

Associations between overweight and obesity and risk factors for cardiovascular disease and fatty liver in young offenders serving community orders

Elizabeth Denney-Wilson PhD<sup>1</sup>, Dianna T Kenny PhD<sup>2</sup>, Louise L Hardy PhD<sup>1</sup>,  
Paul Nelson MHSci (Hons)<sup>2</sup>

<sup>1</sup> NSW Centre for Overweight and Obesity,

<sup>2</sup>School of Behavioural and Community Health Sciences,  
University of Sydney

Corresponding author:

Dr. Elizabeth Denney-Wilson

NSW Centre for Overweight and Obesity

Level 2, K25, Medical Foundation Building

University of Sydney NSW 2006

Phone: 61290363181

Fax: 61290363184

Email: [elizabethd@health.usyd.edu.au](mailto:elizabethd@health.usyd.edu.au)

Obesity and risk factors in young offenders

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## ABSTRACT

Purpose: The health of young offenders supervised in the community has not been previously studied. This paper describes the prevalence of overweight, obesity and obesity associated cardiovascular and hepatic risk factors in a sample of young offenders supervised in the community in New South Wales, Australia.

Methods: During 2003-2005, 802 (85% male) young offenders took part in a comprehensive health survey that included direct measurement of height and weight as well as blood sampling.

Results: The prevalence of combined overweight and obesity was 33.7% in boys and 35.3% in girls; both rates were higher than those of a comparable community sample. Cardiovascular risk factor prevalence was extremely high compared with other published studies, with over 90% of boys and almost 80% of girls having low levels of HDL cholesterol, and over 40% of both boys and girls having elevated LDL cholesterol. Risk factors for fatty liver disease were also prevalent with almost 15% of boys, and 30% of girls having raised ALT suggesting hepatic cell injury. Cardiovascular and fatty liver disease risk factors were significantly associated with overweight and obesity among boys, but not girls in this sample. Young people of Aboriginal or Torres Strait Islander descent were at no greater risk than the rest of the population.

Conclusions: Young offenders are among the most disadvantaged people in Australian society and are particularly vulnerable to a range of health problems.

The high prevalence of risk factors represents a substantial health burden for these young people in early adulthood. Timely intervention is required to address the complex health needs of this under-served population.

## INTRODUCTION

Overweight and obesity are among the most common health problems facing young people throughout the world(1). The prevalence of overweight and obesity has been increasing over several decades, with the most recent figures from Australia suggesting that 30% of boys and 25% of girls are either overweight or obese(2). One study from the United States suggests that young people from low socioeconomic backgrounds have a higher prevalence of overweight and obesity than those from higher socioeconomic groups (3) and that some cultural groups may be at increased risk (4). Morbidities associated with obesity may also be more prevalent in young people from some ethnic groups, with research from the United States suggesting that Hispanic migrants were at greater risk of metabolic syndrome than other ethnic groups (5) and evidence from Australia that people of Aboriginal descent have a greater prevalence of risk factors than the general population(6;7).

Cardiovascular disease and fatty liver are among the most commonly associated co-morbidities reported in obese adults and contribute greatly to the overall burden of disease (8;9). Although the consequences of obesity may not be fully realised until adulthood, risk factors for cardiovascular disease and evidence of fatty liver may be present among adolescents (10;11). Several studies have found

that both weight status and risk factors track into adulthood, suggesting that overt disease may be present at younger ages (10;12).

Young offenders are a particularly vulnerable group with respect to a wide range of health problems (13), and research among those in correctional care facilities found that these young people have a higher prevalence of asthma, sexually transmitted disease, dental caries and mental health problems(14). The weight status and prevalence of associated morbidities have not been previously reported. This study aimed to identify the prevalence of overweight, obesity and associated cardiovascular and fatty liver risk markers in a population of community-supervised young offenders in New South Wales, Australia.

## METHODS

### *Ethics*

Ethics approval was independently granted by the University of Sydney Human Research Ethics Committee, the Research Applications Subcommittee of the Department of Juvenile Justice Collaborative Research Unit, Justice Health Human Research & Ethics Committee (formerly Corrections Health), and the Aboriginal Health and Medical Research Council. Written consent was required as a condition of participation. Parental consent was required for participants under the age of 14 years.

### *Participants*

Between October 2003 and December 2005, The University of Sydney, in collaboration with New South Wales (NSW) Department of Juvenile Justice (DJJ), and NSW Justice Health (JH) undertook a comprehensive population physical and mental health survey, titled *Young People on Community Orders Health Survey (YPoCOHS)* (15). The study comprised a comprehensive interview covering 32 domains, a battery of psychological, cognitive and educational assessments, blood and urine sampling and health assessment of visual acuity and BMI of young people on community orders in NSW, Australia. All consenting young people on community orders in NSW in the study period were eligible. DJJ supervises approximately 1,700 young people in the community each year. Approximately 1,900 young people were eligible for inclusion in the survey. Of this group, 400 refused to participate, 600 could not be contacted or did not respond to invitations to participate, and 100 (90 boys and 10 girls) were excluded because of: serious mental health problems, substance withdrawal, considered to be too violent or disruptive by management, and court appearances or being admitted to custody on the day of the survey.

Young people were recruited from all metropolitan and regional Community Centres and from large rural centres. Rates of voluntary participation in the survey ranged from 33% to 67% per centre or geographical location. Large inter-centre variability was identified in consent to participate in the study but no

systematic reasons for this could be identified. The interviews took approximately 3-4 hours. Eighty percent (80%) of the sample agreed to blood testing.

The sample comprised 802 young people, 683 (85%) boys and 119 (15%) girls. Of these, 521 (446 boys and 75 girls) consented to blood sampling. This represents 42% of all available young people on supervised community orders in the regions covered by the survey across New South Wales, Australia. The mean age of the sample was 16 years 6 months (range: 12 to 21 years), 16 years 7 months (range: 12 to 21 years) for boys and 16 years 2 months (range: 13 to 20 years) for girls. Eighty-four percent (84%) were born in Australia, including 153 (20%) young Aboriginal and Torres Strait Islander people. The remainder were from Oceania (9%), Asia (3%) and Other (Middle East, Africa, Europe and USA) (5%).

#### *Anthropometry and blood samples*

Height and weight were measured using standard techniques and BMI was calculated using the formula height (m<sup>2</sup>)/ weight (kg). Participants were categorised as being of normal weight, overweight or obese according to the IOTF definition(16). Venous blood samples were collected by registered nurses employed by Justice Health NSW and analysed by an accredited laboratory using standard techniques.

### *Blood tests*

The blood samples were tested for High Density Lipoprotein (HDL) cholesterol, Low Density Lipoprotein (LDL) cholesterol and triglycerides; all of which are associated with cardiovascular disease, and are routinely measured among adults to determine cardiovascular disease risk. Alanine aminotransferase is a liver enzyme indicative of fatty infiltration and liver cell injury. Elevated levels suggest fatty liver disease (17).

Blood data were categorised as abnormal according to published guidelines from the American Academy of Pediatrics for HDL and LDL cholesterol and triglycerides and based on recommended clinical cut-points for ALT (18). In the current study, an HDL cholesterol level of less than 1.03 mmol/L was considered abnormal, as was an LDL cholesterol level of 3.4 mmol/L. Triglycerides were considered high if the level was above 2.25 mmol/L. An ALT of greater than 30 U/L was categorised as high in boys, while the cut-point was 19 U/L in girls.

### *Data analysis*

Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 12 (SPSS, Chicago, Illinois). Continuous data were converted to categories using the criteria stated above. Bivariate analyses were conducted using the Chi-squared continuity correction statistic. Odds Ratios (OR) and 95% confidence intervals (95% CI) were calculated to quantify the risk associated with

overweight and obesity and risk factors. Risk factor variables that were significant at the  $P=0.05$  or less were entered step-wise into a logistic regression model, and retained in the model if they remained significant at that level.

## RESULTS

The prevalence of overweight and obesity, cardiovascular and liver disease risk factors among young offenders in this study is shown in table 1 with the prevalence from a population based sample of adolescents (mean age 15.4 years) from the NSW Schools Physical Activity and Nutrition Survey (SPANS) conducted in 2004 (19). All of the risk factors were substantially more prevalent among young offenders than among the population sample.

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TABLE 1 ABOUT HERE

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People from Aboriginal or Torres Strait Islander (ATSI) backgrounds may be at greater risk of cardiovascular and other risk factors than the population as a whole (6), and for this reason risk factors for young people of ATSI backgrounds were examined separately. We found that none of the risk factors was more prevalent; however, boys (but not girls) from ATSI backgrounds were significantly less likely to be overweight or obese than the other participants.

Although the prevalence of overweight was similar among boys, the prevalence of obesity in young male offenders was twice as high as that found in a random sample of adolescents from the SPANS. Among young girls, the prevalence of overweight was over 50% higher, and the rate of obesity was three times as high. The prevalence of cardiovascular disease risk factors is of great concern. Young male offenders were 10 times more likely to have raised LDL cholesterol, and girls were 7 times more likely to have elevated levels. Almost all young male offenders (over 93%) had low levels of HDL (or good) cholesterol, while almost 80% of young girls were also affected.

The associations of biological risk factors with overweight and obesity in boys and girls are shown in table 2.

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TABLE 2 ABOUT HERE

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All of the examined cardiovascular risk factors were significantly associated with overweight and obesity among boys but not girls after adjusting for other risk factors. In addition, overweight and obese boys were more likely to have elevated ALT after adjusting for cardiovascular risk factors. The small numbers of individuals (6 boys, 0 girls) with other causes of elevated liver enzymes such as hepatitis were excluded from these analyses.

## DISCUSSION

The weight status and associated morbidities of young offenders serving community orders in NSW, Australia were quantified for the first time in this study in order to better understand their complex health care needs. In this representative group of young offenders, boys had a similar prevalence and girls had a higher prevalence of overweight than comparable school-attending adolescents, and, as a group were at much greater risk of cardiovascular disease and fatty liver disease.

The prevalence of low HDL in this group of young people was extremely high compared with other published studies (2;20). There are a number of possible explanations for this finding in our study. In addition to obesity, physical inactivity, dietary fat intake and acute infection, low HDL cholesterol is associated with cigarette smoking, cannabis use and anabolic steroid intake(21;22). Almost two-thirds of boys and girls in this sample were current smokers, while 65% of boys and 56% of girls admitted to cannabis use in the last month. Only a small number (4 boys and 1 girl) admitted to steroid use. Low HDL cholesterol is associated with cardiovascular disease, but HDL levels can be increased through changes in modifiable risk factors such as smoking cessation, physical activity and the consumption of a low fat diet.

Low HDL was not the only cardiovascular risk factor over-represented in this group of young offenders. High levels of LDL cholesterol were also more common than in other published studies. LDL cholesterol is associated with the development of cardiovascular disease and elevated levels are generally caused by high fat diets, physical inactivity and excess weight. The young people in this study are at substantially increased risk of developing cardiovascular disease and need primary health care programs that address diet and exercise.

Elevated levels of the liver enzyme ALT are suggestive of fatty infiltration within the liver and hepatic cell injury. Almost 15% of young boys and almost 30% of young girls had elevated ALT. The natural history of young people with elevated ALT is unknown, but fatty liver is a serious condition that compromises liver function and can ultimately lead to liver failure and cirrhosis (23). Lifestyle interventions such as improving diet and increasing physical activity have been effective in reducing severity of fatty liver in adults (24).

Several studies have shown an association between cardiovascular risk factors and overweight and obesity in adolescents (5;25;26). Other studies have confirmed that risk factors are associated with atherosclerotic changes such as fatty streaks in the aorta and arterial plaques, even in adolescents (27;28). There is strong evidence to suggest that the boys in this study who were overweight or obese were at significantly greater risk of cardiovascular disease.

Although cardiovascular and fatty liver disease risk factors were highly prevalent among girls in this study, none were associated with overweight and obesity. This would suggest that other causes of abnormal values of risk factors such as physical inactivity, smoking and cannabis use may be contributing to cardiovascular risk among girls and that even those who are of a healthy weight require further investigation for cardiovascular and liver disease.

Boys in this study had a higher prevalence of risk factors, and exhibited a stronger association of risk factors with overweight and obesity compared with girls. Other research suggests that boys are more at risk from risk factors associated with overweight than girls (29), possibly because boys are more likely to have higher levels of abdominal fat than girls, but this could not be confirmed in the current study.

This comprehensive study of young offenders examined a wide range of health and social variables, and was not specifically designed to assess obesity associated morbidity. As such, some limitations exist in terms of interpreting these findings. Further investigation of these young people and medical follow-up is required to improve their long term morbidity. Adolescents in general, and this population in particular are under-served in terms of health care (30).

Although the health systems are very different, physicians in Australia and the

United States report similar barriers including cost, time and confidence in skills in treating adolescents (30). Many young people may use emergency rooms as their only source of health care, and may not have access to any preventive health or counselling services that may be found in primary care (31).

Management of cardiovascular risk factors may not be seen as a priority for young offenders with serious mental health and or social problems.

This study presents the first examination of the weight status and associated risk factors among young offenders supervised in the community. Young offenders are a particularly disadvantaged and vulnerable group within the community, and this study demonstrates further disparities in terms of their risk for long term, chronic morbidity. Programs that address physical, social and mental health needs are required to treat existing risk factors and improve long term outcomes among these young people. Lifestyle programs that encourage cardiovascular risk prevention such as smoking cessation (both tobacco and cannabis), healthy eating and physical activity would also be beneficial. More research is needed to identify novel strategies and interventions to improve the health of young offenders.

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Table 1 Prevalence of overweight, obesity and abnormal values of biomarkers in young offenders, compared with a representative sample of adolescents

	Young offenders		School survey sample	
	Boys % N=446	Girls % N=75	Boys % N=290	Girls % N=204
Overweight	20.0	22.4	21.5	14.6
Obese	13.7	12.9	6.6	4.4
High ALT	14.9	29.7	9.0	5.3
High LDL	42.5	42.9	4.5	6.3
High Triglycerides	4.4	5.0	1.0	0.0
Low HDL	93.3	79.0	10.7	3.9

Table 2 Associations of biological risk factors with overweight and obesity in young offenders

Risk factor	N	Overweight or obese (%)	Odds Ratio (95% CI)	P value
<i>Boys</i>				
High ALT	65	32.9	7.6 (3.9, 14.6)	<0.0001
High LDL	290	50.0	2.3 (1.1, 4.6)	0.02
High Triglycerides	30	9.3	6.1 (2.1, 18.1)	<0.0001
Low HDL	258	96.1	3.3 (1.3, 8.2)	0.01
<i>Girls</i>				
High ALT	22	39.3	2.1 (0.7, 5.7)	0.2
High LDL	51	40.9	0.9 (0.4, 1.9)	0.7
High Triglycerides	6	9.1	3.6 (0.6, 20.8)	0.1
Low HDL	44	81.8	1.3 (0.5, 3.4)	0.6