

行政院國家科學委員會專題研究計畫 成果報告

兒童青少年肥胖，體適能與學業表現關係之長期追蹤研究
(第2年)

研究成果報告(完整版)

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中華民國 101 年 08 月 21 日

中文摘要：目的：本研究主要在探討六年長期追蹤調查之孩童肥胖與學業成就之關係。

方法：2002年台中市某國小一年級學生參與本研究，並追蹤六年時間(樣本數為409人)。學業成就來自每年級學期末之學校校務系統登記之分數；學生身高與體重係於每年級學期初所測量之紀錄；身體質量指數(BMI)為體重(公斤)除以身高(公尺)的平方，並以國際肥胖工作小組(IOTF)的標準定義正常、過重及肥胖。並依據小一和小六體位的差異，將體位改變情形作分類。多變量線性迴歸用來預測小六成績，並控制個人基本資料、智商、和學校缺席日數。

結果：小一的肥胖盛行率，男生為18.8%，女生為15.2%，男女生間無顯著差異存在($p=.346$)。六年後，肥胖盛行率上升，男生為34.3%，女生為20.7% ($p=.002$)；大約17.9%的男生和12.2%的女生一直都維持肥胖體位，16.9%的男生和9.5%的女生由正常變成肥胖體位。迴歸結果顯示，不管男生或女生，六年期間之體位改變與學業成就並無顯著關係存在。

結論：本研究六年長期追蹤調查結果支持肥胖與學業成就之間無顯著關係存在，提供現有文獻上體位改變與學業成就關係更深入的了解。

中文關鍵詞：肥胖, 體適能, 學業成就, 學業表現, 學術表現

英文摘要：Purpose: This study was designed to examine the association between childhood obesity and academic performance with six-year follow-up.

Methods: The first-grade students from one elementary school district in Taichung City, Taiwan participated in this study in 2002 and followed up for six years ($n=409$). Academic performance was extracted from the school records at the end of each grade. The weight and height were measured at the beginning of each grade and body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters. The International Obesity Task Force (IOTF) criteria were used to determine normal, overweight and obesity classifications. A weight change variable was created based on an individual's weight status differences at grade one and grade six. Multivariate linear regression models for predicting academic performance at grade six were undertaken after adjusting for individual characteristics,

intelligence quotient (IQ) and absenteeism at school. Results: At the first grade, the prevalence of overweight and obesity was 18.8% in boys and 15.2% in girls. No significant difference was found between genders in obesity prevalence ($p=.346$). The obesity increased after six years, with 34.3% in boys and 20.7% in girls ($p=.002$). Around 17.9% of boys and 12.2% of girls were always overweight/obese and 16.9% of boys and 9.5% of girls became overweight/obese. The results of the regression analyses revealed that change in weight status over a six-year period was not significantly associated with academic performance among either boys or girls. Conclusion: This study provided additional support of the lack of independent association of obesity on academic performance over six years, extending the understanding of the relationship between weight change and academic performance.

英文關鍵詞： obesity, fitness, academic performance, school performance, school achievement

兒童青少年肥胖，體適能與學業表現關係之長期追蹤研究
A longitudinal study on obesity, physical fitness and academic performance
among children and adolescents

- 計畫類別(單選)：新進人員研究計畫
- 研究型別：個別型計畫
- 計畫歸屬：人文處
- 申請機構/系所(單位)：國立臺灣體育運動大學運動健康科學學系
- 本計畫主持人姓名：陳俐蓉
- 本計畫名稱：

中文：兒童青少年肥胖，體適能與學業表現關係之長期追蹤研究

英文：A longitudinal study on obesity, physical fitness and academic performance among children and adolescents

- 全程執行期限：民國 99 年 07 月 31 日至 101 年 07 月 31 日

兒童青少年肥胖，體適能與學業表現關係之長期追蹤研究
**A longitudinal study on obesity, physical fitness and academic performance
among children and adolescents**

Study one: A longitudinal study on childhood obesity and academic performance

Abstract

Purpose: This study was designed to examine the association between childhood obesity and academic performance with six-year follow-up.

Methods: The first-grade students from one elementary school district in Taichung City, Taiwan participated in this study in 2002 and followed up for six years (n=409). Academic performance was extracted from the school records at the end of each grade. The weight and height were measured at the beginning of each grade and body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters. The International Obesity Task Force (IOTF) criteria were used to determine normal, overweight and obesity classifications. A weight change variable was created based on an individual's weight status differences at grade one and grade six. Multivariate linear regression models for predicting academic performance at grade six were undertaken after adjusting for individual characteristics, intelligence quotient (IQ) and absenteeism at school.

Results: At the first grade, the prevalence of overweight and obesity was 18.8% in boys and 15.2% in girls. No significant difference was found between genders in obesity prevalence ($p=.346$). The obesity increased after six years, with 34.3% in boys and 20.7% in girls ($p=.002$). Around 17.9% of boys and 12.2% of girls were always overweight/obese and 16.9% of boys and 9.5% of girls became overweight/obese. The results of the regression analyses revealed that change in weight status over a six-year period was not significantly associated with academic performance among either boys or girls.

Conclusion: This study provided additional support of the lack of independent association of obesity on academic performance over six years, extending the understanding of the relationship between weight change and academic performance.

Keywords: obesity; academic performance; school performance

中文摘要

Study one: 孩童肥胖與學業成就之長期追蹤調查

目的：本研究主要在探討六年長期追蹤調查之孩童肥胖與學業成就之關係。

方法：2002年台中市某國小一年級學生參與本研究，並追蹤六年時間(樣本數為409人)。學業成就來自每年級學期末之學校校務系統登記之分數；學生身高與體重係於每年級學期初所測量之紀錄；身體質量指數(BMI)為體重(公斤)除以身高(公尺)的平方，並以國際肥胖工作小組(IOTF)的標準定義正常、過重及肥胖。並依據小一和小六體位的差異，將體位改變情形作分類。多變量線性迴歸用來預測小六成績，並控制個人基本資料、智商、和學校缺席日數。

結果：小一的肥胖盛行率，男生為18.8%，女生為15.2%，男女生間無顯著差異存在($p=.346$)。六年後，肥胖盛行率上升，男生為34.3%，女生為20.7% ($p=.002$)；大約17.9%的男生和12.2%的女生一直都維持肥胖體位，16.9%的男生和9.5%的女生由正常變成肥胖體位。迴歸結果顯示，不管男生或女生，六年期間之體位改變與學業成就並無顯著關係存在。

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A longitudinal study on childhood obesity and academic performance

Introduction

Obesity is increasingly prevalent among children and adolescents (L.-J. Chen, K. R. Fox, A. M. Haase, & J.-M. Wang, 2006; Lobstein, Baur, & Uauy, 2004). Evidence suggests that obesity during early years is associated with risk factors and related physical and psychosocial consequences (French, Story, & Perry, 1995; Must & Strauss, 1999; Regan & Betts, 2006; Williams, Wake, Hesketh, Maher, & Waters, 2005). However, less attention has been paid to the association between obesity and academic performance. A review paper found that from 1994 to 2004, only nine studies examining the link between childhood obesity and school performance were published (Taras & Potts-Datema, 2005), suggesting a lack of understanding in this area.

The previous limited studies showed a possible association between obesity and academic performance, showing obese children had a poor academic performance (Datar & Sturm, 2006; Datar, Sturm, & Magnabosco, 2004; Sabia, 2007; Sigfúsdóttir, Kristjánsson, & Allegrante, 2007). The findings from preceding studies suggested that obesity might have a negative effect on academic performance for children. However, more research is needed for addressing more potential confounders when examining the association between obesity and academic performance. The influence of being overweight or obese on academic performance might differ between genders. Moreover, absenteeism in school and intelligence quotient (IQ) could be important factors when examining the association between obesity and academic performance (Campos, Sigulem, Moraes, Escrivão, & Fisberg, 1996; Li, 1995; Schwimmer, Burwinkle, & Varni, 2003). Nevertheless, these factors have not been put into consideration in a single study. Additionally, longitudinal data are particularly scarce. Therefore, this study is designed to investigate the relationship between childhood obesity and academic performance over six years controlling for several important confounders.

Methods

Participants

All of the first-grade students in 2002 in one school district in Taichung City, Taiwan were selected in this study. Data were collected from the beginning of grade one in 2002 as the baseline data and followed up to the end of grade six in 2008. Over a six-year period, 70 children had left the school, resulting in 409 participants (211 boys and 198 girls).

Measures

Dependent variable

Academic performance was the mean scores of Language, Mathematics, Science and Social Studies, extracted from the school records at the end of each grade.

Independent variables

The weight and height were measured at school by the school nurse. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters (kg/m^2). The International Obesity Task Force criteria (Cole, Bellizzi, Flegal, & Dietz, 2000) were used to determine normal, overweight and obesity classifications at each age and for each gender. As low obesity prevalence was consistently found, both the overweight and obesity figures were combined for some analyses and subsequently referred to as 'overweight/obesity'. Then, three groups were categorized as 'Never overweight/obese' (the child was not overweight/obese at grade one and grade six), 'Became overweight/obese' (the child was not overweight/obese at grade one but was overweight/obese at grade six), 'Always overweight/obese' (the child was overweight/obese at grade one and at grade six). There were very few cases ($n=9$) that went from being overweight/obese at grade one to not overweight/obese at grade six. These cases were dropped from analyses due to the insufficient statistical power.

Absenteeism: the total number of days absent from school was collected from the school record from grade one to grade six.

Intelligence quotient (IQ): The Raven's Colored Progressive Matrices (CPM) was administered at grade two in school. The Chinese version was developed and validated. The test-retest reliability of the Chinese version was .59 - .83 over a 4-week period and it was significantly associated with the Wechsler Intelligence Scale for Children ($\gamma = .31-.33$) (Hsu, 1990).

Demographic characteristics: variables included gender, parental education, having siblings or not, and whether the child belongs to single parent household. Age was not considered since all participants were first graders in 2002 and sixth graders in 2008 who were either 11 or 12 years old.

Statistical analysis

The differences between gender, weight status, and among the groups of weight status change were tested using χ^2 , T-test or ANOVA. In order to estimate the relationship between change in weight status and academic performance, multivariate linear regressions were used controlling for absenteeism, IQ and demographic characteristics. The dependent variable is academic performance at grade six.

Results

Descriptive statistics

This study showed that 18.8% of the boys and 15.2% of the girls were either overweight or obese at baseline (gender difference: $p = .346$). However, the overweight/obesity prevalence increased after six years, with 34.3% in boys and 20.7% in girls (gender difference: $p = .002$). The figure of BMI changes over six years was shown in figure 1. The finding illustrated that the trajectory pattern of BMI was linear. However, the trajectory of changes in academic

performance was non-linear, as shown in figure 2. The average score increased at the second grade than dropped sharply.

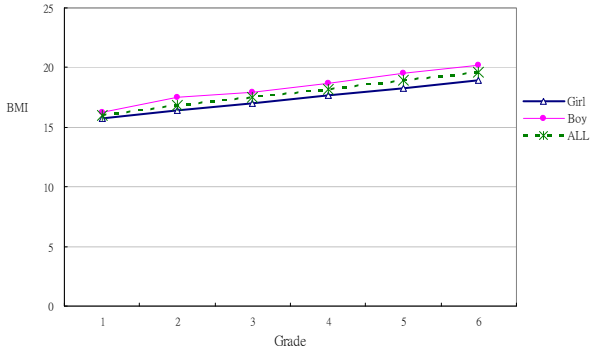


Figure 1: BMI change over six years

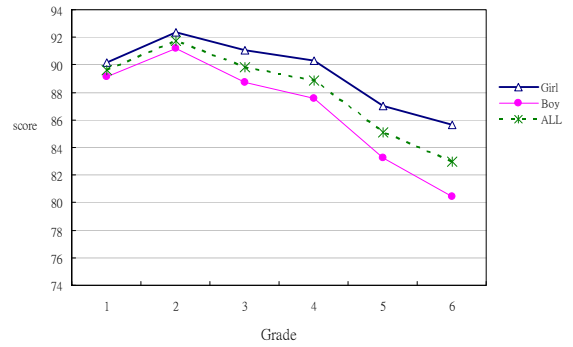


Figure 2: Academic performance over six years

No significant difference was found between genders in demographic variables, IQ, absenteeism or academic performance at grade one (table 1). There was no significant difference between overweight/obese and not overweight/obese groups in gender, parental education, IQ, absenteeism or academic performance at grade one. However, children living in one child family or single parent household were more overweight/obese than the compared group.

Table 1: Descriptive statistics by gender and weight status

Variables	Gender		<i>p</i>	Weight status at grade one		<i>p</i>
	Boys	Girls		Overweight/ obese	Normal/ underweight	
Gender (%)						.346
Boys (n=211)				18.8	81.3	
Girls (n=198)				15.2	84.8	
Father's education (%)			.358			.420
Low (college or lower)	50.3	49.7		18.0	82.0	
High (bachelor or higher)	55.7	44.3		14.4	85.6	
Mother's education (%)			.724			.913
Low (college or lower)	50.8	49.2		17.1	82.9	
High (bachelor or higher)	52.9	47.1		17.6	82.4	
Having siblings (%)			.222			.007
Yes	44.8	55.2		28.4	71.6	
No	52.9	47.1		14.8	85.2	
Single parent household (%)			.942			.013
Yes	52.1	47.9		29.8	70.2	
No	51.5	48.5		15.4	84.6	
Weight status_grade one (%)			.346			
Overweight/obese	56.5	43.5				
Not overweight/obese	50.3	49.7				
Absenteeism (Mean)	7.5	7.3	.785	7.6	7.4	.851
IQ (Mean)	66.6	67.8	.656	68.2	67.2	.789
Score_grade one (Mean)	88.7	90.3	.107	90.0	89.4	.630

About 18.0% of boys and 12.1% of girls were always overweight/obese and 17.0% of boys and 9.5% of girls became overweight/obese. No significant difference was found in absenteeism, IQ, and academic performance between groups.

The results from the multivariate regression analyses controlling for baseline academic performance, demographic variables, absenteeism, and IQ showed that Change in weight status over a six-year period was not significantly associated with academic performance among either boys or girls (all $p > .05$).

Acknowledgement

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兒童青少年肥胖，體適能與學業表現關係之長期追蹤研究
**A longitudinal study on obesity, physical fitness and academic performance
among children and adolescents**

Study two: Relationship between fitness and academic performance in adolescents

Abstract

Purpose: This study examined the association between fitness and academic performance in adolescents with three-year follow-up.

Methods: The 7th graders from one junior high school district participated in this study (n=669) and were followed up for three years (n=669, boys=352). Academic performance was extracted from school records at the end of each grade. Cardiovascular (CV) fitness, sit-and-reach flexibility, bent-leg curl-ups and height and weight for calculating body mass index (BMI) were assessed at the start of each grade. Univariate and multivariate linear regressions for predicting academic performance at grade nine was performed.

Results: The results showed that changes of weight status and cardiovascular fitness significantly predicted academic performance (p=0.003 and 0.001, respectively), whereas changes of flexibility and muscle strength were unrelated to academic performance (p=0.188 and 0.158, respectively). Those who persisted in being underweight or who became underweight showed worse academic scores than those who were consistently normal weight (p=0.027 and p=0.018, respectively). Those who passed both CV fitness tests and those who failed in the first test but passed in the second had higher academic scores than those who went on to fail both tests (p=0.006 and p=0.017, respectively).

Keywords: fitness, academic achievement, school performance, school achievement

A longitudinal study on the association of fitness with academic performance in adolescents

Introduction

Physical fitness is shown to be associated with obesity, cardiovascular disease, skeletal health, and mental health (L. J. Chen, K. R. Fox, A. M. Haase, & J. M. Wang, 2006; Ortega, Ruiz, Castillo, & Sjöström, 2008). Recently, there is a small but increasing interest on the relationships between physical fitness and academic performance. The limited evidence base generally indicates that physical fitness is positively associated with academic performance (Chomitz et al., 2009; Welk et al., 2010).

One review of research showed that only four studies were found examining the link between physical fitness and academic performance and all studies were cross-sectional and correlational in design (Keeley & Fox, 2009). For example, one study reported a positive relationship between overall physical fitness and academic performance with a large sample size in the US (n=884715). The effect of this relationship was stronger for girls than boys and stronger for high social-economic status (SES) students than lower SES students (Grissom, 2005). Dwyer (Dwyer, Sallis, Blizzard, Lazarus, & Dean, 2001) used numerous subjective tests for measuring physical fitness and a rating of academic ability on a five-point scale to represent academic performance among 7961 Australian schoolchildren (7-15 year olds). Associations were found between cardiovascular fitness, muscular force/power, flexibility and academic ratings. Another research examined the association between various components of fitness and academic performance in 259 third-and fifth-grade American schoolchildren (Castelli, Hillman, Buck, & Erwin, 2007). The results showed that aerobic capacity and body composition was significant associated with academic performance, whereas muscle strength and flexibility fitness were unrelated to academic performance. A recent study with 134 elementary schoolchildren in the US found that aerobic fitness and muscular fitness, but not BMI, were related to mathematics scores

(Eveland-Sayers, Farley, Fuller, Morgan, & Caputo, 2009). These findings suggested that a positive relationship existed between mainly cardiovascular fitness and academic performance and different components of fitness might have different effects on academic performance.

However, these cross-sectional studies are unlikely to provide an accurate estimate of the causal effect of physical fitness on academic performance. Longitudinal data controlling potential confounders (e.g., gender and SES) are limited with only one published prospective study found (London & Castrechini, 2011). London and Castrechini (London & Castrechini, 2011) examined the association between academic performance and overall physical fitness longitudinally from fourth to seventh (n=1325) and sixth to ninth grades (n=1410) in the US. The results indicated that a combination of fitness tests was more predictive of academic performance than any one test. Students who were persistently fit had higher academic scores than those who were persistently unfit, suggesting improved fitness is associated with increased academic performance over time.

In order to add more evidence to the literature, the present study was designed to explore the longitudinal effects of different forms of fitness on academic performance among adolescents.

Methods

Participants

This study was conducted in one high school district in Taichung City in Taiwan. All students who enrolled in the school at grade seven (n=723) were invited to take part in this study. Any student who moved out of the district, students with disability, or who did not return the consent form was excluded from this study. The final sample was 669 with 352 boys and 317 girls (mean age = 14.6). They participated in this study in 2008 year and were followed up for three years from grade seven to grade nine until 2011.

Measures

Academic performance was the outcome variable, which was measured as the mean score of Language, Mathematics, Science and Social Studies. All students took exactly the same tests in school and the scores were extracted from the school records at the end of each grade, ranging from 0 to 100.

The fitness tests were completed during physical education (PE) classes between October and November each year, and administered by the Chief of PE to ensure consistency from grade seven to grade nine. The fitness tests included four measures: (1) 1600(boys)/800(girls)-meter run was used to assess cardiovascular endurance; (2) The standardised sit-and-reach test was used to measure the lower back and hip joint flexibility; (3) The number of bent-leg curl-ups attained in 1min was used to test abdominal muscle strength and endurance; (4) Body composition was obtained through measured height and weight by the school nurse.

The raw scores of the 1600(boys)/800(girls)-meter run, sit-and-reach test and bent-leg curl-ups were converted into a percentile rank (PR) based on normative data at each age and for each gender in Taiwan. Then, the above fitness results were grouped into two levels: 'pass' and 'fail'. Those who had fitness PR less than the 25th were classified as 'fail', which was suggested by the Taiwan Ministry of Education as 'needs improvement'. Changes in fitness levels were created based on the difference between each child's scores in 7th grade and 9th grade. Four groups were categorized: 'pass-pass' (pass at 7th grade and 9th grade), 'pass-fail' (pass at 7th grade but fail at 9th grade), 'fail-pass' (fail at 7th grade but pass at 9th grade), 'fail-fail' (fail at 7th grade and 9th grade).

Weight and height were converted to BMI and children categorized as underweight, normal weight, overweight and obesity using age and gender specific criteria suggested by the Taiwan Ministry of Education (Taiwan Ministry of Education, 2011). Both the overweight and obesity figures were combined for analyses and subsequently referred to as 'overweight/obesity'. Then, a weight change variable was created based on an individual's weight status difference between 7th

grade and 9th grade. Six groups were categorized as ‘always normal’ (normal weight at 7th grade and 9th grade), ‘always underweight’ (underweight at 7th grade and 9th grade), ‘always overweight/obese’ (overweight/obese at 7th grade and 9th grade), ‘became normal’ (not normal weight at 7th grade but was normal weight at 9th grade), ‘became overweight/obese’ (not overweight/obese at 7th grade but was overweight/obese at 9th grade), ‘became underweight’ (not underweight at 7th grade but was underweight at 9th grade).

Variables including gender and parental socio-economic status (SES) were collected at 7th grade. These factors have been shown to be associated with children’s academic performance (Datar & Sturm, 2006; Sigfúsdóttir et al., 2007). SES was assessed by parents’ occupation and education based on Hollingshead’s ‘Two Factor Index of Social Position’, modified to fit Taiwanese society by Lin (Lin, 1994). Parents’ occupation and education were both divided into 5 levels and scored from 5 to 1. The SES score was obtained with occupational score \times 7 + educational score \times 4 (Chen, Fox, Haase, & Ku, 2010). Scores were then grouped into tertiles (low, moderate and high). The child’s age was not considered since all participants were 7th graders in 2008-2009 school year.

Statistical analysis

Means and percentages of variables were calculated for gender and academic performance at grade nine. The differences were tested using χ^2 , t-test or analysis of variance (ANOVA). In order to estimate the relationship between change in fitness levels and academic performance, univariate and multivariate linear regressions were conducted. The dependent variable was academic performance at 9th grade. Variables showing significant relationships with academic performance in the univariate model were then entered into a multivariate model simultaneously. The above analyses were performed with SPSS 16.0 for Windows.

Results

Descriptive statistics

Table 1 provides descriptive statistics by gender and academic performance at grade nine for SES and all fitness components. About one third of boys and half of girls remained normal weight. More than one quarter of boys and 18.2% of girls persisted overweight or obese. Less than 4.0% of students became overweight or obese in either boys or girls. The prevalence of became underweight ranged from 4.4% to 7.3% for girls and boys. No significant gender difference was found in SES, changes of cardiovascular fitness, flexibility and muscular strength ($p=0.072$, 0.209 , 0.831 , and 0.061 , respectively). Significant associations were found in gender, SES, changes of weight status and cardiovascular fitness with academic performance ($p<0.001$, $p<0.001$, $p=0.003$, $p=0.001$, respectively).

Table 1: Descriptive statistics by gender and academic performance

Variables	Gender			Academic score (9 th grade)	
	Boys	Girls	p	Mean	p
Gender (%)					<0.001
Boys (n=352)	52.6			68.2(14.6)	
Girls (n=317)		47.4		74.4(12.4)	
SES (%)			0.072		<0.001
Low	45.5	54.4		70.3(13.0)	
Moderate	40.4	32.1		71.9(13.3)	
High	14.0	13.6		80.2(11.4)	
Weight status change (%)			0.004		0.003
Always normal	34.9	50.0		73.7(13.6)	
Always underweight	16.8	11.7		63.3(12.7)	
Always overweight/obese	26.3	18.2		71.7(14.0)	
Became normal	11.1	12.4		72.8(13.7)	
Became overweight/obese	3.5	3.3		69.8(15.3)	
Became underweight	7.3	4.4		65.7(13.7)	
1600/800-meter run (%)			0.209		0.001
Pass - Pass	54.5	59.4		72.3(13.8)	
Pass - Fail	17.8	18.8		67.8(14.0)	
Fail - Pass	10.3	10.7		74.2(14.9)	
Fail - Fail	17.5	11.1		67.4(14.0)	
Sit and reach (%)			0.831		0.488
Pass - Pass	78.7	78.1		71.0(14.1)	
Pass - Fail	7.0	8.9		69.2(14.0)	
Fail - Pass	6.7	5.9		73.6(15.0)	
Fail - Fail	8.0	7.1		69.4(13.9)	
Bent leg Curl ups (%)			0.061		0.158
Pass - Pass	69.3	65.0		71.6(13.5)	
Pass - Fail	7.0	13.9		68.4(14.7)	
Fail - Pass	12.3	10.9		71.6(13.6)	
Fail - Fail	11.3	10.2		68.1(17.1)	

Notes: Figures in brackets are standard deviation.

Univariate and multivariate linear regressions

A small amount variance was explained by gender (4.9%) and SES (6.0%), illustrating that girls and those in the higher SES reported greater academic scores than the reference group. Weight status change was a significant predictor of academic performance ($R^2=3.0$, $p=0.003$). Students who persisted to be underweight or became underweight had lower academic scores than those who persisted to be normal weight ($p=0.002$ and 0.001 , respectively). Less than 3% of variance was explained by cardiovascular fitness, flexibility and muscular strength separately (2.9%, 0.4% and 0.9%, respectively). Those who went on to pass cardiovascular fitness tests and those who failed in the first test but passed in the second showed higher scores than those who went on to fail both tests ($p=0.006$ and 0.005 , respectively). No relationship was found between changes of flexibility and muscular strength with academic scores ($p=0.488$ and 0.158 , respectively).

Simultaneous multiple regression analysis was performed to explore predictors of academic performance and determine the proportion of variance explained by key variables. Four variables (gender, SES, changes of weight status and cardiovascular fitness) were entered into the multivariate model. Similar results were found between univariate and multivariate models among these variables. Boys and those who went on to be underweight or became underweight had worse academic performance than girls and those who went on to be normal weight ($p<0.001$, $p=0.027$ and $p=0.018$, respectively). Students who were in the high SES, who passed both cardiovascular fitness tests and who failed in the first test but passed in the second had higher academic scores than those who were in the moderate SES and who went on to fail both tests ($p<0.001$, $p=0.006$ and $p=0.017$, respectively).

Conclusions

This research demonstrated that various forms of fitness have different relationships with academic performance with three-year follow-up among schoolchildren. The findings suggested

that changes of muscle strength and flexibility fitness were unrelated to academic performance, which is consistent with previous cross-sectional studies (Castelli et al., 2007; Edwards, Mauch, & Winkelman, 2011). Changes of weight status and cardiovascular fitness were significant predictors for overall academic performance

Acknowledgements

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國科會補助出席國際學術會議報告

101 年 2 月 13 日

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國科會 補助金額	新台幣: 70,000元整 補助編號: 99-2410-H-028-002-MY2		
會議時間	2012 February 8 th to 10 th	會議地點	Melbourne, Australia
會議 名稱	(中文) 2012 第九屆澳洲健康行為與醫學年會 (英文) ASBHM 9 th Annual Scientific Conference		
發表 論文題目	(中文) 青少年體適能與學業成就之長期追蹤調查研究 (英文) A longitudinal study on the link between physical fitness and academic performance in adolescents		
論文 發表形式	Poster		

報告內容

一、會議性質介紹：

第九屆之澳洲健康行為與醫學會（Australian Society for Behavioral Health and Medicine, ASBHM）學術會議（9th Annual Scientific Conference）於澳洲墨爾本（Melbourne）城市舉辦，會議期間為2012年2月8日至10日，共計3日。舉辦地點在 Rydge Hotel, Melbourne。本會議係由澳洲健康行為醫學會主辦，主要會員國為澳洲與紐西蘭等亞太國家。澳洲健康行為與醫學會之學術研討會係國際間研究健康行為與醫學領域之重要學術會議，其任務為提供健康行為與醫學領域之研究者發表與討論的研究空間，在推動健康行為與醫學的發展與實踐，並促進健康行為與醫學的影響與世界交流，其中身體活動(運動行為)為該學會之重要議題之一。

本次研討會主題為：縮減差距：強化夥伴關係以了解與改善民眾健康行為（Closing the gaps: Strengthening partnerships for understanding and improving health behaviors）。三天緊湊的會議行程包含下列子題：Health behaviours (健康行為)、Indigenous health issues (原住民健康議題)、Cancer (癌症)、Translation of research to policy and practice (研究轉化政策與實踐)、Physical activity (身體活動)、Achieving equity (追求公

平)、Intervention and Program Evaluation (介入與方案評估)、Chronic Disease Prevention and Management (慢性疾病的預防與管理)、Eating Issues (飲食行為)、Unhealthy Behaviours: Alcohol and Smoking (不健康行為:喝酒與抽菸)、Factors Affecting Health Behaviour Change (影響健康行為改變之因子)、Critical Perspectives (批判觀點)、Quality of Life Issues (生活品質)、Work-Related Health (職場健康)、Emotional, Cognitive and Social Issues Related to Health and Illness Behaviours (各種與健康疾病有關之情緒、認知與社會議題)。

因此，該研討會吸引來自澳洲、紐西蘭、美國、英國及台灣等地的心理學家、臨床學者、教育學者、研究者、運動教練等共襄盛舉，相互交流與討論相關研究。

二、參加會議經過；

研討會會議於 2 月 8 日開始至 10 日結束。參與人數中，亞太地區參與人數佔多數，人員包含癌症研究學會研究員、大學教授、臨床醫生與學者，另外，有部份為碩博士學生。由於會議議題眾多，內容極為多元與豐富，會議議程亦相當緊湊。會議議程從早上 9:00 開始，排到晚上 6:00 結束。除了上述提及研討會議題外，本研討會形式亦包含專題演講 (keynotes)、專題座談會 (symposia)、專題討論會

(workshops)、口頭發表(oral presentations) 以及海報發表 (posters)等，同一時段在不同會議廳，各有不同子題同時進行發表。

三、參加會議心得

- 本次會議係屬中型研討會(人數約為 300 人)。主要參與者均對健康行為與醫學有濃厚興趣，因此在口頭研究發表當中，提問情況相當踴躍。海報發表之交流情形亦不惶多讓。由於身體活動為該研討會之主要子題之一，本人所發表之體適能與學業成就一文，引起研究者的興趣並接收到許多肯定。其中，澳洲 Deakin University 團隊在學童身體活動之推動促進與介入等研究相當豐碩，值得學習。
- 本研討會有許多學者進行跨理論模式 (Transtheoretical Model, TTM) 研究，及有關影響健康行為之相關因素之探討，可供未來進行運動行為研究之參考。另外，有學者對 facebook 中的 image 對學生進行身體意象、體型滿意度與飲食及減重行為之相關研究，議題頗為新穎。

四、相關參考資料

攜回該研討會會議議程及相關書面資料

五、成果照片 (圖 1 - 圖 3)



圖 1:海報發表 1



圖 2:海報發表 2



圖 3:海報發表 3

A Longitudinal Study on the Link Between Physical Fitness and Academic Achievement in Adolescents

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Introduction

Physical fitness is shown to be associated with obesity, cardiovascular disease, skeletal health, and mental health. There is a small but increasing interest on the relationships between physical fitness and academic performance. However, most studies are cross-sectional in design, which are unlikely to provide an accurate estimate of the causal effect of physical fitness on academic performance. This study therefore examined the link between fitness change and academic achievement among adolescents over three years.

Methods

Seven graders from one junior high school district in Taiwan participated in this study and were followed for three years (n=669, girls=371). Academic achievement was extracted from the school records at grade nine. The fitness tests were tested every year, including 1600(boys)/800(girls)-meter run, sit-and-reach, bent-leg curl-ups and body composition. Body composition was measured by the school nurse using weight and height. It grouped into underweight, normal weight and overweight/obese according to the national criteria using body mass index. A weight change variable was created based on individuals' weight status differences between grade seven and nine (always normal, always overweight/obese, always underweight, became normal, became overweight/obese or became underweight). Fitness scores were classified as 'pass' or 'fail' based on normative data for each fitness component. Fitness changes were categorized based on fitness levels between grade seven and nine (pass-pass, pass-fail, fail-pass or fail-fail). Univariate and multivariate linear regression was performed controlling for gender and social-economic status. Variables showing significant relationships with academic performance in the univariate model were then entered into a multivariate model simultaneously.

Results

Results from the univariate models revealed that changes of weight status and cardiovascular fitness significantly predicted academic performance (p=.003 and .001, respectively), whereas changes of flexibility and muscle strength were unrelated to academic performance (p=.488 and .158, respectively). In the multivariate model, adolescents who were always underweight or became underweight showed worse academic performance than those who were always normal weight (p=.027 and .018, respectively). Those who passed both cardiovascular fitness tests and who failed in the first test but pass in the second had higher academic scores than those who went on to fail both tests (p=.006 and .017, respectively). However, only a modest total amount of variance (17.3%) was explained for academic achievement by these variables.

Table 1: Univariate and multivariate regression estimates of the relationship between fitness change and academic performance

Variables	Univariate model				Multivariate model			
	R ²	B (SE)	t	P	R ²	B (SE)	t	P
Gender	4.9			<0.001	17.3			
Boys*		-0.22(1.07)	-5.83	<0.001		-7.20(1.20)	-6.06	<0.001
SES	6.0			<0.001				
Low ^b		0.52(1.13)	0.73	0.468		0.37(1.25)	0.28	0.781
High ^b		10.74(1.71)	6.30	<0.001		10.02(1.91)	5.24	<0.001
Weight status change	3.0			0.005				
Always underweight ^c		-5.37(1.72)	-3.12	0.002		-3.87(1.74)	-2.22	0.027
Always overweight/obese ^c		-2.05(1.47)	-1.39	0.164		0.10(1.60)	0.10	0.921
Became normal ^d		-0.93(1.86)	-0.48	0.629		-0.23(1.89)	-0.12	0.903
Became overweight/obese ^d		-3.93(3.18)	-1.24	0.218		0.91(3.25)	0.28	0.780
Became underweight ^e		-8.03(2.47)	-3.26	0.001		-6.08(2.55)	-2.38	0.018
1600/800-meter run	2.9			0.001				
Pass - Pass ^f		4.88(1.70)	2.78	0.004		4.94(1.78)	2.77	0.006
Pass - Fail ^f		0.37(2.10)	0.17	0.869		0.24(2.08)	0.11	0.909
Fail - Pass ^f		6.81(2.42)	2.82	0.005		5.59(2.52)	2.19	0.017
Sit and reach	0.4			0.488				
Pass - Pass ^g		1.64(2.20)	0.73	0.468				
Pass - Fail ^g		-0.11(3.02)	-0.04	0.979				
Fail - Pass ^g		4.25(3.22)	1.32	0.187				
Bent leg Curl ups	0.9			0.158				
Pass - Pass ^h		3.48(1.05)	3.29	0.001				
Pass - Fail ^h		0.31(2.60)	0.12	0.907				
Fail - Pass ^h		3.44(2.51)	1.37	0.171				

*. Quoted category is 'Girl' ^b. Quoted category is 'Moderate'
^c. Quoted category is 'Normal weight' ^d. Quoted category is 'Fail-Fail'

Conclusions

Changes of weight status and cardiovascular fitness, but not flexibility and muscle strength, significantly predicted academic achievement among schoolchildren.

Acknowledgement

The authors would like to thank the support from the Taiwan National Science Council (NSC-99-2410-H-028-002-MY2).



論文發表接受函

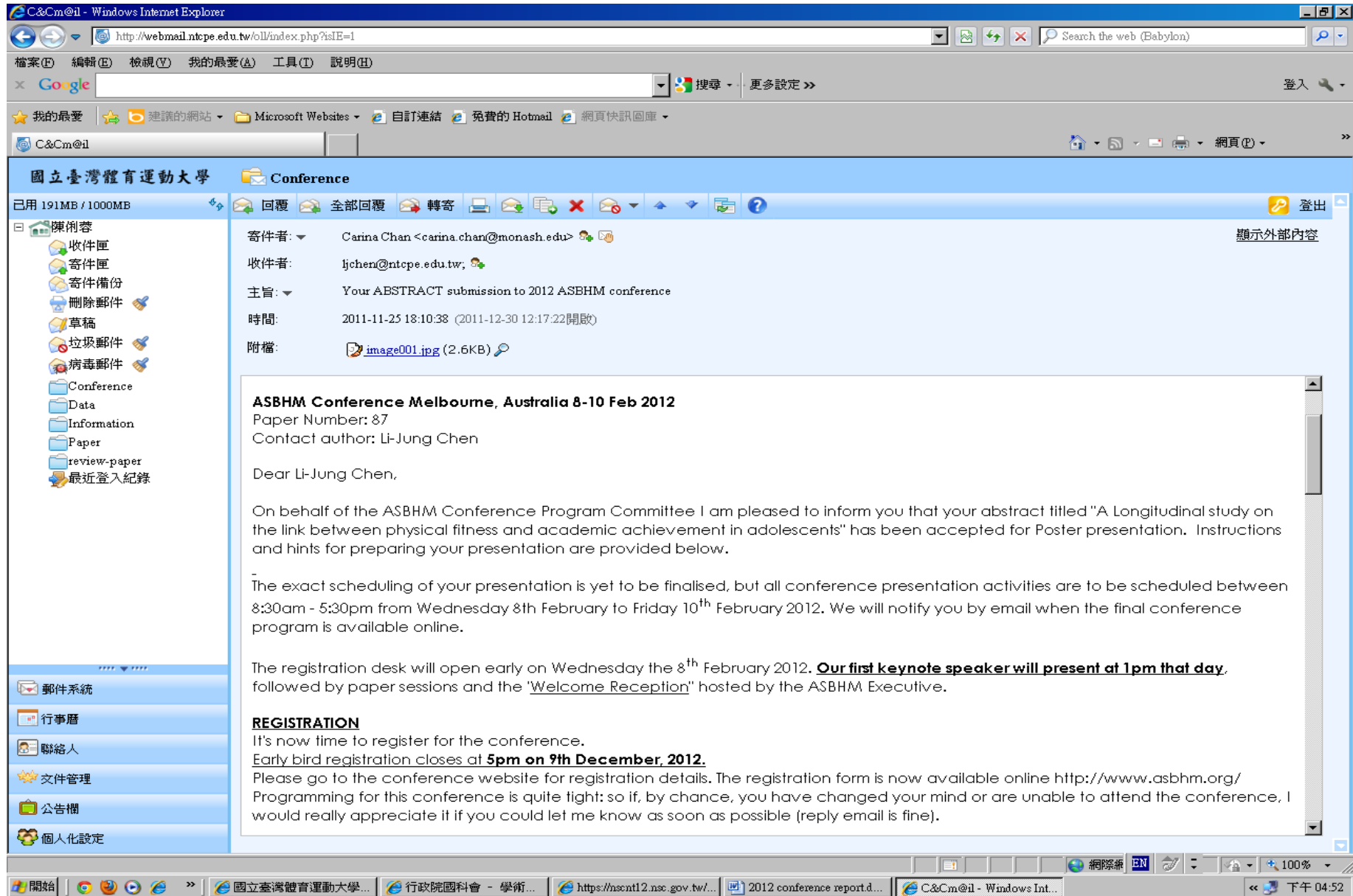


表 Y04

國科會補助計畫衍生研發成果推廣資料表

日期:2012/06/15

國科會補助計畫	計畫名稱: 兒童青少年肥胖, 體適能與學業表現關係之長期追蹤研究
	計畫主持人: 陳俐蓉
	計畫編號: 99-2410-H-028-002-MY2 學門領域: 運動心理學
無研發成果推廣資料	

99 年度專題研究計畫研究成果彙整表

計畫主持人：陳俐蓉		計畫編號：99-2410-H-028-002-MY2				計畫名稱：兒童青少年肥胖，體適能與學業表現關係之長期追蹤研究	
成果項目		量化			單位	備註（質化說明：如數個計畫共同成果、成果列為該期刊之封面故事...等）	
		實際已達成數（被接受或已發表）	預期總達成數（含實際已達成數）	本計畫實際貢獻百分比			
國內	論文著作	期刊論文	0	0	100%	篇	
		研究報告/技術報告	0	0	100%		
		研討會論文	0	0	100%		
		專書	0	0	100%		
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（本國籍）	碩士生	0	0	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		
國外	論文著作	期刊論文	1	1	100%	篇	目前 1 篇已被國際 SCI 期刊接受刊登, 另有 1 篇投稿於國際 SCI 期刊目前正審查中
		研究報告/技術報告	0	0	100%		
		研討會論文	3	2	100%		
		專書	0	0	100%		章/本
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（外國籍）	碩士生	0	0	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		

<p>其他成果 (無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。)</p>	<p>在獲得補助兩年期計劃當中，除了 1 篇已被國際 SCI 期刊接受刊登，1 篇投稿於國際 SCI 期刊目前正審查中，參加並發表 3 篇論文於國際研討會外；並利用參加國際研討會之會後期間，自費前往與國際知名教授 Prof. Ken Fox 進行學術研討。</p>
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	成果項目	量化	名稱或內容性質簡述
科 教 處 計 畫 加 填 項 目	測驗工具(含質性與量性)	0	
	課程/模組	0	
	電腦及網路系統或工具	0	
	教材	0	
	舉辦之活動/競賽	0	
	研討會/工作坊	0	
	電子報、網站	0	
	計畫成果推廣之參與(閱聽)人數	0	

國科會補助專題研究計畫成果報告自評表

請就研究內容與原計畫相符程度、達成預期目標情況、研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）、是否適合在學術期刊發表或申請專利、主要發現或其他有關價值等，作一綜合評估。

1. 請就研究內容與原計畫相符程度、達成預期目標情況作一綜合評估

達成目標

未達成目標（請說明，以 100 字為限）

實驗失敗

因故實驗中斷

其他原因

說明：

2. 研究成果在學術期刊發表或申請專利等情形：

論文： 已發表 未發表之文稿 撰寫中 無

專利： 已獲得 申請中 無

技轉： 已技轉 洽談中 無

其他：（以 100 字為限）

本計畫已有 1 篇被國際 SCI 期刊接受刊登，目前仍有 1 篇投稿於 SCI 期刊審查當中，已參加並發表 3 篇論文於國際研討會中

3. 請依學術成就、技術創新、社會影響等方面，評估研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）（以 500 字為限）

本研究主要由兩個子計畫組成，第一個研究系探討國小 1 至 6 年級體位變化與學業成就之關係，第 2 個研究則探討國中 3 年體適能變化與學業成就之關係。經過國小 6 年長期追蹤調查結果發現：小一的肥胖盛行率，男生為 18.8%，女生為 15.2%，男女生間無顯著差異存在。六年後，肥胖盛行率上升，男生為 34.3%，女生為 20.7%。例外，不管男生或女生，六年期間之體位改變與學業成就並無顯著關係存在。而國中期間，橫斷性研究發現學生的體位與心肺適能可以預測學業成就，然而學生的柔軟度與肌力則與學業成就間之關係未達顯著水準。3 年長期追蹤結果顯示，心肺適能愈好的人學業成就較佳。

雖然部分西方文獻指出肥胖者成績通常較差，然則從本研究長期追蹤結果並未發現類似結果，也許肥胖者被過度污名化，學校教師應特別注意勿對肥胖者有刻板印象。其次，本研究發現良好心肺適能與學業成就有正相關，因此，學校應鼓勵學童積極從事提升體適能之相關運動以利其學習成效。