

# The potential of school-based physical education to increase physical activity in Aotearoa New Zealand children and young people: a modelling study

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## ABSTRACT

**AIMS:** Regular physical activity (PA) is critical for children and young people's health and wellbeing. Schools are an important setting for promoting PA. This study aimed to examine prevalence of PA through physical education in New Zealand schools and the potential impact of increasing physical education on young people's PA levels.

**METHODS:** We used data from the Active NZ Young People Survey of over 8,000 young people and modelled the impact of a hypothetical intervention that increased school-based physical education time to 2.5 hours (consistent with international best practice) on the distribution of PA.

**RESULTS:** At baseline, 61.3% (95%UI 60.2–62.5) of young people were classified as being sufficiently active (7+ hours/week), 19.8% (95%UI 18.9–20.8) were moderately active, and 18.8% (95%CI 17.9–19.7) were minimally active. The intervention scenario would more than halve the prevalence of minimal activity to 8.1% (95%UI 7.5–8.8) and increase the proportion of sufficiently active young people to 68.4% (95%UI 67.3–69.5).

**CONCLUSION:** Increasing time being active through physical education has the potential to reduce the prevalence of minimally active young people in New Zealand. Policies to support increased physical education time, such as time-based requirements, would increase PA levels.

Regular physical activity is critical for children and young people's health and wellbeing; it contributes to the development of healthy cardiovascular and musculoskeletal systems and the maintenance of a healthy body weight, and it is associated with positive psychological and cognitive benefits.<sup>1</sup> In New Zealand, the Ministry of Health recommends that young people aged 5–17 years accumulate at least one hour of moderate to vigorous physical activity per day,<sup>2</sup> which is in line with inter-

national guidelines.<sup>1</sup> As few of 7% of young New Zealanders are currently doing enough physical activity at a sufficient frequency to meet these recommendations,<sup>3</sup> with nearly half failing to achieve a sufficient total volume of physical activity on a weekly basis.<sup>4</sup> This suggests that urgent action is required.

Schools are an important setting for promoting physical activity in young people. Nearly all young people spend over half their waking hours at school, and school-level policies have great potential

to increase physical activity and improve wellbeing.<sup>5</sup> The routine and regularity of the five-day school week may provide an opportunity to ensure physical activity is better spread throughout the week and that daily physical activity recommendations are met. Opportunities for physical activity include physical education as part of the timetabled curriculum, transport to and from school, activities during lunch and morning tea breaks, after-school activities and in-class activity breaks.<sup>5,6</sup> This paper focuses on physical activity as part of the curriculum (ie, physical education classes or similar), as this is an area where New Zealand policy appears weak in comparison to overseas.

Nearly all countries include physical education for at least part of compulsory schooling years,<sup>7</sup> with legal requirements for physical education in over 80% of countries.<sup>7,8</sup> Internationally, the presence of laws and policies that mandate a minimum amount of physical education are associated with higher levels of physical activity in young people.<sup>6</sup> The provision of physical education is embedded within the New Zealand curriculum,<sup>9,10</sup> but the curriculum does not specify a minimum time requirement. This contrasts many countries that have time-based requirements in place,<sup>7</sup> such as in Australia, where schools are required to provide at least two hours of physical education per week.<sup>11</sup>

This study aimed to examine the current prevalence of physical activity through physical education in New Zealand schools and the potential impact of increasing physical education on young people's physical activity levels. We also examined the differential impact of increasing school-based physical education by gender, ethnicity, urban–rural status, deprivation and age.

## Methods

### Data

We used data on physical activity participation from young people aged 5–17 years in the Active NZ Young People dataset, a component of the Active NZ Survey.<sup>4,12</sup> The Active NZ Survey aims to recruit a sample of adults and young people in New Zealand via a household-level sampling strategy. Approximately 5,000 young people, who are recruited continually throughout the year

via the household level sampling frame, are sampled on an annual basis. Survey respondents are asked to recall their physical activity (type, time, and location) over the previous seven days via an online survey, with adult caregivers responsible for survey completion for young people aged 5–11 years.<sup>12</sup> The survey also records sociodemographic information, attitudes towards physical activity and other lifestyle characteristics. This study used data collected between January 2017 and July 2018. Further details on survey methodology are available in a technical report.<sup>12</sup>

School years were grouped into primary (year 0 to year 6), intermediate (year 7 and year 8) and high school (year 9 to year 13), which reflects the organisation of the New Zealand school system. Deprivation, measured using the New Zealand Index of Deprivation (NZDep), was grouped into quintiles, with 1 representing the least deprived and 5 representing the most deprived areas. A series of dummy variables were developed to represent different ethnic groups (New Zealand European, Māori (the indigenous population of New Zealand), Pacific, Asian and other), which is consistent with a total ethnicity approach<sup>13</sup> and enabled survey participants to identify with multiple ethnicities. Finally, household meshblock was used to group young people based on a urban–rural indicator using Stats NZ concordance mapping,<sup>14</sup> and they were further grouped into major/large urban, small/medium urban and rural.

It was not possible to determine which young people completed the survey during school holidays at an individual level, and therefore we used the month the survey was completed as a proxy. For each day in the survey period, we calculated whether a young person completing the survey would have attended school in the previous seven days, based on national school holiday dates. We used this to estimate the average proportion of survey respondents who would have attended school for each calendar month. This allowed us to estimate whether each individual did or did not complete the survey during school holidays, assuming that responses to the survey were evenly distributed throughout the month. Each analysis was replicated 2,000 times using a Monte Carlo simulation

to generate uncertainty intervals (UI) and capture uncertainty around which young people completed the survey during school holidays. Survey participants who do not attend school were excluded from the analysis.

### Physical-activity levels

We grouped physical-activity levels into three categories of time spent being physically active across reported activities: sufficiently active (7+ hours/week), moderately active (3.5 to 7 hours/week) and minimally active (less than 3.5 hours/week). We were unable to ascertain the proportion of young people meeting physical-activity recommendations (one hour of moderate to vigorous physical activity per day) from the dataset, due to the lack of robust information on the spread of physical activity throughout the week. We estimated the proportion of young people in each physical activity group (sufficient, moderate, and minimal) and applied survey weighting to the analyses.

### Modelling physical-education increases

We modelled the impact of increasing school-based physical education time on young people's physical-activity levels. We set the school-based physical education time to 2.5 hours per week, which reflects the upper-end of physical education duration observed internationally.<sup>7</sup> We identified all young people who reported less than this amount of physical activity and re-coded their school-based physical education time to 2.5 hours. We did not change the school-based physical education time for those who reported more than 2.5 hours of physical education in the survey, as these young people are already achieving the scenario we modelled and their schools would not need to alter their curriculum.

Following the re-coding of the dataset, we re-calculated each young person's total weekly physical activity and re-grouped the young people according to their level of physical activity. The results are reported separately by school (primary, intermediate and high school), gender, ethnicity, urban-rural status and deprivation, to give an idea of the possible differential impact of increasing school-based physical education time across different population groups.

Analyses were conducted in Excel using the Ersatz add in to run the Monte Carlo analysis, with graphs plotted in R using the tidyverse package.

### Declarations

Ethics approval and consent to participate: This study was reviewed by and received ethical approval by the University of Otago Human Ethics Committee (D19/123).

### Availability of data and materials

The data that support the findings of this study are available from Sport NZ but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Sport NZ.

## Results

We excluded 99 respondents, who reported not attending school or who were missing locations for physical activity, from an initial sample of 8,983, leaving an analytic sample of 8,884. Sociodemographic characteristics of the sample are displayed in Table 1.

Overall, during term time, 61.3% (95%CI 60.2–62.5) of young people were classified as being sufficiently active across all sources of physical activity; 19.8% (95%CI 18.9–20.8) were moderately active; and 18.8% (95%CI 17.9–19.7) of young people were classified as minimally active (see Figure 1). Nearly half of young people reported receiving one hour or less of physical activity through school-based physical education (43.9%, 95%UI 42.7–45.1) in the last week (see Appendix Table 1). The majority of young people with low school-based physical activity were classified as being minimally active (86.5%, 95%UI 84.7–88.4%).

Increasing school-based physical education would increase the proportion of young people meeting physical-activity guidelines from 61.3% to 68.4% and more than halve the prevalence of minimal activity (from 18.8% to 8.1%) (see Figure 1).

There was variation in the proportion of young people who were sufficiently active across different sociodemographic groups at baseline (see Figure 2, and the full results in Appendix Table 2). Males had higher physical-activity levels than females, and the least

**Table 1:** Demographic characteristics of the sample.

	<b>N</b>	<b>%</b>
Total	8,884	
<b>Gender</b>		
Male	4,333	48.8
Female	4,526	50.9
Gender diverse*	25	0.3
<b>School</b>		
Primary	4,273	48.1
Intermediate	1,713	19.3
High school	2,898	32.6
<b>Urban-rural</b>		
Major/large urban	4,570	51.4
Small/medium urban	1,386	15.6
Rural	1,702	19.2
Unknown	1,226	13.8
<b>Deprivation level (NZDep)</b>		
1 (least deprived)	2,382	26.8
2	1,880	21.2
3	1,526	17.2
4	1,263	14.2
5 (most deprived)	959	10.8
Unknown	874	9.8
<b>Ethnicity**</b>		
European	7,505	84.5
Māori	1,505	16.9
Pacific	466	5.2
Asian	918	10.3
Other	124	1.4

\*Only provided as an option for those aged 13+.

\*\*Percentages sum to more than 100% as individuals could identify with multiple ethnicities.

deprived young people had higher physical-activity levels than the most deprived young people. We also observed differences in physical-activity levels by ethnicity, with Asian young people being the ethnic group least likely to have sufficient levels of physical activity.

Under the intervention scenario, all groups benefited from increased levels of physical activity. However, there were differences in the level of benefit (see Figure 2, and the full results in Appendix Tables 2 and 3). Absolute differences between sociodemographic groups were reduced. For example, the difference in the percentage of males and females in the minimally active group was reduced from 4.7% to 2.4%. The difference in the prevalence of minimal activity between the least-deprived and most-deprived quintiles was reduced from 10.7% to 7.8% and across different ethnicities from 14.7% to 7.2%. Relative differences in the proportion of young people who were minimally active remained and, in some cases, increased under the intervention scenario. For example, the relative difference in the proportion of females who were in the minimally active group increased slightly from 1.3 to 1.4 times the proportion of males in the minimally active group.

## Discussion

A high proportion of young New Zealanders report low levels of physical activity through school-based physical education. A low level of school-based physical education contributes to nearly a fifth of young people being classified as inactive. Our modelling shows that implementing 2.5 hours of school-based physical education each week would halve the overall prevalence of inactivity in young people and reduce absolute differences in physical activity between different sociodemographic groups. It would also substantially increase the proportion of young people meeting overall physical-activity recommendations. Importantly, the actual impact on the proportion meeting physical activity recommendations may be even greater than we have reported if the 2.5 hours of physical education were spread evenly throughout the school week (eg, 30 minutes per day). This would directly address the issue that many young people are not meeting daily physical-activity requirements, despite high overall volumes of participation.

### Strengths and limitations

The dataset used for this study is the largest national survey of young New

**Figure 1:** Young people's physical-activity distribution at baseline and under intervention simulation.

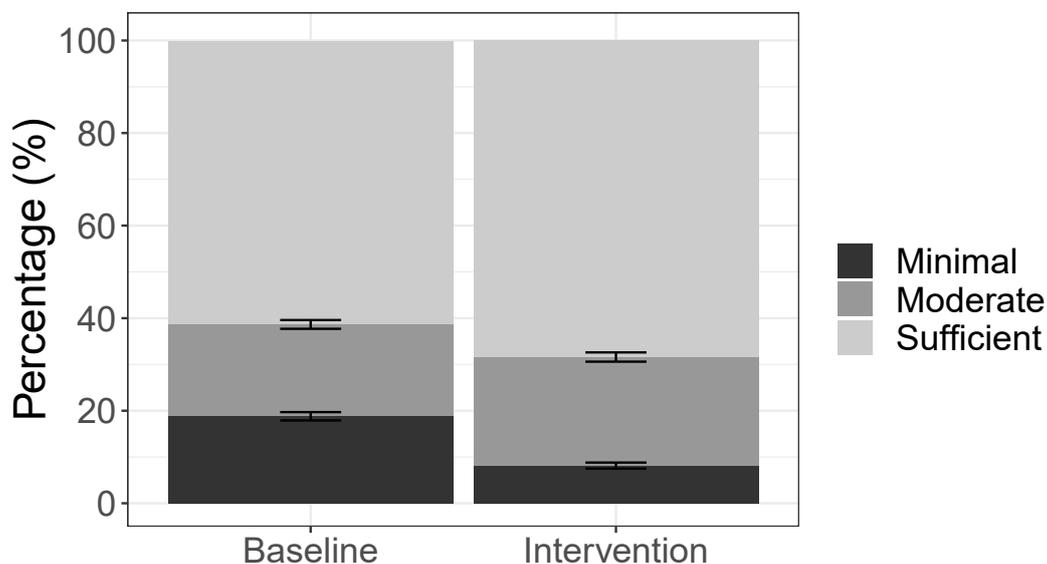
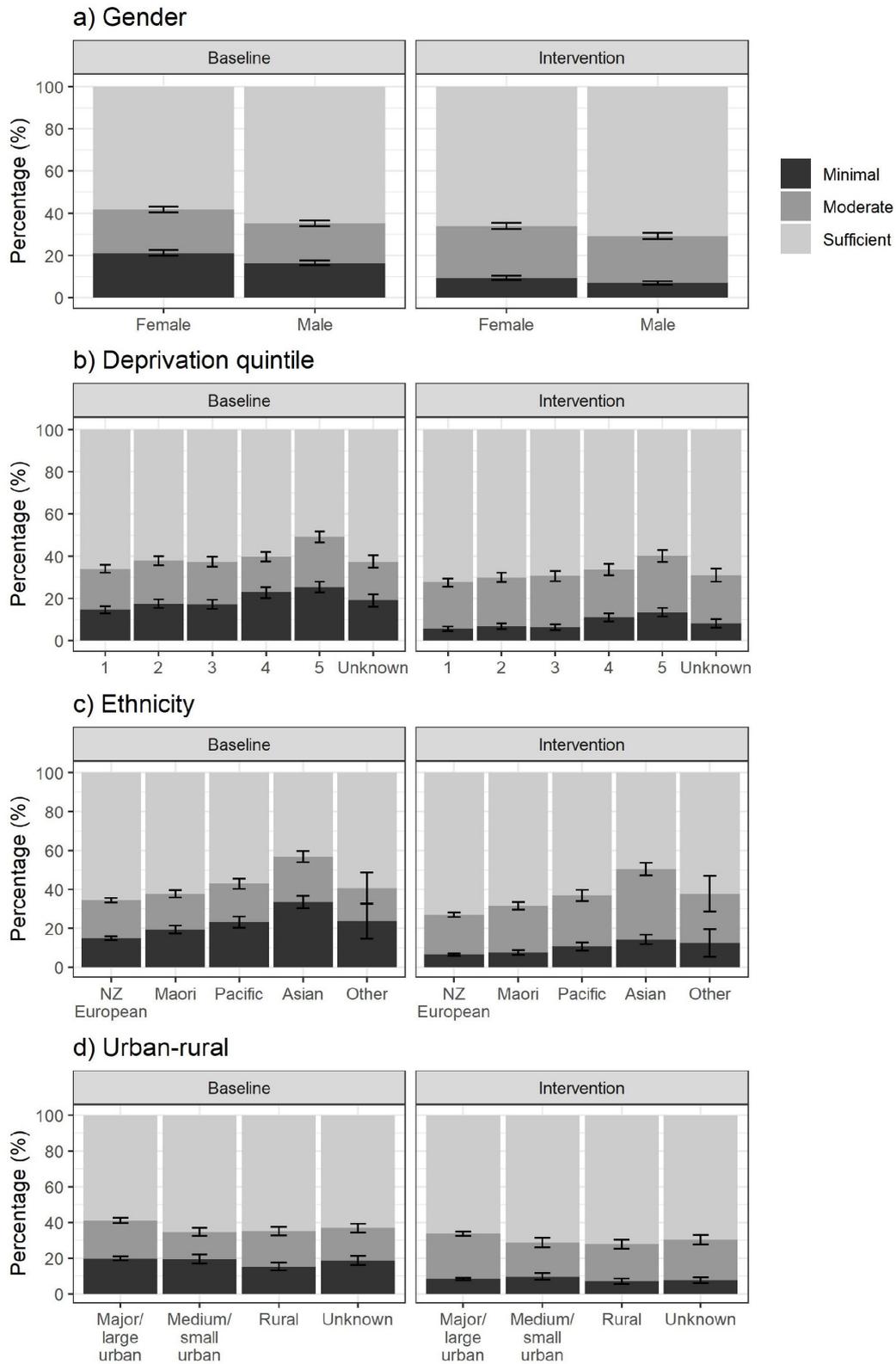


Figure 2: Young people's physical-activity distribution, disaggregated by sociodemographic characteristic.



Zealanders' participation in physical activity, and it is the only dataset that disaggregates physical-activity participation by location. However, the survey requires young people (or their parents) to recall physical activity over the previous week and has not been formally validated against objectively measured physical activity levels. Further research at the school level that captures time spent on school-based physical education is warranted to validate our findings.

Given that school holidays account for around a quarter of the calendar year, it was important to ensure that the results of our model reflected school holidays. Survey respondents were not required to report whether or not they completed the survey during school holidays. To overcome this shortcoming of the dataset, we applied a probabilistic approach to determine which survey respondents were sampled during school holiday periods.

We grouped physical activity into three categories: minimally active, moderately active and sufficiently active. The sufficiently active category is an approximation of the proportion of young people meeting physical-activity recommendations. We did not capture the spread of physical activity throughout the week; if increases in physical education were spread throughout the week, we would expect substantial increases in the proportion of young people meeting recommendations, compared to if physical education was not spread throughout the week. The difficulty of using survey data to accurately determine whether physical-activity recommendations are met is well established as a source of large differences in prevalence estimates.<sup>15</sup> Continual surveillance with consistent methodology is needed to evaluate changes in physical activity over time and will be required to evaluate the impacts of policy changes. International physical-activity report cards represent an important step in this direction.<sup>3,16,17</sup>

Our results suggest that increasing physical activity through school-based physical education is likely to reduce absolute differences in physical-activity participation across sociodemographic groups, including the current inequalities by deprivation. However, the sample included in this analysis is, on average, less deprived

than we would expect from a nationally representative sample, which suggests there is an underlying sampling bias. Maintenance and increases in the relative inequalities by sociodemographic characteristics should be considered in the context of large reductions in proportion of minimally active young people. For example, following the intervention, the proportion of females in the minimally active group was nearly half the current proportion of minimally active males. Evidence of an underlying sampling bias suggests that our interpretation of the likely differential impacts of increasing school-based activity should be interpreted with caution. Further work is required to better understand the potential differential impacts of increasing physical-education time, including the likely impacts on educational achievement in other areas.

### Policy implications

Physical activity is crucial for the health, wellbeing and development of young people.<sup>1</sup> Despite this, monitoring has shown that young New Zealanders have low levels of physical activity that do not seem to be improving.<sup>3,16,17</sup> This suggests that existing policies are not sufficiently effective. This modelling shows that a universal policy that achieves 2.5 hours of physical activity per week as part of the school curriculum (similar to levels reported in other jurisdictions)<sup>7</sup> would have a considerable impact on the total level of physical activity and the proportion of young people meeting recommendations. Importantly, it would disproportionately shift the 'tail' of minimally active children towards more favourable levels of physical activity. Dose-response relationships between physical activity and health outcomes in both adults and young people consistently suggest those who are least active have the most to gain from a unit increase in physical activity.<sup>18-21</sup> This suggests that interventions that positively impact the least active have the greatest potential benefit.

Despite physical education being part of the New Zealand school curriculum, a large proportion (44%) of young people report minimal physical-education participation at school ( $\leq 1$  hour/week). The observably low levels of physical activity through physical education likely result from a combination of the lack of timetabled physical-education

classes and low levels of physical activity within existing classes. International research show that time-based requirements are associated with higher levels of physical activity.<sup>6</sup> In addition, high variability has been observed in the proportion of physical-education time spent being physically active (from 11.4% to 88.4% of class time).<sup>22</sup> Our results demonstrate a need to further examine the gap between the national curriculum and measured physical education participation.

School-based physical education is one of a number of opportunities for building physical activity into the school day.<sup>5</sup> Within the literature, there are limited examples of effective policy to support the role of active transport to/from school to promote physical activity, despite an abundance of evidence indicating a small but significant effect on physical-activity levels.<sup>23-26</sup> Similarly, there is limited evidence around policies that target school-based activity programmes and in-class activity breaks, despite evidence from individual programmes of significant effects.<sup>27-29</sup> Consequently, we recommend regulating minimum standards for physical education as part of a comprehensive intervention and policy package to increase physical activity. This recommendation aligns with the strong international evidence that school-based physical education makes

a meaningful difference to physical activity at a population level. Close evaluation of the impacts of such a policy is needed, especially given the known differences in physical activity participation by ethnicity and area-level deprivation.

## Conclusion

This study found that young New Zealanders self-report low levels school-based physical education. Increasing school-based physical education has the potential to reduce the prevalence of minimally active young people and increase the prevalence of sufficiently active school-aged young New Zealanders. Further research is needed to examine the differential impacts of such a universal policy to increase physical-activity levels.

## Authors' contributions

AM was responsible for the conceptualisation, design of the study, analysis and drafting of the manuscript. CS and JR contributed to the design of the study, analysis, and interpretation of the results. BL contributed to the design and analysis of the study. All authors read and approved the final manuscript.

## Appendix

**Appendix Table 1:** Proportion of young people reporting low levels of school-based physical education (under 1 hour per week) by sociodemographic characteristics.

		<b>% Reporting low school physical education</b>
<b>Overall</b>		43.9 (42.7–45.1)
<b>Gender</b>	Male	42.5 (40.8–44.2)
	Female	45.3 (43.6–46.9)
	Gender diverse*	50.0 (28.5–71.5)
<b>School</b>	Primary	46.0 (44.1–47.9)
	Intermediate	38.1 (35.3–41.0)
	High school	44.2 (42.4–46.0)
<b>Urban-rural</b>	Major urban area	45.0 (43.4–46.5)
	Large urban area	43.4 (40.2–46.7)
	Medium urban area	40.3 (37.4–43.3)
	Small urban area	44.0 (40.9–47.1)
	Rural	43.2 (40.9–45.5)
	Unknown	44.5 (41.8–47.2)
<b>NZDep</b>	1 (least deprived)	44.8 (41.8–47.7)
	2	43.0 (40.0–46.1)
	3	43.7 (40.6–46.8)
	4	45.0 (41.2–48.7)
	5 (most deprived)	42.6 (41.3–44.0)
	Unknown	41.6 (39.2–44.0)
<b>Ethnicity**</b>	European	44.1 (40.8–47.3)
	Māori	51.0 (47.6–54.5)
	Pacific	43.9 (42.7–45.1)
	Asian	42.5 (40.8–44.2)
	Other	45.3 (43.6–46.9)

\*Only provided as an option for those aged 13+.

\*\*Percentages sum to more than 100% as individuals could identify with multiple ethnicities.

**Appendix Table 2:** Distribution of physical activity levels by sociodemographic characteristics (from simulation run excluding respondents completing survey during school holidays) at baseline.

		% Minimally active	% Moderately active	% Sufficiently active
<b>Total</b>		18.8 (17.9–19.7)	19.8 (18.9–20.8)	61.3 (60.2–62.5)
<b>Gender</b>	Male	16.4 (15.2–17.7)	18.9 (17.6–20.2)	64.6 (63.0–66.3)
	Female	21.1 (19.8–22.5)	20.7 (19.3–22.0)	58.2 (56.5–59.8)
	Gender diverse*	20.7 (3.3–38.1)	22.6 (4.6–40.6)	56.7 (35.4–78.0)
<b>School</b>	Primary	19.3 (17.9–20.8)	20.4 (18.9–21.9)	60.3 (58.5–62.1)
	Intermediate	14.9 (12.8–17.0)	18.9 (16.6–21.2)	66.2 (63.4–69.0)
	High school	19.8 (18.4–21.2)	19.7 (18.3–21.1)	60.5 (58.8–62.2)
<b>Urban–rural</b>	Major/large urban area	19.7 (18.5–21.0)	21.3 (20.0–22.6)	58.9 (57.4–60.5)
	Medium/small urban area	19.4 (16.8–22.0)	15.1 (12.8–17.4)	65.5 (62.4–68.6)
	Rural	15.2 (13.0–17.3)	19.8 (17.4–22.2)	65.0 (62.2–67.9)
	Unknown	18.6 (16.2–21.1)	18.2 (15.7–20.6)	63.2 (60.2–66.3)
<b>NZDep</b>	1 (least deprived)	14.7 (13.0–16.3)	19.3 (17.4–21.1)	66.0 (63.8–68.3)
	2	17.5 (15.5–19.6)	20.4 (18.2–22.5)	62.1 (59.5–64.7)
	3	17.2 (15.0–19.4)	20.1 (17.8–22.5)	62.7 (59.9–65.6)
	4	22.9 (20.3–25.4)	16.9 (14.6–19.2)	60.3 (57.3–63.3)
	5 (most deprived)	25.4 (22.7–28.0)	23.7 (21.1–26.3)	50.9 (47.9–54.0)
	Unknown	19.1 (16.1–22.0)	18.3 (15.4–21.2)	62.6 (59.0–66.2)
<b>Ethnicity**</b>	European	15.0 (14.0–15.9)	19.5 (18.4–20.6)	65.5 (64.2–66.8)
	Māori	19.4 (17.5–21.4)	18.3 (16.4–20.2)	62.3 (59.9–64.6)
	Pacific	23.2 (20.4–26.0)	19.8 (17.1–22.4)	57.0 (53.7–60.3)
	Asian	33.5 (30.2–36.7)	23.3 (20.4–26.3)	43.2 (39.8–46.6)
	Other	23.8 (14.8–32.9)	16.9 (8.9–24.8)	59.3 (48.9–69.7)

\*Only provided as an option for those aged 13+.

\*\*Percentages sum to more than 100% as individuals could identify with multiple ethnicities.

**Appendix Table 3:** Distribution of physical activity levels by sociodemographic characteristics (from simulation run excluding respondents completing survey during school holidays), in the intervention scenario where school-based physical activity is increased to 2.5 hours per week.

		% Minimally active	% Moderately active	% Sufficiently active
<b>Total</b>		8.1 (7.5–8.8)	23.5 (22.5–24.5)	68.4 (67.3–69.5)
<b>Gender</b>	Male	6.9 (6.0–7.7)	22.3 (20.9–23.7)	70.8 (69.3–72.4)
	Female	9.3 (8.3–10.3)	24.6 (23.2–26.1)	66.1 (64.5–67.6)
	Gender diverse*	15.7 (.1–31.4)	16.2 (.3–32.1)	68.1 (48.0–88.1)
<b>School</b>	Primary	8.0 (7.0–9.0)	24.5 (22.9–26.2)	67.5 (65.7–69.2)
	Intermediate	6.7 (5.2–8.2)	20.4 (18.0–22.7)	72.9 (70.3–75.5)
	High school	8.8 (7.8–9.8)	23.6 (22.1–25.1)	67.6 (65.9–69.3)
<b>Urban–rural</b>	Major/large urban area	8.2 (7.4–9.1)	25.4 (24.0–26.7)	66.4 (64.9–67.9)
	Medium/small urban area	9.6 (7.7–11.5)	19.0 (16.4–21.6)	71.4 (68.5–74.4)
	Rural	6.9 (5.4–8.5)	20.8 (18.4–23.3)	72.2 (69.5–74.9)
	Unknown	7.6 (5.9–9.3)	22.7 (20.0–25.3)	69.7 (66.8–72.6)
<b>NZDep</b>	1 (least deprived)	5.6 (4.6–6.7)	22.0 (20.0–23.9)	72.4 (70.3–74.5)
	2	6.7 (5.4–8.1)	23.2 (20.9–25.5)	70.1 (67.6–72.5)
	3	6.3 (4.9–7.7)	24.3 (21.8–26.8)	69.4 (66.7–72.1)
	4	11.0 (9.0–12.9)	22.6 (20.0–25.2)	66.4 (63.5–69.3)
	5 (most deprived)	13.4 (11.3–15.5)	26.8 (24.0–29.5)	59.8 (56.8–62.9)
	Unknown	8.2 (6.1–10.2)	22.8 (19.7–25.9)	69.1 (65.6–72.5)
<b>Ethnicity**</b>	European	6.5 (5.8–7.1)	20.5 (19.3–21.6)	73.1 (71.9–74.3)
	Māori	7.7 (6.4–9.0)	23.9 (21.8–25.9)	68.4 (66.1–70.7)
	Pacific	10.8 (8.7–12.8)	26.2 (23.3–29.1)	63.1 (59.9–66.3)
	Asian	14.3 (11.9–16.7)	36.2 (32.9–39.5)	49.5 (46.0–52.9)
	Other	12.6 (5.5–19.6)	25.2 (16.0–34.4)	62.2 (51.9–72.5)

\*Only provided as an option for those aged 13+.

\*\*Percentages sum to more than 100% as individuals could identify with multiple ethnicities.

**Competing interests:**

Sport NZ provided the funding for this study as part of a larger project and were responsible for collecting the data that was used in this study. Sport NZ staff members contributed to the analysis and interpretation of data and are included as co-authors (BL and JR). Dr Mizdrak reports grants from Sport New Zealand, during the conduct of the study. Dr Lynch reports being currently employed by Sport New Zealand, the government ministry responsible for physical activity.

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