As Good as the REAL THiNG?

By Mark Anders

It all really started going downhill with TV remotes. Those little handheld devices saved us the trouble of getting off the sofa to change the channel and successfully sucked yet another tiny bit of movement from our daily lives. Then came video games, which gave Americans, especially our kids, more reason to keep their rear ends firmly planted on the couch. In fact, people in this country now spend an average of 19 to 25 hours per week watching TV and playing video games.

Study by John Porcari, Ph.D., Karel Schmidt and Carl Foster, Ph.D.

In the fall of 2006, a new video game system called the Nintendo Wii hit the streets. It became an instant hit and is now a full-fledged craze, selling more than 11 million consoles in the Americas alone since its release. At first blush, this would seem like another sad blow to the battle between fit and fat, but thankfully the Wii is actually an exergame. That is, it's a video game that requires players to use actual physical movements to manipulate the action.

Employing a wireless handheld controller (about the size of a TV remote, ironically) with acceleration sensors and an infrared camera built into the console, the Wii senses players' motions and translates them into on-screen movement. For instance, in Wii Tennis you swing the controller like a racket; for Wii Golf, the controller is your club.

"When my brother-in-law and sister first got Wii they were saying, 'Oh we're getting a workout from it.' I thought they were just being ridiculous, but then I played it," says Karel Schmidt, a graduate student in clinical exercise physiology at the University of Wisconsin, La Crosse. "There were certain games that I could tell right away I was working harder than I would've been if I was playing a normal video game."

But just how hard was she really working? That very question is what motivated Schmidt and others to study the exercise benefits of Wii for this exclusive American Council on Exercise–sponsored research.

The Study

To test the potential fitness benefits of playing Wii, a team of exercise scientists at the University of Wisconsin, La Crosse Exercise and Health Program, led by John Porcari, Ph.D., and Schmidt, recruited 16 volunteers—eight men, eight women—all between the ages of 20 to 29 years old.

First, all volunteers were given an exercise test on a motorized treadmill to determine each subject's maximal heart rate and maximal oxygen uptake (i.e., $\dot{V}O_2$ max). Once that fitness baseline was established, the subjects were given a quick demonstration on how to use the video game system. Researchers used the standard Nintendo Wii ($250; www.nintendo.com/wii) bundled with Wii Sports, which includes baseball, boxing, bowling, golf and tennis games. Previous Wii experience was not required as subjects were given 15 minutes of practice time for each of the five sports and allowed to continue practicing until they felt they'd mastered the skills needed to play each one successfully.

Though it's possible to manipulate the onscreen players using minimal body movement, researchers instructed the subjects to simulate the body movements used in each actual sport. "With the tennis game, I could just stand in one spot and flick my wrist and the ball will go back. You can do

Continued on page 8

minimal movement, but we tried to teach the participants to mimic the real game as closely as possible," says lead researcher John Porcari, Ph.D. "We told them when you hit a forehand, swing your arm the way you would swing a racket. When you're doing a backhand, change your stance and really use your body."

Actual testing on the Wii was conducted on a subsequent day. At that time, subjects played each of the five sports in random order. Each game lasted 10 minutes and researchers recorded heart rate and $\dot{V}O_2$ at one-minute intervals. Researchers also interviewed the subjects during the final minute of each sport to determine their perceived exertion levels using the Borg rating of perceived exertion (RPE). A five-minute break was given between each game to return the subjects' heart rates to within 10 beats of their normal resting heart rate prior to beginning testing for the next game.

The Results

Data compiled from all subjects showed that playing Wii Sports increases heart rate, $\dot{V}O_2$ and perceived exertion—and thus calorie burn. Specifically, playing the golf game burns approximately 3.1 calories per minute while eliciting 50 percent of HR max and 20 percent of $\dot{V}O_2$ max. The bowling game burns slightly more at 3.9 calories per minute with 52 percent of HR max and 23 percent of $\dot{V}O_2$ max. Calorie expenditure for the baseball game was recorded at 4.5 calories per minute with 55 percent of HR max and 28 percent of $\dot{V}O_2$ max. And finally, the energy expenditure for the tennis game (at 5.3 calories per minute, 59 percent of HR max, and 33 percent of $\dot{V}O_2$ max) was significantly greater than all of the other sports except boxing, which weighed in at 7.2 calories per minute, 74 percent of HR max, and 44 percent of $\dot{V}O_2$ max.

"When you play the lower-intensity games like bowling or golf you can see that you're not really doing that much," says Schmidt, "but then when you play tennis or boxing you really do feel like you're getting a workout, like you're getting breathy. And that's exactly what we found and that's what our subjects reported to us as well."

In fact, in addition to burning the most calories, boxing was the only Wii game tested that would be considered intense enough to maintain or improve cardiorespiratory endurance as defined by the American College of Sports Medicine (ACSM). "People were increasing their oxygen consumption, or how many calories they're burning, by five or six times above their normal resting values," notes Porcari. "Even the golf game was two or three times higher than resting rates."

A Wii BIT MORE EXERCISE

The latest and most fitness-oriented addition to the Wii world is Wii Fit, a game that comes with a wired balance board and leads users through 40 different exercises, including everything from aerobic workouts to strength and balance training to yoga. The balance board acts as a game controller and body-weight scale, while also measuring balance and tracking users' fitness results. It was launched after this study was already completed, but an ACE-sponsored study examining Wii Fit is already underway. ($90, requires standard Wii gaming system; www.nintendo.com/wiifit)

To compare Wii Sports to the average calorie burn of playing the actual sports, researchers turned to values described in McArdle, Katch and Katch's *Exercise Physiology*, a standard text for caloric expenditure information. Compared to golfing at a driving range (3.9 calories per minute), playing Wii Golf burned 0.8 calories less per minute. Actual bowling burns nearly twice as much (7.2 calories per minute) as Wii Bowling, while baseball burns 7.3 calories per minute and Wii Baseball burns 2.8 calories per minute less. Similarly, Wii Tennis burns 2.8 calories per minute less than the actual game (8.1 calories per minute). Finally, Wii Boxing burns about 3.0 calories per minute less than conventional sparring at 10.2 calories per minute.

The Bottom Line

"The take-home message is that it's better than sitting around," says Porcari. "While not as good as playing the real sport, Wii certainly does burn more calories and gets your energy expenditure up compared to sitting around playing a sedentary video game."

Of course participating in the actual sports themselves provides more cardiovascular and strength benefits than Wii because you're moving your entire body and swinging things with more weight like baseball bats, tennis racquets and golf clubs. Even so, Wii can be a suitable workout and a great option for folks who can't find the time or motivation to get out of the house and exercise. For instance, playing 30 minutes of Wii Boxing burns 216 calories, which is 51 calories more than brisk walking, while a 30-minute Wii Tennis match burns a respectable 159 calories. Some people may also find that the natural competitiveness that comes with playing Wii against an opponent can help with their motivation and, thus, their ability to stick with a regular exercise regime. The convenience of exercising in one's own living room may also improve exercise adherence.

Wii can provide some fitness benefits and help with weight management, but the key comes down to simulating the movements used in the actual sports, says Porcari. "If you want to get as good a workout as you can with Wii Sports, you really need to mimic the real movements as closely as possible."

Too often people look at regular exercise as a chore. Our hope is that new exergames like Wii will entice non-exercisers to get up off the couch and realize that fitness can, in fact, be fun.

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WEB SIGHTINGS

exergamelab.blogspot.com

Hosted by Stephen Yang, co-director of the Physical Activity Research Laboratory at the State University of New York–Cortland, this blog explores the latest developments in the "exergame" trend.

www.gamesforhealth.org

An arm of the nonprofit Serious Games Initiative (founded at the Woodrow Wilson Center for International Scholars in Washington, D.C.), Games for Health offers news and hosts conferences based on how exergames and other computer-based games can best impact health care and policy.

Physiologic Responses to Each of the Wii Sports Games

GOLF	MEAN ± SD	RANGE
HR (bpm)	94.0 ± 9.2[de]	82.0–109.0
% HR max	50.0 ± 4.8[de]	42.0–59.0
$\dot{V}O_2$ (ml/kg/min)	8.4 ± 2.3[de]	5.4–13.2
% $\dot{V}O_2$ max	20.0 ± 7.6[de]	12.0–38.0
Kcal/min	3.1 ± 1.2[de]	1.7–6.1
RPE	7.9 ± 0.9[de]	7–9

Kcal/min for actual sport (golf at driving range): 3.9

BOWLING	MEAN ± SD	RANGE
HR (bpm)	98.0 ± 13.1[cde]	80.0–120.0
% HR max	52.0 ± 5.9[de]	42.0–61.0
$\dot{V}O_2$ (ml/kg/min)	10.4 ± 2.8[de]	7.5–15.2
% $\dot{V}O_2$ max	23.0 ± 5.4[e]	15.0–32.0
Kcal/min	3.9 ± 1.4	2.2–7.3
RPE	8.8 ± 1.6[e]	7–11

Kcal/min for actual sport: 7.2

BASEBALL	MEAN ± SD	RANGE
HR (bpm)	103.0 ± 13.9[abde]	83.0–130.0
% HR max	55.0 ± 6.6	46.0–71.0
$\dot{V}O_2$ (ml/kg/min)	12.0 ± 3.6	8.3–16.9
% $\dot{V}O_2$ max	28.0 ± 10.5	15.0–50.0
Kcal/min	4.5 ± 1.7[a]	2.17–8.0
RPE	9.0 ± 1.2	7–12

Kcal/min for actual sport (pitching a baseball): 7.3

TENNIS	MEAN ± SD	RANGE
HR (bpm)	111.0 ± 14.9[abce]	87.0–140.0
% HR max	59.0 ± 6.9[abce]	51.0–74.0
$\dot{V}O_2$ (ml/kg/min)	14.3 ± 3.5[abce]	9.0–20.7
% $\dot{V}O_2$ max	33.0 ± 10.2	18.0–62.0
Kcal/min	5.3 ± 1.8[ab]	2.8–9.8
RPE	9.9 ± 1.8	8–15

Kcal/min for actual sport: 8.1

BOXING	MEAN ± SD	RANGE
HR (bpm)	139.0 ± 11.3[abcd]	126.0–165.0
% HR max	74.0 ± 8.6[abcd]	62.0–94.0
$\dot{V}O_2$ (ml/kg/min)	19.2 ± 4.9[abcd]	11.6–25.4
% $\dot{V}O_2$ max	44.0 ± 12.9[abcd]	29.0–75.0
Kcal/min	7.2 ± 2.5[abcd]	3.42–12.1
RPE	11.3 ± 2.1[abcd]	9–16

Kcal/min for actual sport (sparring): 10.2

a = significantly different than golf ($p < 0.05$); b = significantly different than bowling ($p < 0.05$); c = significantly different than baseball ($p < 0.05$); d = significantly different than tennis ($p < 0.05$); e = significantly different than boxing ($p < 0.05$)

NOTE: There were no significant ($p > 0.05$) differences in the physiological responses between males and females for any of the variables measured; thus, data were collapsed across gender.

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