Energy expenditure in adolescents playing new generation computer games

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ABSTRACT
Objective To compare the energy expenditure of adolescents when playing sedentary and new generation active computer games.

Design Cross sectional comparison of four computer games.

Setting Research laboratories.

Participants Six boys and five girls aged 13-15 years.

Procedure Participants were fitted with a monitoring device validated to predict energy expenditure. They played four computer games for 15 minutes each. One of the games was sedentary (XBOX 360) and the other three were active (Wii Sports).

Main outcome measure Predicted energy expenditure, compared using repeated measures analysis of variance.

Results Mean (standard deviation) predicted energy expenditure when playing Wii Sports bowling (190.6 (22.2) kJ/kg/min), tennis (202.5 (31.5) kJ/kg/min), and boxing (198.1 (33.9) kJ/kg/min) was significantly greater than when playing sedentary games (125.5 (13.7) kJ/kg/min) (P<0.001). Predicted energy expenditure was at least 65.1 kJ/kg/min greater when playing active rather than sedentary games.

Conclusions Playing new generation active computer games uses significantly more energy than playing sedentary computer games but not as much energy as playing the sport itself. The energy used when playing active Wii Sports games was not of high enough intensity to contribute towards the recommended daily amount of exercise in children.

INTRODUCTION
Young people are currently recommended to take an hour of moderate to vigorous physical exercise each day, which should use at least three times as much energy as is used at rest.1 2 Many adolescents have mostly sedentary lifestyles,3 however, as a result of a variety of factors. Time spent in front of television and computer screens has been causally linked to physical inactivity and obesity, although the associations are often weak.4

The new generation of wireless based computer games is meant to stimulate greater interaction and movement during play. A recent study reported that playing computer games using a hand held controller while seated increased energy expenditure above resting values by 22%, whereas activity based games that require upper body movements and dance games increased energy expenditure by 108% and 172%, respectively.5 The new generation of computer games could therefore be a useful addition to the range of opportunities for physical activity available to adolescents. Children spend a large amount of time playing computer games,6 and it is difficult to persuade them to relinquish these screen based activities.7 Activity promoting computer games might therefore be a useful way to increase activity in young people. In this study, we measured the energy expenditure of adolescent girls and boys playing Nintendo Wii (active) and Microsoft XBOX 360 (inactive) computer games.

METHOD
Participants and settings
A convenience sample of five girls and six boys aged 13-15 participated in the study. All participants regularly played sedentary computer games for at least two sessions of two hours each week and had not previously used Wii. All girls and boys were competent at sport; they regularly represented their school at hockey or netball (girls) and rugby or soccer (boys). Parents and adolescents consented to the study.

Anthropometry
We measured height to the nearest 0.1 cm using a portable stadiometer and weight to the nearest 0.1 kg using a calibrated mechanical flat scale. Measures were taken using standard anthropometric techniques.8

Familiarisation
On separate days from experimental trials, participants practised playing on the XBOX 360 and Wii computer consoles. For sedentary gaming, participants completed two races on a single player race mode on the game Project Gotham Racing 3 (XBOX 360) using a wireless hand held controller. For activity promoting gaming, participants completed the training modes for bowling, tennis, and boxing on the Wii Sports computer game. During familiarisation participants wore an IDEEA (intelligent device for energy expenditure and activity) system.

Participants’ mean resting energy expenditure and predicted energy expenditure when playing computer games

<table>
<thead>
<tr>
<th>Activity</th>
<th>Energy Expenditure (kJ/kg/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resting</td>
<td>125.5 (13.7)</td>
</tr>
<tr>
<td>Wii bowling</td>
<td>202.5 (31.5)</td>
</tr>
<tr>
<td>Wii boxing</td>
<td>198.1 (33.9)</td>
</tr>
<tr>
<td>Wii tennis</td>
<td>202.5 (31.5)</td>
</tr>
<tr>
<td>Wii boxing</td>
<td>198.1 (33.9)</td>
</tr>
<tr>
<td>XBOX 360</td>
<td>125.5 (13.7)</td>
</tr>
</tbody>
</table>

Participants’ mean resting energy expenditure and predicted energy expenditure when playing computer games.
Boys (n=6) 

Each hour

Each minute

Girls (n=5)

Height (m) 1.69 (0.1) 1.78 (0.05) 1.59 (0.04)

Age (years) 14.6 (0.5) 14.9 (0.3) 14.3 (0.5)

Body mass index (kg/m²) 21.2 (2.5) 20.7 (2.6) 21.7 (2.6)

Table 1

*Significantly lower than in boys (P=0.013).

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Results

Predicted energy expenditure was at least 51% greater during active gaming than during sedentary gaming. This equates to an increase in energy expenditure of 250 kJ (60 kcal) an hour during active gaming compared with sedentary gaming. In a typical week of computer play for these participants, active gaming rather than passive gaming would increase total energy expenditure by less than 2%[13,14], although this figure is trivial it might contribute to weight management. Active gaming used less energy than authentic bowling, tennis, and boxing, and the exercise was not intense enough to contribute towards the recommended amount of daily physical activity for children.[2] Nevertheless, new generation computer games stimulated positive activity behaviours—the children were on their feet and they moved in all directions while performing basic motor control and fundamental movement skills that were not evident during seated gaming. Given the current prevalence of childhood overweight and obesity, such positive behaviours should be encouraged.

Sex comparisons interestingly showed that, although all participants were competent sportspeople, the boys’ predicted energy expenditure during active gaming was

<table>
<thead>
<tr>
<th>Activity</th>
<th>Mean energy expenditure (kJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Each minute</td>
</tr>
<tr>
<td><strong>This study</strong></td>
<td></td>
</tr>
<tr>
<td>Resting energy expenditure</td>
<td>5</td>
</tr>
<tr>
<td>XBOX 360</td>
<td>7.5</td>
</tr>
<tr>
<td>Wii Sports bowling</td>
<td>11.7</td>
</tr>
<tr>
<td>Wii Sports tennis</td>
<td>12.5</td>
</tr>
<tr>
<td>Wii Sports boxing</td>
<td>12.1</td>
</tr>
<tr>
<td><strong>Various activities</strong></td>
<td></td>
</tr>
<tr>
<td>Sitting playing board games</td>
<td>6.7</td>
</tr>
<tr>
<td>Bowling</td>
<td>13.3</td>
</tr>
<tr>
<td>Tennis (doubles)</td>
<td>22.2</td>
</tr>
<tr>
<td>Boxing (punch bag)</td>
<td>26.8</td>
</tr>
<tr>
<td>Boxing (sparring)</td>
<td>40.1</td>
</tr>
</tbody>
</table>

We calculated values for the various activities using metabolic equivalents.[13]
Limitations
The study has several limitations. Firstly, the IDEEA accurately estimates free living and physical activity energy expenditure, but the monitor does not detect arm movements well. Energy expenditure may therefore have been underestimated during active gaming, which involves arm movements. The use of this system was supported by a recent method comparison study, which used the IDEEA as its criterion measure. Secondly, the study was laboratory based and may not have replicated conditions in the home. However, the children followed the instructions provided for home use, and energy responses are unlikely to be significantly different in a home based study. Thirdly, although we detected statistically significant differences in energy expenditure, our study was small and results are applicable only to lean, sports competent 12-15 year old adolescents and to the Wii Sports computer game, which is more active than other Wii games. Finally, we did not randomise the order of gaming during trials. This was because the children's availability was limited and because we wanted to make the experimental design as efficient as possible.

CONCLUSION
Activity promoting new generation active computer games significantly increased participants' energy expenditure compared with sedentary games, but not to the same extent as the authentic sports. Further research is needed to investigate the energy demands of active gaming across sexes, ages, and consoles.