

Ergospirometry & body percussion. Case study based on BAPNE FIT method

Ergospirometría & body percussion. Estudio de caso basado en el método BAPNE FIT

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Abstract. El propósito de este estudio es realizar un estudio de caso evaluando aspectos cardiorrespiratorios y de ergospirometría o prueba de esfuerzo con análisis de gases empleando percusión corporal según el método BAPNE. Se estudió a un sujeto de 43 años con una altura de 182 centímetros y 81,7 kilogramos en un centro médico especializado para deportistas dirigido por el médico especialista en medicina deportiva Jeroni Llorca en el Sport Clínica Arena de Alicante. Al sujeto se le realizó un test de esfuerzo en cinta ergométrica de la marca Excite Technogym donde se le realizó un incremento de 0,6 Km/h cada minuto a partir de 4,0 Km/h. Se le aplicó una pendiente constante del 1% a la par que se le aplicó una monitorización ECG continua y análisis del intercambio ventilatorio de gases (Blue-Cherry/Geratherm de Ergostix). Las sesiones del método BAPNE FIT duran 50 minutos, aunque el estudio de ergospirometría duró 2 minutos cada actividad a analizar. Durante ese proceso se le evaluó al sujeto mientras realizaba cinco actividades diferenciadas del programa BAPNE FIT (actividades motoras, rítmicas y cognitivas con dual task) con Step, bandas elásticas en muslos tobillos, pesos en muñequeras y tobilleras y por último actividades de percusión corporal con calzado Kangoo Boots. El sujeto alcanzó un consumo máximo de oxígeno VO₂ PICO de 2,61l/min a 32,0 ml/kg/min. Se le aplicó una velocidad máxima de 10,0 Km/h alcanzando con actividades BAPNE FIT de FCM de 189 PPM. Con todo ello se demuestra que las actividades de BAPNE FIT ayudan y aumentan el consumo máximo de oxígeno, así como la frecuencia cardiaca. Hasta el momento no existe ningún estudio de este tipo relacionado con la percusión corporal siendo este un primer estudio que puede servir para estudios posteriores.

Keywords: Body percussion, Neuromotricity, BAPNE, Ergospirometría, Dual Task.

Abstract. The purpose of this study is to perform a case study evaluating cardiorespiratory aspects and ergospirometry or stress test with gas analysis using body percussion according to the BAPNE method. A 43-year-old subject with a height of 182 centimeters and 81.7 kilograms was studied in a specialized medical center for athletes directed by the sports medicine specialist Jeroni Llorca at the Sport Clinic Arena in Alicante. The subject underwent an exercise test on an Excite Technogym treadmill where he was given an increase of 0.6 km / h every minute from 4.0 km / h. The slope of the treadmill was applied at a constant gradient of 0.6 km / h every minute. A constant slope of 1% was applied at the same time as continuous ECG monitoring and analysis of ventilatory gas exchange (Blue-Cherry/Geratherm by Ergostix). The BAPNE FIT method sessions last 50 minutes, although the ergospirometry study lasted 2 minutes for each activity to be analyzed. During this process, the subject was evaluated while performing five different activities of the BAPNE FIT program (motor, rhythmic and cognitive activities with dual task) with Step, elastic bands on thighs and ankles, weights on wrist and ankle bracelets and finally body percussion activities with Kangoo Boots shoes. The subject reached a VO₂ PEAK maximal oxygen consumption of 2.61 l/min at 32.0 ml/kg/min. A maximum speed of 10.0 km/h was applied, reaching with BAPNE FIT activities an FCM of 189 PPM. This shows that BAPNE FIT activities help and increase the maximum oxygen consumption as well as the heart rate. So far there is no study of this type related to body percussion and this is a first study that can be used for further studies.

Keywords: Body percussion, Neuromotricity, BAPNE, Ergospirometry, Dual Task.

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Introduction

Body percussion in physical activity and sport sciences has an exclusive program that differentiates it from activities in other subjects (Romero-Naranjo, 2013a, 2013b, 2013c, 2014, 2017, 2018, 2019, 2020, 2021, 2022), such as visual arts (Alonso-Sanz & Romero-Naranjo, 2013), music (Romero-Naranjo, 2019, 2020, 2021, 2022), theater (Asurmendi-Telleria & Romero-Naranjo, 2022), learning a foreign language (Fernández-Molina et al., 2019), ethnography (Di Russo & Romero-Naranjo, 2021a, 20221b; Romero-Naranjo, 2008), socioemotional (Fabra-Brell & Romero-Naranjo, 2017; Moral-Bofill et al., 2020), etc. In the sciences of physical activity, the Bapne method provides a whole protocol of practical activities divided into two main lines. One of them in body expression with its corresponding manuals (Romero-Naranjo, 2019), and secondly, the subject that interests us here, protocols linked to physical activity called BAPNE FIT. In this area we can study cardiorespiratory aspects and er-

gospirometry or stress test with gas analysis (Romero-Naranjo & González de Benatuil, 2022a, 2022b; Romero-Naranjo & Romero-Naranjo, 2022).

Ergospirometry studies on body percussion do not exist, and based on neuromotricity much less, so here we provide a first case study that can serve as a basis for further research due to the results obtained.

Body percussion in Physical Activity and Sport Sciences

The performance of physical activity and sports has studies that demonstrate very positive aspects for the human being (Aguilar-Herrero et al., 2021; Martínez-Heredia et al., 2021; Pacheco et al., 2022; Padial-Ruz et al., 2022; Palma et al., 2021; Pérez et al., 2022; Romero-Ramos et al., 2021; Zambrano-Pintado et al., 2022). In the same way, there are also studies that show that when statistical data are correlated, the contribution is greater and, above all, they provide new lines to be improved (Luis-de Cos et al., 2019; Mezcua-Hidalgo et al., 2020; Villa de

Gregorio et al., 2019).

Body percussion is a discipline that requires seriousness and research, which is why it must be based on publications collected in academic search engines such as WOS, Scopus, Jstor, Eric, Proquest, etc. (Arnau-Mollá & Romero-Naranjo, 2022a, 2022b, 2022c, 2022d, 2022e).

At the University of Alicante, the BAPNE method is implemented with an exclusive protocol for children with activities ranging from three to six years old; also, for students of the music specialty with a specific activity protocol for learning musical language called cognitive solfeggio. A completely different protocol called BAPNE FIT is applied to students of physical activity and sport sciences. The activities that we analyze here with ergospirometry are carried out with this type of students using Steps, weights on the wrists and ankles and Kangoo Boots among other things (Figure 1).

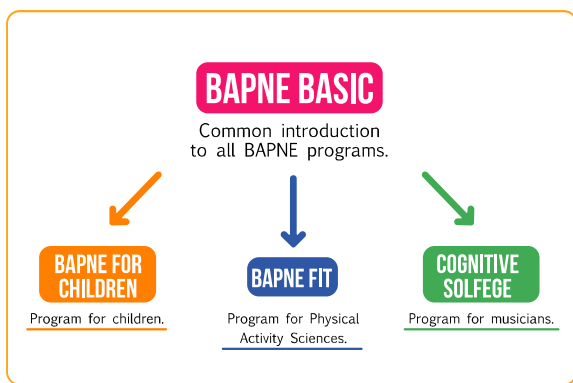


Figure 1. Outline of the BAPNE method

First of all, it is important to emphasize that body percussion is much more than clapping, having fun or doing choreographies whose objective is to entertain the students by making the classes a "theme park" from the "society of the spectacle" or "pedagogy of entertainment". For this reason, the model systematized under the name of neuromotricity was born, which seeks the creation and justification of activities focused on executive functions and especially the dual task (Álvarez-Morales & Romero-Naranjo, 2019; Andreu-Cabrera & Romero-Naranjo, 2021; Gonzalez de Benatuil, et al., 2022; Latre-Nava et al., 2019; Piqueres-Juan et al., 2019; Romero-Naranjo & Andreu-Cabrera, 2023c; Romero-Naranjo & Sayago-Martinez, 2021a, 2021b; Romero-Naranjo, 2020a, 2020b, 2020c, 2020d). This is why there is a clear difference between the concepts of motricity, psychomotricity and neuromotricity.

Motricity: is the ability to control body movements in a voluntary and coordinated manner involving the motor system. Activities such as walking, jumping, running, rolling, crawling, going up or down stairs, etc. clearly represent motor skills.

Psychomotricity: It is the set of "cognitive, emotional, symbolic and sensory-motor interactions in the capacity to be and to express oneself in a psychosocial context".

Neuromotricity: It is the educational and neurorehabilitative procedure that affects cognitive stimulation through the executive functions in which the dual task and mainly the language (spoken, sung, recited, etc.) thus providing a superior function to the stimulation (Romero-Naranjo, 2018).

Biomechanics in the didactics of body percussion has a very important role in structuring the movements and above all demonstrating that the activities of the BAPNE method are not harmful (Aedo-Muñoz et al., 2021; Alonso-Marco & Romero-Naranjo, 2022; Bermejo-Frutos, 2014; Burbano-Pantoja et al., 2021; Cadenas-Sánchez et al., 2015). Similarly, there are already proposals on body percussion and body schema in the sciences of physical activity and sport. (Romero-Naranjo & Andreu-Cabrera & Arnau-Mollá, 2023b).

Executive functions in the didactics of body percussion and their justification

Neuropsychology has structured three classic paradigms in relation to the so-called "dual task" (Baddeley, 1986; Falbo et al., 2016; Fritz et al., 2015; Koch et al., 2018; Mendel et al., 2015; O'Shea et al., 2022; Ruthruff et al., 2001):

1. Motor / Motor
2. Cognitive / Cognitive
3. Cognitive / Motor

Later other researchers proposed another model (Park & Brünken, 2014; Kim et al., 2017) called:

4. Rhythmic / Motor

The BAPNE method proposes another possible paradigm due to the type of activities executed named:

5. Rhythmic / Motor / Cognitive (Romero-Naranjo et al., 2023a).

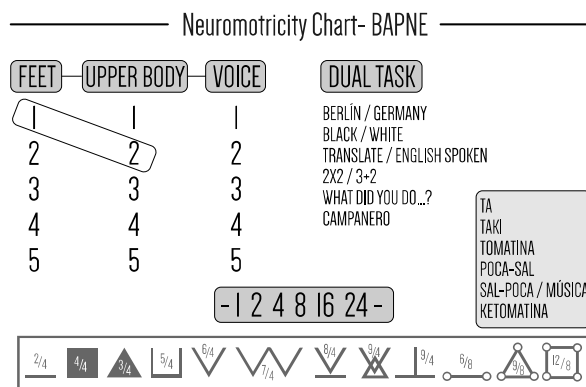


Figure 2. Neuromotricity Chart

The activity protocol of the BAPNE FIT program is based on activities in which the subject must perform motor movement activities while performing rhythmic structures with the upper limb and from the verbal point of view performs cognitive activities that the teacher can indicate (addition, subtraction, capitals of countries, saying opposites, translating words, singing a melody, etc.) (Figure 2).

This aspect has already been discussed more extensively in our research entitled "Pilot Study of the Assessment

of Anxiety and Attention through Body Percussion and Neuromotricity in Secondary Education Students in Physical Education, Music and Visual Arts Classes" (Romero-Naranjo et al., 2023a).

Purpose of the research

The purpose of this research was to check if through BAPNE FIT activities it was possible to work and improve aerobic endurance as well as the number of pulsations in a population that does not exercise regularly enough.

In order to answer the purpose of this study, we posed the following research questions:

1. Can BAPNE FIT activities help to increase aerobic endurance?
2. Can BAPNE FIT activities increase the number of heart beats?
3. Can BAPNE FIT be an alternative to improve physical activity and sports?

In order to solve these questions, we proposed the following objectives:

1. To quantitatively analyze the initial level of the subject to be studied, assuming that he/she has no lesion or heart murmur.
2. To quantitatively analyze the effect of BAPNE FIT activities on cardio as well as the maximum amount of oxygen that a person's body can process during exercise.
3. To know if the use of BAPNE FIT activities can be recommended for the improvement of physical condition.

Method

The information that we can obtain through Ergospirometry is important because it offers us the clinical status of the subject already from the possible elaboration of a training plan or even knowing its diagnosis or evaluation (Valdés et al., 2016).

The method to be used is implemented by performing an exercise test on an Excite Technogym treadmill with the purpose of increasing by 0.6 Km/h every minute from 4.0 Km/h to the 43-year-old subject with a height of 182 centimeters and 81.7 kilograms. At the same time, a constant slope of 1% was applied, together with continuous ECG monitoring and analysis of the ventilatory gas exchange (Blue-Cherry/Geratherm by Ergostix).

It is important to note that the BAPNE FIT method sessions last 50 minutes (Romero-Naranjo, 2020a, 2020b, 2022a, 2022b), although the ergospirometry study lasts 2 minutes for each activity to be analyzed. During this process the subject is evaluated while performing five different activities of the BAPNE FIT program (motor, rhythmic and cognitive activities with dual task) with Step, elastic bands on thighs and ankles, weights on wrist and ankle bands and finally body percussion activities with Kangoo Boots footwear.

The information it offers us can be divided into different blocks.

1. Evaluation of the maximum exercise tolerance. It al-

lows us to evaluate the determination of VO₂ peak and the factors that limit exercise.

2. Evaluation of cardiovascular disease. It allows us to evaluate a functional assessment of people with heart failure where exercise can be prescribed and evaluation of physical training for cardiac rehabilitation.

3. Evaluation of respiratory disease. It allows us to know if the subject has intolerance to intense exercise or if on the contrary has a chronic obstructive pulmonary or interstitial disease.

With this research, what we are looking for is to know what the subject's maximum oxygen consumption is, given that it represents the maximum capacity of the organism to extract, use and transport oxygen from the inspired air during an activity of maximum effort.

For this, the exercise protocol is articulated through an increase in the workload at the same time that the VO₂ increases in direct proportion, until there comes a time when the load continues to rise, but the VO₂ ceases to do so, presenting a ceiling or plateau. When we reach this level is the time when it is argued that the subject reached its limit of aerobic power.

For the development of this analysis, we analyzed a 43 year old male who does not exercise regularly and has a sedentary habit in order to obtain a sample as real as possible to the average population. Several phases were carried out for the study, which are described below:

- Phase 1. Physical exploration. The subject is observed to have good skin and mucous membrane coloration, as well as palpable and symmetrical pulses and absence of murmurs.

- Phase 2. Echocardioscopic examination. The subject has normal valve morphology and function and absence of pericardial effusion (Figure 3).

Figure 3. Initial examination



- Phase 3. Resting ECG. The subject provides morphology and segments within normality providing 60 bpm.

- Phase 4. Start of BAPNE FIT activities to analyze Ergometry on the Excite Technogym treadmill as well as analysis of the Ergostix Blue-Cherry Geratherm ventilatory gas exchange. Performance of activities with different intensities and data collection.

BAPNE FIT Activities

In the evaluation process, 5 types of activities with different types of intensities were carried out. All these activities are included in the methodology manuals (Romero-Naranjo, 2019).

Activity 1. Body percussion with STEP performing Clap Change simple and double (Figure 4).

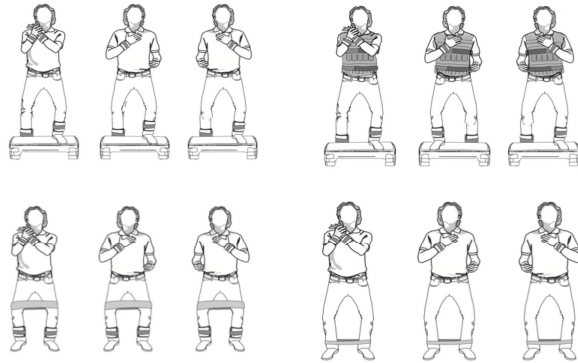


Figure 4. Sample of some initial activities with BAPNE FIT



Figura 5. Bapne FIT's activities with Kangoo Boots

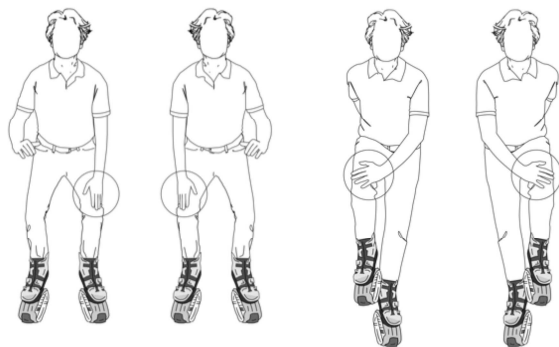


Figure 6. Sample of body percussion activities with Kangoo Boots

Activity 2. Body percussion with STEP performing Handball Change and dual task.

Activity 3. Body percussion with STEP and rubber band performing Clap change.

Activity 4. Body percussion with Kangoo Boots easy (Figure 5).

Activity 5. Body percussion with Kangoo Boots (Figure 6).

Results

The evaluation of various parameters showed that the BAPNE FIT activities help aerobic work from several areas. The subject reached a heart rate of 187 beats in the final phase of activities and a maximum VO2 consumption of 32.0 (Figure 7).



Figure 7. Kangoo Boots and Neurometricity

With regard to the gas analysis, it is important to note that oxygen consumption increases as a function of the level of demand of the activities, given that the subject must constantly answer questions while performing neuromotor activities. Determinations from this preliminary evaluation of breath test during BAPNE FIT exercise suggest that may reduce the oxidative stress, and Laser photoacoustic spectroscopy system provides a useful evaluation of ethylene biomarker (as a by-product of oxidative stress occurring inside the cells), being perfectly suitable to assessing the breath gases (Figure 8).

	Unidad	Pred.	Reposo	AT	AT / %Máx	Max VO2	Max VO2 / %Pred.	
Tiempo	min:sec		0:02 - 0:57	5:59	58	10:36 - 0:08		
Velocidad	km/h		0,0	7,6	76	10,0		
Elev	%		0,0	1,0	100	1,0		
VO2	l/min ⁽⁸⁾	3,15	1,03	1,93	74	2,61	83	
VO2/kg	ml/min/kg ⁽⁸⁾	38,5	12,6	23,6	74	32,0	83	
VCO2	l/min ⁽¹¹⁾	3,50	0,68	1,75	59	2,97	85	
RER	⁽⁹⁾		1,21	0,66	0,91	80	1,14	94
FC	1/min ⁽³²⁾	177	118	159	85	187	105	
O2Pulso	ml/beat ⁽³²⁾	16,2	8,8	12,2	87	14,0		

Figure 8. Ergospirometry analysis

The data collected in relation to the aerobic threshold were positive given that it contributed 7.6 km/h at an average of 167 bpm (74%) (Figure 9).

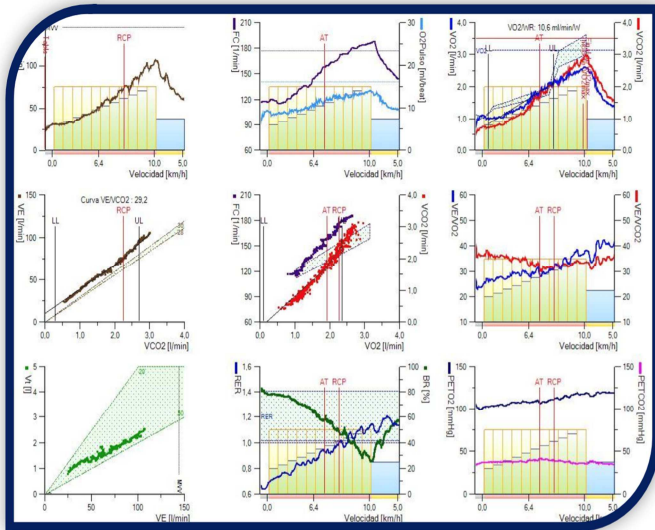


Figura 9. V02 Analysis

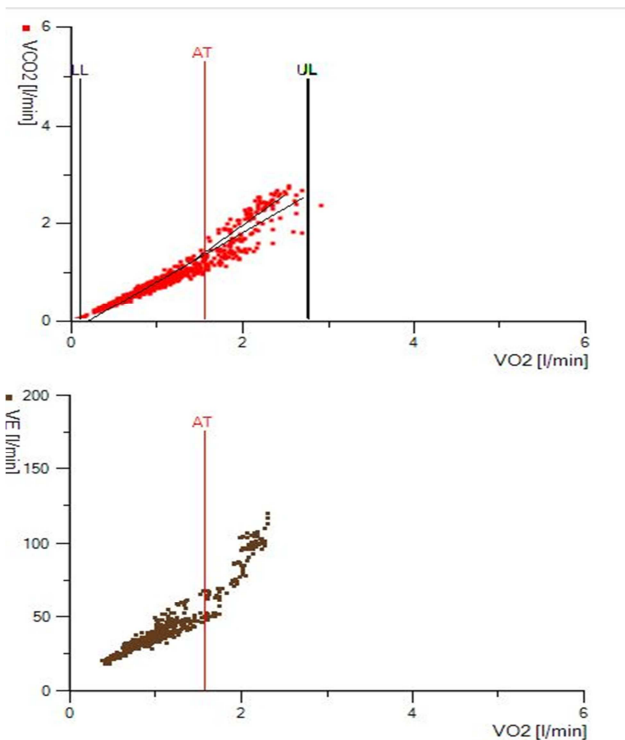


Figure 10. Specific analysis of oxygen consumption.

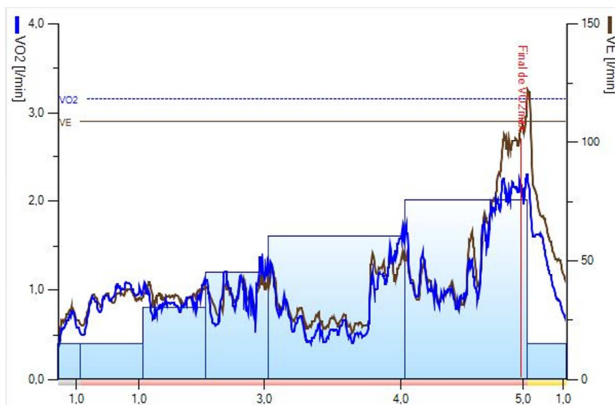


Figure 11. Global analysis

Regarding the respiratory compensation point, it provided 8.2 km/h at 174 bpm (82%) (Figure 10).

This pilot study demonstrates the possibility of effective application of the use of neuromotor activities of the BAPNE method in the practice of the subject of physical activity and sport sciences. It reveals the possibility of a significant increase in the cardiorespiratory fitness indexes in the practice of these activities (Figure 11).

Conclusions

The purpose of this study was to analyze both the cardiorespiratory and gas analysis parts through neuromotoricity activities in the BAPNE FIT program. The work of the cardiorespiratory system is important at a motor and functional level in both the young and adult population. For this reason, a statistically significant correlation has been determined between cardiorespiratory fitness and the practice of a healthy lifestyle that can be very positive for the population. This is the reason for recommending activities that do not have a very high intensity and that allow us to keep in shape without having a high risk of injury or muscle wasting.

There are several studies that recommend movement through dance with studies with ergospirometry (Duarte, 2015; Hernandez, 2010; Kokubo et al., 2018) although the data provided here are somewhat better. The BAPNE method proposes various performance protocols for very diverse groups where the BAPNE FIT program can be an alternative for the improvement of physical and cognitive fitness.

The questions and objectives at the beginning of this research have been answered after the analysis performed. This research helped us at first to resolve whether the study subject does not have any lesion or heart murmur, which helped us to evaluate his gas analysis showing that the study subject is in full health. On the other hand, it shows that BAPNE FIT activities, in this case study, bring a positive result in gas analysis. Based on this case study, it must be said that the BAPNE FIT program, in the absence of analysis with more subjects, does help to improve aerobic endurance while also helping to increase heart rate. For this reason it can be an alternative for physical activity and sports, and above all it can be taught in universities. We are aware that we need more tests with a much larger number of subjects and gender equality to obtain more specific results.

Body percussion in the sciences of physical activity and sport must have an exclusive protocol that defines it and gives it a specific autonomy. It is true that it can be used in different thematic areas, but it must have a specific program. Even so, it is important to emphasize that body percussion should not fall into the pedagogy of entertainment, as a mere resource within the umbrella of low-cost pedagogies. Social networks play a very important role in the educational field and we all know their influence, but

we cannot fall into a pedagogical amusement park whose objective is to make students have fun without them acquiring knowledge that will allow them to grow professionally. For this reason, we always argue that education is not an event, it is a process.

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