The power of policy to influence behaviour change: daylight saving and its effect on physical activity

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Abstract

Objective: To measure the impact of the introduction of daylight saving in Western Australia in December 2006 on when during the day adults engaged in physical activity.

Methods: In early December 2006, 1,300 Western Australian adults were telephoned and asked about how the introduction of daylight saving would influence when during the day they typically engaged in physical activity. At the end of the daylight saving period in March 2007, 1,083 of the baseline cohort agreed to answer questions relating to how daylight saving had affected when during the day they were physically active.

Results: Almost half the cohort (45.5%) reported that daylight saving had affected when during the day they were physically active. During daylight saving fewer people exercised in the morning and more people exercised in the evening. When analysed at the individual level, 23% of the cohort ceased to exercise in the morning during daylight saving and 22% exercised in the evening only during daylight saving. In addition, to changes in when during the day people exercised, there was also an overall reduction in the average number of daily exercise sessions, with 8% not exercising at all during daylight saving.

Conclusions: The results suggest that the introduction of daylight saving, a relatively modest compulsory change to increase daylight by one hour had an impact on patterns of when during the day people were physically active.

Implications: The study results reinforce the value of focusing on policy as an effective means of supporting population behaviour change.

Key words: Daylight saving, physical activity, Western Australia, excercise sessions, change behaviour.

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Daylight saving has been introduced in numerous countries and is said to affect more than 1.6 billion people worldwide.[1] Typically, the rationale is to increase the number of useable hours of daylight and/or reduce energy consumption.[1] Increasing physical activity has not featured as a primary motivator for daylight saving policy change to date. Nonetheless, evidence indicates that structural and policy changes are most likely to achieve sustainable improvements in population level physical activity participation.[2,3] In part, this reflects well-established views that many of the influences on health behaviour fall outside the control of individuals.[4,5] While it is plausible that daylight saving could affect physical activity patterns, either as an enabler or barrier (for example capacity to exercise in daylight at times previously dark or shifting peak times of heat to common participation periods), our review of the literature suggests that these and other issues relating to the potential nexus between daylight saving and physical activity are relatively unexplored. A report by The Health Department of Western Australia (HDWA)[6] showed that overall self reported physical activity participation rates increased during the daylight saving period, compared with the period immediately prior to daylight saving and corresponding periods in previous years. Their analysis from Western Australian physical activity surveillance data showed population prevalence effects of daylight saving, although adaptation at the individual level remain unanswered.

Increasing physical activity has been identified as a public health priority and challenge in many countries. Precipitated by physical activity levels that have remained unchanged or declined in recent years.[7,8] In Australia, Bauman et al.[9] reported a decline in physical activity participation among Australian adults between 1997 and 1999, despite increasing, co-ordinated public health campaigns targeting physical inactivity occurring over the same period. In Western Australia, there was little change in the proportion of the adult population meeting the minimum recommends level of physical activity between 1999 (58%), 2002 (55%) and 2006 (59%). This is despite persistent community wide campaigns encouraging participation in recommended levels over this period, such as the 'Be active every day' message promoted by the National Heart Foundation (WA Branch) and the 'Find 30, it's not a hard exercise' promoted by the Health Department of Western Australia. In addition, there has been a rapid increase in the level of overweight and obesity in Australia,[10,11] a trend physical inactivity has contributed to and compounded.

Public health attempts to increase participation in physical activity have grown in effect since the mid-1980s and have traditionally focused on awareness raising campaigns, professional education and organisational collaboration.[8,9] A 2005

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Cochrane review of interventions promoting physical activity found that among 17 studies that met the inclusion criteria, a positive moderate sized effect on increasing self-reported physical activity and measured cardio-respiratory fitness was found, at least in the short to mid-term.[8] However, this Cochrane review focused mainly on clinical or targeted interventions and efficacy trials. Real world application of these types of approaches at the population level is often limited by wider and contextual environmental influences.

More recently, ecological models of health behaviour have been applied to influence physical activity, as they consider a broader range of influences upon individuals and the community.[4,5] For example, the use of public health policy to create supportive environments through establishment of walking and cycling paths, access to open spaces, traffic calming structures and, more recently, urban planning considerations.[12-14]

An evidence review of ecological approaches to influence physical activity by Foster and Hillsdon[2] found that although the case for structured environments encouraging physical activity was supported theoretically, there were limited observational studies exploring the nature of these relationships. The evidence is also mixed. For example, Foster and Hillsdon's review contended that even large investments in physical structured environmental changes have often only reported moderate effects on physical activity behaviour.[2] By contrast, studies by Linenger et al.[15] and Peel and Booth[16] that altered the structured environment to support physical activity participation, suggest that health-enhancing physical activity can be increased.

What is clear is that public policies can have an impact on human behaviour. They can elicit both positive outcomes, such as those observed as a result of the mandatory use of car seatbelts and introduction of smoke-free public places, as well as negative outcomes, such as the illicit drug use spawned under a zero tolerance drug policy.[17] In addition, policies not directly related to health, such as industrial relations, housing, immigration and education may indirectly influence people's health related decisions.

Convincing policy makers that public policy is a powerful tool to influence health behaviours, in this instance physical activity, is important and providing evidence to support this assertion is crucial. The introduction of daylight saving on the 3 December 2006 in Western Australia provided an opportunistic natural experiment to measure the effect, if any, of this policy on adult participation in physical activity. The purpose of this study was therefore to determine the influence of daylight saving on the physical activity patterns of Western Australians.

Methods

This study is based on data from a physical activity survey collected via telephone among a sample of Western Australian adults prior to the introduction of daylight saving in December 2006. Ethics approval was granted by the UWA Human Research Ethics Committee. The survey was administered by the UWA Survey Research Centre in November 2006, and the same group were re-contacted several months later at the completion of daylight saving in March 2007. The original sample of 3,336 Western Australians were randomly selected from households listed in the electronic white pages directory. The adult whose birthday was due next was invited to participate to reduce selection bias.[18] The original survey measured physical activity using the Active Australia survey questions.[19]

A sub-sample of 1,300 respondents were recontacted via telephone between 5 December 2006 and 10 December 2006, seven days prior to the commencement of daylight saving. This sub-sample of respondents were invited to complete three additional questions in relation to the time of day they were usually physically active ('in the morning before work', 'during the day', 'in the afternoon after work' or 'later in the evening'), the time of day they thought they would be physically active in the coming summer months and what impact, if any, daylight saving was likely to have on their engagement in physical activity.

In the final week of the four-month daylight saving period (the last week of March 2007), the respondents who completed the pre-daylight saving survey and agreed to be recontacted (n=1,200) were invited to participate in a follow-up telephone survey. At follow-up, the baseline questions were modified to ask respondents about their physical activity patterns over the summer months, including the usual time of day they engaged in physical activity, and the number of sessions per day ('in the morning before work', 'during the day', 'in the afternoon after work' or 'later in the evening'). Administration of the Active Australia self-reported physical activity questions were not completed at the post-test survey, due to financial constraints. Participants were also asked the time of day they thought they were likely to be physically active in the coming months following the completion of daylight saving. A total of 1,083 respondents completed both the pre- and post-daylight saving survey, a response rate of 83%.

In the pre-daylight saving survey, respondents were asked to recall the time of day they were usually physically active (in the morning before work, during the day, in the afternoon after work or later in the evening) during the previous summer of 2004/05 and at baseline (November 2006). The same question was asked at follow up for the most recent summer (2006/07) and following the end of daylight saving (March 2007).

Data were entered directly into the CATI system and cleaned and analysed using SPSS 15 for Windows. The pre- and post-test data were analysed firstly at the group level. This entailed determining the overall prevalence of the sample who participated in physical activity at different times throughout the day between pre- and post-test. Individual changes to 'when during the day' respondents were physically active pre- and post-test were calculated. This was to determine (explain) any change in 'when during the day' respondents reported participating in physical activity for the daylight saving period. Cross tabulations and Chi Square statistics were used to determine the effect of daylight saving on the proportion of respondents who increased, decreased or did not change the time during the day they were physically active. A repeated measures t-test was conducted to determine

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difference between the number of sessions respondents indicated participating in physical activity pre- compared with post–test.

The data were then investigated to assess individual level changes between pre- and post-test on reported participation in physical activity over the daylight saving period, compared with other time periods.

Results

Respondents were mainly from metropolitan Perth (77%), married/de facto (65%), more likely to be female (54%) with just over one half of the cohort (55%) was participating in sufficient levels of physical activity (i.e. 150 minutes and five sessions per week) at baseline. Compared with the original sample from the State survey, a significantly greater proportion of respondents in the DLS survey were from the metropolitan area, slightly older and male (Table 1).

Perceived impact of daylight saving on when physically active

Prior to the commencement of daylight saving, slightly more than one-third (37%) of respondents believed the introduction of daylight saving would change the time of day they were physically active. This belief was significantly greater among females (60%) compared with (40%) males ($p<0.05$), although no significant difference was observed between country and metropolitan respondents.

When resurveyed at the completion of daylight saving, 45.5% of respondents indicated that daylight saving had caused them to change the time of day they were physically active. Similar to the gender differences observed in anticipated impact of daylight saving on time of day of physical activity, a significantly greater proportion of females (60%) compared with males (40%) ($p<0.05$) reported daylight saving had influenced the time of day they were physically active. No significant difference between metropolitan and country respondents was observed at post-test.

Table 1: Demographic characteristics of the DLS cohort compared with respondents to the Western Australian adult survey of physical activity.

	DLS Cohort (n=1,083) %	State Sample (n=2,291) %
Gender ($P<0.01$)		
Male	52	48
Female	46	54
Age Group (0.00)		
18-29	10	12
30-44	24	28
45-59	32	32
60+	34	28
Location ($P<0.00$)		
Metropolitan	77	66
Country	23	34
Physical activity		
Inactive	13	14
Insufficient	30	31
Sufficient	58	55

Perceived changes in physical activity levels as a result of daylight saving

In relation to the perceived impact of daylight saving on physical activity levels, 27% of respondents had increased the time spent participating in physical activity during the period, while 22% reported a decrease in their time spent being physically active (Table 1). Significant gender variations were observed, with 26% of females reporting a decrease in their perceived physical activity participation during this time, compared with 18% of males ($p<0.01$). Half (51%) respondents reported no impact from daylight saving on their physical activity participation. While no association between age and changes to physical activity participation were observed, there were differences between metropolitan and rural respondents ($p<0.05$) (Table 1).

Impact on the timing of physical activity, before, during and following daylight saving

For all periods excluding the period of daylight saving, the prevalence pattern of physical activity participation was similar, with about half respondents reporting usually exercising in the morning, and about one quarter in each of the afternoon and evening (see Figure 1). However, during the period of daylight saving, fewer people exercised in the morning and more people exercised in the evening. Following daylight saving, the pattern of participating during the day reverted to those of the pre-daylight saving period.

In addition to the overall prevalence patterns previously observed, we also analysed individual level changes in the time of day they were physical active. At this individual level, the impact of daylight saving on physical activity patterns were more pronounced. As shown in Figure 2, 23% of respondents who exercised in the morning prior to daylight saving (November 2006) did not exercise in the morning during the daylight saving period. By contrast, 10% of respondents exercised in the morning only

Table 2: Perceived change in time spent in PA in a typical week during daylight saving.

(n=1,083)	Increase %	Decrease %	No Change %
Overall change in PA	27	22	51
Gender ($P<0.05$)			
Male	27	18	55
Female	28	26	46
Age Group			
18-29	24	24	52
30-44	28	24	48
45-59	27	22	50
60+	28	21	52
Location ($P<0.05$)			
Metropolitan	29	19	52
Country	24	29	47

Includes people who continue to not exercise

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during daylight saving. In relation to evening activity, nearly one quarter of respondents (22%) who had not previously exercised in the evening did so during the daylight saving period. However, 11% of respondents who exercised during the evening before daylight saving did not do so during the daylight saving period. Twenty-nine per cent of respondents maintained their regular morning exercise pattern during daylight saving, as did 17% of those who were active in evenings.

Impact of number of exercise sessions

In addition to changes in relation to time of day and physical activity, there were also changes in the number of sessions of physical activity people typically engaged in per day prior to and during daylight saving (Table 2). Across all respondents, the majority (69%) engaged in exercise once each day prior to daylight saving, while a greater proportion (75%) exercised daily during daylight saving ($p<0.01$). However, compared with the pre-daylight saving period (18.5%), fewer respondents (12.6%) participated in two sessions per week ($p<0.01$) and twice as many (8.1% compared with 3.6%) participated in no sessions per week during the daylight saving period (8.1%) compared with the period immediately preceding the introduction of daylight saving (3.6%) ($p<0.01$).

When analysed at the individual level, 61.0% of respondents participated in the same number of exercise sessions pre and during daylight saving, while 26% participated in fewer sessions and 12% in more sessions ($p<0.01$).

Figure 1: Time of day of physical activity: Prevalence during the most recent summer, prior to, during and following the daylight saving period.

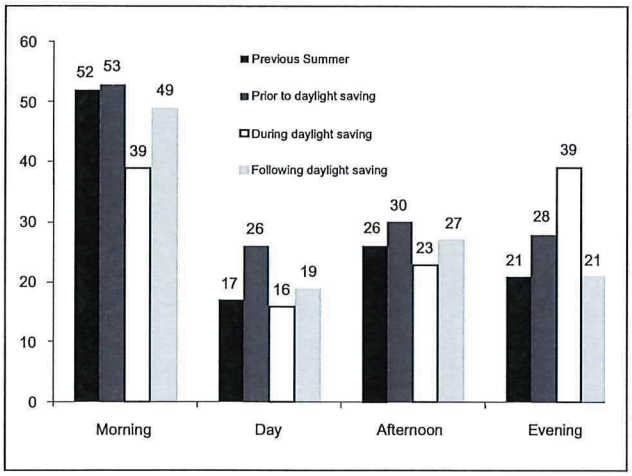
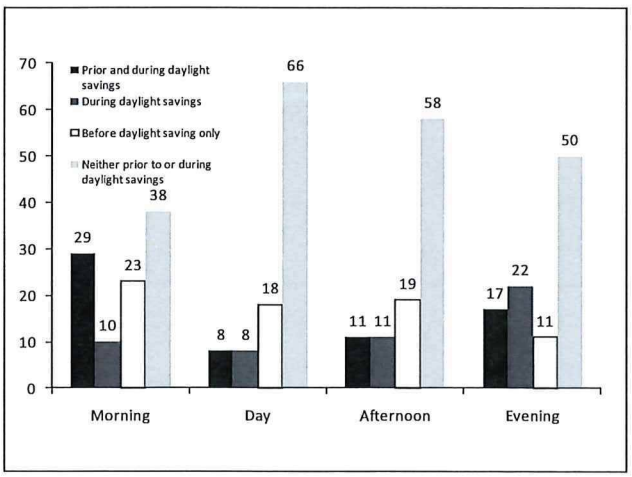


Figure 2: Comparison of individual changes in exercise patterns prior to and during daylight saving.



Discussion

The findings of this study suggest that the introduction of daylight saving in Western Australia resulted in almost half the population changing their physical activity patterns. These changes were evident both in terms of when people were physically active (in the morning before work, during the day, in the afternoon after work, later in the evening) and the number of sessions of physical activity.

The results capture some of the changes to people's physical activity patterns as a result of daylight saving. This was, in part, evident among the 23% of people who exercised in the morning before work pre-daylight saving not doing so during the daylight saving period, as well as, a similar proportion of people engaged in physical activity in the evening only during daylight saving. These observations were greater for females and those living in the country, although they were not related to the age of respondents. At the end of the daylight saving period, most respondents believed they would return to their 'usual' non-daylight saving physical activity patterns, providing some confirmation that the changes reported in relation to participation in physical activity had been attributable to daylight saving. The extent to which this reflects adaptability to daylight saving requires further investigation.

From the observed changes and anecdotal reports, it could be inferred that for males, respondents 30-44 years of age, and those living in the metropolitan Perth area, daylight saving provided a greater opportunity to take advantage of additional after work hours of daylight for physical activity, compared with their counterparts. The observed changes in physical activity patterns also suggest that about one quarter of the population will adapt their physical activity patterns in response to an environmental policy change such as a daylight saving introduction, in order to maintain participation in physical activity. However, differences

Table 3: Number of times engaging in exercise throughout the day.

Number of exercise sessions each day	Month prior to daylight saving (n=1,083) %	During daylight saving (n=1,083) %
No sessions	3.0	8.1
One session	69.0	74.8
Two sessions	20.9	12.6
Three sessions	3.3	1.5
Four sessions	3.8	3.0
Average number of sessions each day ($p<0.00$)	1.37 ± 0.83	1.16 ± 0.71

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in the adaptability of physical activity habits among sub-groups in the population requires further investigation as it was beyond the scope of this study.

As the amount of physical activity is linked to health and wellbeing outcomes, the study considered changes in the frequency of daily physical activity sessions. Although the number of people engaging in physical activity once per day increased during daylight saving, overall there was a decline in the number of daily sessions of activity among the respondents, with 26% participating in fewer sessions. However, what is not known from the data is whether the total time spent being physically active in a single session increased to compensate for fewer total sessions. Moreover, 12% of respondents did more sessions of physical activity during daylight saving, although again the total time spent being physically active is unknown. Of greatest concern is the fact that twice as many people (8.1% v 3.6%) did not participate in any physical activity in a typical day during the daylight saving period.

In part, some of the observed changes may reflect the climatic patterns of WA, which typically has summer maximums ranging from 25° to 40° Celsius, typically peaking in the afternoon. In addition, sunrise in the latter part of the daylight saving period encroached on the available sunlight for morning physical activity. Anecdotally and in media reporting, some WA residents objected to not being able to exercise in the cool of the day, others welcomed the opportunity to exercise post work, but the late afternoon heat was sometimes seen as restrictive. This study was designed to examine the impact of daylight saving on physical activity, and purposely chose not to enter into the contention and attitudinal debate surrounding daylight saving in some Australian states such as Queensland and WA.[20,21] As such, the relationship between attitudes and physical activity adaptability is unknown but could be usefully explored in future studies.

Numerous individual, group and community interventions have only produced modest effects on changing physical activity behaviour.[2,9] By contrast, daylight saving, a simple one hour shift in time, appears to have affected almost half respondents in this study, in both their reported participation in physical activity and when during the day they were able to engage in physical activity.

The reported overall impact on physical activity participation identified in this study were congruent with those reported by the HDWA's[6] analysis of Western Australian physical activity surveillance data. In the HDWA study, the most pronounced increase in physical activity was among males, with minimal impact upon women, whereas in the current study we observed a deterrent influence of daylight saving on physical activity patterns among women, with similar benefits of daylight savings reported by their male counterparts. However, methodological differences in the HDWA[6] methodology (Surveillance) and this study (Cohort) make detailed comparisons difficult. This raises issues of the equitable impact of daylight saving on physical activity, and although appears to be unrelated to age, may be associated with other social economic status variables not included as part of this study. Further empirical research and complementary qualitative research would enable further exploration of these issues.

While an impact on physical activity participation may have been an unintended consequence of introducing daylight saving, the results suggest that this impact was real for nearly half the study population. This paper highlights that even a relatively modest change, shifting time by one hour, can have an impact on physical activity patterns in positive and negative ways. The impact is not uniform across the population, with females who did not change from exercising in the morning during daylight saving to another time during the day, likely to drop out of physical activity and younger males more likely to increase the number of sessions they engage in physical activity each day during daylight saving. However, when extrapolated, to the population level, small individual changes result in larger observed impacts on physical activity patterns, For example, if the results of this study are true and overall 5% of the metropolitan Perth population did more PA during daylight savings and this increase was a modest five minutes more for each of these people, this would translate into 375,000 more minutes of PA among the 1.5 million metropolitan Perth residents.

Above and beyond changes in actual physical activity behaviour, the study draws attention also to significant attitudinal change, with almost half respondents perceiving a change in when they were physically active during the periods of daylight saving. Independent of changes in actual physical activity, this represents a large effect of daylight savings at the attitudinal level that would be considered extremely successful in a more traditional physical activity intervention that seek to influence physical activity related attitudes as a precursor or adjunct to behaviour change.

The results of this study also suggest the need to further understand the role of complementary policies around flexible access to recreational facilities, public transport timetables, working conditions and child care support to assist people as they adapt their patterns of physical activity during daylight saving. The study also highlights the importance of assessing the unintended impact on health behaviours of various public policies that do not prima facie appear to be about health. Such thinking is congruent with growing momentum around health impact assessments[22,23] relating to public policy, and also to compelling arguments for research that can be framed opportunistically around naturally occurring experiments, such as occurred in WA with the daylight saving trial. Other examples of public policy that may have a public health impact are the deregulation of trading hours, liquor and gaming restrictions and government responses to petrol pricing.

Limitations

The generalisability of this study's findings is in part limited by the 65% response rate achieved in recruiting Western Australian adults into the original prevalence study. However, we achieved 95% agreement among participants re-contacted to participate in the daylight saving survey. Although the selective attrition of the study was small (5%), we were unable to follow-up this group. However, at baseline, the cohort held similar physical activity

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patterns with the remaining unselected 2,000 respondents from the adult physical activity survey who did not participate in this study.

Although changes in the pattern of behaviour were observed in this study, the overall impact of daylight saving on actual levels of physical activity pattern are unknown, as limited funding prevented collection of post daylight saving physical activity levels. The study relied upon respondents recalling when they were typically physically active during the day, and it was beyond the scope of the study to assess the validity of these responses. Furthermore, with one-third of respondents indicating they increased their overall physical activity levels, despite participating in fewer sessions, longer sessions may have occurred during the period a measurement not included in the study.

Conclusions

Notwithstanding the limitations of this study, the results indicate that the introduction of a public policy that imposes a relatively modest compulsory change, such as daylight saving, can unintentionally have a powerful impact on patterns of physical activity at least equal to most other attempts to directly influence this health behaviour. In a typical media campaign, a behaviour change of a few percentage points would be considered successful.[24] The results also provide encouragement for continued efforts towards introducing public health policy as an effective means of supporting population behaviour change interventions more broadly. In addition, the study suggests that public policy seemingly outside of health can have an indirect and significant effect on health behaviours, hence the merits of health impact assessments of proposed public policies and non health sector collaboration. There are number of opportunities to further investigate the effect of policy change. The recent Western Australian referendum rescinding DLS, proposed changes to Western Australian retail trading hours, changes to liquor licensing laws allowing alcohol consumption without a meal at all restaurants and the fencing of local parks deter vandalism.

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