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Effects of consuming different doses of red wine on male blood pressure

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Abstract

Introduction: Moderate consumption of red wine (RW) has been associated with a decrease in cardiovascular risk due to its phenolic composition. **Purpose:** Assessing the effects of consuming different doses of RW on the blood pressure (BP) of men during 24 hours after its ingestion. **Methods**: 10 normotensive male subjects (25.1±3.6 years) consumed three different doses of RW (250ml, 200ml and 150ml) randomly for three weeks; one dose was ingested per week. The BP was measured by using the Ambulatory BP Monitoring every 15 minutes during waking, and every 30 minutes during the sleep period for 24 hours. **Results**: There was a reduction in mean values of Systolic Blood Pressure (SBP) from six to nine hours of waking period, and the Diastolic Blood Pressure (DBP) from nine to 12 hours of sleep compared with BP at rest. **Conclusions**: The moderate RW consumption significantly reduced SBP and DBP in men, with a 150ml dose sufficient to reduce and maintain better BP levels.

Keywords: Wine; Blood pressure; Men; Blood Pressure Monitoring, Ambulatory.

Introduction

Cardiovascular disorders (CVD) accounted for 17.5 million deaths worldwide in 2012[1], and in Brazil, approximately 100,000 annual deaths are due to heart diseases[2], accounting for at least 20% of the deaths of the Brazilians over 30 years of age[3]. Therefore, these diseases have been considered as the main problems concerning national public health, and they are configured as chronic and multifactorial disorders[4].

High blood pressure levels have a strong impact on the increased risk for CVD[5], resulting in systemic arterial hypertension. In Brazil, hypertension affects 32.5% (36 million) adults, in addition to contributing to 50% of deaths caused by CVD[6]. However, the moderate consumption of red wine (RW) has been recommended in epidemiological studies[7-9] as a means of prevention and alternative intervention, since it reduces the incidence of cardiovascular events and blood pressure (BP) levels.

Moderate RW ingestion increases the expression and production of nitric oxide (NO), which is the main responsible factor for vasodilatation of the arteries, and a great ally in the treatment of BP-related problems[10], which shows an inverse relationship between RW consumption and the development of coronary artery disease[11].

The beneficial effects of RW are derived from phenolic compounds (resveratrol, quercetin, gallic, caffeic and tannic acids) found in grape[12] and alcohol, which in moderate amounts enhance cardiovascular protection due to their antioxidant properties[13]. In addition, the RW from *Vale do São Francisco* region in northeastern Brazil has shown differentiated characteristics in its phenolic composition, since it has high antioxidant activity when compared with wines from different regions worldwide, with high levels of epigallocatechin, trans-caffeic acid[14] and cis-resveratrol, a significant factor for the wine produced in this region [15,16].

Although the RW effect on blood pressure reduction and cardiovascular protection is well evidenced, its concentration and dosage might influence the effect zone[17-19], and there is no consensus in the current literature on the ideal dose for daily consumption that shall reduce the BP. Therefore, the present study aimed at assessing the effects of consuming different doses of RW on the BP of adult men from *Vale do São Francisco* during the 24 hours after its ingestion.

Materials and methods

This is a longitudinal quantitative study, which assessed the effect of consuming different RW doses on the BP of healthy adults in the city of Petrolina, state of Pernambuco, northeastern Brazil. Such a study was part of an experiment of a larger project entitled 'The effect of red wine, grape peel and grape juice from *Vale do São Francisco* on normotensive and hypertensive humans considering cardiovascular aspects, body composition, lipid profile and physical performance in weight training', approved by the Committee on Ethical Research with Humans and Animals (CERHA) of the university known as *Universidade Federal do Vale do São Francisco* (UNIVASF) under Protocol nº. 0008/240811.

Ten 18-35-year-old male subjects, students at UNIVASF, who were healthy, non-smokers, sedentary, with no symptoms of acute diseases and who accepted to participate in the study by signing the Free Informed Consent Form (FICF) were assessed. The participants were recruited by using print and digital information for four weeks.

Design and experimental protocol

The volunteers were informed about the general characteristics of the study, and previously advised not to perform any type of vigorous physical activity and not to ingest alcoholic drinks during the 24 hours prior to the days of data collection. In addition, the subjects were advised to avoid drinking caffeine-based beverages, not to be on urinary continence at

the time of their BP measurement, have a good night sleep (minimum of six hours) before collection, and maintain usual activities during the study period.

Initially, the body mass (BM) and height of the participants were measured for calculating the body mass index (BMI), as recommended by the World Health Organization (WHO)[20]. Then, the participants consumed different doses of RW with ambulatory blood pressure monitoring (ABPM) to verify BP behavior during a 24-hour period according to the V Brazilian Guidelines of ABPM[21]. All measurements were carried out by a single evaluator with experience in the procedures.

The BM was measured by using an anthropometric mechanical scale, Balmak (model 104A) with an accuracy of 0.1 kg; and height with the stadiometer of the scale itself with an accuracy of 0.1 cm. The BMI was determined by the body mass/height ratio^2; the BM was expressed in kilograms and the height in meters.

Each participant consumed three different doses of RW (250ml, 200ml and 150ml) in a total period of three weeks; one dose per week. The order of the doses was at random for each participant, only maintaining the standard of the day, time of consumption and installation of the device to verify the BP. Fine dry RW was consumed with an approximate temperature between 16 and 18ºC of the Shiraz grape, with an alcoholic graduation of 13% and produced in *Vale do São Francisco* during the harvest of 2010.

The resting BP was measured by using the Meditech ABPM device (model ABPM-04), with the participants seated on a chair and at rest for 10 minutes prior to data collection. The evaluation was carried out at the same place and with the left arm being raised to the height of the sternum midpoint and supported on a table.

BP monitoring was performed by using ABPM, which measured the BP of the volunteers every 15 minutes during the waking period and every 30 minutes during the sleep period for 24 hours from the time the participant had ingested RW.

Statistical analysis

Descriptive statistics was used with mean and standard deviation. All the variables were in absolute variation (Δ = difference between the periods and rest). After assessing and finding the normality of data distribution with Shapiro-Wilk test, the two-way ANOVA for repeated measures was used to verify the main effects of the interaction 'time' (Rest, 3h, 6h, 9h, 12h and 15h)*, condition (150ml, 200ml and 250ml) and the main effects on time under the different conditions. The values of 'F-ratio', degrees of freedom and 'p' were reported.

The two-way ANOVA for repeated measurements was also used for intra-individual comparison between the total means of the 15h ABPM analysis in the three conditions (150ml, 200ml and 250ml). The 'F-ratio' values, freedom degrees and 'p' were reported. Bonferroni post hoc was adopted to identify the difference pairs. The significance level was set at $p < 0.05$, and the IBM® SPSS® Statistics software version 22.0.0.0 was used for data analysis.

Results

The participants consisted of 10 men, mean age of 25.1 ± 3.6 years, a body mass of 75.4 ± 6.2 kg, height of 1.73 ± 3.4 meters and BMI of 24.9 ± 1.8 kg/m^2. There were significant reductions with the consumption of different RW doses, mainly in the mean values of both, the SBP during the waking period and the DBP in the sleep period, compared to the resting BP of the volunteers.

Figure 1 shows the absolute variation (ΔmmHg) of SBP (1A) and DBP (1B) during the total period of 15h of ABPM in the three conditions. There was a main time effect for SBP [$F_{(5,45)}$= 29,840; p<0,001; η^2= 0,76] and DBP [$F_{(5,45)}$= 35,615; p<0,001; η^2= 0,79], as well as time*condition interaction for SBP [$F_{(10,90)}$= 2,612; p<0,01; η^2= 0,22] and DBP [$F_{(10,90)}$= 2,558; p<0,05; η^2= 0,20].

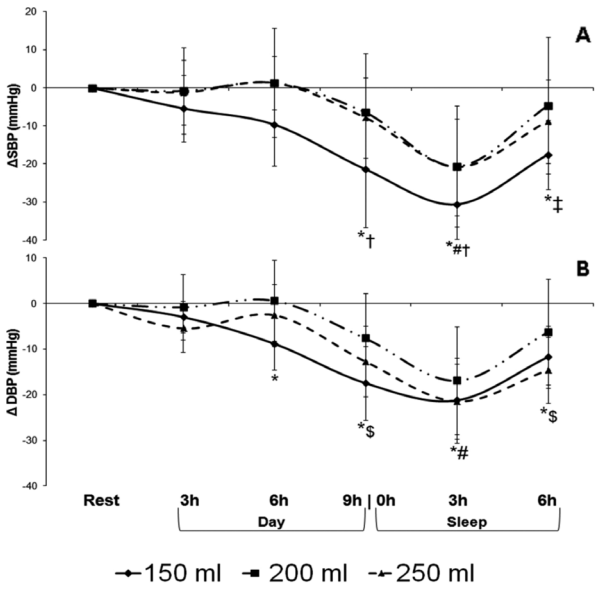

Figure 1
Absolute variation (Δ mmHg) of SBP (A) and DBP (B) during the total ABPM period of 15 h under the three conditions, Petrolina-PE, 2015. *p<0.05 in relation to REST for the dose of 150 ml ; #p <0.05 in relation to REST for 200 ml and 250 ml; †p <0.05 when compared to 150 ml with 250 ml; ‡ p <0.05 when compared to 150 ml with 200 ml; $p <0.05 in relation to REST for 250 ml.
Source: Authors.

Table 1 shows the mean ± standard deviation of SBP reduction (mmHg) during the total period of the intra-individual ABPM at the different doses, in addition to the interaction values among the conditions.

Table 1 shows a greater reduction of the SBP clinical values (mmHg) in the interval from six to nine hours of waking period after RW ingestion, with reductions of up to -20.3 ± 12.4 mmHg for 250 ml, -18.6 ± 17.2 mmHg for 200 ml and -31.7 ± 12.8 mmHg for 150 ml.

Figure 2 shows the intra-individual absolute variation of SBP (ΔmmHg) during the total period of 15 h of ABPM in the three conditions (150 ml, 200 ml and 250 ml of RW).

At the interval of the first nine hours corresponding to the waking period it was seen that the dose of 150 ml of RW was able to provide greater reductions of the SBP (ΔmmHg) in 62.5% of the volunteers, followed by the dose of 200 ml in 37, 5% of the participants. It is worth mentioning that the dose of 250 ml also reduced the SBP values (ΔmmHg) in such a period, but with less significance.

Table 2 shows the mean ± standard deviation of DBP reduction (mmHg) in the total period of intra-individual ABPM in the different doses, besides the interaction values among the conditions.

During the sleep period, a greater reduction was seen in the interval from 9 to 12 hours after RW ingestion, with reductions of up to -20.8 ± 11.0 mmHg for 250 ml, -19.3 ± 5.0 mmHg for 200 ml and -17.7 ± 15.0 for 150 ml.

Table 1: Mean±SD of SBP reduction (mmHg) during the total intravoluntary ABPM period in the different doses (n=10), Petrolina-PE, 2015

	150 ml	200 ml	250 ml	ANOVA
Participant 1	-31.7±12.8*	-13.4±11.2	-12.7±17.6	$F_{(2,8)}$= 10.453 P<0.01 η^2= 0.72
Participant 2	-17.6±9.2	-13.3±10.5	-15.2±10.4	$F_{(2,8)}$= 1.838 P=0.22 η^2= 0.31
Participant 3	-7.3±9.6	-6.5±13.0	-9.4±5.9	$F_{(2,8)}$= 0.327 P=0.73 η^2= 0.07
Participant 4	-12.1±13.4*	31.5±8.8	-2.7±8.6	$F_{(2,8)}$= 74.529 P<0.001 η^2= 0.95
Participant 5	-26.5±10.1†	-18.6±17.2	-11.4±11.2	$F_{(2,8)}$= 6.987 P<0.05 η^2= 0.63
Participant 6	-5.1±14.8	-4.8±11.7	-2.4±10.5	$F_{(2,8)}$= 0.429 P=0.66 η^2= 0.09
Participant 7	-8.5±8.1†	-11.4±6.4†	6.8±5.0	$F_{(2,8)}$= 25.716 P<0.01 η^2= 0.86
Participant 8	-27.7±15.3	-12.9±4.9	-20.3±12.4	$F_{(2,8)}$= 3.314 P=0.08 η^2= 0.45
Participant 9	-12.5±9.0	-9.2±7.5	-9.8±8.4	$F_{(2,8)}$= 4.402 P<0.05 η^2= 0.53
Participant 10	-18.5±12.1*†	-2.5±7.7†	4.0±7.6	$F_{(2,8)}$= 33.664 P<0.001 η^2= 0.89

*p<0.05 in relation to the dose of 200 ml; †p<0.05 in relation to the dose of 250 ml.
Source: Authors.

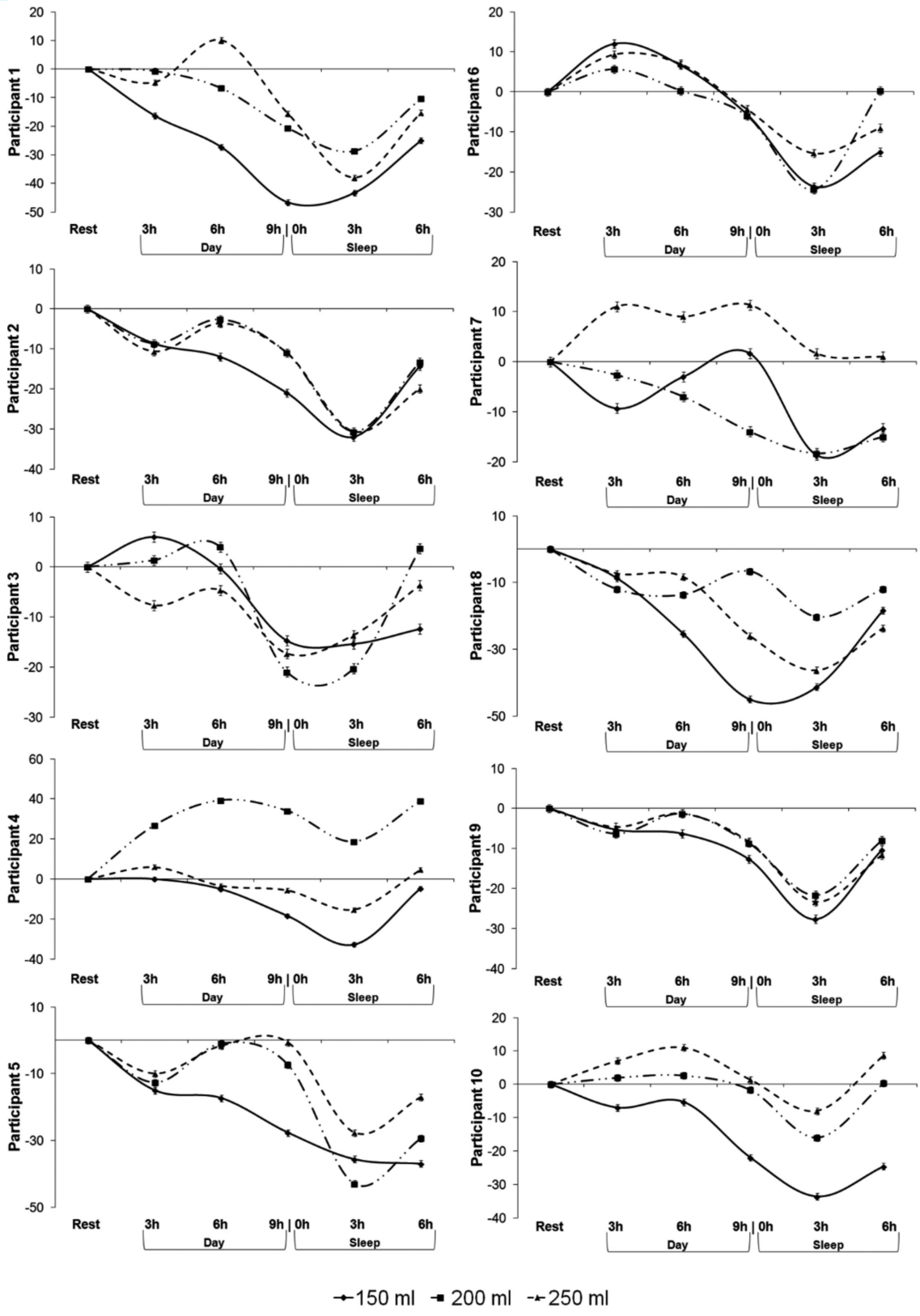

Figure 2: Intra-individual absolute variation of SBP (Δ mmHg) during the total ABPM period of 15h under the three conditions, Petrolina-PE, 2015.
Source: Authors.

Table 2: Mean±DP of DBP reduction (mmHg) during the total intravoluntary ABPM period in the different doses (n=10), Petrolina-PE, 2015

	150 ml	200 ml	250 ml	ANOVA
Participant 1	-7.7±11.2	-11.9±12.9	-11.4±14.7	$F_{(2,8)}$= 0.184 P=0.83 η^2= 0.04
Participant 2	-11.5±5.4	-3.6±9.0†	-12.1±10.1	$F_{(2,8)}$= 4.254 P<0.05 η^2= 0.52
Participant 3	-15.9±9.6*	-3.4±9.5	-3.9±3.8	$F_{(2,8)}$= 10.796 P<0.01 η^2= 0.73
Participant 4	-10.1±7.9*	10.7±4.0	-11.6±7.0	$F_{(2,8)}$= 33.642 P<0.001 η^2= 0.89
Participant 5	-11.1±8.6	-10.0±17.0	-11.7±10.6	$F_{(2,8)}$= 0.900 P=0.91 η^2= 0.02
Participant 6	-10.1±11.4	-5.5±10.4	-3.0±6.8	$F_{(2,8)}$= 3.385 P=0.08 η^2= 0.46
Participant 7	-16.0±10.1	-12.8±4.6	-11.8±6.7	$F_{(2,8)}$= 1.125 P=0.34 η^2= 0.23
Participant 8	-17.7±15.0	-19.3±5.0	-20.8±11.0	$F_{(2,8)}$= 0.174 P=0.84 η^2= 0.04
Participant 9	-12.7±7.1*	-1.7±4.7†	-11.9±7.3	$F_{(2,8)}$= 37.530 P<0.001 η^2= 0.90
Participant 10	-10.2±6.7*	-2.0±5.4†	-14.1±8.5	$F_{(2,8)}$= 15.636 P<0.01 η^2= 0.79

*p<0.05 in relation to the dose of 200 ml; †p<0.05 in relation to the dose of 250 ml.
Source: Authors.

Figure 3 shows the intra-individual absolute variation of DBP (ΔmmHg) during the total period of 15h of ABPM in the three conditions.

Figure 3 shows that the dose of 150 ml of RW caused greater reductions in DBP (Δ mmHg) in 50% of the volunteers, followed by doses of 200 ml in 32.5% and 250 ml in 17.5 % of the volunteers.

Discussion

The present study showed a significant reduction of BP for some dosages, with a significant clinical reduction of up to -31.7 ± 12.8 mmHg in SBP and up to -20.8 ± 11.0 mmHg for 250 ml of RW compared with BP at rest. In a similar study[22] it was shown that the ingestion of 100 ml of RW 30 minutes before an aerobic exercise session provided a higher post-exercise SBP of up to -10.7 ± 3.5 mmHg and in the DBP of - 5.6 ± 4.9 mmHg in relation to exercise sessions without prior RW ingestion.

According to the results of this research, when comparing the consumption of different doses of wine in relation to BP reduction, there was an expressive decrease of SBP and DBP in the first three to six hours following the dose of 200 ml and, mainly with the dose of 150 ml. Barden *et al.*[23], when monitoring BP for 24 hours in normotensive men, found a reduction in SBP and DBP in the first four hours after the ingestion of a single dose of alcoholic RW (375 ml).

Huang *et al.*[24] studied eighty healthy subjects who were asked to consume water (100 ml), RW (100 ml), beer (250 ml) or vodka (30 ml) daily for three weeks. The authors found an increase in NO plasma in the young subjects who consumed 100 ml/day of RW, which was not seen when concerning the consumption of equivalent amounts of alcohol, such as beer or vodka; NO is a substance responsible for the vasodilatation of the arteries, besides being a great ally in

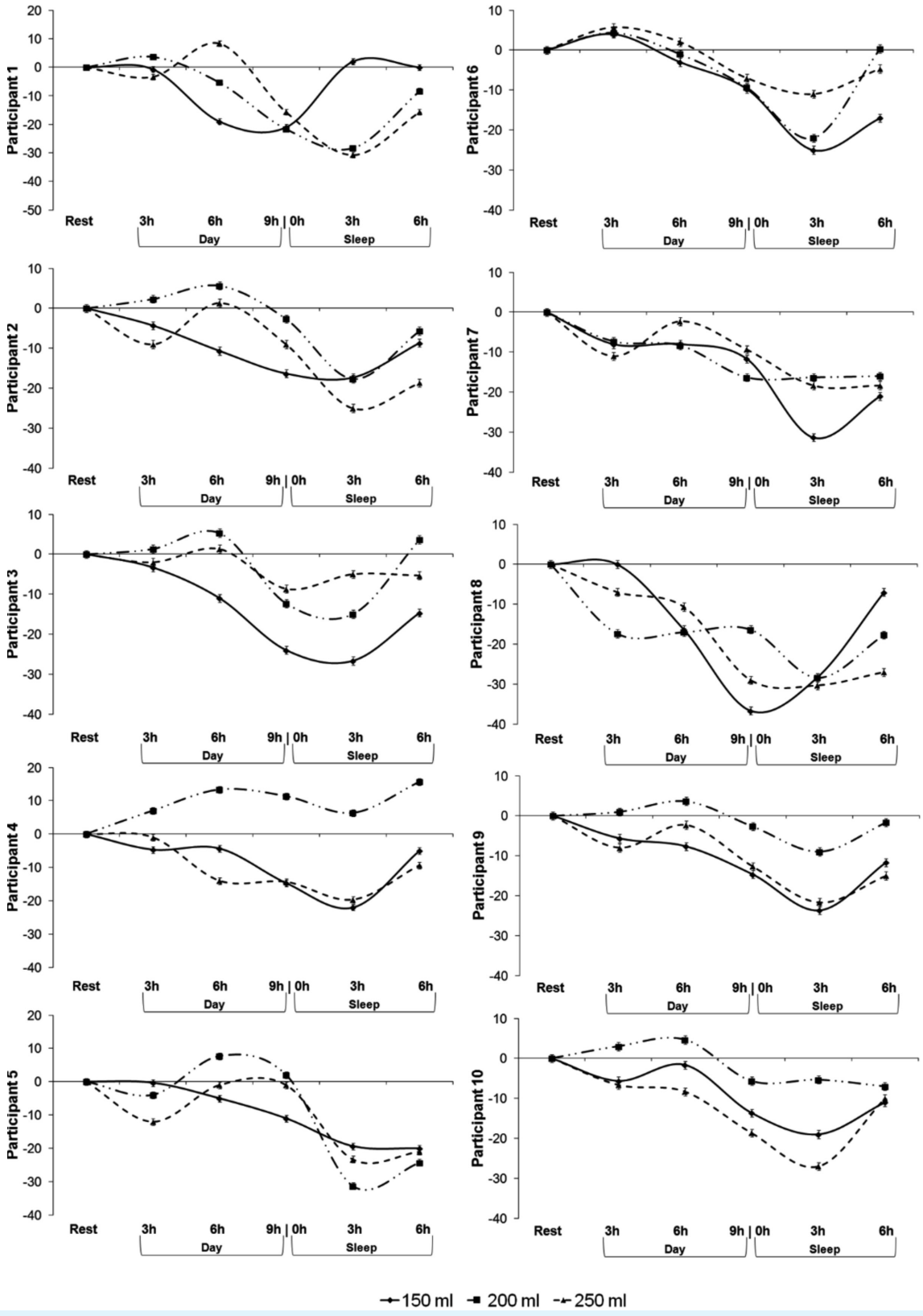

Figure 3: Intra-individual absolute variation of SBP (Δ mmHg) during the total ABPM period of 15h under the three conditions, Petrolina-PE, 2015.
Source: Authors.

the treatment of problems associated with high blood pressure levels.

The research by Krnic *et al.*[25] compared the acute effects of RW, vodka, beer (0.32 g ethanol / body weight-kg) and water as a control of the increase of oxidative stress and oxygen-induced arterial stiffness in healthy men. The results showed that alcoholic beverages provided similar protection against increased arterial stiffness, but only RW provided protection against oxidative stress. However, Chiva-Blanch *et al.*[8], after four weeks of interventions with RW ingestion, non-alchoolic red wine (NARW) and Vodka-Gin in a cross-sectional study with seventy-three 55-75-year-old men with a high cardiovascular risk, showed that NARW decreased SBP and DBP while increasing NO plasma concentration. RW tended to have effects similar to those of NARW, but BP changes were not significant, and Gin had no effect.

O'keefe *et al.*[9] emphasize that among several alcoholic beverages, RW is usually associated with better health outcomes, especially when considering cardiovascular issues. This is probably due to its unique matrix of non-alcoholic components, which are known as potent antioxidants[26] and have relevant biochemical and pharmacological effects when consumed in moderation, as part of a balanced diet and mainly by people who do not have a contraindication to the consumption of alcoholic beverages[7].

Considering the beneficial effects of alcohol consumption, Ronksleyet *et al.*[11] advocate a protective association of alcohol seen in several populations of female and male patients, as well as a specific association: moderate drinking (up to 1 drink or 12.5 g of alcohol per day for women, and 2 drinks or 25 g of alcohol per day for men) is associated with lower rates of cardiovascular disease.

Among other alcoholic beverages, RW is widely studied and applied in diets due to its effectiveness in cardioprotective function. Tresserra-Rimbau *et al.*[27] in a cross-sectional study highlighted that wine is considered a key component in the traditional Mediterranean diet, and that different designs have suggested that the higher health benefits of moderate RW consumption may be related to its higher content of polyphenols compared with other alcoholic beverages. Sabadashka *et al.*[10] also found that the natural polyphenol complex might attenuate oxidative-nitrative stress caused by ionizing radiation.

According to the systematic review by Barbosa and Fernandes[28], most studies emphasize the effects of resveratrol on cardiovascular health in individuals affected by CVD and in animals with atherogenic diet, such as significant improvement of lipid profile parameters, attenuation of oxidative stress and inflammation, prevention of endothelial dysfunction and SBP reduction. However, dosage, time and form of ingestion considered ideal require discussions, not yet clearly defined in the literature.

Polyphenols are found in various forms, such as quercetin and resveratrol, and in different kinds of food. Habauzit and Morand[29] emphasized the consumption of food rich in polyphenols (fruits and fruit juice, tea, wine, cocoa, among others) and the protective effect of the compounds on CVD, which shows a reduction of SBP (-7 ± 2 mmHg) and DBP (-5 ± 2 mmHg) in hypertensive patients Stage 1 after the treatment with quercetin. Another meta-analysis[30] found associations of flavonol ingestion with stroke incidence, in addition to finding in two placebo-controlled clinical trials that quercetin increased NO plasma concentration by 35% and, in hypertensive patients, reduced SBP in 7 mmHg.

The reduction of clinically significant BP provided by RW consumption at some doses seen in the present study can be explained by the sample size, which is still insufficient so that the difference found is statistically higher.

This study has some limitations, such as the non-use of a control group, since its real purpose was to compare the different doses of RW consumption in the reduction of BP in view of the necessity of a consensus of an ideal dosage. The participants were normotensive, which restricted the results for healthy individuals. In

addition, the sample was small for more comprehensive results in relation to the population assessed; in fact, it is difficult to recruit and select participants for longitudinal studies with methodological rigor and usual restrictions.

Conclusion

Moderate RW consumption in *Vale do São Francisco* reduced SBP and DBP in acutely healthy adult men, taking into account the mean BP values after the consumption of RW near or below the resting values. It is worth mentioning that a dose of 150 ml is enough to reduce and maintain better blood pressure levels, possibly due to the moderate amount of alcohol compared with the other doses.

It is recommended that further research is carried out in order to analyze the effects of RW doses on different populations for obtaining more reliable and comprehensive results.

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