

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/340638906>

# Medicina dello Sport EDIZIONI MINERVA MEDICA Cardiovascular effort intensity and energy expenditure during a Zumba® class according ponderal status and its relationship to age in a...

Article · April 2020

CITATIONS

0

READS

13

6 authors, including:



**Rodrigo Yañez-Sepúlveda**

Pontificia Universidad Católica de Valparaíso

30 PUBLICATIONS 32 CITATIONS

[SEE PROFILE](#)



**Eduardo Ignacio Báez**

Playa Ancha University

22 PUBLICATIONS 278 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Respuesta aguda del ejercicio Física en la Atención selectiva en estudiantes de Viña del Mar. [View project](#)



Using the strategy Z in the detection of sport talents in Chile [View project](#)

## **Cardiovascular effort intensity and energy expenditure during a Zumba® class according ponderal status and its relationship to age in adult women**

Journal: Medicina dello Sport

Paper code: Med Sport-3618

Submission date: November 2, 2019

Article type: Original Article

### Files:

1. Manuscript

Version: 4

Description: Manuscript

File format: application/vnd.openxmlformats-officedocument.wordprocessingml.document

2. Figures 1

Version: 1

Description: Figure 1

File format: image/jpeg

1  
2  
3 **Cardiovascular effort intensity and energy expenditure during a Zumba® class**  
4  
5 **according to the ponderal status and its relationship to age in adult women**  
6  
7

---

8  
9  
10 Marcelo TUESTA<sup>1,5</sup>, Fernando BARRAZA<sup>2</sup>, Rodrigo YAÑEZ-SEPULVEDA<sup>3</sup>, Eduardo  
11 BAEZ-SAN MARTIN<sup>4,\*</sup>  
12  
13

14  
15  
16 <sup>1</sup> School of Kinesiology, Faculty of Rehabilitation Sciences, Universidad Andres Bello,  
17 Viña del Mar, Chile.  
18

19  
20  
21 <sup>2</sup> School of Education, Pedagogy in Physical Education, Viña del Mar University, Viña del  
22 Mar, Chile.  
23

24  
25  
26 <sup>3</sup> Facultad de Filosofía y Educación. Pontificia Universidad Católica de Valparaíso,  
27 Valparaíso, Chile.  
28

29  
30  
31 <sup>4</sup> Department of Sports and Recreation, Faculty of Physical Activity and Sports Sciences,  
32 University of Playa Ancha, Valparaíso, Chile.  
33

34  
35  
36 <sup>5</sup> Laboratory of Cardiorespiratory Physiology, Center of Cardiovascular Rehabilitation,  
37 Doctor Jorge Kaplan Meyer Foundation, Viña del Mar, Chile.  
38

39  
40  
41  
42  
43  
44 \* Corresponding author: Department of Sports and Recreation, Faculty of Physical Activity  
45 and Sports Sciences, University of Playa Ancha, Valparaíso, Chile.  
46

47  
48 Address: Avenida Playa Ancha 850, Edificio Puntángelos, cuarto piso. Valparaíso (Chile)  
49

50  
51 Phone: +56 32 2205115. Email: [eduardo.baez@upla.cl](mailto:eduardo.baez@upla.cl)  
52  
53  
54  
55

1  
2  
3 Cardiovascular effort intensity and energy expenditure during a Zumba® class according to  
4  
5 the ponderal status and its relationship to age in adult women  
6  
7  
8

9 **Abstract**

10  
11  
12 BACKGROUND: A maximal-moderate intensity and high energy expenditure during an  
13  
14 aerobic training such as Zumba® fitness are recommended to promote healthy body  
15  
16 weight. However, age and ponderal status could affect the achievement of these results. The  
17  
18 aim of this study was to observe the effect of the ponderal status and age on cardiovascular  
19  
20 intensity, physical effort and energy expenditure in women during a Zumba® class.

21  
22  
23 METHODS: Heart rate (HR) and perceived exertion were measured in 101 women during  
24  
25 one-hour Zumba® class. Energy expenditure was estimated from HR. Participants were  
26  
27 classified as normal weight, overweight, and obese based on the Body Mass Index (BMI).

28  
29  
30 RESULTS: Obese women spent a shorter amount of time in maximal intensity HR  
31  
32 (2.91±11.5% of class time) compared with normal weight (11.74±20.4 % of class time) and  
33  
34 overweight women (11.20±18.6% of class time) with  $p<0.05$ . However, this group  
35  
36 remained at least ~52 min into moderate-maximal intensity. Relative energy expenditure  
37  
38 was lower in obese (4.35 kcal·kg<sup>-1</sup>) than normal weight (7.54 kcal·kg<sup>-1</sup>) and overweight  
39  
40 women (6.42 kcal·kg<sup>-1</sup>) with  $p<0.05$ . Total energy expenditure for obese women was ~380  
41  
42 kcal. A highest BMI was associated with a lower relative ( $r=-0.68$ ;  $p<0.0001$ ) and absolute  
43  
44 ( $r=-0.26$ ;  $p<0.008$ ) energy expenditure, and older age was related to a lower HR<sub>MEAN</sub> ( $r=-$   
45  
46 0.29;  $p<0.05$ ) and HR<sub>MAX</sub> ( $r=-0.34$ ;  $p<0.05$ ) respectively. CONCLUSION: A Zumba®  
47  
48 class can facilitate reaching the cardiovascular intensity and relative energy expenditure  
49  
50 required for weight control and lowering cardiometabolic risk in women. However, it is  
51  
52  
53  
54  
55

1  
2 necessary to consider ponderal status and age to achieve the goals of improving  
3  
4 cardiovascular fitness using Zumba® training.  
5  
6  
7  
8

9 **Key words:** Aerobic exercise, nutritional status, physical effort, energy expenditure.  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55

PEER REVIEW COPY  
Medicina dello Sport

1  
2  
3 **Cardiovascular effort intensity and energy expenditure during a Zumba® class**  
4  
5 **according to the ponderal status and its relationship to age in adult women**  
6  
7

8  
9 **Introduction**  
10

11 Aerobic exercise is still considered as an effective method for improving cardiorespiratory  
12 fitness and controlling body weight <sup>1-3</sup>. Both of these parameters are helpful to prevent the  
13 emergence of chronic metabolic and cardiovascular diseases <sup>4, 5</sup> and contribute to an  
14 improvement in quality of life <sup>6</sup>. It is noteworthy that a low level of cardiorespiratory  
15 fitness is associated with a higher risk of mortality from any cause, particularly from  
16 cardiovascular diseases <sup>7, 8</sup>. For this reason, it is recommended to have a regular aerobic  
17 practice of at least 150 minutes per week when performing moderate-to-vigorous physical  
18 activity (MVFA), or 75 minutes of vigorous activity to promote a healthy lifestyle <sup>9</sup>. To  
19 obtain the MVFA benefits, intensities between 60% to 95% of the maximum heart rate  
20 should be achieved and maintained for 20 to 60 minutes per session, 3 to 5 days per week <sup>9</sup>.  
21 However, motivation and regular practice are some of the biggest challenges for those who  
22 are not used to exercising systematically and wish to improve their cardiorespiratory fitness  
23 status via periodic exercise. To encourage a ~60-minute practice of group exercising is a  
24 good alternative. Then, to achieve the health benefits, it would be necessary to carry out  
25 only a ~50 minute or one-hour session of MVPA, at least three times per week.  
26  
27

28 Zumba® is one of the most known aerobics today that enables group physical activity<sup>10</sup>. It  
29 is not only a gym activity, but also practiced in open spaces (e.g.: public areas) where it can  
30 be carried out by a large number of people. This type of practice is called community-based  
31 physical activity <sup>11</sup>. During the last decade, Zumba® popularity has increased significantly.  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55

1  
2  
3 Apparently, the reason behind this fact is the essence of Zumba®: A mixture of gymnastics  
4 and music, where choreography is not necessarily rigid. The latter encourages spontaneous  
5 and periodic practice. Today, Zumba® is practiced by ~15-million people in ~200,000  
6  
7 locations among 180 countries <sup>10</sup>.

8  
9  
10  
11 Zumba® produces a high aerobic energy expenditure<sup>12</sup>. Studies have shown that young  
12 subjects can spend from ~350 to 450 kcal on average during a one-hour session of Zumba®  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55

13, 14. Luetzgen (2012) reported an average energy consumption of 369 kcal in a 39-minute session of Zumba® <sup>15</sup>. It should be noted that the American College of Sports Medicine (ACSM) recommends spending at least 300 kcal per session in order to promote weight loss or to maintain a healthy body weight <sup>9</sup>. In this regard, attending three Zumba® classes a week would help reach the recommended energy expenditure required to achieve health benefits, i.e.: > 1000 kcal <sup>16</sup>. Now, one of our recent studies used accelerometry to assess women with different ponderal statuses according to the Body Mass Index. It was suggested that among women who practice Zumba®, it is necessary to consider this factor to determine the adequate duration of sessions and number of sessions per week to promote the previously discussed health benefits <sup>17, 18</sup>.

56  
57  
58  
59  
60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82  
83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100  
101  
102  
103  
104  
105  
106  
107  
108  
109  
110  
111  
112  
113  
114  
115  
116  
117  
118  
119  
120  
121  
122  
123  
124  
125  
126  
127  
128  
129  
130  
131  
132  
133  
134  
135  
136  
137  
138  
139  
140  
141  
142  
143  
144  
145  
146  
147  
148  
149  
150  
151  
152  
153  
154  
155  
156  
157  
158  
159  
160  
161  
162  
163  
164  
165  
166  
167  
168  
169  
170  
171  
172  
173  
174  
175  
176  
177  
178  
179  
180  
181  
182  
183  
184  
185  
186  
187  
188  
189  
190  
191  
192  
193  
194  
195  
196  
197  
198  
199  
200  
201  
202  
203  
204  
205  
206  
207  
208  
209  
210  
211  
212  
213  
214  
215  
216  
217  
218  
219  
220  
221  
222  
223  
224  
225  
226  
227  
228  
229  
230  
231  
232  
233  
234  
235  
236  
237  
238  
239  
240  
241  
242  
243  
244  
245  
246  
247  
248  
249  
250  
251  
252  
253  
254  
255  
256  
257  
258  
259  
260  
261  
262  
263  
264  
265  
266  
267  
268  
269  
270  
271  
272  
273  
274  
275  
276  
277  
278  
279  
280  
281  
282  
283  
284  
285  
286  
287  
288  
289  
290  
291  
292  
293  
294  
295  
296  
297  
298  
299  
300  
301  
302  
303  
304  
305  
306  
307  
308  
309  
310  
311  
312  
313  
314  
315  
316  
317  
318  
319  
320  
321  
322  
323  
324  
325  
326  
327  
328  
329  
330  
331  
332  
333  
334  
335  
336  
337  
338  
339  
340  
341  
342  
343  
344  
345  
346  
347  
348  
349  
350  
351  
352  
353  
354  
355  
356  
357  
358  
359  
360  
361  
362  
363  
364  
365  
366  
367  
368  
369  
370  
371  
372  
373  
374  
375  
376  
377  
378  
379  
380  
381  
382  
383  
384  
385  
386  
387  
388  
389  
390  
391  
392  
393  
394  
395  
396  
397  
398  
399  
400  
401  
402  
403  
404  
405  
406  
407  
408  
409  
410  
411  
412  
413  
414  
415  
416  
417  
418  
419  
420  
421  
422  
423  
424  
425  
426  
427  
428  
429  
430  
431  
432  
433  
434  
435  
436  
437  
438  
439  
440  
441  
442  
443  
444  
445  
446  
447  
448  
449  
450  
451  
452  
453  
454  
455  
456  
457  
458  
459  
460  
461  
462  
463  
464  
465  
466  
467  
468  
469  
470  
471  
472  
473  
474  
475  
476  
477  
478  
479  
480  
481  
482  
483  
484  
485  
486  
487  
488  
489  
490  
491  
492  
493  
494  
495  
496  
497  
498  
499  
500  
501  
502  
503  
504  
505  
506  
507  
508  
509  
510  
511  
512  
513  
514  
515  
516  
517  
518  
519  
520  
521  
522  
523  
524  
525  
526  
527  
528  
529  
530  
531  
532  
533  
534  
535  
536  
537  
538  
539  
540  
541  
542  
543  
544  
545  
546  
547  
548  
549  
550  
551  
552  
553  
554  
555  
556  
557  
558  
559  
560  
561  
562  
563  
564  
565  
566  
567  
568  
569  
570  
571  
572  
573  
574  
575  
576  
577  
578  
579  
580  
581  
582  
583  
584  
585  
586  
587  
588  
589  
590  
591  
592  
593  
594  
595  
596  
597  
598  
599  
600  
601  
602  
603  
604  
605  
606  
607  
608  
609  
610  
611  
612  
613  
614  
615  
616  
617  
618  
619  
620  
621  
622  
623  
624  
625  
626  
627  
628  
629  
630  
631  
632  
633  
634  
635  
636  
637  
638  
639  
640  
641  
642  
643  
644  
645  
646  
647  
648  
649  
650  
651  
652  
653  
654  
655  
656  
657  
658  
659  
660  
661  
662  
663  
664  
665  
666  
667  
668  
669  
670  
671  
672  
673  
674  
675  
676  
677  
678  
679  
680  
681  
682  
683  
684  
685  
686  
687  
688  
689  
690  
691  
692  
693  
694  
695  
696  
697  
698  
699  
700  
701  
702  
703  
704  
705  
706  
707  
708  
709  
710  
711  
712  
713  
714  
715  
716  
717  
718  
719  
720  
721  
722  
723  
724  
725  
726  
727  
728  
729  
730  
731  
732  
733  
734  
735  
736  
737  
738  
739  
740  
741  
742  
743  
744  
745  
746  
747  
748  
749  
750  
751  
752  
753  
754  
755  
756  
757  
758  
759  
760  
761  
762  
763  
764  
765  
766  
767  
768  
769  
770  
771  
772  
773  
774  
775  
776  
777  
778  
779  
780  
781  
782  
783  
784  
785  
786  
787  
788  
789  
790  
791  
792  
793  
794  
795  
796  
797  
798  
799  
800  
801  
802  
803  
804  
805  
806  
807  
808  
809  
810  
811  
812  
813  
814  
815  
816  
817  
818  
819  
820  
821  
822  
823  
824  
825  
826  
827  
828  
829  
830  
831  
832  
833  
834  
835  
836  
837  
838  
839  
840  
841  
842  
843  
844  
845  
846  
847  
848  
849  
850  
851  
852  
853  
854  
855  
856  
857  
858  
859  
860  
861  
862  
863  
864  
865  
866  
867  
868  
869  
870  
871  
872  
873  
874  
875  
876  
877  
878  
879  
880  
881  
882  
883  
884  
885  
886  
887  
888  
889  
890  
891  
892  
893  
894  
895  
896  
897  
898  
899  
900  
901  
902  
903  
904  
905  
906  
907  
908  
909  
910  
911  
912  
913  
914  
915  
916  
917  
918  
919  
920  
921  
922  
923  
924  
925  
926  
927  
928  
929  
930  
931  
932  
933  
934  
935  
936  
937  
938  
939  
940  
941  
942  
943  
944  
945  
946  
947  
948  
949  
950  
951  
952  
953  
954  
955  
956  
957  
958  
959  
960  
961  
962  
963  
964  
965  
966  
967  
968  
969  
970  
971  
972  
973  
974  
975  
976  
977  
978  
979  
980  
981  
982  
983  
984  
985  
986  
987  
988  
989  
990  
991  
992  
993  
994  
995  
996  
997  
998  
999  
1000

The effect of age on cardiovascular intensity during Zumba® classes has not been studied yet. It is well known that the older the age, subjects are able to reach lower values of maximum HR; therefore, there is a tendency to experience a reduction in cardiac reserve<sup>19</sup>,  
<sup>20</sup>. While some studies show the maximum and average heart rate obtained during a Zumba® class <sup>21</sup>, there are no studies that link these variables to age, let alone with ponderal status. Therefore, the described recommendations are valid only for young adult women, as most of the studies have been focused on this age group <sup>22, 23</sup>. The aim of this

1  
2  
3 study is to observe the effects of a Zumba® class on heart rate, energy expenditure and  
4  
5 perceived exertion, and observe their relations with age and ponderal status according to  
6  
7 Body Mass Index (BMI) in adult and young adult women.  
8  
9

## 10 11 **Methods**

### 12 *Participants*

13  
14 Sedentary young adult and adult women (N = 101; Age 18-45 years) who attended a  
15  
16 Zumba® class for the first time. They were voluntarily recruited from workshops dictated  
17  
18 by certified Zumba® fitness instructors and carried out by *Instituto Nacional del Deporte*  
19  
20 (National Institute of Sports) of Valparaiso, Chile. To analyze the effects of overweight on  
21  
22 the variables of the physical effort, the participants were divided according to the ponderal  
23  
24 status using Body Mass Index. It is defined as the person's weight in kilograms divided by  
25  
26 the square of the person's height in meters<sup>24</sup>. Later, normal weight (N= 39; BMI= 18.5 -  
27  
28 24.9 kg·m<sup>-2</sup>), overweight (N= 40; BMI= 25-29.9 kg·m<sup>-2</sup>), and obesity (N= 22; BMI> 30  
29  
30 kg·m<sup>-2</sup>) groups were measured. Before signing the consent, participants were informed in  
31  
32 detail about the experimental procedures and possible risks associated with the study and  
33  
34 their participation. These experimental protocols were approved by the Ethics Committee  
35  
36 of the University of Viña del Mar. The study was conducted following the  
37  
38 recommendations of the Declaration of Helsinki for research involving human subjects. At  
39  
40 the time of measurement, all participants were healthy and had no records of injuries or  
41  
42 cardiovascular and respiratory diseases. In addition, no coffee, cigarettes or alcohol  
43  
44 consumption was allowed in the 24 hours prior to the beginning of monitoring the  
45  
46 variables.  
47  
48  
49  
50  
51  
52  
53  
54  
55

### *Anthropometric measurements and hydration status*

Before the internal physiological load monitoring, basic anthropometric variables were assessed: weight and height. Height was determined using a portable stadiometer (SECA® 213, Germany). Participants were not to have consumed any diuretic (i.e. alcohol, coffee, etc.) or performed moderate or intense physical activity in the previous 48 hours. Their personal data were also collected. A digital flat scale (SECA® 803, Germany) was used to obtain body weight and percentage of dehydration by Body Weight Change (%BWC) post-session. Finally, to observe possible effects of dehydration, the Urine Specific Gravity (USG) was measured before and after the class. Hydration status was controlled before and after exercise since this is a variable that can affect heart rate levels<sup>25, 26</sup>. For that purpose, a urine sample (100 ml, mid-stream) deposited in a sterile container was requested from participants. The USG was determined with a hand Refractometer (Robinair®, Spx model, USA) using duplicate measurements. The refractometer was cleaned with distilled water and calibrated between measurements<sup>27</sup>.

### *Data collection and analysis*

The study was conducted over a period of three weeks. During the first week, volunteers who met the inclusion criteria were recruited. During the following week, subjects participated in two Zumba® sessions (approx. 60 minutes) with a 72-hours gap between each session, in order to familiarize participants with the choreography and rhythm. During the third week, one hundred and one participants were randomly selected from 10 one-hour-long sessions of Zumba®, who were monitored to obtain the study variables. The

1  
2  
3 Zumba® class started with a 5 minutes warm-up using general exercises at low intensity.  
4  
5 The choreography performed during each session was always the same, including Latin  
6  
7 rhythms such as rumba, salsa, merengue, and reggaeton. Finally, a 5-minute of stretching  
8  
9 and a 5-minute of cool-down exercises were included in the procedures.  
10

#### 11 12 13 14 *Cardiovascular effort intensity, perceived exertion, and energy expenditure*

15  
16 To determine cardiovascular effort intensity, 11 heart rate sensors were used (Polar® model  
17  
18 H7, Finland), which were placed on the participants chests. Therefore, the devices were  
19  
20 linked via Bluetooth with an Ipad (Apple®, model A1474, California), which is compatible  
21  
22 with the Polar Team 1.3 application (Polar Electro® OY, USA). The maximum and mean  
23  
24 heart rate during the Zumba® class were obtained in absolute ( $HR_{MAX}$  and  $HR_{MEAN}$ ) and in  
25  
26 percentage relative to age-predicted maximal heart rate values ( $\%HR_{MAXP}$  and  $\%HR_{MEANP}$ )  
27  
28 from  $HR_{max} = [205.8 - (0.685 \cdot age)]^{20, 28}$ . Moreover, the time of the class in which the  
29  
30 subjects were at different zones of cardiovascular intensity was determined in relation with  
31  
32 individual age-predicted maximal heart rate according to Edwards (1993). These zones and  
33  
34 relative intensities were zone 1: very soft (50-60%  $HR_{MAXP}$ ), zone 2: soft (60-70%  
35  
36  $HR_{MAXP}$ ), zone 3: moderate (70-80%  $HR_{MAXP}$ ), zone 4: intense (80-90%  $HR_{MAXP}$ ), and  
37  
38 zone 5: maximum (90-100%  $HR_{MAXP}$ )<sup>29</sup>. The subjective sensation of effort was registered  
39  
40 immediately after the session ended with a 10-point modified rating of perceived exertion  
41  
42 (RPE)<sup>30</sup>. Finally, the energy expenditure in relation to time ( $kcal \cdot min^{-1}$ ) was estimated  
43  
44 using the Polar Team® application, which estimates energy expenditure based on  
45  
46 regression equations that consider gender, age, body weight, and heart rate during exercise  
47  
48  
49  
50  
51  
52  
53<sup>31</sup>. For the absolute energy expenditure of one hour of Zumba® class ( $kcal \cdot class^{-1}$ ), this  
54  
55

1  
2 value was multiplied by 60. To obtain the relative energy expenditure during the class (kcal  
3  
4  
5 · kg<sup>-1</sup> · class<sup>-1</sup>), this result was divided by the subject's body weight.  
6  
7

### 8 9 *Statistics*

10 All data collected are presented in mean ± standard deviation (SD). The Shapiro-Wilk test  
11  
12 was used to determine the homogeneity of variances. A one-way ANOVA was used to  
13  
14 compare means among the study variables according to the participants' BMI. Then,  
15  
16 Tukey's multiple comparisons test with a statistical significance level set in a P-value<0.05  
17  
18 was applied to specifically determine differences between groups. Finally, Pearson  
19  
20 correlation test was used to determine the relation between variables, with a significance  
21  
22 level set in P<0.001. All statistical analysis were conducted using the statistics software  
23  
24 GraphPad Prism 6.01 for Windows (GraphPad® Software Inc., La Jolla, CA, USA).  
25  
26  
27  
28  
29  
30  
31

### 32 **Results**

33  
34 The participants classified as obese presented a higher averages of body weight and BMI  
35  
36 compared with normal weight and overweight groups. Additionally, the overweight group  
37  
38 presented a higher BMI average than the normal weight group (Table 1). In regards to USG  
39  
40 (p= 0.77) and %BWC (p=0.57) no significant differences were observed between groups  
41  
42 (Table 1). Table 2 also shows that HR<sub>MAX</sub> and %HR<sub>MAXP</sub> were also lower in the obese  
43  
44 group compared with normal weight subjects Similarly, the percentage of %HR<sub>MAXP</sub> was  
45  
46 lower than in the overweight group.  
47  
48

49  
50 Regarding the percentage of the class spent in different cardiovascular intensities, only  
51  
52 zone 5 in the obese group was significantly lower than in normal weight and overweight  
53  
54  
55

1  
2 groups (Table 2). Moreover, all groups carried out more than 50 minutes of exercise to  
3 moderate-vigorous intensity (Table 2). On the other hand, a difference was observed in  
4 relative energy expenditure, which was lower in the obese group when compared with the  
5 normal weight and overweight groups during the Zumba® class. Here, the total energy  
6 expenditure of the session for all groups was more than 379 kcal.  
7

8  
9  
10  
11  
12  
13 Finally, a highest BMI was associated with a lower relative energy expenditure ( $r=-0.68$ ;  
14  $p<0.05$ ) and absolute ( $r=-0.26$ ;  $p<0.008$ ), and an older age was associated with a lower  
15  $HR_{MEAN}$  ( $r=-0.29$ ;  $p<0.05$ ) and  $HR_{MAX}$  ( $r=-0.34$ ;  $p<0.05$ ), respectively (Figure 1).  
16  
17  
18  
19

20  
21  
22  
23 \*\*Please, add near here Table 1\*\*

24  
25 \*\*Please, add near here Table 2\*\*

26  
27  
28 \*\*Please, add near here Figure 1\*\*

## 29 30 31 32 **Discussion**

33  
34 The main result of this study showed that a higher ponderal status may affect the time of  
35 exercise spent in maximum cardiovascular intensity during a one-hour Zumba® class in  
36 women. In addition, obesity and older age were associated with a lower ability to reach  
37 high maximum cardiovascular intensities and energy expenditure during the Zumba® class.  
38

39  
40 In this regard, a higher BMI was associated with a lower relative energy expenditure. It  
41 should be noted that obesity is correlated with a higher content of adipose tissue in the  
42 body, which acts as an obstacle against body movement, reducing the possibility of  
43 developing a greater effort and energy expenditure relative to body weight <sup>32</sup>. In this study,  
44 normal weight, overweight, and obese participants maintained a moderate intensity or  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55

1  
2  
3 higher (between zone 2 and 5;  $\geq 60\%$   $HR_{MAXP}$ ) during the 91.2% (54.7 min), 92.1% (55.3  
4  
5 min) and 87.2% (52.3 min) of the Zumba® class, respectively, according to CSEP (2002)  
6  
7 and ACSM (2014) guidelines. Moreover, the  $HR_{MEAN}$  during the sessions was 150.1  
8  
9  $beats \cdot min^{-1}$  (77.7% of  $HR_{MEANP}$ ), 150  $beats \cdot min^{-1}$  (78.1% of  $HR_{MEANP}$ ) and 144.4  
10  
11  $beats \cdot min^{-1}$  (73.7% of  $HR_{MEANP}$ ) in the normal weight, overweight, and obese groups,  
12  
13 respectively. Similar results were observed in previous studies, which showed heart rates of  
14  
15 147  $beats \cdot min^{-1}$  (78.3% of the maximum heart rate)<sup>33</sup>, 136  $beats \cdot min^{-1}$  (74.9-75.3% of the  
16  
17 maximum heart rate)<sup>34</sup> and 154  $beats \cdot min^{-1}$  (79% of the maximum heart rate)<sup>15</sup> in women  
18  
19 of different age and fitness level. However, despite the detrimental effect of obesity on the  
20  
21 increase in cardiovascular intensity, said this group remained within the time and intensity  
22  
23 recommended to achieve health benefits<sup>35, 36</sup>.

24  
25  
26  
27 On the other hand, the average perceived exertion during all Zumba® classes was  
28  
29 considered as moderate by all participants, rating between 4-6 (10-point Borg scale).  
30  
31 However, in other study conducted by our group, all participants (normal weight,  
32  
33 overweight and obese) declared an exertion perceived as vigorous, between 7-8 (10-point  
34  
35 Borg scale)<sup>17</sup>. The participants in both studies had similar characteristics. It is possible that  
36  
37 a long duration of the exercise (one hour) does not allow to determine an objective average  
38  
39 value of the whole session, therefore it would be advisable not to rely on this method to  
40  
41 control the specific effort in one-hour classes.  
42  
43  
44

45  
46 Another issue was the energy expenditure, which is also a decisive factor when directing  
47  
48 aerobic activities towards health purposes. Although the average energy expenditure  
49  
50 relative to body weight was significantly lower in the obese group when compared with the  
51  
52 normal and overweight groups in our study, this value exceeded the 300 kcal recommended  
53  
54  
55

1  
2  
3 for weight control in a 60-min session of aerobic exercise (~380 total kcal)<sup>36</sup>. Also, the  
4  
5 energy expenditure in the overweight group was lower than in normal weight subjects.  
6  
7 However, when total energy expenditure was observed, only the obese group presented  
8  
9 lower results than the normal weight group, demonstrating the deleterious effect of an  
10  
11 excessive increase in body weight, as occurs in obesity. Now, a higher BMI in the obese  
12  
13 group not only caused the subjects to reach a lower average cardiovascular intensity during  
14  
15 the Zumba® class, but it was also related to lower energy expenditure (relative and  
16  
17 absolute) and older age. Therefore, BMI should be considered when calculating parameters  
18  
19 related to cardiometabolic health recommendations, and for the prescription of exercise  
20  
21 from specialists who use physical activity as a prevention or treatment tool in weight  
22  
23 control. Furthermore, as age progresses, there should be a concern for increasing the  
24  
25 amount of weekly physical activity to compensate for the intensity decrease as consequence  
26  
27 of aging. It should be noted that previous studies of Zumba® had not observed this relation.  
28  
29  
30 In conclusion, a one-hour Zumba® class enables reaching the recommended cardiovascular  
31  
32 intensities and energy expenditure per session that the ACSM suggests for women<sup>16, 36</sup>,  
33  
34 independent of their BMI and age. Therefore, for adult women to achieve an effect in  
35  
36 weight control, it will be necessary to perform at least three sessions of one-hour Zumba®  
37  
38 class per week. Furthermore, in order to reach a certain level of fitness and weight control  
39  
40 such as weight loss, it will be important to consider both factors (ponderal status and age)  
41  
42 to generate suitable modifications in exercise prescription (planning).  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55

1  
2  
3 **Notes**

4  
5 *Conflicts of Interest*

6  
7 The authors have no conflicts of interest relevant to this article.  
8  
9

10  
11  
12 *Authors' contributions*

13  
14 Marcelo Tuesta and Eduardo Baez-San Martin carried out design of the work, experimental  
15 protocols, statistical analysis, interpretation of data and writing paper. Fernando Barraza-  
16 Gómez carried out statistical analysis and interpretation of data. Rodrigo Yáñez-Sepúlveda,  
17 carried out experimental protocols and interpretation of data.  
18  
19  
20  
21  
22  
23  
24

25  
26 *Acknowledgements*

27  
28 This work was supported by the Research Direction of the University of Playa Ancha (UPA  
29 1301/2017).  
30  
31

32 We want to thank the voluntary availability of the National Institute of Sport of Valparaiso  
33 for allowing the proper development of the project.  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55

## References

1. Rognmo O, Hetland E, Helgerud J, Hoff J, Slordahl SA. High intensity aerobic interval exercise is superior to moderate intensity exercise for increasing aerobic capacity in patients with coronary artery disease. *Eur J Cardiovasc Prev Rehabil.* 2004;11:216-22.
2. Wisloff U, Stoylen A, Loennechen JP, Bruvold M, Rognmo O, Haram PM, et al. Superior cardiovascular effect of aerobic interval training versus moderate continuous training in heart failure patients: a randomized study. *Circulation.* 2007;115:3086-94.
3. Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc.* 2007;39:1423-34.
4. Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee I-M, et al. Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory, Musculoskeletal, and Neuromotor Fitness in Apparently Healthy Adults: Guidance for Prescribing Exercise. *Medicine & Science in Sports & Exercise.* 2011;43:1334-59.
5. Nichols S, Taylor C, Page R, Kallvikbacka-Bennett A, Nation F, Goodman T, et al. Is Cardiorespiratory Fitness Related to Cardiometabolic Health and All-Cause Mortality Risk in Patients with Coronary Heart Disease? A CARE CR Study. *Sports Med Open.* 2018;4:22.
6. Blair SN, Kohl HW, Barlow CE, Paffenbarger RS, Gibbons LW, Macera CA. Changes in physical fitness and all-cause mortality: A prospective study of healthy and unhealthy men. *JAMA.* 1995;273:1093-8.
7. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT, et al. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet.* 2012;380:219-29.

- 1  
2  
3 8. Laukkanen JA, Rauramaa R, Salonen JT, Kurl S. The predictive value of  
4 cardiorespiratory fitness combined with coronary risk evaluation and the risk of  
5 cardiovascular and all-cause death. *J Intern Med.* 2007;262:263-72.  
6
- 7  
8 9. ACSM. Guidelines for Exercise Testing and Prescription 8th ed. Baltimore,  
9 MD, USA: Lippincott, Williams & Wilkins; 2010.  
10
- 11 10. Zumba F. 2018; Available from: <https://www.zumba.com/en-US/about>.  
12
- 13 11. Hanson S, Jones A. Is there evidence that walking groups have health  
14 benefits? A systematic review and meta-analysis. *Br J Sports Med.* 2015;49:710-5.  
15
- 16 12. Muhammad HFL, Safika EL, Wahyuni FC, Ermamilia A, Huriyati E. The  
17 Effect of Zumba Training on Body Composition, Dietary Intake, Sleep Quality, and  
18 Duration in Adult Sedentary Women With Overweight. *Top Clin Nutr.*  
19  
20 2019;34:277-86.  
21
- 22 13. Delextrat A, Neupert E. Physiological load associated with a Zumba((R))  
23 fitness workout: a comparison pilot study between classes and a DVD. *J Sports Sci.*  
24  
25 2016;34:47-55.  
26
- 27 14. Otto R, Maniguet E, Peters A, Boutagy N, Gabbard A, Wygand J. The  
28 energy cost of Zumba exercise. *Med Sci Sports Exer* 2011;43:S329.  
29
- 30 15. Luetngen M, Foster C, Doberstein S, Mikat R, Porcari J. Zumba((R)): is the  
31 "fitness-party" a good workout? *J Sports Sci Med.* 2012;11:357-8.  
32
- 33 16. Donnelly JE, Blair SN, Jakicic JM, Manore MM, Rankin JW, Smith BK.  
34 American College of Sports Medicine Position Stand. Appropriate physical activity  
35 intervention strategies for weight loss and prevention of weight regain for adults.  
36  
37 *Med Sci Sports Exerc.* 2009;41:459-71.  
38
- 39 17. Yanez-Sepulveda R, Barraza-Gomez F, Baez-San Martin E, Araneda OF,  
40  
41 Zavala JP, Hecht GK, et al. Differences in energy expenditure, amount of physical  
42 activity and physical exertion level during a Zumba fitness class among adult  
43 women who are normal weight, overweight and obese. *J Sports Med Phys Fitness.*  
44  
45 2018;58:113-9.  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55

18. Cugusi L, Manca A, Bergamin M, Di Blasio A, Yeo TJ, Crisafulli A, et al. Zumba Fitness and Women's Cardiovascular Health: A SYSTEMATIC REVIEW. *J Cardiopulm Rehabil Prev*. 2019;39:153–60.
19. Karvonen J, Vuorimaa T. Heart rate and exercise intensity during sports activities. Practical application. *Sports Med*. 1988;5:303-11.
20. Inbar O, Oren A, Scheinowitz M, Rotstein A, Dlin R, Casaburi R. Normal cardiopulmonary responses during incremental exercise in 20- to 70-yr-old men. *Med Sci Sports Exerc*. 1994;26:538-46.
21. Vendramin B, Bergamin M, Gobbo S, Cugusi L, Duregon F, Bullo V, et al. Health Benefits of Zumba Fitness Training: A Systematic Review. *PM R*. 2016;8:1181-200.
22. Donath L, Roth R, Hohn Y, Zahner L, Faude O. The effects of Zumba training on cardiovascular and neuromuscular function in female college students. *Eur J Sport Sci*. 2014;14:569-77.
23. Domene PA, Moir HJ, Pummeli E, Knox A, Easton C. The health-enhancing efficacy of Zumba(R) fitness: An 8-week randomised controlled study. *J Sports Sci*. 2016;34:1396-404.
24. Schwartz MW, Seeley RJ, Zeltser LM, Drewnowski A, Ravussin E, Redman LM, et al. Obesity Pathogenesis: An Endocrine Society Scientific Statement. *Endocr Rev*. 2017;38:267-96.
25. Marcos A, Manonelles P, Palacios N, Warnberg J, Casajus JA, Perez M, et al. Physical activity, hydration and health. *Nutr Hosp*. 2014;29:1224-39.
26. Sawka MN, Francesconi RP, Young AJ, Pandolf KB. Influence of hydration level and body fluids on exercise performance in the heat. *JAMA*. 1984;252:1165-9.
27. Castro-Sepúlveda M, Astudillo S, Álvarez C, Zapata-Lamana R, Zbinden-Foncea H, Ramírez-Campillo R, et al. Prevalencia de deshidratación en futbolistas profesionales chilenos antes del entrenamiento. *Nutr Hosp*. 2015;32:308-11.
28. Robergs RA, Landwehr R. The Surprising History of the “HRmax=220-age” Equation. *Journal of Exercise Physiology online*. 2002;5.

- 1
- 2
- 3 29. Edwards S. High performance training and racing. In: Edwards S, editor.
- 4 The heart rate monitor book. Sacramento: Feet Fleet Press; 1993. p. 113-23.
- 5
- 6 30. Borg G. Borg's Perceived Exertion And Pain Scales. Champaign, IL: Human
- 7 Kinetics; 1998.
- 8
- 9 31. Keytel LR, Goedecke JH, Noakes TD, Hiiloskorpi H, Laukkanen R, van der
- 10 Merwe L, et al. Prediction of energy expenditure from heart rate monitoring during
- 11 submaximal exercise. J Sports Sci. 2005;23:289-97.
- 12
- 13 32. Leibel RL, Rosenbaum M, Hirsch J. Changes in energy expenditure
- 14 resulting from altered body weight. N Engl J Med. 1995;332:621-8.
- 15
- 16 33. Delextrat AA, Warner S, Graham S, Neupert E. An 8-Week Exercise
- 17 Intervention Based on Zumba Improves Aerobic Fitness and Psychological Well-
- 18 Being in Healthy Women. J Phys Act Health. 2016;13:131-9.
- 19
- 20 34. Barene S, Krustrup P, Jackman SR, Brekke OL, Holtermann A. Do soccer
- 21 and Zumba exercise improve fitness and indicators of health among female hospital
- 22 employees? A 12-week RCT. Scand J Med Sci Sports. 2014;24:990-9.
- 23
- 24 35. CSEP. Canada's guidelines for increasing physical activity in youth. Ottawa
- 25 - Ontario, Canada: Public Works and Government Services Canada; 2002.
- 26
- 27 36. ACSM. ACSM's Guidelines for Exercise Testing and Prescription. 9th ed.
- 28 Philadelphia, USA: Paul D Thompson Wolters Kluwer/Lippincott Williams &
- 29 Wilkins; 2014.
- 30
- 31
- 32
- 33
- 34
- 35
- 36
- 37
- 38
- 39
- 40
- 41
- 42
- 43
- 44
- 45
- 46
- 47
- 48
- 49
- 50
- 51
- 52
- 53
- 54
- 55

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38

## Tables

Table 1. Pre- and post-exercise general characteristics of participants and hydration status.

Variables	All (n = 101)	Normal weight (n = 39)	Overweight (n = 40)	Obese (n = 22)
	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Age (years)	30,51 ± 7,0	29,6 ± 6,9	31,39 ± 7,0	30,56 ± 7,1
Weight (kg)	68,94 ± 12,6	59,13 ± 3,9	67,97 ± 6,1	88,09 ± 9,8*, **
Height (m)	1,60 ± 0,05	1,61 ± 0,05	1,58 ± 0,06	1,62 ± 0,04**
BMI (kg·m <sup>-2</sup> )	26,84 ± 4,4	22,08 ± 1,2	27,08 ± 1,4*	33,41 ± 3,4*, **
USG (g·mL <sup>-1</sup> )	1,017 ± 0,01	1,017 ± 0,01	1,017 ± 0,01	1,018 ± 0,01
BWC (%)	-0,84 ± 0,45	-0,77 ± 0,40	-0,91 ± 0,49	-0,84 ± 0,44

BMI: Body Mass Index, USG: urine specific gravity, BWC: Body Weight Change [(pre-exercise weight - post exercise weight)/ pre-exercise weight] x100; \* p<0.05 compared to the normal weight group using or \*\* p<0.05 compared to the overweight group, both using One-Way ANOVA Test.

Table 2. Cardiovascular effort intensities, rating of perceived exertion and energy expenditure during a one-hour Zumba® class.

Variables	All (n = 101)	Normal weight (n = 39)	Overweight (n = 40)	Obese (n = 22)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
HR <sub>MEAN</sub> (beats·min <sup>-1</sup> )	148,8 ± 15,7	150,1 ± 17,7	150±14,5	144,4 ± 14,0
HR <sub>MEANP</sub> (%)	77,00 ± 8,2	77,74 ± 8,8	78,08±8,2	73,73 ± 6,5
HR <sub>MAX</sub> (beats·min <sup>-1</sup> )	175,0 ± 14,5	177,8 ± 15,7	175,9±12,9	168,1 ± 13,6*
HR <sub>MAXP</sub> (%)	90,25 ± 7,8	91,79 ± 8,2	91,1±7,3	85,95 ± 6,3*, **
Zone 1 (% of class time)	4,72 ± 10,9	5,64 ± 12,2	3,75±11,1	4,86 ± 8,3
Zone 2 (% of class time)	19,10 ± 17,6	19,51 ± 20,3	15,98±15,1	24,05 ± 16,3
Zone 3 (% of class time)	33,36 ± 20,1	27,67 ± 17,6	35,73±21,7	39,14 ± 19,7
Zone 4 (% of class time)	28,58 ± 22,58	32,23 ± 23,20	29,15±20,9	21,09 ± 23,7
Zone 5 (% of class time)	9,60 ± 18,28	11,74 ± 20,4	11,20±18,6	2,91 ± 11,5 *, **
RPE (Borg Scale CR-10)	5,73 ± 1,97	5,84 ± 1,93	5,83±2,12	5,36 ± 1,81
Total energy expenditure	426,7 ± 76,16	445,3 ± 81,92	433,9 ± 66,66	379,5 ± 64,03*,

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38

(kcal·class <sup>-1</sup> )				**
Relative energy expenditure	6,40 ± 1,67	7,54 ± 1,38	6,42±1,10*	4,35 ± 0,89 *, **
(kcal· kg <sup>-1</sup> ·class <sup>-1</sup> )				
<p>HR: Heart rate; HRMAX: Maximum heart rate; HRMEAN: Mean heart rate; HRMAXP: Heart rate relative to maximum heart rate predicted; HRMEANP: Mean heart rate relative to maximum heart rate predicted; RPE: Rating of perceived exertion; *p&lt;0,05 compared to the normal weight group or **p&lt;0,05 compared to the overweight group, both using One-Way ANOVA Test.</p>				

### Figure title

**Figure 1.** Association between HR<sub>MEAN</sub>, HR<sub>MAX</sub> with age (A - B) and energy expenditure with BMI (C - D).

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55

