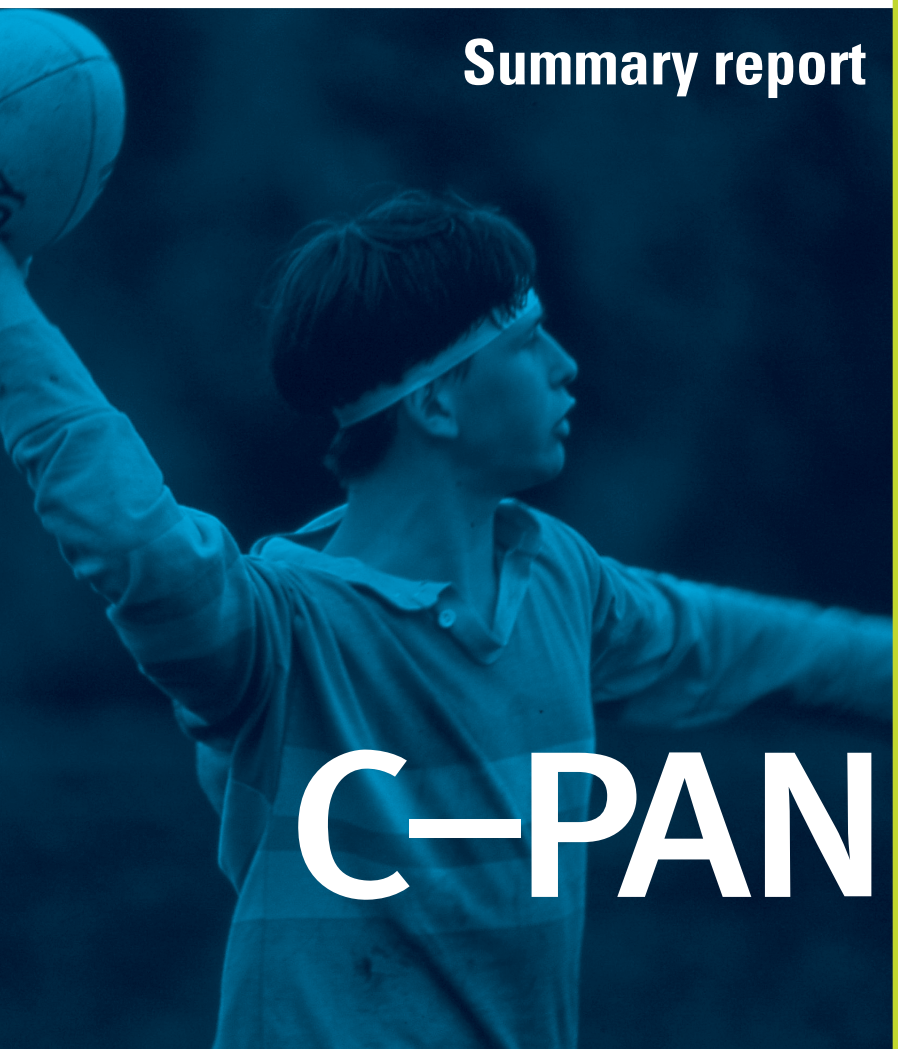
DEAKIN UNIVERSITY AUSTRALIA

Mental health and physical activity among adolescents

Centre for Physical Activity and Nutrition Research



Summary report

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Executive summary

In the World Health Organisation's report on the Global Burden of Disease, depression is identified as the leading cause of disability among adults, and one of the leading causes of overall disease burden.

Young people are an important group to consider when examining mental health issues as the symptoms of depression are often first evident during childhood and adolescence.

Physical activity has been shown to have substantial benefits among adults experiencing symptoms of depression, but there is less evidence for its effects on depressive symptoms amongst children and adolescents.

In order to inform efforts to promote mental health amongst young people, this study sought to examine associations between symptoms of depression and physical activity, organised sport and television viewing. It also sought to examine whether depression itself influences levels of physical activity. This study examined a sample of Victorian adolescents in 2004 (aged 14) and again in 2006 (aged 16). Depression symptoms were measured using the Centre for Epidemiological Studies Depression Scale for Children (CES-CD) and physical activity was objectively measured using accelerometers.

Symptoms of depression were present in over 40% of adolescent girls and over 20% of adolescent boys in 2004. The proportion of boys and girls reporting significant depressive symptoms did not increase from 2004 to 2006.

Tracking individuals during the study period helped to identify persisting symptoms of depression as well as patterns of emerging symptoms over time. It was found that 11% of boys and 28% of girls showed depressive symptoms in both 2004 and 2006. Further, 14% of boys and 13% of girls who did not display depressive symptoms in 2004 had developed depressive symptoms by 2006.

In 2004, when the participants were 14 years of age, neither participation in physical activity or organised sport, nor television viewing were associated with the presence of depressive symptoms. Furthermore, neither physical activity nor organised sport were predictive of the likelihood of developing depressive symptoms two years later. However, girls who reported symptoms of depression at age 14 watched approximately 168 minutes/week more television at age 16.

It would seem from this study that physical activity has little association with the presence of depressive symptoms for adolescents between the ages of 14 and 16 in this small sample; however reporting depressive symptoms at age 14 was associated with increased TV viewing at age 16 among girls. It may be that girls with depressive symptoms withdraw from social activities preferring more solitary pursuits such as TV viewing, or that specific symptoms of depression (e.g. feeling tired or finding it hard to initiate activities), may also explain higher levels of TV viewing.

It is evident that the findings from adult studies cannot necessarily be extrapolated to adolescents, and that we need to direct future research efforts to understanding the complex influences on adolescent health so that appropriate action can be taken.

This report describes the key findings of the study. It will be of interest to parents and families of adolescents; teachers and schools; policy makers; health professionals; and other organisations interested in mental health among young people.

Background and study aims

1.1 How do we define mental health disorders?

Mental health is complex and is much more than simply the absence of illness. It describes the capacity of individuals to interact with each other and their environment in a way that promotes optimal development and the use of cognitive, affective and relational abilities, as well as overall wellbeing [1].

Mental health disorders are described as the range of cognitive, emotional and behavioural disorders that affect lives and productivity [1]. According to the United States Department of Health and Human Services: "Mental illness is a term that refers collectively to all diagnosable mental disorders. Mental disorders are health conditions that are characterised by alterations in thinking, mood or behaviour (or some combination thereof) associated with distress and/or impaired functioning." [2]

According to the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), there are several major diagnostic classes of mental disorders, including for example, substance-related disorders, mood disorders, anxiety disorders, dissociative disorders and personality disorders [2].

Depression is one of the most common mental disorders [1]. It is defined as a mood disorder and is characterised by feelings of sadness, a loss of interest or pleasure in nearly all activities, feelings of hopelessness and suicidal thoughts or self-blame [1]. Depression or depressive symptoms can occur on a continuum. Clinical depression must be diagnosed by a health professional, however, people with depressive symptoms could be considered at risk of developing a mental health disorder.

1.2 How common are mental health disorders among adults?

The Australian Institute of Health and Welfare report into Australia's health describes the prevalence of mental health disorders, including trends over recent years. Data collected via the National Survey of Mental Health and Wellbeing (published in 1997) suggests that the proportion of adults with a mental health disorder was approximately 18%, and the prevalence of a long-term mental or behavioural disorder was 11%[3]. In the 2004-2005 National Health survey, the prevalence of mental health problems was estimated using self-report measures. When considered in combination, these data suggest there has been a substantial increase in mental health problems in recent years from 5.9% in 1995, to 9.6% in 2001, and 11.0% in 2004-05[3].

In the 1997 National Survey of Mental Health and Wellbeing, the Composite International Diagnostic Interview was used to identify the prevalence of certain mental disorders among Australian adults. According to the survey, depression was experienced by 6.8% of females and 3.4% of males, making it the most common mental disorder among females and the third most common among males[1]. In terms of disease burden, anxiety and depression were the leading cause of disease burden among females (10% of total disease burden) and the third leading cause of disease burden among males (4.8% of total disease burden)[4].

These figures are supported by international data. In the World Health Organisation's report into the Global Burden of Disease, depression was identified as the leading cause of disability among adults, and one of the leading causes of overall disease burden in low, middle and high income countries[5].

1.3 How common are mental health disorders among youth?

Depression is also seen among children and adolescents,[6] and young people have been identified as an important group to consider when examining mental health issues, since symptoms of depression are often first exhibited during childhood and adolescence[1].

Data from the United States suggests that in 2004, approximately 9% of adolescents aged 12-17 years experienced a major depressive episode, with prevalence higher among females (approximately 11%) compared to males (approximately 6%)[7]. Data from Australia suggest that 5% of young people suffer from a depressive disorder, and approximately 20% of young people suffer from a mental health problem or disorder within any six month period[1]. Consistent with United States data, Australian adolescent girls are more likely than boys to exhibit depressive symptoms[1].

These figures are of significant concern in light of evidence that depressive symptoms persist over time, with approximately 40% of adolescents reporting maintenance of depressive symptoms after four years[8]. This suggests that effective strategies to treat and manage symptoms of depression in this population group are needed.

1.4 How is depression treated and managed?

A range of effective treatment options for mental health disorders are available. These generally fall into two categories, psychosocial and pharmacological treatments[2].

Psychosocial treatments typically involve psychotherapy and/or counselling. For example, cognitive psychotherapy has been shown to have long-term benefits in reducing symptoms of depression[1]. Depressed persons tend to view events in an overly pessimistic way, and have a variety of distorted patterns of thinking. Cognitive therapy aims to teach them to develop a realistic, positive and adaptive view of themselves, their future and the world[1].

Pharmacological treatments target the known changes in patterns of brain neurotransmitters associated with depression. Anti-depressant medications are commonly prescribed as treatments for depressive symptoms[1].

There are, however, ongoing issues with maintenance of both psychological and pharmacological treatments among individuals experiencing depression[9]. Common barriers to effective treatment and management of depression include: social stigma which may prevent patients acknowledging that they have depression and need help; a lack of systematic screening for the general population; patients' perception that treating specialists lack the competency and capacity to handle issues that patients with depression may present with; and poor adherence to treatment guidelines[9]. Alternative models of treatment and management are therefore urgently required.

1.5 Physical activity and depression?

Physical activity includes any bodily movement produced by the contraction of skeletal muscle that results in the expenditure of energy[10]. Physical activity includes activities performed predominantly in leisure-time such as organised sport. It also includes transport-related activity such as walking to work or school[10].

Physical activity has been shown to have substantial benefits among adults experiencing symptoms of depression[11]. A recent review of the evidence found 27 observational and 40 intervention studies examining the relationship between physical activity and depression in adults[12]. The review concluded that even low doses of physical activity can protect against depression, though moderate and vigorous-intensity physical activity is more effective in reducing the likelihood of depression than activities of a lighter intensity. Further, activities performed during leisure-time appear to have greater benefit than activities performed in other domains such as transport or occupation.

To date, few studies have examined the associations between physical activity and depression among adolescents, and whether the beneficial effects on depressive symptoms seen among adults are also evident among younger people. Findings of the studies are also mixed. Mahoney and colleagues (2002) found that adolescents who engaged in after-school activities (including sports) had significantly lower depressed mood scores compared to non-participants[13]. This was supported by Fredericks and Eccles (2006) who found team sports participation was associated with lower levels of depression[14]. In contrast, several other studies have found no association between participation in organised extra curricular activities and depression in adolescents[15 - 17].

Whilst these studies have looked at how physical activity may affect depression, a further question remains; does depression affect physical activity? In other words, does depression actually lead to a lower likelihood of being physically active, for example, through reducing motivation? It is also possible that the association between activity participation and depression is bi-directional[17]. Bohnert and Garber (2007) examined this in a prospective study of adolescents' participation in organised physical activity and symptoms of depression, however, no evidence of an association was found in either direction.

Significantly, few studies among adolescents have measured overall physical activity levels and as such, an accurate measure of the intensity or domain

of activity being performed has not been captured. This is an important limitation, as specific domains (leisure-time) and intensities of activity (moderate and vigorous) have shown the strongest associations with reduced depression among adults [12]. One study by Desha and colleagues (2007), which used a self-report measure of physical activity among adolescents, found no association between self-reported moderate-to vigorous-intensity physical activity (MVPA) and symptoms of depression. Adolescents also self-reported their involvement in sporting clubs, and higher involvement was associated with reduced severity of depressive symptoms among males but not among females [18]. However, the validity and reliability of the measure of physical activity (self-reported time use diaries) was not reported and the authors suggest using objective measures to comprehensively capture physical activity participation.

1.6 Television viewing and depression

Few studies have examined the association between time spent in sedentary pastimes such as television viewing and mental health, particularly among young people. Existing evidence, including one study among young Spanish adults [19], is primarily cross-sectional rather than longitudinal, therefore it is not known whether high levels of television viewing increase the risk of mental health disorders such as depression.

High levels of television viewing have been associated with several negative physical and psychosocial health outcomes among youth. There is evidence of increased risk of overweight and obesity in children and adolescents who spend large amounts of time watching television [20]. There is also evidence that high amounts of screen time during adolescence can predict obesity later in life [21].

In addition to the physical health outcomes, Ozmert and colleagues (2002) examined Turkish children aged approximately eight years and found high levels of television viewing was significantly correlated with social problems, and with both aggressive and delinquent behaviour [22]. However, whether television viewing is associated with other psychosocial health outcomes among youth, such as symptoms of depression, is currently unknown.

1.7 Study aims

In light of the gaps in evidence described above, the aims of this study were:

1. To describe the prevalence and incidence of depression between 2004 and 2006 among a sample of Victorian adolescents;
2. To explore associations between physical activity, organised sport, television viewing and symptoms of depression at age 14;
3. To examine whether physical activity, organised sport or television viewing at age 14 predict depressive symptoms at age 16; and
4. To examine whether depressive symptoms at age 14 predict physical activity, organised sport or television viewing at age 16.

Study design and methods

2.1 Study design

The 'Children Living in Active Neighbourhoods' study or 'CLAN' involved follow-up of children participating in the Children's Leisure Activities Study (CLASS), which was conducted in 2001. This report contains information collected from adolescents participating in the CLAN study in 2004 and 2006.

The study involved:

- assessment of depression symptoms of adolescents at 14 years and 16 years of age;
- objective assessment of physical activity at the two timeframes; and
- self-report of organised sport participation and television viewing at the two timeframes.

Approval to conduct this study was received from the Deakin University Human Research Ethics Committee, from the Victorian Department of Education and from the Catholic Education Office. Consent for participation in the study was provided by the child.

2.2 Study participants

Children were recruited to the CLASS study in 2001 from government primary schools located in high and low socioeconomic status (SES) suburbs of metropolitan Melbourne. Ten primary schools in eastern suburbs (high SES) and nine primary schools in western suburbs (low SES) participated in the study. Participating children and their families were asked if they wished to be contacted again for a follow-up study.

Data for the present study was only collected from the older cohort of children who were adolescents in 2004 and 2006.

In 2004, participants were:

- secondary schoolchildren (adolescents) in years 7-10.

In 2006, participants were:

- secondary schoolchildren (adolescents) in years 9-12.

2.3 Objectively-measured physical activity

Adolescents' physical activity was objectively measured using an accelerometer. Accelerometers allow researchers to estimate the amount of activity, as well as the intensity of that activity throughout the day. Adolescents participating in the CLAN study were requested to wear an MTI Actigraph accelerometer for eight consecutive days in order to measure their habitual physical activity[23]. These devices were worn on the right hip and measured intensity and duration of movement in real-time. A formula was then applied to calculate average minutes per day in moderate-to vigorous-intensity physical activity (MVPA)[24].

2.4 Participants survey

Organised sport

Adolescents' participation in organised sport was examined using a modified version of the valid and reliable Adolescent Physical Activity Recall Questionnaire (APARQ) [25], which was incorporated into a survey administered at school. This questionnaire asks adolescents to list the 'organised' sports or games they usually participated in during summer and winter school terms. For each activity, adolescents reported the number of times per week (frequency) with which they participated in this activity and the usual amount of time they spent performing this activity each time they did it (duration). The frequency was multiplied by the duration to obtain the total time spent in each activity per week. This was then summed to indicate the total time (minutes) spent in organised sport per week.

Television viewing

The survey also included questions about television viewing. Adolescents were asked to estimate the total time they usually spent watching television and videos/DVD's during a typical week.

Symptoms of depression

The survey also contained 20 items from the Center for Epidemiological Studies Depression Scale for Children (CES-DC) [26, 27]. The CES-DC is a valid and reliable tool for examining symptoms of depression among children and young people. Adolescents were asked to indicate their agreement with the items that listed ways they may have felt or acted in the past week, with response options on a four point scale ('Not at all', 'A little', 'Some' and 'A lot').

Some examples of items included in the questionnaire are as follows:

During the past week…

- I was bothered by things that don't usually bother me
- I felt down and unhappy
- I felt like things I did just didn't work out right
- I felt lonely, like I didn't have any friends
- I felt sad
- I didn't sleep as well as I usually sleep
- It was hard to get started doing things
- I felt like crying

The responses to each of the 20 items were summed to create a scale, with a score greater than 15 indicating the presence of depressive symptoms [26].

Study findings

3.1 Characteristics of participants

A total of 264 adolescents participated in this component of the CLAN study in 2004, however, the results presented here are based on a sample of 155 adolescents for whom there was complete information for 2004 and 2006.

As shown in Table 1, in 2004 participants were aged approximately 14 years and in 2006 approximately 16 years.

Table 1 Mean age of adolescent boys and girls in 2004 and 2006

	Boys	Girls
n	**62**	**93**
Average age (years)		
2004	14.5	14,4
2006	16.4	16.2

3.2 Patterns of physical activity and depressive symptoms

Key findings:

- **Adolescent boys were significantly more active than girls at both time points in the study.**
- **Participation in MVPA, including organised sport, declined significantly over the two years among adolescent boys and girls.**
- **Time spent viewing television was similar amongst girls and boys and declined over the two year period of the study.**
- **At both time points in the study, symptoms of depression were present in almost 40% of adolescent girls and almost 20% of adolescent boys.**
- **Eleven percent of boys and 28% of girls showed depressive symptoms in both 2004 and in 2006.**
- **Fourteen percent of boys and 13% of girls who did not display depressive symptoms in 2004 had developed depressive symptoms by 2006.**

Physical activity, organised sport and television viewing

Table 2 shows the amount of time spent in moderate-to vigorous-intensity physical activity (MVPA, minutes/day), in organised sport (minutes/week) and in television viewing (minutes/week) among adolescent boys and girls in 2004 and 2006.

In both 2004 and 2006, boys spent significantly more time in MVPA compared to girls. On average, at age 14, boys spent over 100 minutes/day and girls spent approximately 70 minutes/day. At age 16, boys spent 56 minutes/day and girls 39 minutes/day. These figures show significant declines in MVPA as adolescents got older, with MVPA almost halving among both boys and girls over the two-year period.

Adolescents performed between 359 and 394 minutes/week of organised sport in 2004, and there was no significant difference between boys and girls. Participation in organised sport declined as adolescents got older, with boys' participation declining by 130 minutes/week and girls' declining by 79 minutes/week over the two-year period.

There was no significant difference in time spent watching television between boys and girls, however, television viewing time declined significantly over the two years by approximately three hours/week among girls and approximately two hours/week among boys.

Table 2. Changes in physical activity, organised sport and television viewing time among adolescent boys and girls

	Boys	Girls
n	62	93
MVPA		
(Mean, SD mins/day)		
2004 ‡	105.3 (±45.53)	71.1 (±27.99)
2006 §	55.9 (±21.80)	39.2 (±19.04)
Change from 2004 and 2006	-49.4 (±43.79)†	-31.9 (±27.68)†
Organised sport		
(Mean, SD mins/week)		
2004	394.2 (±294.08)	358.5 (±259.40)
2006	263.8 (±198.99)	279.5 (±231.46)
Change from 2004 and 2006	-130.4 (±290.07)[a]	-79.0 (±272.70)[a]
Television viewing		
(Mean, SD mins/week)		
2004	836.1 (±424.51)	800.4 (±500.38)
2006	692.7 (±464.09)	611.3 (±383.04)
Change from 2004 and 2006	-143.5 (±482.26)[b]	-189.1 (±425.80)†

‡p≤0.0001 – significant difference in between boys and girls in 2004

§ p≤0.0001 – significant difference between boys and girls in 2006

†p≤0.0001 – significant decline between 2004 and 2006

[a] p≤.0.001 – significant decline between 2004 and 2006

[b] p≤.0.05 – significant decline between 2004 and 2006

Symptoms of depression

Table 3 shows the presence of depressive symptoms among CLAN participants. A score on the CES-DC of 15 or greater indicates the presence of depressive symptoms[26].

Significantly more girls than boys scored 15 or greater on the scale at both time points, with almost 40% of girls showing the presence of depressive symptoms in 2004 and again in 2006; compared with approximately 19% and 26% respectively for boys. The mean score on the CES-DC was approximately 11 (out of a possible 60) among boys and approximately 14 among girls.

Table 3. Presence of depressive symptoms among adolescent boys and girls

	Boys	Girls
n	62	93
Depressive symptoms (% CES-DC score ≥15)		
2004*	19.4	37.6
2006 [c]	25.8	40.9
Depressive symptoms (mean, SD range 0-42)		
2004	11.0 (±6.86)	13.7 (±9.66)
2006	11.8 (±9.18)	14.1 (±8.45)
Change from 2004 and 2006	+0.8 (±8.05)	+0.4 (±8.67)

**p≤0.05– significant difference between boys and girls in 2004*

[c]p≤0.1 – non-significant trend for difference between boys and girls in 2006

When individuals' symptoms of depression were analysed over-time, it was found that among boys:

- 66% did not show depressive symptoms in 2004 or 2006;
- 8% who showed depressive symptoms in 2004 resolved these symptoms by 2006;
- 14% who did not show depressive symptoms in 2004 had developed symptoms by 2006; and
- 11% who showed depressive symptoms in 2004 had maintained these in 2006.

Among girls:

- 49% did not show depressive symptoms in 2004 or 2006;
- 9% who showed depressive symptoms in 2004 had resolved these symptoms by 2006;
- 13% who did not show depressive symptoms in 2004 had developed symptoms by 2006; and
- 28% who showed depressive symptoms in 2004 had maintained these in 2006.

3.3 Associations between depression and physical activity, organised sport and television viewing

Key findings:

- **No association was found between participation in MVPA, organised sport and television viewing and the presence of depressive symptoms.**
- **Participation in MVPA, organised sport or time spent watching television at baseline did not predict likelihood of depressive symptoms at follow-up in 2006.**
- **Adolescents who reported depressive symptoms in 2004 did not participate in significantly more or less physical activity or organised sport at follow-up.**
- **Girls who reported depressive symptoms in 2004 watched approximately 168 more minutes of television per week at follow-up compared with girls who did not report depressive symptoms in 2004.**
- **Between the ages of 14 and 16 years, physical activity seems to have little association with the presence of depressive symptoms.**

The study examined:

- whether physical activity, organised sport and television viewing are associated with the presence of depressive symptoms among adolescents;
- whether physical activity, organised sport and television viewing predict the presence of depressive symptoms later in adolescence; and
- whether depressive symptoms predict lower participation in physical activity and organised sport, and higher levels of television viewing later in adolescence.

The analyses showed no significant associations between MVPA, organised sport and television viewing and the presence of depressive symptoms among boys and girls in 2004 (Figures 1,2,3).

There were also no significant associations between participation in physical activity, organised sport and television viewing in 2004, and the presence of depressive symptoms in adolescent boys and girls at follow-up in 2006.

Figure 1. Physical activity and depressive symptoms in boys and girls in 2004

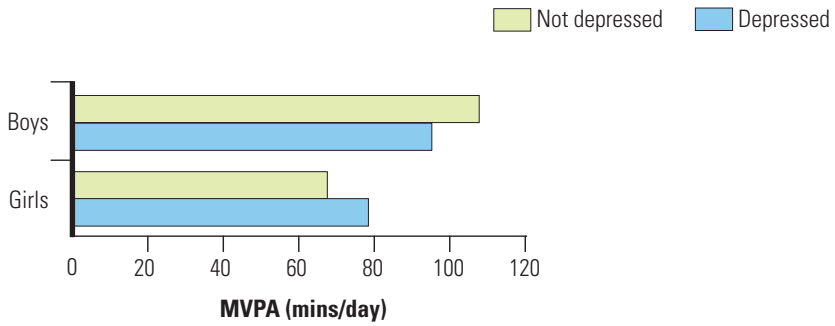

Figure 2. Organised sport and depressive symptoms in boys and girls in 2004

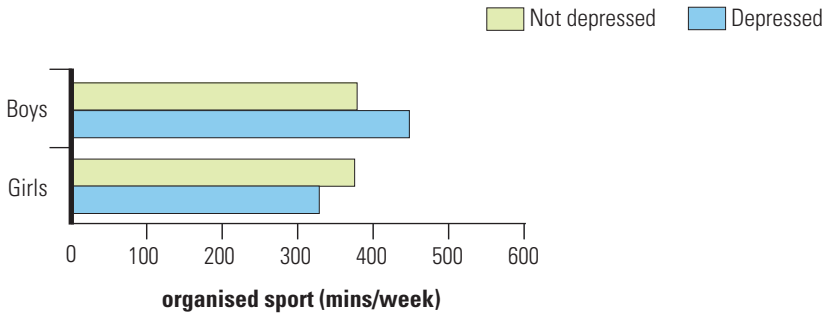

Figure 3. Television viewing and depressive symptoms in boys and girls in 2004

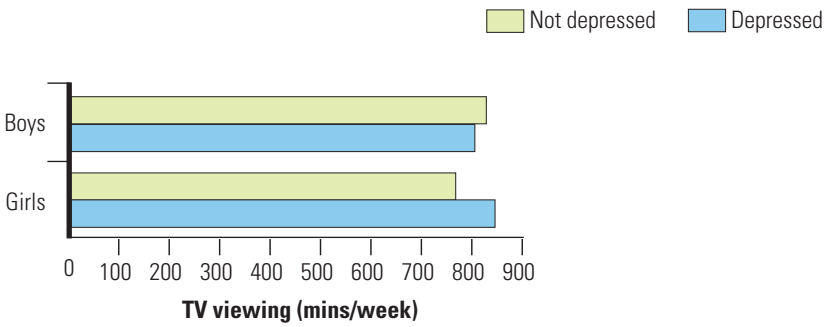

Table 4 shows that girls who reported depressive symptoms at baseline watched approximately 168 more minutes/week of television at follow-up than girls who did not report depressive symptoms at baseline. No significant associations were shown for television viewing among boys or for MVPA or organised sport among boys or girls.

Table 4. Associations between depressive symptoms in 2004 and physical activity, organised sport and television (TV) viewing in 2006

	Depression			
	Boys		Girls	
	Beta coefficient	95%CI	Beta coefficient	95%CI
MVPA‡ (mins/day)	0.06	-0.23 – 0.36	-0.09	-0.34 – 0.16
Organised sport† (mins/week)	0.54	-4.36 – 5.43	0.29	-2.39 – 3.96
TV viewing§ (mins/week)	-4.28	-12.30 – 3.75	3.53* (~168.5 mins/week)	1.27 – 5.79

‡ Analyses were adjusted for MVPA in 2004 and clustering by school

† Analyses were adjusted for organised sport in 2004 and clustering by school

§ Analyses were adjusted for TV viewing in 2004 and clustering by school

**p≤0.01*

Study conclusions

The CLAN study has been one of the first studies internationally to examine the prevalence of depressive symptoms longitudinally among a sample of Victorian adolescents, and to explore associations between physical activity, organised sport and television viewing and depression.

The study found the prevalence of depression to be particularly high among this sample of adolescent girls, with over 40% displaying symptoms of depression (compared with 20% of adolescent boys).

Previous studies have shown that adolescent girls exhibit twice the prevalence rate of depressive symptoms compared to males in the same age group [28]. Prepubertal boys and girls are equally likely to show depressive symptoms, however, the high number of females with depressive symptoms arises after the age of 13 years [29]. In the current study, tracking of individuals over the two year period found that 28% of girls showed depressive symptoms in both 2004 and in 2006, and 13% of girls who did not display depressive symptoms in 2004 had developed depressive symptoms by 2006. Another study of 1,176 adolescents found that nearly 40% of adolescents reported continued depressive symptoms over a four year period, with much higher proportions of girls than boys reporting depressive symptoms [8].

The study found no significant associations between the physical activity variables and the presence of depressive symptoms in adolescents. However, girls with depressive symptoms in 2004 reported significantly higher TV viewing in 2006. One possible explanation for this finding is that adolescent girls with depressive symptoms may withdraw from social activities [30], preferring more solitary pursuits such as TV viewing. Additionally, specific symptoms of depression (e.g. feeling tired; finding it hard to initiate activities) may also explain higher levels of TV viewing in these girls [27].

Studies of adults suggest physical activity may protect against depression [27]; but the current study does not support this among adolescents. There are a number of possible explanations for this. Firstly, the number of participants

in the study with complete data was small, with the final sample reduced to 155 adolescents. This may have influenced the power of the analyses to detect associations between depressive symptoms and MVPA, and organised sport. Secondly, during adolescence, MVPA is likely to be strongly influenced by a number of factors external to the adolescent, for example mandatory physical education, which may be less likely to influence individuals' mental health than voluntary participation in physical activity. Another factor that future research may need to consider is the social element of physical activity (such as spending time with friends), which may be particularly important for adolescents. It is also important to acknowledge that there are multidimensional causes of depression in children/adolescents such as emotional and/or social issues [31] which may interact with physical activity to influence the onset/presence of depression.

A possible limitation of the study lies in the use of the CES-DC scale. The cut point of 15 on the CES-DC used to indicate the presence of depressive symptoms is somewhat arbitrary and scores one or two above or below this point may not necessarily indicate the presence or absence of depressive symptoms [26].

A further limitation was that accelerometers were worn for just one week on two occasions, two years apart, and this may not represent habitual physical activity for the participants involved. In addition, the accelerometer data does not enable the authors to distinguish, leisure time physical activity from other forms of physical activity. This may be significant given that the adult literature specifically identifies leisure-time physical activity as important for protecting against depressive symptoms.

Physical activity appears to have little association with depressive symptoms among adolescents in this sample, but girls with depressive symptoms in early adolescence had increased TV viewing two years later. This suggests that a range of different factors may be more important in adolescents, including social and emotional factors which were not examined in this study.

It is evident that the findings from adult studies cannot necessarily be extrapolated to adolescents, and that future research efforts should be directed to understanding the complex influences on adolescent health so that appropriate action can be taken.

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Summary report