Rev 1

The authors utilize a logic based on heart period, measured as the RR interval from the electrocardiogram, to compute the pulse-respiration quotient (PRQ). This logic introduces the issue of R-wave peaks that do not belong to the considered breathing period. The authors address this issue and try to elucidate the relevance of accounting for border phenomena in the computation of PRQ based on RR interval via a linear regression analysis of PRQ and its portions on breathing period.
The contribution is interesting and rich of data and physiological considerations. However, some issues need clarification.

1) It is expected that sympathetic activation induced by active standing reduces the strength of the causal dependence from respiration to RR interval series (see A. Porta et al, Comput Biol Med, 42, 298-305, 2012). It is unclear whether the present study confirms this result.

This is a very good question. By looking at the two types of scatter-plot distributions of points (*BBI*, *mRRI*), where AG type is more frequent in supin (15/20) and supin01 (8/20) states than in stand (4/20) and stand01 (1/20) states, and under assumption that AG type corresponds to a greater Resp → RR dependence, then the answer is yes. However, in order to corroborate this with a quantitative result, some analyses including a model (such as e.g. CLMDA, applied in Porta et al. 2012), or some other causality measuring procedure should be carried out. Although we had an intention to do so, presently we have not studied CR causal dependencies, because this paper already contains enough results as it is. Nevertheless, we consider them extremely interesting and relevant for future work, especially after the introduction of the new quantity *mRRI*. This point certainly deserves a separate study. We added a sentence concerning the results reported in Porta et al. (2012) in the Discussion section, p. 24 (lines 715-726).

2) Discussion should be enlarged by accounting for modifications of cardiorespiratory phase synchronization during active standing reported via synchrogram analysis (see B. Cairo et al, Phil Trans R Soc A, 379, 20200251, 2021). Cardiorespiratory phase synchronization is reduced by orthostatic challenge likely because it is a vagal phenomenon. Again, discussion should be enlarged.

Results presented in Cairo et al. are interesting and offer a possible future sophistication of our method. Our results, presented in Fig. 14a, where standard deviation of *b1* is increased in orthostasis, are in accordance with results of Cairo et al. where phase synchronization was reported to be reduced in standing, although the two results were obtained using very different approaches. Next, it would be interesting to combine the optimizing procedure described in Cairo et al. with our notion of *b1* synchronization, as a step toward automated threshold-depended detection of *b1* synchronization. As well, we could extend our method to study temporal dependence (variability) of *b1*, an approach introduced and practiced in conventional synchrograms. We added a comparison of these two types of synchronization in the Discussion, p. 26 (lines 809-819).

3) It remains unclear whether some terms of the decomposition of the PRQ into PRQint, b1 and b2 could be utilized to assess directionality of interactions. It is well-known that bidirectional interactions between respiratory system and the heart are present and can be quantified (see e.g., A. Porta et al, Phil Trans R Soc A, 371, 20120161, 2013). Discussion could be enlarged at this regard.

While it is easier to qualitatively assess CR coupling strength by correlating it with the type of analyzed scatter-plots (AG – stronger; RD – weaker), it is harder to infer the CR interaction direction, based on the characteristics these two types of distributions. As said in answer to question 1), we initially wanted to explore whether and in which direction interactions could be quantified, related to our present results. In fact, after decomposing *PRQ* into *PRQint*, *b1* and *b2*, there are two candidates for such an analysis – *mRRI* and *b1*, which are both temporally concurrent with the *BBI* time series (*b2* is not usable because it is not independent from *b1*). However, due to the length of our present paper we were in position to postpone investigating Granger directionality of these interactions for our future work. We added these points to Discussion, p. 25 (lines 777-786).

4) The authors should elucidate how their conclusions change whether the number of cardiac beats per respiratory cycle is considered instead of the number of RR intervals per respiratory cycle.

The number of cardiac beats per *i*th respiratory cycle (*Rn*(*i*)) is equal to the integer number of RR intervals per cycle +1, i.e. *Rn*(*i*)=*PRQint*(*i*)+1. Therefore, as presented in Figs. 3b and 3c, if relying on this quantity instead of all parts of *PRQ*, information about the non-integer parts of *PRQ* would be lost, also causing the loss of different scattering profiles, while numerical values ascribed to all *PRQint* lines would have to be increased by 1.

5) It remains unclear the final relevance of decomposing PQR in its portions especially because the use of the number of cardiac beats per respiratory cycle would not require any decomposition and it would be more linked to cardiac electrical activity.

As said in the previous answer, the number of beats per respiratory cycle is an integer, equal to *PRQint* +1. By disregarding non-integer parts of *PRQ* (*b1* and *b2*) we would not have been able to detect two different scatter-plot subtypes (AG and RD) and consequently two operating regimes of the cardio-respiratory system. Also, in our previous work we showed that without the precise calculation of non-integer parts of the *PRQ*, we would not be able to get an insight into the *PRQ* quantization in different states. And one of the goals of this decomposition is to explain the physical and physiological causes of the occurrence of *PRQ* quantization.

6) The authors should consider shortening and making more compact their contribution especially because some methodological considerations have been already published in a recent paper (see ref #16).

Yes, thank you for this remark. However, by omitting the only part that was repeated, i.e.

$$b1(i) = \frac{R_j - B_i}{R_j - R_{j-1}} \text{ and } b2(i) = \frac{B_{i+1} - R_{j+k}}{R_{j+k+1} - R_{j+k}},$$

would make the next formula,

$$b1(i+1) + b2(i) = \frac{R_{j+k+1} - B_{i+1}}{R_{j+k+1} - R_{j+k}} + \frac{B_{i+1} - R_{j+k}}{R_{j+k+1} - R_{j+k}} = 1$$

which is not contained in [16] and which we consider important as it explains why it is not necessary to analyze both *b1* and *b2*, much harder to understand.

7) Please check if the locution "breath interval increases" is always correct throughout the manuscript. It seems to be that sometimes it should be substituted with "breathing rate increases".

Thank you, we corrected this where it was necessary (p. 23; line 656).

On the same page (line 662) we added a more precise formulation
"…number of *RRI*s per *BBI*..." instead of
"…number of *RRI*s…",
because we are dealing with *PRQ*.