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Mental Health and Hours Worked Among Nurses

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Abstract

Accounting for the endogenous relationship between health and hours worked, the goal of this study was to estimate the effect of mental health on the working hours of nursing professionals. The impact of hours worked on mental health was also investigated. The data was based on the Work Outcomes Research Cost-benefit (WORC) survey conducted in Australia during 2005 and 2006. The study sample of 6086 nurses represented ~15 per cent of nurses in Queensland. Analysis involved the use of simultaneous equations estimated with Generalized Method of Moments. The analysis of the data identified an endogenous relationship between mental health and hours of labour supplied. The findings revealed that among Queensland nurses, a deterioration of mental health was associated with a reduction in hours worked and increasing hours worsened mental health. The findings imply that an effective approach to meeting nursing shortages should include strategic attempts to improve the mental health capital of nursing staff. Previous studies have shown resilience training in the workplace as effective in increasing the supply of labor.

1. Introduction

Similar to other countries, Australia is experiencing a shortage of nurses (Buchan and Calman, 2004). In the late 1980s and through the 1990s nursing grew at half the rate of other occupations (ABS, 2005). Since the mid-1980s there has been a fall in the nursing workers to population ratio. This is partly the result of the ageing of the nursing workforce and the increased part time work within the profession that have led to reductions in average hours worked (ABS, 2005). Thus, it is important to understand factors that affect nursing labour supply so that appropriate interventions can be instigated.

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The labour supply of nursing staff through recruitment and retention has become a serious policy concern (Commonwealth of Australia, 2002; Shields, 2004; ABS, 2005; Christmas and Hart, 2007). Australian studies of the nursing profession are dominated by issues of work conditions, work related stress, recruitment and retention (Eley *et al*., 2007a; Eley *et al*., 2007b; Hegney *et al*., 2006; Moyle *et al*., 2003). This is also the case overseas (see Andrews and Dziegielewski (2005) for a review of the literature; Shields and Ward, 2001; Tourangeau and Cranley, 2006; Hart, 2001). In general, the nursing literature associates reduced workforce participation, due to stress, as a consequence of poor workplace milieu. Psychological distress, however, may intrinsically influence workforce participation and decisions to quit.

Antonazzo and colleagues (2003) provide a comprehensive literature review of the labour supply of nurses. They classify American research into first generation, second generation and recent empirical evidence. The studies reviewed used either labour force participation or hours worked as the dependent variable. The authors noted the considerable variation in the results that appeared to depend on the various econometric assumptions used in the analysis. They also identified only one UK study on the nursing profession that undertook an econometric empirical approach based on the classic model of labour supply. Instead UK studies tended to examine the determinants of turnover, quit rates and job satisfaction (see Antonazzo *et al*., 2003). Given the shortage of nurses expected in the near future, the dearth of literature is surprising and in stark contrast with the urgent need for research on the major drivers in nursing labour market behaviour (Antonazzo *et al*., 2003).

In terms of morbidity, as measured by life years lost to disability, mental illnesses are the leading cause of disease burden in Australia (Mathers *et al*., 2000; Begg *et al*., 2008). In 2003, mental illnesses accounted for 13 per cent of the total burden of disease (AIHW, 2006). Individuals experiencing mental illness tend to possess lower rates of labour force participation and productivity (Lim, Sanderson and Andrews, 2000; Chatterji *et al*., 2007; Marcotte and Wilcox-Gok, 2003; Dewa and Lin, 2000; French and Zarkin, 1998; Kessler and Frank, 1997). Averting a mental health or nervous condition had the largest positive impact on labour force participation in Australia compared to cancer, cardiovascular disease, major injury, diabetes and arthritis (Laplagne, Glover and Shomos, 2007). According to Boston Consulting (2006), mental illness costs the Australian state of Victoria approximately $5.4b annually (i.e. approximately A$22b scaled for all Australia), driven largely by diminished workforce participation and productivity.

Often studies within the nursing literature fail to consider the two-way or simultaneous relationship between mental health and the labour supply of nurses. Poor mental health, such as psychological distress, anxiety and/or depression, may impact on the supply of labour. Similarly, hours of work may impact on mental health – hours either below or above the optimal level leading to poorer mental health. Thus, there may be feedback between work hours and mental health such that these factors are inherently linked (and said to be endogenous), and both may be correlated with the error term in a statistical model (i.e. both can be affected from unobserved factors). Without statistically controlling for endogeneity, estimates of the effect of mental health on labour supply will be biased and inconsistent; that is, as the sample size increases indefinitely, the estimators will not converge to their true values (Gujarati 1995: 636).

Accounting for the endogenous relationship between health and hours worked, the goal of this study is to estimate the effect of mental health on the working hours of nursing professionals by using mental health conditions as instruments in a simultaneous equation model. This study extends the work of previous research in several ways. First, this research benefits from the use of the WORC cross-section data (http://www.qcmhr.uq.edu.au/worc) that contains 6220 observations on Queensland nurses. Detailed information relating to health conditions, health status and productivity measures allow the investigation of variables previously unavailable. In the literature, health conditions are studied in isolation or with a small selection of other conditions. However, there is considerable co-morbidity among many chronic illnesses (Zhang *et al*., 2009). Including information relating to 26 health conditions reduced the biases that could arise from co-morbidity – a feature lacking in the majority of studies that investigate health and labour market performance. Second, to assist policy makers in the formulation of programs dealing with personal and educational development and retention, the analysis investigates mental health. If, for example, it is found that mental health significantly impacts on hours worked then a case is made here to develop strategically effective occupational health and safety workplace programs that proactively improve the mental health capital of the nursing profession. This is expected to improve retention rates and productivity levels within the profession. Third, the study considers the simultaneous relationship between mental health and the labour supply of nursing hours.

2. Method

According to the human capital theory, health and labour force participation are positively related. Increases in health capital lead to greater involvement in the labour market (Grossman and Benham, 1974). Poor health is likely to lead to a reduction in labour force participation (Cai and Kalb, 2006; Waghorn and Lloyd, 2005). Grossman (1972) argues that health is an endogenously determined capital stock. A feedback effect may exist between health and labour force participation. In the health production model, health capital can be maintained and improved through economic resources and time. Health impacts on participation and this in turn impacts on health.

To account for the potential endogeneity between health and hours worked, simultaneous equation models of health and hours worked is employed. The statistical analysis controls for a range of factors shown to be relevant to hours worked and health.

Hours worked and mental health are determined in the equations below:

$$h_1 = a_1 + b_1 m_1 + b_2 x_h + b_3 marr_h + b_4 sex_h + b_5 marr*sex_h + \epsilon_{h1} \quad (1a)$$

$$m_1 = a_2 + b_6 h_1 + b_7 x_h + b_8 mc_m + \epsilon_m \quad (1b)$$

Where h is the hours worked per week, and x_h is the vector of demographic variables that includes education, age, age squared, poor/fair physical health and number of children. *Marr* represents married, *sex* represents gender and their interaction is represented by *marr*sex*. The mc represents the groupings of current mental health conditions. These variables, and their rationale for inclusion, are described in detail below. Self reported

mental health status is represented by *m*. It is common to empirically quantify the stock of health by using an indicator that measures an individual's self-evaluation of health (Cai and Kalb, 2006).

The second set of equations, 2a and 2b, include that same set of variables plus a vector of variables for physical health conditions, represented by *pc*, and is defined below also:

$$h_1 = a_1 + b_1 m_1 + b_2 x_h + b_3 marr_h + b_4 sex_h + b_5 marr*sex_h + b_6 pc_h + \epsilon h_1 \quad (2a)$$

$$m_1 = a_2 + b_7 h_1 + b_8 x_h + b_9 mc_m + b_{10} pc_h + \epsilon_m \quad (2b)$$

The endogenous variables are mental health status and hours worked. In a preliminary analysis, the Durbin-Wu-Hausman test confirmed the presence of endogeneity between hours worked and mental health status.

The analysis involves two separate simultaneous regressions. The first investigates the impact of mental health on hours worked. This is the focus of the study. The second investigates the impact of hours worked on mental health. Due to the endogenous relationship between mental health status and hours worked, the mental health conditions – chronic sleeping problems, anxiety, depression and emotional problems – are chosen as instruments for health status, represented by *mc*.

Marital status and gender are chosen as instruments for hours worked (Stern, 1989). Becker's (1985) paper relating to the sexual division of labour argues that the persistence of gender wage differences may be evidence of the continuing responsibility of women for housework. Studies have shown that for women, being married typically have negative effects on labour supply. For men, the effect of these factors on labour supply tends to be positive (Roberts, 1999; Carmichael and Charles, 2003). Although marital status and gender are chosen as instruments, the suitablity of the simultaneous equation is called into question by the Hansen, J. and Durbin-Wu-Hausman tests. This is later discussed in this paper. It is possible that marital status and gender directly impact on mental health and so may not be suitable instrumental variables. Studies have shown that married people enjoy better mental health than unmarried people (Kessler and McRae, 1984; Simon, 2002; Madden, 2008). Also females tend to possess lower levels of mental health than males (Gove, 1972; Llena-Nozal *et al*., 2004), although it has been argued that studies based on psychological problems common among females are likely to overestimate women's distress and underestimate men's (Dohrenwend and Dohrenwend, 1976; Simon, 2002).

The two basic conditions for valid instruments are that the instruments must be: 1) highly correlated with the variable to be instrumented; and 2) correlated with the outcome variable of interest only through the variable to be instrumented. Health conditions are appropriate instruments since they are highly correlated with health status (see Cai and Kalb, 2006). While each measure of health (either health conditions or health status) explains a significant amount of variation in hours worked, health status and health conditions are not perfect substitutes. Health status is a composite of various factors such as genetic influences, cumulative life time exposures to risk factors and events (e.g. previous injury that may include musculoskeletal impairment),

social factors affecting health, quality of life, and so forth. There is evidence in the health literature that health conditions are appropriate instruments for health status (Cai and Kalb, 2006; Laplagne *et al*., 2007).

The rejection of the null hypothesis of the Anderson's canonical correlations likelihood ratio test indicated that the instruments were adequate to identify the equations. A further test for instrument validity, the difference-in-Sargan test (also known as the C test), determined that the subset of instruments was appropriately exogenous.[1]

The two-stage estimation method produces consistent parameter estimates but is not efficient because the potential correlation between the error terms in the structural equations is not considered (Cai and Kalb, 2006; Baum, 2006). To account for this, the efficient General Methods of Moments (GMM) estimates are calculated using the IVREG2 function in Stata.[2] [3] [4]

To further support the findings of models 1 and 2, another set of models are run that replace *m* with a continuous measure of mental wellbeing that is closely correlated with mental health status (0.47, $p<0.001$). Represented by Kessler 6 (K6), this measure is a six-item scale of psychological distress with high internal consistency and reliability. The score strongly discriminates between community mental health cases and non-cases (Kessler *et al*., 2002; Furukawa *et al*., 2003; Kessler *et al*., 2003; Cairney *et al*., 2007). Detailed information on the K6 measure has been published (Furukawa *et al*., 2003; Kessler *et al*., 2003). On the 24 item scale, 0 represents the lowest psychological distress and 24 represent the highest psychological distress (e.g. likelihood of a mental health disorder). The log linear functional form is used to estimate the marginal effects between hours worked and psychological distress. The elasticity of the dependent variable with respect to the independent variable is equivalent to $\delta\log(y)/\delta\log(x)$. These are evaluated at the multivariate point of means of the data (Baum, 2006). This method is particularly appropriate given that the actual value of K6 when converted to its log is reduced to within a normal range (skewness = 0.515; kurtosis = 2.468). The equations are estimated using the OLS and GMM. Each equation is specified as follows:

$$\ln h_1 = a_1 + b_1 \ln K6_1 + b_2 \ln x_h + b_3 \ln marr_h + b_4 \ln sex_h + b_5 \ln marr*sex_h + b_6 \ln pc_h + \epsilon_{h1} \quad (3a)$$

$$\ln K6^1 = a_2 + b_7 \ln h_1 + b_8 \ln x_h + b_9 \ln mc_m + b_{10} \ln pc_h + \epsilon_m \quad (3b)$$

3. The Data

The data presented are sub-analyses of data compiled as a component of the Work Outcomes Research Cost-benefit (WORC) Project (www.qcmhr.uq.edu.au/worc). The WORC Project is designed to investigate the return on investment, from an

[1] Tests a subset of the original set of orthogonality conditions. Orthogonality conditions imply that instrumental variables and error terms are uncorrelated.
[2] In large samples consistency means that as N goes to ∞, the estimates will converge to their respective population parameters (see Baum, 2006).
[3] The property of efficiency refers to the precision of the estimator - a relatively smaller sampling variance (see Baum, 2006).
[4] ivreg2 with robust and GMM reports coefficients that are efficient in the presence of arbitrary heteroskedasticity as well as correct standard errors (Schaffer, 2008).

employer's perspective, from early detection of depression and facilitating help-seeking behaviours by employees. The information in this paper was collected from the Health and Performance at Work Questionnaire (HPQ) developed by the World Health Organisation (WHO). The HPQ is a health risk assessment survey developed for the purpose of estimating the impact of health problems on the workplace (Kessler *et al*., 2003). Further information about the HPQ can be accessed at www.hcp.med.harvard.edu/hpq/.

Employees over the age of 18-years were invited to respond to the HPQ. Participation in the survey was voluntary and confidential. The University of Queensland Human Research Ethics Committee approved the study protocol.

Detailed information on the engagement of companies and HPQ survey distributuion has been previously published (Hilton *et al*., 2008). In summary employers agreed to distribute the surveys to their employees between October 2005 and October 2006. 78,726 employees responded to the HPQ survey of which 6,220 were Queensland nurses. In 2005, there were 46,464 registered and enrolled nurses in Queensland (AIHW, 2008). Of these 41,373 were employed. The sample of 6086 employees used in the analysis of this study represents 15 per cent of the Queensland nursing professionals. The recording of a substantial sample of the population assisted in ensuring that the survey was representative of the nursing population in Queensland. The analysis was confined to nursing professionals aged 25 to 64 years. Those aged 65 and over were excluded from the analysis because the minimum Age Pension for males is 65 years in Australia. Persons aged less than 25 years were omitted because many may not yet have completed their tertiary studies (Cai, 2007).

The variable, hours worked per week, was derived from the reported actual hours worked over the last 28 days divided by four weeks. This took into consideration the shift work component within the nursing profession. To reduce outliers, five observations that recorded 93 hours or more of work per week were dropped from the analysis. This resulted in skewness and kurtosis of -0.508 and 3.609, respectively, for mean hours worked.

Self-reported mental health was used as the observed counterpart of latent mental health capital and the health conditions employed in the mental health equation. The survey presented respondents with a Likert scale asking respondents whether their mental health was excellent, very good, good, fair or poor.

The hours worked and mental health equations included education, sex, married, marr*sex, poor/fair physical health, age and age-squared. The interaction term marr*sex captured the impact of married males. Poor/fair physical health controlled for the severity of a physical health condition. Age was included in the health model because people's health capital depreciates with age (Grossman, 1972). Consistent with previous studies that focused on labour supply the hours worked equation included age-squared (Cai, 2007; Wolf and Soldo, 1994; Carmichael and Charles, 1998; Roberts, 1999). Age-squared captured the effect of age on labour force participation. Age and its square became proxies for work experience.

Physical health conditions as explanatory variables were included in the hours worked and mental health equations, 2a and 2b respectively. Each medical condition was coded as a dummy variable. A value of 1 represented respondents currently seeking professional treatment for a specific condition, 0 otherwise.

4. Estimation Results

A basic assumption of the Ordinary Least Square (OLS) regression model is that the values of the error terms are independent of the values of the predictors. Yet, a feedback loop may exist between the dependent (hours worked) and predictor (health) variable, thus the error in the dependent variable may be correlated with the predictor, violating the axiom of independent errors. The Two Stage Least Squares (2SLS) model can help solve these problematic predictors by assuming that the instruments (current medical conditions) correlate with the problematic predictors (health status) but not with the error term.

Analysis was performed using the Stata statistical package. The inefficiency of the 2SLS in the presence of heteroskedasticity led to the use of the more efficient two-step Generalized Method of Moments (GMM) (Ikenwilo and Scott, 2007). This step generated heteroskedasticity-robust standard errors (Baum, 2006: 197). Results using OLS are also reported for comparison.

Descriptive Statistics

Table 1 presents the definitions and proportions or mean values for the variables included in the models. The variables are grouped into the model specification as: those variables in both the hours and mental health equations, additional exogenous variables included in the mental health equation only, and additional exogenous variables in the hours worked equation only.

Table 1 - Definition of Variables

Variable Name	*Definition of Variable*	*% or Mean (n=6086)*
Mental Health	1 excellent	23.6
Status (per cent)	2 very good	40.3
	3 good	27.1
	4 fair	8.3
	5 poor	0.8
Hours Worked	Mean hours worked per week	30.5
K6	Scale of psychological distress from 0 (lowest) to 24 (highest)	2.9
Variables in both hours worked and health equations		
Education	1 year 11 or under, 0 otherwise (per cent)	12.3
	1 year 12, 0 otherwise (per cent)	10.2
	1 tertiary education, 0 otherwise (per cent)	24.9
	1 degree graduate (referent), 0 otherwise (per cent)	29.6
	1 post graduate, 0 otherwise (per cent)	23.0
Physical health	Fair/poor physical health	8.1
No. of children	Mean	0.3
Age	Mean age of those from 25 years to 64 years (inclusive)	43.6
Age squared	Square of age	1990.5
Physical medical	arthritis/rheumatism	4.3
conditions -	chronic back/neck pain	9.4
currently seeking	migraine	2.7
treatment	other frequent or sever headaches	2.1
(per cent)	other chronic pain	3.3
	high blood pressure/hypertension	8.4
	congestive heart failure	0.1
	coronary heart disease	0.7

Table 1 - Definition of Variables (continued)

Variable Name	*Definition of Variable*	*% or Mean (n=6086)*
	high blood cholesterol	4.7
	stomach/intestine ulcer	1.4
	irritable bowel disorder	1.5
	chronic heartburn/oesophageal reflux	5.0
	seasonal allergies/hay fever	2.9
	asthma	5.4
	chronic bronchitis/ emphysema	0.3
	chronic obstructive lung disease	0.1
	urinary/ bladder	1.1
	diabetes	1.9
	obesity	2.7
	osteoporosis	1.3
	skin cancer	2.7
	other cancer	1.3
Instrumental variables for mental health		
Mental medical conditions - currently seeking treatment (per cent)	1 if currently receiving treatment, 0 otherwise: (per cent)	
	chronic sleeping problems	2.2
	anxiety	2.4
	depression	6.5
	emotional problems	1.5
Instrumental variables for hours worked		
Married	1 married/cohabitation (referent), 0 otherwise (per cent)	73.4
Gender	1 male	9.4
	2 female	90.6

Source: WORC Survey 2005.

The nurses in the sample were predominantly female (91 per cent, table 1). The participants' mean age of 44-years reflects the ageing of the nursing workforce. Over 47 per cent of nursing professionals in the sample are employed part-time. These figures closely mirror the 2005 national data that reported 92 per cent of nurses being female and nurses with an average age of 45 years (AIHW, 2008: 9). Of all nurses in Australia, 50 per cent were employed on a part-time basis (AIHW, 2008: 9). The Queensland data of the same year revealed 94 per cent of nurses being female, an average age of 47 years and 50 per cent employed part-time (AIHW, 2008: 29). Thus, the WORC sample closely resembles the national and state data.

In this sample of nurses, the dominant health conditions are chronic back/neck pain (9.4 per cent), high blood pressure/hypertension (8.4 per cent) and depression (6.5 per cent). The majority (63.9 per cent) report excellent/very good mental health, with 27.1 per cent reporting good mental health and 9.1 per cent reporting fair to poor mental health.

Table 2 presents the mean hours worked per week by mental health status. The total mean of 31 hours worked per week is similar to the national and Queensland average of 33 and 34-hours, respectively, reported in 2005 (AIHW, 2008: 15). The statistics in table 2 suggest that among nursing professionals, mean hours worked per week appear to change little with changes in mental health status.

Table 2 - Queensland Nursing Professionals Aged 25 to 64: Hours Worked by Self-Reported Mental Health Status, WORC Survey, 2005

	Hours Worked			
Mental Health	*N*	*% Total*	*Mean*	*Std. Dev*
Excellent/Vgood	3846	63.2	30.50	11.38
Good	1628	26.7	30.53	11.42
Fair/poor	542	8.9	30.73	12.14
Total	6086	100.0	30.51	11.48
missing	70			

Source: WORC Survey 2005

Regression Analysis

Tables 3 and 4 are each split into two distinct sections. The first presents the impact of mental health status on the hours worked (equations (1a) and (2a)) and the second presents hours worked on mental health status (equations (1b) and (2b)).[5] The control variables are also reported. Table 5 presents the marginal effects based on the analysis between hours worked and pschological distress (equations (3a) and (3b)).

Mental Health Status on Hours Worked

The OLS model treats health status as exogenous. This model is compared with the GMM regression that accounts for the endogenous relationship between mental health and hours worked. The OLS model indicates that self-reported mental health status does not impact on the hours worked (although there is a trend in increased hours worked with deteriorating mental health, this does not reach statistical significance) (refer table 3, column 3.1 and table 4, column 4.1). Running the model with health status as a categorical variable produced similar results.[6]

The Durbin-Wu-Hausman test confirms the presence of endogeneity for the mental health on hours worked model. The GMM model passes the Hansen J-test of over-identifying restrictions indicating that the instruments are appropriately uncorrelated with the disturbance process. The Anderson canonical correlation statistic shows that the instruments adequately identify the GMM model. That is, the selected mental health conditions are strong instrumental variables for mental health status. The first stage regression output reported F statistics greater than 10 for the endogenous regressors. This further verifies no evidence of a weak instrument problem.

The GMM model reveals that each incremental decrease in mental health reduces hours worked by over 2 hours per week (refer table 3, column 3.2 and table 4, column 4.2). The standard error of the estimates show a variability of 0.7 hours around the prediction line. In comparison to the OLS, changes in the remaining estimated coefficents and statistical significance are modest. Those that work less hours per week tend to be female, married, have fewer children and lower educational level.

[5] First stage regressions provided by authors on request.
[6] For the analysis the categories were reduced from five to three categories (1 if excellent/very good; 2 if good; 3 if fair/poor). The estimated coefficient for mental health good is -0.012 ($p>0.80$) and mental health fair/poor is 1.078 ($p\leq0.10$). Remaining estimates provided by authors on request.

Table 3 - Regression Results: Queensland Nursing Professionals, 2005

	Mental Health on Hours Worked: Model 1a				*Hours Worked on Mental Health: Model 1b*					
	OLS (n=5969)		*GMM (n=5969)*		*OLS (n=5969)*		*OLS (n=5969)*		*GMM (n=5969)*	
	(3.1)		*(3.2)*		*(3.3)*		*(3.3l)*		*(3.4)*	
	Coef.	*S.E*	*Coef.*	*S.E*	*Coef.*	*S.E*	*Coef.*	*S.E*	*Coef.*	*S.E*
Sleeping problems					0.197 ***	0.077	0.199 ***	0.077	0.205 **	0.086
Anxiety					0.283 ***	0.080	0.286 ***	0.080	0.281 ***	0.078
Depression					0.796 ***	0.049	0.787 ***	0.049	0.811 ***	0.047
Emotional problems					0.572 ***	0.091	0.558 ***	0.092	0.572 ***	0.095
Age	0.167	0.136	0.273 *	0.144	0.033 ***	0.010	0.033 ***	0.010	0.032 ***	0.010
Age-squared	0.000	0.002	-0.002	0.002	0.000 ***	0.000	0.000 ***	0.000	0.000 ***	0.000
Sex	-1.692 *	0.989	-2.080 **	0.938			-0.134 *	0.074		
Married	-3.725 ***	0.344	-3.948 ***	0.342			-0.037	0.026		
Sex*Married	4.415 ***	1.140	3.957 ***	1.079			-0.179 **	0.086		
Kid	0.875 ***	0.175	1.040 ***	0.171	0.071 ***	0.013	0.074 ***	0.013	0.064 ***	0.015
Year 12[a]	-1.013 *	0.621	-0.864	0.613	0.066	0.047	0.064	0.047	0.072	0.047
Tertiary[a]	0.004	0.513	0.039	0.500	0.012	0.039	0.011	0.039	0.010	0.038
Degree Graduate[a]	1.904 ***	0.528	1.986 ***	0.517	0.028	0.040	0.024	0.040	0.009	0.041
Post graduate[a]	2.964 ***	0.530	2.995 ***	0.522	-0.008	0.040	-0.012	0.040	-0.035	0.043
Ph Hlth: fair/poor	-2.600 ***	0.561	0.070	0.920	0.970 ***	0.040	0.967 ***	0.040	0.983 ***	0.044
Mean hours					0.002 **	0.001	0.002 **	0.001	0.010 *[c]	0.005
Mental Health	0.146	0.165	-2.253 ***[b]	0.655						
(Constant)	27.880 ***	3.537	31.888 ***	3.759	1.418 ***	0.221	1.707 ***	0.266	1.235 ***	0.256
Adj R^2 or Centered R^2		*0.064*		*0.033*		*0.191*		*0.192*		*0.183*
Anderson Canon			506.703Chi-sq(5) P-val = 0.000					207.788Chi-sq(2) P-val = 0.000		
Hansen J			1.193Chi-sq(4) P-val = 0.755					2.188Chi-sq(1) P-val = 0.139		
D-W-H test			17.904Chi-sq(1) P-val= 0.000					2.278Chi-sq(1) P-val= 0.131		

[a] Reference group is Year 11 or less.
[b] Instrumental variable estimators are chronic sleeping problems, anxiety, depression and emotional problems.
[c] Instrumental variable estimators are sex and married.
***p≤0.01, ** p≤0.05, *p≤0.10
Source: WORC Survey 2005.

Table 4 - Regression Results, Including Physical Health Conditions: Queensland Nursing Professionals, 2005

	Mental Health on Hours Worked: Model 2a				*Hours Worked on Mental Health: Model 2b*					
	OLS (n=5537)		*GMM (n=5537)*		*OLS (n=5537)*		*OLS (n=5537)*		*GMM (n=5537)*	
	(4.1)		*(4.2)*		*(4.3)*		*(4.31)*		*(4.4)*	
	Coef.	*S.E*	*Coef.*	*S.E*	*Coef.*	*S.E*	*Coef.*	*S.E*	*Coef.*	*S.E*
Sleeping problems					0.191 **	0.081	0.191 **	0.081	0.199 **	0.089
Anxiety					0.265 ***	0.085	0.268 ***	0.085	0.263 ***	0.086
Depression					0.807 ***	0.051	0.798 ***	0.051	0.819 ***	0.050
Emotional problems					0.563 ***	0.094	0.550 ***	0.094	0.562 ***	0.098
Age	0.156	0.141	0.241 *	0.147	0.027 **	0.011	0.027 ***	0.011	0.026 **	0.010
Age-squared	0.000	0.002	-0.001	0.002	0.000 ***	0.000	0.000 ***	0.000	0.000 ***	0.000
Sex	-1.924 *	1.040	-2.300 **	0.946			-0.105	0.078		
Married	-3.842 ***	0.357	-4.054 ***	0.352			-0.037	0.027		
Sex*Married	4.343 ***	1.190	3.959 ***	1.086			-0.137	0.090		
Kid	0.794 ***	0.185	0.958 ***	0.182	0.073 ***	0.014	0.075 ***	0.014	0.067 ***	0.015
Year 12[a]	-1.239 *	0.645	-1.072 *	0.635	0.068	0.049	0.067	0.049	0.075	0.050
Tertiary[a]	-0.160	0.536	-0.153	0.517	0.000	0.040	-0.001	0.040	0.000	0.040
Degree Graduate[a]	1.709 ***	0.548	1.765 ***	0.533	0.013	0.041	0.009	0.041	-0.003	0.042
Post graduate[a]	2.702 ***	0.552	2.696 ***	0.536	-0.026	0.042	-0.029	0.042	-0.048	0.045
Ph Hth: fair/poor	-2.253 ***	0.612	0.288	0.950	0.962 ***	0.044	0.958 ***	0.044	0.970 ***	0.048
Mean hours				0.002	**	0.001	0.002 **	0.001	0.009 *[c]	0.005
Mental Health	0.179	0.172	-2.134 ***[b]	0.678						
arthritis/rheumatism	0.409	0.799	0.216	0.855	-0.129 **	0.060	-0.129 **	0.060	-0.131 **	0.060
back/neck pain	-0.945 *	0.550	-0.543	0.607	0.143 ***	0.041	0.143 ***	0.041	0.149 ***	0.042
migraine	-1.037	1.057	-1.175	1.059	-0.060	0.080	-0.061	0.080	-0.051	0.083
other headaches	1.112	1.232	1.416	1.401	0.008	0.093	0.011	0.093	-0.003	0.098
other chronic pain	-2.254 ***	0.899	-1.994 **	1.029	0.078	0.068	0.083	0.068	0.092	0.069
high blood/hyp	0.656	0.597	0.684	0.624	-0.017	0.045	-0.018	0.045	-0.023	0.046
cong heart failure	-9.785	6.513	-10.235 ***	2.005	-0.086	0.490	-0.071	0.490	-0.026	0.139
coro heart disease	-1.656	1.932	-1.178	1.778	0.265 *	0.145	0.258 *	0.145	0.280	0.179
High bld chol/diab	-0.597	0.710	-0.714	0.725	-0.047	0.053	-0.045	0.053	-0.046	0.055
stomach/int ulcer	1.409	1.340	1.601	1.347	0.039	0.101	0.039	0.101	0.024	0.100
irritable bowel	-1.100	1.257	-1.179	1.485	0.018	0.095	0.019	0.095	0.032	0.104

Table 4 - Regression Results, Including Physical Health Conditions: Queensland Nursing Professionals, 2005 (continued)

	Mental Health on Hours Worked: Model 2a				*Hours Worked on Mental Health: Model 2b*					
	OLS (n=5537)		*GMM (n=5537)*		*OLS (n=5537)*		*OLS (n=5537)*		*GMM (n=5537)*	
	(4.1)		*(4.2)*		*(4.3)*		*(4.31)*		*(4.4)*	
	Coef.	*S.E*	*Coef.*	*S.E*	*Coef.*	*S.E*	*Coef.*	*S.E*	*Coef.*	*S.E*
heartburn/reflux	0.395	0.752	0.364	0.732	-0.064	0.057	-0.066	0.057	-0.068	0.057
allergies/hay fever	-0.006	0.933	-0.007	0.963	-0.044	0.070	-0.042	0.070	-0.046	0.069
asthma	0.318	0.697	0.369	0.682	0.009	0.052	0.008	0.052	0.005	0.055
bron/ emphysema	2.032	2.940	0.740	2.352	-0.398 *	0.221	-0.406 *	0.221	-0.408 ***	0.159
obstr lung disease	-6.947	6.702	-7.479	6.310	-0.136	0.503	-0.154	0.504	-0.103	0.219
urinary/ bladder	-1.719	1.434	-1.199	1.517	0.142	0.108	0.143	0.108	0.149	0.109
diabetes	-0.745	1.180	-0.924	1.196	-0.096	0.089	-0.099	0.089	-0.087	0.093
obesity	1.854 *	0.988	2.172 **	1.107	0.007	0.075	0.011	0.075	-0.002	0.083
osteoporosis	1.356	1.378	0.838	1.144	-0.227 **	0.104	-0.231 **	0.104	-0.237 ***	0.088
skin cancer	-0.529	0.913	-0.365	1.004	0.051	0.069	0.048	0.069	0.054	0.070
other cancer	-3.227 **	1.319	-3.575 **	1.539	-0.146	0.099	-0.146	0.099	-0.119	0.092
(Constant)	28.809 ***	3.679	32.988 ***	3.832	1.534 ***	0.229	1.768 ***	0.277	1.368 ***	0.263
Adj R^2 or Centered R^2		*0.066*		*0.043*		*0.192*		*0.193*		*0.19*
Anderson Canon			462.424Chi-sq(5) P-val = 0.000						208.689Chi-sq(2) P-val = 0.000	
Hansen J			1.605Chi-sq(4) P-val = 0.658						1.653Chi-sq(1) P-val = 0.199	
D-W-H test			15.230Chi-sq(1)P-val = 0.000						1.844Chi-sq(1 P-value=0.174	

[a] Referent is Year 11 or less.
[b] Instrumental variable estimators are chronic sleeping problems, anxiety, depression and emotional problems.
[c] Instrumental variable estimators are sex and married.
***p≤0.01, ** p≤0.05, *p≤0.10
Source: WORC Survey 2005.

Table 5 - Marginal effects: Queensland Nursing Professionals, 2005

	Psychological Distress on Hours Worked: Model 3a				*Hours Worked on Psychological Distress: Model 2b*					
	OLS (n=5555)		*GMM (n=5555)*		*OLS (n=5555)*		*OLS (n=5555)*		*GMM (n=5555)*	
	(5.1)		*(5.2)*		*(5.3)*		*(5.31)*		*(5.4)*	
	ey/ex.	*S.E*	*ey/ex.*	*S.E*	*ey/ex.*	*S.E*	*ey/ex.*	*S.E*	*ey/ex.*	*S.E*
Sleeping problems					0.0085 ***	0.0031	0.0085 ***	0.0031	0.0085 ***	0.0031
Anxiety					0.0118 ***	0.0034	0.0119 ***	0.0034	0.0118 ***	0.0035
Depression					0.0559 ***	0.0059	0.0556 ***	0.0059	0.0560 ***	0.0064
Emotional problems					0.0178 ***	0.0026	0.0177 ***	0.0026	0.0178 ***	0.0029
Age	0.2526	0.2003	0.2923	0.2078	0.1980	0.7771	0.2366	0.7793	0.1595	0.7541
Age-squared	-0.0253	0.1039	-0.0496	0.1073	-0.1954	0.4030	-0.2180	0.4043	-0.1811	0.4006
Sex	-0.1192 *	0.0646	-0.1210 **	0.0569			0.1309	0.2515		
Married	-0.0927 ***	0.0086	-0.0971 ***	0.0086			-0.0257	0.0340		
Sex*Married	0.0103 ***	0.0028	0.0105 ***	0.0025			0.0042	0.0109		
Kid	0.0074 ***	0.0017	0.0078 ***	0.0016	0.0091	0.0066	0.0095	0.0066	0.0090	0.0065
Year 12[a]	-0.0040 *	0.0022	-0.0042 **	0.0021	-0.0051	0.0084	-0.0051	0.0084	-0.0049	0.0091
Tertiary[a]	-0.0019	0.0043	-0.0034	0.0042	-0.0298 *	0.0167	-0.0297 *	0.0167	-0.0300 *	0.0186
Degree Graduate[a]	0.0169 ***	0.0054	0.0158 ***	0.0054	-0.0307	0.0212	-0.0309	0.0212	-0.0320	0.0237
Post graduate[a]	0.0207 ***	0.0042	0.0196 ***	0.0041	-0.0314 **	0.0163	-0.0318 *	0.0164	-0.0325 *	0.0191
Ph Hlth:fair/poor	-0.0055 ***	0.0015	-0.0013	0.0020	0.0617 ***	0.0059	0.0615 ***	0.0059	0.0617 ***	0.0061
Mean hours					0.1311 ***	0.0514	0.1280 **	0.0524	0.1854[c]	0.2490
K6	0.0056 *	0.0034	-0.0488 ***[b]	0.0171						
arthritis/rheumatism	0.0007	0.0011	0.0006	0.0012	-0.0059	0.0043	-0.0059	0.0043	-0.0060	0.0039
back/neck pain	-0.0029 *	0.0017	-0.0018	0.0018	0.0178 ***	0.0064	0.0176 ***	0.0064	0.0179 ***	0.0068
migraine	-0.0009	0.0009	-0.0012	0.0010	-0.0053	0.0036	-0.0054	0.0036	-0.0053 *	0.0031
other headaches	0.0007	0.0008	0.0011	0.0010	0.0036	0.0032	0.0036	0.0032	0.0035	0.0029
other chronic pain	-0.0024 **	0.0009	-0.0022 **	0.0011	0.0010	0.0037	0.0010	0.0037	0.0010	0.0033
high blood/hyp	0.0018	0.0015	0.0011	0.0016	-0.0147 **	0.0059	-0.0147 **	0.0059	-0.0152 ***	0.0050
cong heart failure	-0.0002	0.0001	-0.0002 ***	0.0000	-0.0002	0.0005	-0.0002	0.0005	-0.0002	0.0002
coro heart disease	-0.0003	0.0004	-0.0004	0.0004	-0.0010	0.0016	-0.0009	0.0016	-0.0009	0.0012
High bld chol/diab	-0.0009	0.0011	-0.0010	0.0011	-0.0023	0.0042	-0.0023	0.0042	-0.0023	0.0038
stomach/int ulcer	0.0006	0.0006	0.0008	0.0006	0.0033	0.0024	0.0033	0.0024	0.0031	0.0025
irritable bowel	-0.0006	0.0006	-0.0003	0.0008	0.0055 **	0.0025	0.0054 **	0.0025	0.0056 **	0.0030

Table 5 - Marginal effects: Queensland Nursing Professionals, 2005 (continued)

	Psychological Distress on Hours Worked: Model 3a				*Hours Worked on Psychological Distress: Model 2b*					
	OLS (n=5555)		*GMM (n=5555)*		*OLS (n=5555)*		*OLS (n=5555)*		*GMM (n=5555)*	
	(5.1)		*(5.2)*		*(5.3)*		*(5.31)*		*(5.4)*	
	ey/ex.	*S.E*	*ey/ex.*	*S.E*	*ey/ex.*	*S.E*	*ey/ex.*	*S.E*	*ey/ex.*	*S.E*
heartburn/reflux	0.0006	0.0012	0.0005	0.0011	-0.0057	0.0046	-0.0057	0.0046	-0.0056	0.0049
allergies/hay fever	0.0001	0.0009	0.0003	0.0009	0.0024	0.0034	0.0024	0.0034	0.0025	0.0035
asthma	0.0004	0.0012	0.0006	0.0012	0.0039	0.0046	0.0039	0.0046	0.0036	0.0047
bron/ emphysema	0.0002	0.0003	0.0001	0.0002	-0.0006	0.0011	-0.0006	0.0011	-0.0006	0.0007
obstr lung disease	-0.0001	0.0001	-0.0001	0.0001	-0.0003	0.0005	-0.0003	0.0005	-0.0003 **	0.0001
urinary/ bladder	-0.0006	0.0005	-0.0003	0.0005	0.0041 **	0.0020	0.0041 **	0.0020	0.0042 **	0.0020
diabetes	-0.0005	0.0007	-0.0004	0.0007	0.0012	0.0027	0.0012	0.0027	0.0013	0.0029
obesity	0.0016 *	0.0008	0.0016 *	0.0009	-0.0054 *	0.0032	-0.0055 *	0.0032	-0.0055 **	0.0026
osteoporosis	0.0004	0.0006	0.0004	0.0005	-0.0010	0.0021	-0.0011	0.0021	-0.0011	0.0021
skin cancer	-0.0005	0.0008	-0.0005	0.0009	-0.0011	0.0033	-0.0011	0.0033	-0.0011	0.0030
other cancer	-0.0014 **	0.0006	-0.0014 **	0.0007	0.0001	0.0022	0.0001	0.0022	0.0000	0.0023
Adj R^2 or Centered R^2		*0.067*		*0.029*		*0.086*		*0.086*		*0.092*
Anderson Canon			281.755Chi-sq(5) P-val = 0.000						208.636Chi-sq(2) P-val = 0.000	
Hansen J			2.958Chi-sq(4) P-val = 0.398						0.595Chi-sq(1) P-val = 0.4405	
D-W-H test			13.458Chi-sq(1)P-val = 0.000						0.046Chi-sq(1 P-value=0.8313	

[a] Referent is Year 11 or less.
[b] Instrumental variable estimators are chronic sleeping problems, anxiety, depression and emotional problems.
[c] Instrumental variable estimators are sex and married.
***p≤0.01, ** p≤0.05, *p≤0.10
Source: WORC Survey 2005.

The health conditions, chronic pain, congestive heart failure and cancer are negatively associated with hours worked (refer table 4, column 4.2). Those reporting obesity tend to work more hours per week.

Psychological Distress on Hours Worked

The GMM output show that the significance levels and signs for the psychological distress on hours worked model (equation (3.a)) are similar to that reported in the previous subsection (refer table 5, column 5.2). The regressor, *K6*, is inelastic with an increase in distress having a 5 per cent decreased effect on mean hours worked in proportional terms.

Hours Worked on Mental Health Status

Referring to columns 3.4 and 4.4 in tables 3 and 4, the output shows that the GMM models do not pass the Hansen J-test of overidentifying restrictions. Furthermore, the Durbin-Wu-Hausman test rejects the endogeneity of mean hours worked – that is OLS rather than the GMM is the appropriate estimation technique.

Given this, two OLS regressions are also run with and without the variables sex, married and married*sex as control variables (refer table 3, columns 3.3, 3.31 and table 4, columns 4.4, 4.41). Poor/fair physical health tends to increase the likelihood of deterioration in mental health, as does having children, increasing age, and mental health conditions (i.e. sleeping problems, anxiety, depression, emotional problems). When physical health conditions are included as control variables (refer table 4) the sex and sex*married variables are no longer significant. A possible explanation is that marital status and gender may correlate with certain health conditions. For instance, having children and being female is expected to correlate with osteoporosis. Physical health conditions such as back and neck pain and coronary heart disease are associated with deteriorating mental health. Those with arthritis/rheumatism, osteoporosis and bronchitis/emphysema tend to possess better mental health. Similar results are reported when the dependent variable is a categorical variable in the Logit regression.[7]

Hours Worked on Psychological Distress

Similar to the previous subsection, the tests reveal that the OLS is the appropriate model. Ramsey's omitted variable regression specification error test accepted the null hypothesis of no misspecification for the OLS model.[8] The hours worked on psychological distress model show significance levels and signs similar to that reported for the hours worked on mental health model (refer table 5, columns 5.3, 5.31). The regressor, mean hours worked, is inelastic with an increase in hours worked having a 13 per cent increased effect on psychological distress. Of the medical conditions, all the mental health conditions plus back/neck pain, irritable bowel and urinary/bladder conditions are associated with increasing psychological distress. High blood pressure and obesity are associated with lower psychological

[7] The estimated coefficient for mean hours is 0.005 ($p \leq 0.10$). Remaining estimates provided by authors on request.

[8] Model without sex, married and marr*sex: 0.76 (Prob>F=0.518). Model with sex, married and marr*sex: 0.71 (Prob>F=0.548). distress. The remaining estimated coefficients are similar to that reported in tables 3 and 4 with the exception of the education variables which are now significant.

5. Discussion

Mental Health Status on Hours Worked

The findings from the GMM estimation identified that mental health had a significant and substantial effect on the working hours of nurses, once endogeneity was considered. By using OLS to adjust for covariates, there was a non-significant trend in hours worked from deteriorating mental health. However, the GMM results showed that the OLS results underestimated both the size of the effect and the statistical significance; as mental health deteriorated, nurses tended to work fewer hours.

The Australian investigation by Laplagne and colleagues (2007) support the findings reported here of an association between poorer mental health and decreasing labour supply. The results are also consistent with previous research into occupational groups (French and Zarkin, 1998) and populations abroad (Chatterji *et al*., 2007; Marcotte and Wilcox-Gok, 2003; Savoca and Rosenheck, 2000).

Also, consistent with the Australian literature (Cai and Kalb, 2006; Laplagne, Glover and Shomos, 2007), this study found that being female, married and lower education had a negative impact on labour supply.

Specific health conditions played an influential role in the determination of hours worked among nurses. For instance, chronic pain, congestive heart failure and cancer significantly and negatively impacted on the hours worked. However, obesity was positively correlated with hours worked. Since the health conditions are self reported, possibly some indiviudals may have under reported their weight and this led to bias. Also the findings may reflect lifestyle – longer work hours may discourage the consumption of lower caloried/home cooked meals and exercise. Alternatively, certain variables omitted from the regression model could be positively correlated with both obesity and hours worked.

Hours Worked on Mental Health Status

This study also found that increasing hours of work had a negative impact on mental health status. That is, the physical and mental demands within the nursing profession may cause a deterioration in mental health status. Although this tends to contradict the human capital theory of a positive relationship between health and productivity, the findings reported here are consistent with several studies of the workforce in general and studies specifically relating to the nursing profession.

Investigating the effect of disability on the labor force participation of 3052 Americans by using symptoms or diseases as instruments in a simultaneous equations model, Stern (1989) found that increasing hours led to deterioration in health status. Stern (1989) suggested that participation may diminish health, either due to stress or bad working conditions. However, Stern acknowledged that an omitted variable from the two equations may also explain the negative estimated correlation.

Laplagne *et al*., (2007) cite evidence from Dollard and Winefield (2002) that work can cause a deterioration in a person's mental health. Individual's with jobs that have high demands and are low in control experience the highest level of stress. Lindholm and colleague's (2003) examination of 268 Swedish nurse managers found that those exposed to high job demands had elevated odds for low-self rated health, regardless of the level of psychosocial resources within and outside work.

Back and neck pain and coronary health disease were negatively associated with mental health status. There was also evidence that these conditions plus irritable bowel and urinary /bladder conditions were linked to higher levels of psychological distress. The link between lower distress and obesity and high blood pressure/ hypertension may reflect lifestyle variables not captured in the analysis.

Limitations of the Study

The sample used in the analysis did not include the unemployed or those outside the labour force; therefore, the decision to participate in the labour force could not be modelled. If these data could be included, we expect that the modelled effects reported might be even greater due to the larger variance. Furthermore, no information was gathered on the age of the respondents' children. This would have facilitated stratifying the sample to assess any differences between new parents and parents of less dependent adolescents.

The analysis may suffer from omitted variable bias. The result that increasing hours of work had a negative impact on mental health could be the result of a variety of factors that are not included in the model. For instance individuals may work beyond what they desire because of financial stress and this financial situation caused deterioration in mental health. A variable that controls for household wealth was not captured in the survey. A regression was run that included several occupational categories in the health sector (not reported here). This produced non-significant coefficients among the occupational groups. The influence of financial stress remains inconclusive.

Treating health status as a continuous variable did not take into account the discrete nature of the indicators. The GMM estimator does not allow the legitimate transformation of the self-reported health variable into several dummy variables when it is endogenous. Thus, self reported health was not treated as a categorical variable. The results, however, were supported by linear and logit regressions that used mental health status as a categorical variable. Also additional OLS and GMM regressions were run that substituted the mental health variable for a continuous variable that represents psychological distress. The output further supported the findings.

6. Conclusion

Australian research on mental health and its impact on the workforce participation within the nursing profession are scant. Investigations relating to nursing hours are based on the assumption of a unidirectional relationship in which mental health/stress is a consequence of the work conditions and hours worked. The evidence reported here showed a simultaneous or two-way relationship between mental health and hours worked – that is, worsening mental health reduced hours worked and increasing hours worked worsened mental health.

Reports on the nursing profession indicate that a stressful work environment negatively impacts on recruitment and retention. Resilience is linked to stress-associated variables of burnout (Simoni and Paterson, 1997), job satisfaction (Larrabee *et al*., 2003) and issues of retention, turnover and absenteeism (Martin, 1995; Noble, 1993; Judkin *et al*., 2006). Studies confirm the benefits of a hardy personality (that is

the ability to experience high degrees of stress without becoming ill) and its positive relationship to mediating stress and reducing illness (Dreher, 1995; Kemeny and Laudenslager, 1999). Judkin's *et al*., (2006) investigation of nurse managers revealed that high levels of resilience under stress made a positive difference to time off due to illness. Others also highlight the need to value nurses' individual coping styles in the work environment (Stacciarini and Troccoli, 2004).

It is reasonable to assume that mental health is highly correlated with resilience. An individual's good mental state and associated resilient personality allows them to better cope under a stressful work environment. Consequently they are able to supply more of their labor than others. Previous studies have shown resilience training within the workplace as effective in improving hardiness scores among nurse managers (Judkins and Ingram, 2002) and nurses (Tierney and Lavelle, 1997). The findings of this study imply that an effective approach to meeting shortages in the nursing workforce should include strategic attempts to improve mental health capital.

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