across models with different health dimensions. The only explanatory variable that is consistently significant across all health dimensions is the health score of last year, i.e., a person's health status this year is highly predictable by his/her health status last year.

Table 1 presents what and the level of strength in terms of certain explanatory variables significantly impacting on each of the eight health dimensions. In addition to the universal impact of person's health status last year to this year's health, other significant explanatory variables for specific relevant health dimensions are: age affecting physical function; the state where the respondent lives affecting social function, mental health and general health; the remoteness of living location in a specific state affecting the role-physical and role-emotional dimensions. Gender and employment status also affect the role-emotional dimension.

### *Non-Aboriginal Australians*

Table 2 presents the results of panel estimation of all eight derived individual health scores and total health score for non-aboriginal Australians. The variation explained by the regression models varies in a range of 9% to 32%. The model produces the highest R square for explaining general health dimension and the lowest for explaining the role-emotional dimension. Just as a person's last year health is strongly related to this year health for aboriginal Australians, the health score of last year is also highly significant in predicting all health dimensions for non-Australians.

Most health dimensions of non-aboriginal Australians can be explained by personal demographic characteristics, employment status and physical condition of dwelling, rather than the state where they live. Specifically, age negatively affects bodily pain, general health, physical function, and role-physical, and positively associated with mental health, vitality, social function and the role-emotional dimension. Compared to females, males reported worse health scores in general health but better self-reported health in mental health, social function, vitality and the role-emotional dimension

A better physical condition of dwelling is associated with less bodily pain as well as better general health, mental health, social function, vitality and the role-emotional dimension. The state of residency and remoteness of its locality affect bodily pain. The remoteness of locality significantly affects mental health, vitality and the role-emotional dimension.

### ***Overall contrasts between results of aboriginal and non-aboriginal Australians***

As mentioned before, for both aboriginal and non-aboriginal Australians, last year health significantly impact on all eight specific health dimensions. Regarding each specific health dimension other than the common determinant of last year health, other significant explanatory factors differ between aboriginal and non-aboriginal Australians as summarised in Table 3.

For the physically related dimensions (i.e., physical function, role physical and bodily pain), age has negative impacts on health, especially for non-aboriginal Australians. Not being in labour force only produces significant negative impact on physical function for non-aboriginal Australians. This relation may imply that physical disability or retirement due to aging result in non-aboriginal Australians' not being able to be in the labour force in the first place. There might be non-physical related reasons for aboriginal Australians' not looking for work in the past four weeks. These reasons might be child care, lacking of transportation, having difficulties with reading, writing or cultural background, welfare payment might be affected, etc.

The remoteness of residency affects aboriginal and non-aboriginal Australians' physical related dimensions in different ways. For aboriginal Australians, compared to living in a major urban area, living in an 'other urban' and 'bounded local' environment creates positive impact on the physical capacities of doing things



while living in a rural area has negative impact, but only the strength of such impact of living in ‘bounded locality’) is statistically significant for aboriginals. For non-aboriginal Australians, compared to living in a major urban area, only living in ‘other urban’ area has better ‘role-physical’ dimension, while living in smaller environment creates a negative impact, but overall such an impact of ‘remoteness’ on the ‘role-physical’ dimension is not statistically significant.

For the dimension of bodily pain, the patterns between aboriginal Australians and non-aboriginal Australians are very different. The only variable that is significant for explaining bodily pain of aboriginals is the level of bodily pain last year. For non-aboriginal Australians, household wealth, remoteness of locality and aging all impact on bodily pain. Specifically, better physical condition of dwelling is associated with less bodily pain. Old people living in Queensland and West Australia (compared with living in Victoria), and living in other urban and rural areas (compared with living in major urban), are associated with more bodily pain.

Regarding the dimensions relating to respondents’ mental state (mental health, social function, vitality and the role-emotional dimension), there are different explanatory factors for aboriginal and non-aboriginal Australians. For aboriginals, only the state of residency matters. Aboriginals living in ACT reported a significantly worse mental condition, while living in SA, WA and ACT creates a negative impact on the dimension of social function. For non-aboriginal Australians, being older, being a male, better physical condition of dwelling, and living in an urban area (other than the major urban areas) reported having better mental health, vitality, social function and emotional capacity.

Finally, working status only makes a significant impact on the dimension of ‘vitality’ to aboriginal and non-aboriginal Australians’ mental well being and the

impacts are in opposite ways between the two groups. Compared to being employed, unemployed aboriginal Australians tend to cut down more activity due to emotional difficulty. In other words, being employed aboriginals have a better emotional capacity to do things. It is also possible that aboriginals having a stronger emotional capacity would be more likely to be employed in the first place. In contrast, among non-aboriginal Australians, those who were un-employed or not in the work force were more likely to report better 'vitality' in terms of 'feeling full of life' than those who currently employed. This may imply that the employed non-aboriginal Australians felt somewhat 'worn out'.

For the dimension of general health, for both aboriginal and non-aboriginal Australians, the level of general health last year is significantly related to this year's general health, but the impacts of other explanatory factors differ between the two groups. For aboriginal Australians, none of other explanatory variables create a significant impact on the level of general health except living in ACT does have a significant worse impact on general health. For non-aboriginal Australians, age, gender and physical condition of dwelling all impacts on general health. Older age and male are associated with worse general health. Better physical condition of dwelling is associated with better general health. .

## **Conclusions and Discussions**

The purpose of this study is to explore the impact of changes in individual's socio-economic conditions as well as the living environment of the geographic area on personal health status among the same individuals across a period of time among in Australians by using five-year longitudinal data. Previous studies could not answer the above question due to the limit of using cross-sectional data. Based on the analysis

of panel data by observing the same individuals in the locality overtime, this study has several major findings. I will discuss the implications and some of the limitations of these findings. Firstly, last year's health condition is highly associated with this year's health condition. Incorporating this 'obvious' variable in all of my models is for the sake of 'control', i.e., when the impact of last year's health condition is controlled, the impacts of other independent variables can be specified.

Secondly, aging produces a negative impact on physical health for both aboriginal and non-aboriginal Australians, but it produces a positive impact on mental health for non-aboriginal Australians. It implies that older people who may be less healthy in a physical sense for any human being, but have a better emotional being due to getting wiser or at a later life stage where having less stress due to employment or raising children etc. But aging doesn't significantly impact on aboriginals' mental well being. It may imply that the support from kinship and wider community structure could make a difference for people who are at the age (or life stage) of raising child or employment. Thus, for health planning and policy making, these findings can provide insights for dealing with different needs of aboriginal and non-aboriginal Australians.

Thirdly, personal annual income usually is found to be positively associated with individual's health in cross-sectional studies, but it is insignificant in this panel analysis, after the correction of endogeneity problem (by the 2-stage panel estimation process) due to mutually reinforcing each other between income and health. There are two possible explanations.

The first explanation is that the changes in income and health status of a particular individual may be too small during the five-year time, thus the relationship between income and health cannot be shown. This explanation can be verified when more waves of panel data across longer period of time are available in the future.

The second explanation is that perhaps the overall level of a household's wealth is more important than personal income in predicting individual health. This is supported by the finding of this study in terms of the physical condition of dwelling (rather than personal income) is significantly related to personal health. The physical condition of dwelling is actually an aggregate indicator of the wealth of the household and the quality of a most intimate and daily living environment of the person. This finding is consistent with the findings of Heady and Wooden (2004) using the second wave of HILDA data.

The fourth major finding is regarding a unique health pattern among aboriginal Australians. For most of the dimensions of personal health, most of the individual-level demographic or socio-economic variables (such as age, gender, income, working status and dwelling condition) don't have a significant impact on the health of aboriginal Australians. A significant factor to aboriginal Australians' health is actually at the level of state, i.e., aboriginal Australians living in Victoria reported having better health than aboriginal Australians living in most of other states. Such inequality of health between states does not exist among non-aboriginal Australians. This finding implies that the quality of wider living environment of aboriginal Australians varies between states. It is worthwhile for future HILDA surveys to collect relevant data on health care resources and utilisation and investigate what specific aspects of such wider environment in an area (or state) affecting aboriginals' health. Those aspects of environment can be enhanced by appropriate public policy and adequate government intervention.

Finally, the cases living in Northern Territory was automatically dropped from the multi-variate longitudinal analysis due to the total number of good-quality aboriginal cases in Northern Territory being too small. Thus, it is necessary to draw

an over representative sample for aboriginal Australians, especially for aboriginal Australians living in Northern Territory in future HILDA surveys so that further meaningful analysis regarding aboriginals' health can be conducted.

## References

- Adam, M.L., and Flatau, P., "Job insecurity and mental health outcomes: an analysis using waves 1 and 2 of HILDA", *Economic and Labour Relations Review*, 2006, September, 17:143-70.
- Butterworth, P., and Crosier, T., "The validity of the SF-36 in an Australian National Household Survey: demonstrating the applicability of the Household Income and Labour Dynamics in Australia (HILDA) Survey to examination of health inequalities", *BMC Public Health*, 2004, 4:44 (<http://www.biomedcentral.com/1471-2458/4/44>).
- Butterworth, P., Rogers, B., and Jorm, A.F., "Examining geographic and household variation in mental health in Australia", *Australian and New Zealand Journal of Psychiatry*, 2006, May, 40:491-7.
- Cai, L., and Kalb, K., "Health status and labour participation: evidence from the HILDA data", *Health Economics*, 2006, September, 82:298-314.
- Chandola, T., Clarke, P., Wiggins, R.D., and Bartley, M., "Who you live with and where you live: setting the context for health using multiple membership multilevel models", *Journal of Epidemiology and Community Health*, 2005, 59:170-5.
- Clarke, P.M., and Ryan, C., "Self-reported health: reliability and consequences for health inequality measurement", *Health Economics*, 2006, June, 15(6): 645-52.
- Cutchin, M.P., "The need for the "new health geography" in epidemiologic studies of environment and health", *Health and Place*, 2007, 13:725-42.
- DeChello, L.M., and Sheehan, T.J., "Spatial analysis of colorectal cancer incidence and proportion of late-stage in Massachusetts: 1995-1998", *International Journal of Health Geographics*, 2007, 6:20 (<http://www.ij-healthgeographics.com/content/6/1/20>).
- Maantay, J., "Asthma and air pollution in the Bronx: methodological and data considerations in using GIS for environmental justice and health research", *Health and Place*, 2007, 3:32-56.
- Reeves, W.C., Jones, J.F., Maloney, E., Heim, C., Hoaglin, D.C., Boneva, R.S., Morrissey, M., and Devlin, R., "Prevalence of chronic fatigue syndrome in metropolitan, urban, and rural Georgia", *Population Health Metrics*, 2007, 5:5 (<http://www.pophealthmetrics.com/content/5/1/5>).
- Rodriguez, R.A., Sen, S., Mehta, K., Moody-Ayers, S., Bacchetti, P., and O'Hare, A.M., "Geography matters: relationships among urban residential segregation, dialysis facilities, and patient outcomes", *Annals of Internal Medicine*, 2007, 146:493-501.
- Watson, N., and Wooden, M., "Modelling longitudinal survey responses: the experience of the HILDA survey", A paper presented at the ACSPRI Social Science Methodology Conference, University of Sydney, Sydney, Australia, 10-13 December 2006.

Watson, N., and Wooden, M., "The HILDA survey: what's in it for economists?", *Australian Journal of Labour Economics*, 2002, September, 5(3):397-417.

Table 1. Impacts of Social-Economic and Environmental Factors on Health of Aboriginal Australian, 2-Stage Random Effect Panel Estimations Using Five Waves (2001~2005) HILDA Survey Data

| HealthScore<br>Independent<br>Variables | 1. Physical<br>Function<br>$\beta$ (p value) | 2. Role-<br>Physical<br>$\beta$ (p value) | 3. Bodily Pain<br>$\beta$ (p value) | 4. General<br>Health<br>$\beta$ (p value) | 5. Mental<br>Health<br>$\beta$ (p value) | 6. Social<br>Function<br>$\beta$ (p value) | 7. Role-<br>Emotional<br>$\beta$ (p value) | 8. Vitality<br>$\beta$ (p value) | 9. Total<br>$\beta$ (p value) |
|---|--|---|-------------------------------------|---|--|--|--|----------------------------------|-------------------------------|
| <i>Male</i>                             |  |   |                                     |   |  |  | <i>0.97 (0.01)*</i>                        |                                  |                               |
| <i>Unemployed</i>                       |  |   |                                     |   |  |  | <i>-19.016<br/>(0.01)*</i>                 |                                  |                               |
| <i>Age</i>                              | <i>-0.20(0.01)*</i>                          |   |                                     |   |  |  |  |                                  |                               |
| Last Year<br>Health Score               | 0.05 (0.00)**                                | 0.04 (0.03)*                              | 0.06 (0.01)*                        | 0.06 (0.00)**                             | 0.06 (0.00)**                            | 0.08 (0.00)**                              | 0.06 (0.00)**                              | 0.06 (0.00)**                    | 0.51 (0.00)**                 |
| NSW                                     |  |   |                                     |   |  |  |  |                                  | -56.54 (0.04)*                |
| QLD                                     |  |   |                                     |   |  |  |  |                                  | -76.25 (0.01)*                |
| SA                                      |  |   |                                     |   |  |  |  |                                  | -16.20(0.02)*                 |
| WA                                      |  |   |                                     |   |  |  |  |                                  | -18.20 (0.02)*                |
| ACT                                     |  |   |                                     |   |  |  |  |                                  | -13.94 (0.04)*                |
| BoundedLocality                         |  |   |                                     |   |  |  |  |                                  | -12.41(0.04)*                 |
|   |  | 12.68 (0.04)*                             |                                     |   |  |  |  |                                  | -22.07 (0.02)*                |
|   |  |   |                                     |   |  |  |  |                                  | -21.08 (0.05)*                |
| Overall R-<br>Squared                   | 0.33   | 0.17                                      | 0.17                                | 0.25                                      | 0.35                                     | 0.25                                       | 0.25                                       | 0.38                             | 0.46                          |

Note: 1. N=146; 2. Only significant coefficients are presented.; 3. Italic variables and coefficients are also estimated in the second stage estimation; 4. \*: p<0.05, \*\*: p<0.01



Table 2. Impacts of Social-Economic and Environmental Factors on Health of Non-Aboriginal Australian, 2-Stage Random Effect Panel Estimations Using Five Waves (2001~2005) HILDA Survey Data (to be continued on next page)

| HealthScore Independent Variables | 1. Physical Function<br>β (p value) | 2. Role-Physical<br>β (p value) | 3. Bodily Pain<br>β (p value) | 4. General Health<br>β (p value) | 5. Mental Health<br>β (p value) | 6. Social Function<br>β (p value) | 7. Role-Emotional<br>β (p value) | 8. Vitality<br>β (p value) | 9. Total<br>β (p value) |
|-----------------------------------|-------------------------------------|---------------------------------|-------------------------------|----------------------------------|---------------------------------|-----------------------------------|----------------------------------|----------------------------|-------------------------|
| <i>Annual Income</i>              | 0.00 (0.00)**                       | 0.00 (0.00)**                   | 0.00 (0.00)**                 |                                  | 0.00 (0.00)**                   |                                   |                                  | -0.00 (0.00)**             |                         |
| <i>Male</i>                       |                                     |                                 |                               | -2.44 (0.00)**                   | 1.18 (0.00)**                   | 0.68 (0.04)*                      | 0.96 (0.02)*                     | 2.84 (0.00)**              |                         |
| <i>Unemployed</i>                 |                                     |                                 |                               |                                  |                                 |                                   |                                  | 5.39 (0.00)**              |                         |
| <i>Not in Labour Force</i>        | -2.38 (0.00)**                      | -1.83 (0.00)**                  |                               |                                  |                                 |                                   |                                  | 1.10 (0.01)*               |                         |
| <i>Age</i>                        | -0.30(0.00)**                       | -0.14 (0.00)**                  | -0.15 (0.00)**                | -0.05 (0.00)**                   | 0.15 (0.00)**                   | 0.06 (0.00)**                     | 0.03 (0.01)*                     | 0.11(0.00)**               | -0.24 (0.00)**          |
| <i>Condition of House</i>         |                                     |                                 | 0.45 (0.04)*                  | 0.74 (0.00)**                    | 0.36 (0.02)*                    | 0.42 (0.02)*                      | 0.79 (0.00)**                    | -0.58 (0.00)**             | -3.55 (0.00)**          |
| <i>Last Year Health Score</i>     | 0.05 (0.00)**                       | 0.06 (0.00)**                   | 0.07 (0.00)**                 | 0.07 (0.00)**                    | 0.05 (0.00)**                   | 0.06 (0.00)**                     | 0.04 (0.00)**                    | 0.07 (0.00)**              | 0.55 (0.00)**           |
| <i>Grocery Expenditure</i>        |                                     |                                 |                               |                                  |                                 |                                   |                                  | -0.04 (0.05)*              |                         |
| <i>QLD</i>                        |                                     |                                 | -1.77 (0.00)**                |                                  |                                 |                                   |                                  |                            |                         |
| <i>WA</i>                         |                                     |                                 | -1.67 (0.03)*                 |                                  |                                 |                                   |                                  |                            |                         |
| <i>OtherUrban</i>                 |                                     |                                 | -1.27 (0.01)*                 |                                  | 0.85 (0.03)*                    |                                   |                                  |                            |                         |
| <i>Bounded Locality</i>           |                                     |                                 |                               |                                  |                                 |                                   |                                  | 2.08 (0.04)*               |                         |

Table 2. Impacts of Social-Economic and Environmental Factors on Health of Non-Aboriginal Australian, 2-Stage Random Effect Panel Estimations Using Five Waves (2001~2005) HILDA Survey Data (continued)

| HealthScore<br>Independent<br>Variables | 1. Physical<br>Function<br>$\beta$ (p value) | 2. Role-<br>Physical<br>$\beta$ (p value) | 3. Bodily Pain | 4. General<br>Health<br>$\beta$ (p value) | 5. Mental<br>Health<br>$\beta$ (p value) | 6. Social<br>Function<br>$\beta$ (p value) | 7. Role-<br>Emotional<br>$\beta$ (p value) | 8. Vitality<br>$\beta$ (p value) | 9. Total<br>$\beta$ (p value) |
|---|--|---|----------------|---|--|--|--|----------------------------------|-------------------------------|
| Rural Balance                           |  |   | -1.34 (0.02)*  |   |  |  | -1.09 (0.05)*                              |                                  |                               |
| Overall R-<br>Squared                   | 0.28   | 0.15                                      | 0.22           | 0.32                                      | 0.24                                     | 0.19                                       | 0.09                                       | 0.30                             | 0.44                          |

Note: 1. N=9985; 2. Only significant coefficients are presented.; 3. Italic variables and coefficients are also estimated in the second stage estimation; 4. \*:  $p < 0.05$ , \*\*:  $p < 0.0$

Table 3 Summary of directions of significant explanatory variables of each health dimension for aboriginal and non-aboriginal Australian

|                       | Physical Function |      | Role physical |      | Bodily pain |      | General health |      | Mental health |      | Social function |      | Role emotion |      | Vitality |      |
|-----------------------|-------------------|------|---------------|------|-------------|------|----------------|------|---------------|------|-----------------|------|--------------|------|----------|------|
|                       | A                 | NonA | A             | NonA | A           | NonA | A              | NonA | A             | NonA | A               | NonA | A            | NonA | A        | NonA |
| Income                |                   |      | +/0           |      | +/0         |      |                |      |               |      |                 |      |              |      | +/0      |      |
| Age                   | -                 | -    | -             |      | -           |      | -              |      | +             |      | +               |      | +            |      | +        |      |
| Male                  |                   |      |               |      |             |      | -              |      | +             |      | +               |      | +            |      | +        |      |
| Unemployed            |                   |      |               |      |             |      |                |      |               |      |                 |      | -            |      |          | +    |
| Not in labour         |                   | -    |               | -    |             |      |                |      |               |      |                 |      |              |      |          | +    |
| Condition of dwelling |                   |      |               |      |             |      | +              |      | +             |      | +               |      | +            |      | +        |      |
| Last year health      | +                 | +    | +             | +    | +           | +    | +              | +    | +             | +    | +               | +    | +            | +    | +        | +    |
| QLD                   |                   |      |               |      |             |      | -              |      |               |      |                 |      |              |      |          |      |
| SA                    |                   |      |               |      |             |      |                |      |               |      |                 |      | -            |      |          |      |
| WA                    |                   |      |               |      |             |      | -              | -    |               |      |                 |      | -            |      |          |      |
| ACT                   |                   |      |               |      |             |      |                |      | -             |      |                 |      | -            |      |          |      |
| Otherurban            |                   |      |               |      |             |      | -              |      |               | +    |                 |      |              |      |          |      |
| Bounded locality      |                   |      |               | +    |             |      |                |      |               |      |                 |      |              |      |          | +    |
| Rural balance         |                   |      |               |      |             |      | -              |      |               |      |                 |      | -            | -    |          |      |

Note: A: aboriginal Australian; NonA: non-aboriginal Australian