VASCULAR IMPROVEMENT FOR PERFORMANCE IN SPORTS

The V.I.P.S. Program

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ABSTRACT:

Heart Disease is the leading cause of death in the United States. Although commonly labeled as a disease of the elderly, the disease affects young adults as well. The disease occurs in young adults because of various factors, but Coronary Artery Disease and atherosclerosis cause the majority of occurrences. Despite status of asymptomatic individuals, atherosclerosis is prevalent in ages 18-25, and risk factors are similar as those for adults.

The goal of the study is to educate young adults in vascular health, and to show that despite appearing as healthy individuals, underlying physiology may show that progression of disease is apparent. The study also tries to show that vascular health can be improved within 6 weeks by being properly educated and applying positive changes to lifestyle, including nutrition and exercise.

A semi-professional baseball team was asked to voluntarily participate in the 6-week program, which included an educational presentation, initial assessment of vascular health, nutritional guidelines, and reassessment.

Among the participants who completed the program, 75% followed the guidelines with greater than 50% commitment, and 83% of these participants had an overall positive improvement in vascular health. The results show the importance of being properly educated, and the significance of having a reliable and easily accessible assessment tool in improving the health of young adults.

INTRODUCTION:

Cardiovascular Disease (CVD), commonly referred to as Heart Disease, is the leading cause of death and mortality in the United States.[3] It accounted for about 34.4% of total deaths in American in 2009, which translates to approximately 1 of every 3 deaths.[3,5]

Heart disease is normally labeled as a disease of the elderly, but 4-10% of incidences occur before the age of 45.[3,4,5,6] In fact, heart attacks have been accounted for in young men as early as the age of 18.[5] Various causes for these premature attacks have been determined, with 4% attributed to inborn abnormalities, 5% to blood clots, 5% to the blood clotting system and 6% to a wide range of other problems, including chest trauma, drug abuse, and inflammation of the arteries.[5,6]

However, the 80% majority of these heart attacks that occur in young adults are caused by Coronary Artery Disease (CAD) the most prevalent form of CVD.[4,5,6] CAD results from a process called atherosclerosis, in which fatty plaque deposits build up around the walls of the artery. This diminishes the artery's elasticity and narrows its diameter, making it harder for blood to flow through, and could eventually stop blood flow to the heart, which in turn causes a heart attack.

Though atherosclerosis is more prominent in adults, it starts at a very young age, and rapidly progresses, as a person gets older. Studies have shown that fatty streaks and clinically significant raised lesions increase rapidly in prevalence and extent during the 15- to 34-year age span.[4,6,7,10]

Risk factors for atherosclerosis in young adults are the same as in older men and women: a family history of heart disease, smoking, high cholesterol, hypertension and prehypertension, obesity, diabetes, the metabolic syndrome, lack of exercise, hostility, elevated levels of C-reactive protein, and low educational attainment.[56] These risk factors increase in the teen years, especially in boys. Studies show that teenage boys smoke more, eat more fast food, and that the amount of exercise that a young adult performs declines exponentially in the "university years."[6,11] Ignorance, for lack of a better word, also plays a major part in these risk factors, as a survey of more than 4,000 healthy individuals with an average age of 30 found that over 65% were unable to identify any of the major cardiac risk factors.[5]

Therefore, despite the outward appearance of asymptomatic, healthy individuals, Heart disease does pose a potential threat, if not already present, in young adults and can dangerously lead down a path of morbidity and eventual mortality. Risk factors need to be addressed in order to prevent or reverse the formation of atherosclerosis. Education on the subject and simple changes in nutrition and exercise can have dramatic positive effects, which can be evident in mere weeks. This study proposes to achieve these results by dispelling the presumption that young athletes are considerably healthier than others, educating them about health topics, and showing how vascular health and status can be easily assessed and positively changed within weeks, by merely following positive lifestyle changes, which include nutrition and exercise.[8]

METHODS:

19 members of a semi-professional baseball team were invited to participate in the study. The candidates were between ages 17 and 22, with an outlier of 53 (the team's manager).

The study opened with a 30-minute educational presentation on nutrition, exercise and the fundamentals of the program. At the beginning of the presentation, the volunteers were asked to sign a written consent form and then answer four questions on common health topics, myths and misconceptions to gauge their knowledge and awareness on the subject. The points were tallied for each participant, and their total score was used as a representation of how well they understood health.

After the presentation, the participants' vascular healths were individually measured using these following parameters: weight, blood pressure (systolic and diastolic), heart rate and vascular status. The vascular status was measured via a Bi-directional Doppler Ultrasound that provided waveform data on arterial health. The waveforms are interpreted using these three principles:

1. The number of waveforms signifies level of elasticity of the arteries. Presence of three waveforms, with occasional 4^{th}, shows being in a normal range, with mild to no arterial plaque; two waveforms is a mild to moderate plaque in artery, and one waveform equals a moderate to severe plaque in artery.[1,2,9]

2. A normal artery's first waveform has a maximum velocity of 20 ± 10 cm/s. Slower or faster velocities signify occluded arteries, with severity based on deviation from the normal value.[1,2,9]
3. Wider waveforms signify a healthier artery, and the inverse applies.[1,2,9]

This divided vascular status into 6 categories: the velocity and width of the first waveform, velocity and width of the second, and that of the third.

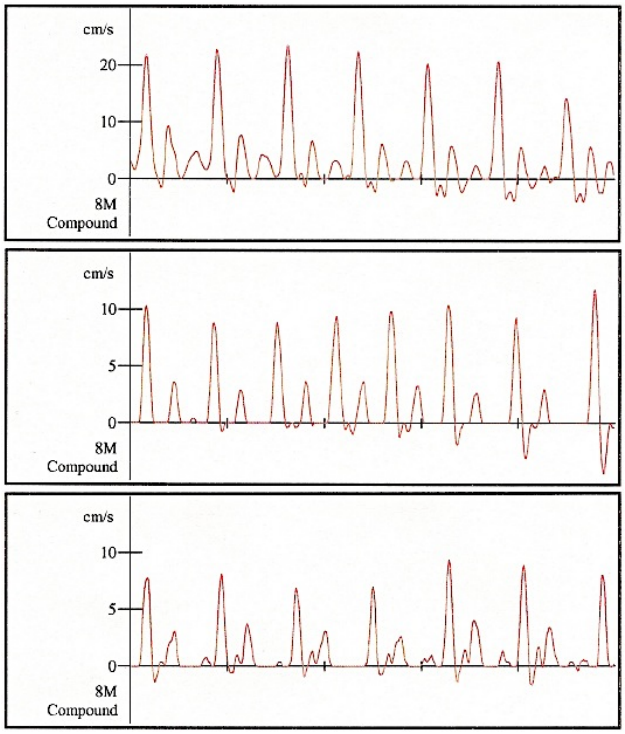

Figure 1. Waveform Comparison by Velocity

The figure shows examples of vascular readings that vary by the maximum velocity of the first waveform. The first reading has a maximum velocity higher than 20 cm/s, which signifies a normal to mildly occlusive artery (20 ± 10 cm/s). The second reading shows a maximum velocity around 10 cm/s, which signifies a mild to moderately occlusive artery. The final reading shows waveforms under 10 cm/s, which signifies moderate to severely occlusive artery. Waveforms shown were obtained from actual data obtained from the study.

The average time it took to measure vascular status was 20-30 seconds per individual. After the measurements were taken from the participants, they were given recommendations on nutrition and exercise to follow (voluntarily) throughout the span of their summer season (6 weeks).

8 out of the initial 19 returned to complete the study after 6 weeks. At this point, the participants were asked to complete a survey to gauge how well they followed the recommendations provided. 6 questions were asked, ranking each recommendation from 5 to 1 (5 signifying the recommendation was well followed). Points were added for a maximum of 30 and the total score was used to determine how well the participant followed the recommendations.

The same health parameters were measured again to compare with the initial data. A positive improvement in a parameter was given a +1 point, no improvement = 0, and decline = -1. These points were tallied and the total scores were used to show overall improvement, with scores > 0 signifying overall positive improvement, and scores < 0 as overall negative.

The participants were also provided certificates containing the pre and post waveform results to commemorate their completion of the study and to give visual feedback through the difference between their pre and post waveforms.

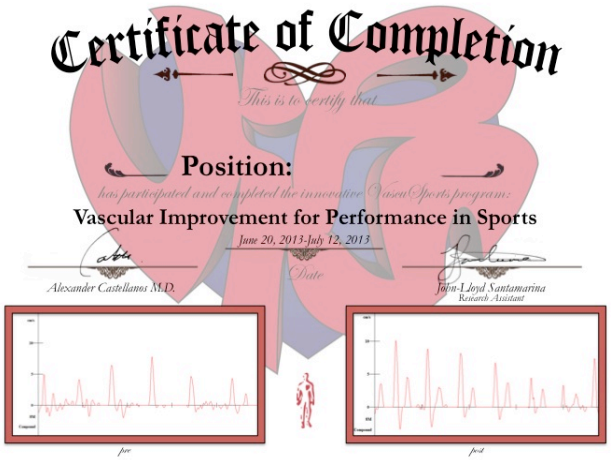

Figure 2. Certificate of Completion

The figure shows a sample certificate provided to the participants in the study, with a capture of their vascular waveforms from before and after the study, labeled pre and post, respectively.

RESULTS:

After analyzing the answers to the health questions provided in the initial portion of the program, 59% of the participants scored 50% or less.

From the initial assessment, 9 out of 19 (~47%) were classified as overweight according to BMI standards (using age, weight and height). All of the participants showed presence of three waveforms in the study, but only 1 out of 19 (~5%) had a maximum peak velocity within the 20 ± 10 cm/s range. 16 out of 19 (~84%) had maximum velocities under 10 cm/s, signifying moderate to severely occlusive arteries.

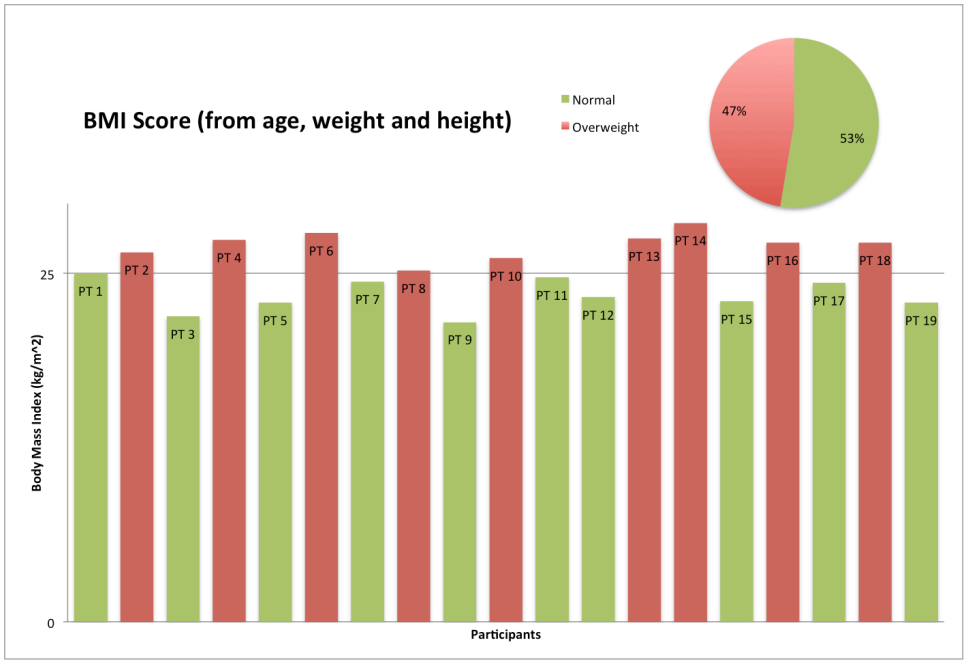

Figure 3. BMI Score. The figure shows each of the participants BMI scores, which were calculated using weight, height and age by the Halls BMI calculator, found at http://www.halls.md/body-mass-index/av.htm. Out of the 19 participants, 9 scored BMI's over 25, which is considered overweight according to BMI standards.

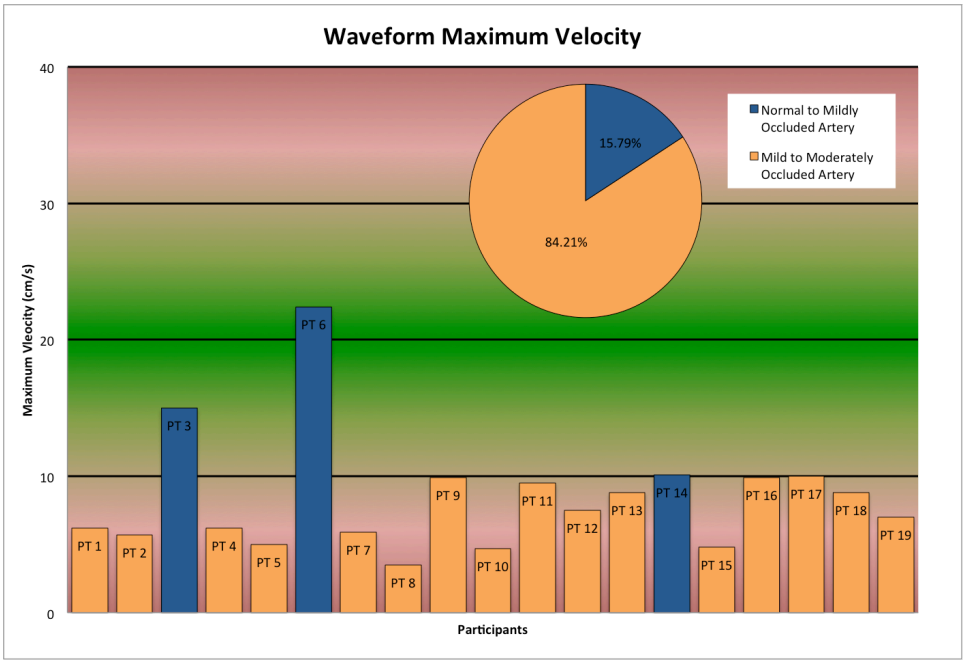

Figure 4. Waveform Maximum Velocity. The figure shows the maximum velocity for each of the participants. Out of the 19, only 3 participants had maximum velocities over 10 cm/s, signifying normal to mildly occlusive arteries (20 ± cm/s). The other participants that had maximum velocities under 10 cm/s show arteries that are moderately to severely occlusive.

Among the 8 who completed the 6-week study, 6 participants (75%) followed the guidelines with greater than 50% commitment ($\bar{x}$ = ~69%). 5 of the 8 (~63%) volunteers had scores > 0, signifying overall positive improvement. 1 participant scored 0, and the other 2 participants scored < 0. Most of the participants (~83%) who followed the guidelines with greater than 50% commitment were able to achieve overall positive improvement.

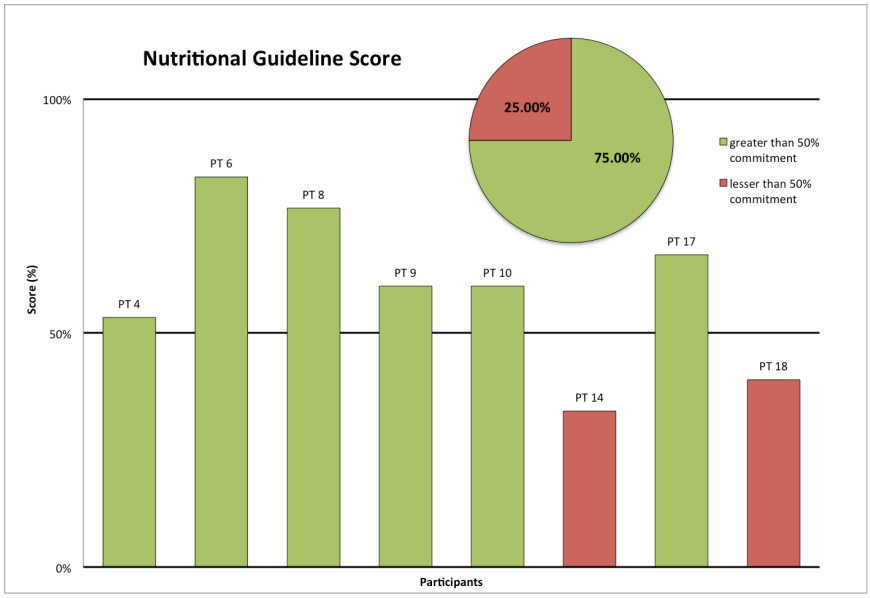

Figure 5. Nutritional Guideline Score. The figure shows the nutritional guideline scores of the 8 participants who had completed the program. The scores were obtained from the questionnaire given after the 6-week program, allowing the participants to rank how well the followed each recommendation. 6 of 8 (75%) followed the guidelines to a total percentage over 50%, while 25% of the participants failed to do so as the recommendations were voluntary.

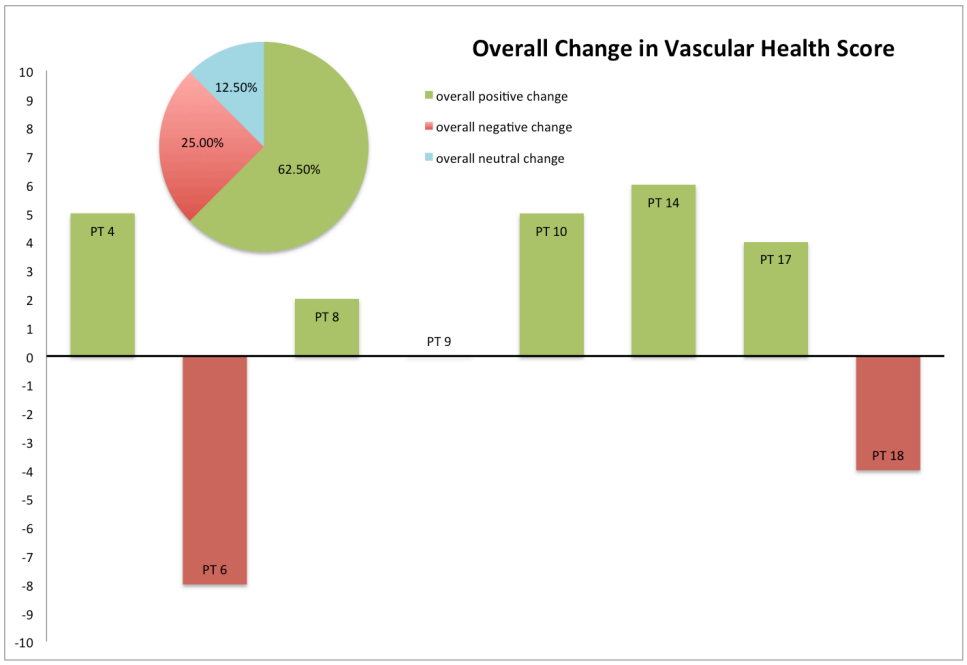

Figure 6. Overall Change in Vascular Health Score. The figure shows the overall scores obtained by each participant in their health improvement for the 10 parameters measured. A score of 1 was given for each parameter if improvement was apparent, a score of 0 for no improvement, and -1 for decline in status. Total positive score signifies overall positive improvement, while a total negative score signifies decline in health status.

CONCLUSION:

As previously stated by other studies, young adults these days do not have a firm understanding of health issues. Majority of the participants in the study failed the simple question and answer portion. Many young adults continue with certain misconstrued practices without realizing the effects on their bodies until damage has been done. It is therefore very important for health education to play a part in this age group's lives. It can help them develop healthier habits and instigate early prevention. Lack of commitment is also an issue with this age group. Majority of the participants failed to complete the 6-week study when offered the option to do so only voluntarily. Despite knowing the benefits to their health, minimal recommendations, and short time frame, most were still unable to complete the simple study.

This study also supports findings of young adults with atherosclerosis. Majority of the participants demonstrated moderate to severely occluded arteries, despite being active athletes. A possible explanation is the type of diet that these athletes have. Common drinks consumed by them were protein shakes, energy drinks, and other water substitiutes, which contain protein and sugar higher than what our body needs and can metabolize.

For those that followed the program's recommendations, majority had overall improvement in their vascular health. This shows that in just six weeks, positive changes are easily apparent by just changing a few things in our lifestyle, including nutrition and exercise.

FUTURE STUDIES:

Future studies should have a higher number of participants to be recruited, preferably from a randomized sample. They should also try to contract the participants into completing the study, and not offer the option to drop out mid-program.

Weekly assessments should also be done to accumulate more data and be able to form a more accurate trend line for the results. This will also help in keeping the participants engaged with the program, allowing increased commitment in the quest to improve their vascular health.

The number of health questions asked in the beginning of the presentation should be increased as well, and provide a wider array of subjects, thus better gauging the participants' knowledge on common health topics.

These suggestions should help in acquiring better data that can allow the results of the study to be generalized into the population.

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APPENDIX A:

Raw Data – BMI and Max Velocity

Patient #	Maximum Velocity	BMI	percentile	Description
PT 1	6.2	25	61	Normal
PT 2	5.7	26.5	69	Overweight
PT 3	15	21.9	51	Normal
PT 4	6.2	27.4	80	Overweight
PT 5	5	22.9	52	Normal
PT 6	22.4	27.9	55	Overweight
PT 7	5.9	24.4	62	Normal
PT 8	3.5	25.2	64	Overweight
PT 9	9.9	21.5	32	Normal
PT 10	4.7	26.1	78	Overweight
PT 11	9.5	24.7	73	Normal
PT 12	7.5	23.3	50	Normal
PT 13	8.8	27.5	77	Overweight
PT 14	10.1	28.6	81	Overweight
PT 15	4.8	23	43	Normal
PT 16	9.9	27.2	80	Overweight
PT 17	10	24.3	57	Normal
PT 18	8.8	27.2	77	Overweight
PT 19	7	22.9	46	Normal

Raw Data – Pre Assessment

Patient #	BP Systole	BP Diastole	HR	Weight	Velocity 1st	Velocity 2nd	Velocity 3rd	Width 1st	Width 2nd	Width 3rd
PT 1	120	78	99	200	6.2	2.3	2.65	2.1	1.9	1.9
PT 2	-	-	169	174	5.7	1.9	2.6	2	1.8	1.3
PT 3	-	-	82	175	15	3.75	6	2	0.9	3.8
PT 4	120	78	73	202	6.2	2.6	2.9	1.8	1.5	1.9
PT 5	-	-	115	164	5	1.9	1.65	2	1.7	1.2
PT 6	-	-	81	200	22.4	2.4	7.5	3.8	1.5	3
PT 7	106	78	67	180	5.9	1.24	1.4	3	0.9	1.5
PT 8	124	60	-	166	3.5	0.9	0.7	1.3	1.2	1
PT 9	130	84	105	163	8	1.3	2.3	2	1.8	1.2
PT 10	122	80	94	209	4.7	0.6	2.7	2.8	1.1	1.9
PT 11	110	78	146	198	9.5	2.3	4.8	2.8	1.5	2.9
PT 12	124	74	187	158	7.5	1.8	5.6	1.3	0.9	1.5
PT 13	140	82	126	232	8.8	1.3	3.8	2.2	0.9	2.3
PT 14	102	58	132	194	10.1	1.9	2.6	1.9	1.2	1.9
PT 15	128	78	-	165	4.8	0.7	1.2	2.1	1.1	1
PT 16	128	82	76	195	9.9	3.7	3.8	1.9	1.9	1.9
PT 17	150	84	-	160	9	1.6	1.4	2.1	0.8	1.9
PT 18	140	82	171	184	8.8	1.4	1.9	2.1	0.9	1
PT 19	-	-	76	155	7	4.8	3.6	2	1.8	1.9

Raw Data – Nutritional Guideline Score

Patient #	more water	less gatorade	less protein shakes	less energy drinks	less dairy	more breathing	sum	max	score
PT 4	4	1	5	1	3	2	16	30	53.33%
PT 6	4	5	5	5	2	4	25	30	83.33%
PT 8	4	5	5	5	1	3	23	30	76.67%
PT 9	3	3	4	1	2	5	18	30	60.00%
PT 10	5	2	2	2	3	4	18	30	60.00%
PT 14	3	1	1	2	1	2	10	30	33.33%
PT 17	4	5	2	3	3	3	20	30	66.67%
PT 18	3	2	1	1	1	4	12	30	40.00%

Raw Data – Post Assessment

Patient #	BP Systole	BP Diastole	HR	Weight	Velocity 1st	Velocity 2nd	Velocity 3rd	Width 1st	Width 2nd	Width 3rd	tally
PT 4	128	80	53	199	11.3	5	6	2.1	1.5	2.1	5
PT 6	-	-	90	208	7.2	1.2	1.4	0.9	0.9	1.6	-8
PT 8	132	88	-	160	6.3	2.3	1.25	2.3	1.2	0.9	2
PT 9	120	80	191	164	6.25	1	3.1	2.1	1.2	2	0
PT 10	112	68	75	211	8.8	6.2	3.8	2.2	2.8	1.9	5
PT 14	118	78	102	192	18	2.5	5	2.1	1.5	2.4	6
PT 17	148	84	-	158	8.7	1.3	2.9	2.7	2.1	2.5	4
PT 18	132	88	219	188	8.7	1.4	2.2	1.8	0.9	0.8	-4