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Alteration of Renin Angiotensin System (RAS) induced by Moderate Intensity Exercise among Female Student-Athletes

Hira Umer
M.Phil. Scholar, Department of Sports Sciences and Physical Education, University of the Punjab, Lahore, Pakistan.

Dr. Alamgir Khan
Department of Sports Sciences and Physical Education, University of the Punjab, Lahore, Pakistan.

Dr. Muhammad Zafar Iqbal Butt
Department of Sports Sciences and Physical Education, University of the Punjab, Lahore, Pakistan.

Dr. Zaliha: Zeliha Selamoglu
Department of Medical Biology, Medicine Faculty, Nigde Omer Halisdemir University, Nigde, Türkiye, Western Caspian University, Baku, Azerbaijan
Department of Biology, Faculty of Sciences, Khoja Akhmet Yassawi International Kazakh-Turkish University, Turkestan, Kazakhstan

Author Details

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Corresponding E-mail & Author*:

Hira Umer
M.Phil. Scholar, Department of Sports Sciences and Physical Education, University of the Punjab, Lahore, Pakistan.

Abstract

This research study aims to investigate that impact of moderate intensity exercise on renin angiotensin system among females. The participants of the study were included twenty (20) female students aged between 18-22 randomly distributed into two groups' i.e. Control group (CG) and Experimental group (EG). Each group comprised of ten (10) subjects. An adopted moderate intensity exercise protocol consisted of warming up for 5 minutes followed by 30 minutes of jogging at 70%-75% of maximal heart rate developed by (Ghaediyan, & Marefati, 2012) was implemented on the experimental group for 8 weeks. RAS was measured with 10ml venous blood collected from the subjects and tested through the Plasma renin direct test from the lab. The pre and posttest results were evaluated through statistical package for the Social Sciences (SPSS, version-26), and then suitable statistical tools were applied according to parametric data. On the basis of detailed data analysis and findings, the researcher concluded that moderate intensity exercise of eight weeks has a positive influence in the plasma renin level of females which promote a healthy physiological balance.

Introduction

The renin angiotensin system (RAS) is a complex system of hormones that regulates many bodily functions especially related to the heart and blood vessels. The RAS is crucial for this involving a series of reactions that ultimately produce angiotensin II. This molecule affects blood vessel tightness and fluid levels. Importantly the RAS is not just in the kidneys and heart it is also found in many other tissues like muscles, brain, bones and the immune system. The RAS starts with renin from the kidneys and angiotensinogen from the liver which combine to create angiotensin II. Angiotensin II then acts on various parts of the body to regulate heart and kidney function and maintain overall balance (Vargas, et al. 2022).

The renin-angiotensin system (RAS) is an old hormonal system. It is discovered a long time ago in the history of evolution. Back in 1898, scientists found it while injecting kidney extracts from rabbits into other rabbits made their blood pressure slowly rise. This effect came from a substance in the outer part of the kidney and this substance was destroyed by heat. They figured it was a protein and called it renin. However other scientists could not reproduce these results at the time and renin was not rediscovered until much later (Fyhrquist, & Saijonmaa, 2008).

The study of the renin-angiotensin system (RAS) has a long and fascinating history beginning with the initial discovery of renin all the way back in 1898. They have identified all the key players including angiotensinogen including different forms of angiotensin-converting enzyme (ACE the enzyme that modifies angiotensin) the various angiotensin peptides (the active hormones) and the receptors that these peptides bind in order to have their effects. Not only have researchers identified these components but they have also developed a wide range of medications and other tools that can precisely target and manipulate the RAS at different stages of the process. This powerful and complex system plays a crucial role in maintaining the body's overall balance. It's essential for regulating water and electrolytes (like sodium and potassium) while controlling the resistance of our blood vessels (which affects blood pressure) and ultimately keeping body’s blood pressure and cardiovascular system healthy and stable (Martyniak, & Tomasik, 2022).

Renin is a primary product named as Preprorenin in renin angiotensin system (RAS). It is released from the juxtaglomerular cells of kidneys which initiates the renin angiotensin system. It is basically a signal peptide which performs an intracellular function in brain and kidneys with the help of mRNA (Vargas, et al. 2022).

The RAS is crucial for blood pressure control. The kidney releases renin when blood pressure is low or due to other factors. Renin starts a chain reaction that leads to the production of angiotensin II. Angiotensin II raises blood pressure by causing blood vessels to tighten and the body to retain fluids. However, Exercise has the opposite effect helping to lower blood pressure by reducing angiotensin II and relaxing blood vessels (Baffour-Awuah et al, 2024).

High blood pressure is a major cause of heart problems around the world. Exercise is a good way to lower blood pressure especially if you already have high blood pressure. Doctors recommend exercise to help prevent high blood pressure when done consistently. Exercise can gradually reduce the risk of hypertension. A system in the body called the renin-angiotensin system (RAS) plays a role in regulating high blood pressure (Goessler, et al. 2016).

Exercise has a great influence on muscles and RAS. The reduction of angiotensin converting enzymes can reverse the decline of physical performance and slow decline of muscle strengthen and hypertrophy in elderly women (Jones & Woods, 2003). When a person performs a physical activity, it actually begins the molecular mechanism which can improve the quality of life. A regular exercise can delay different health

complications/diseases (Ruegsegger et al, 2018). Gender differences also influence RAS responses to exercise. Maximal exercise tends to elevate plasma renin levels more significantly in women than in men (Ahmed et al, 2025).

METHODS & MATERIALS

The present study was carried out to examine the impact of moderate intensity exercise on renin angiotensin system among females. The participants of the study were included twenty (20) female students aged between 18-22 selected from the Department of Sports Sciences and Physical Education, University of the Punjab, Lahore, Pakistan. Participants were randomly distributed into two groups' i.e. Control group (CG) and Experimental group (EG). Each group comprised of ten (10) subjects. The sample size was calculated through **G*Power** statistical software. An adopted moderate intensity exercise protocol consisted of warming up for 5 minutes followed by 30 minutes of jogging at 70%-75% of maximal heart rate developed by (Ghaediyan, & Marefati, 2012) was implemented on the experimental group for 8 weeks. The recruitment criteria for subjects were: the age between 18-22 years female having no chronic issues. RAS was measured with 10ml venous blood collected from the subjects and tested through the Plasma renin direct test from the lab. The pre and posttest results were evaluated through statistical package for the Social Sciences (SPSS, version-26), and then suitable statistical tools were applied according to parametric data.

Analysis of Data:

Descriptive analysis of Experimental Group

Table no 4.1 Shows the Descriptive Statistics of Pre-test Results Experimental Group (EG) in term of Anthropometric Attributes and Plasma Renin Level.

Descriptive Statistics								
Testing Variables	**N**	**Range**	**Minimum**	**Maximum**	**Sum**	**Mean**	**Std. Deviation**	**Variance**
participant	10	9.00	1.00	10.00	55.00	5.5000	3.02765	9.167
Age	10	1.00	1.00	2.00	15.00	1.5000	.52705	.278
Wtpre	10	1.00	1.00	2.00	14.00	1.4000	.51640	.267
Wtpost	10	1.00	1.00	2.00	17.00	1.7000	.48305	.233
PRApre	10	.30	2.30	2.60	24.40	2.4400	.10750	.012
Valid N (listwise)	10							

The above table 4.1 presents a Descriptive Analysis of the Pre-test results for the Experimental Group (EG) focusing on anthropometric attributes and plasma renin level. The total numbers of respondents were 10. The Mean and Standard Deviation of participant in EG during pretest was 5.50±3.027. Sum was 55.00. Minimum Range was 1.00, Maximum Range was 10.00. Variance was 9.167. The Mean and Standard Deviation of age in EG during pre-test was 1.50±.527. Sum was 15.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .278. The Mean and Standard Deviation of Weight (Kg) in EG during pretest was 1.40±.516. Sum was 14.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .267. The mean and Standard Deviation of Weight (Kg) in EG during post-test was 1.70±.483. Sum was 17.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .233. The Mean and Standard Deviation of Plasma Renin Activity (PRA) in EG during pre-test was 2.44±.107. Sum was 24.40. Minimum Range was 2.30, Maximum Range was 2.60. Variance was .012.

Table no 4.2 Shows the Descriptive Statistics of Post test Results Experimental Group (EG) in term of Anthropometric Attributes and Plasma Renin Level.

Descriptive Statistics								
Testing Variables	**N**	**Range**	**Minimum**	**Maximum**	**Sum**	**Mean**	**Std. Deviation**	**Variance**
participant	10	9.00	1.00	10.00	55.00	5.5000	3.02765	9.167
Age	10	1.00	1.00	2.00	15.00	1.5000	.52705	.278
wtpre	10	1.00	1.00	2.00	14.00	1.4000	.51640	.267
wtpost	10	1.00	1.00	2.00	17.00	1.7000	.48305	.233
PRApost	10	1.20	2.30	3.50	24.60	2.4600	.37178	.138
Valid N (listwise)	10							

The above table 4.2 presents a Descriptive Analysis of the Post-test results for the Experimental Group (EG) focusing on anthropometric attributes and plasma renin level. The total numbers of respondents were 10. The Mean and Standard Deviation of participant in EG during post-test was 5.50±3.027. Sum was 55.00. Minimum Range was 1.00, Maximum Range was 10.00. Variance was 9.167. The Mean and Standard Deviation of age in EG during post-test was 1.50±.527. Sum was 15.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .278. The Mean and Standard Deviation of Weight (Kg) in EG during pre-test was 1.40±.516. Sum was 14.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .267. The mean and Standard Deviation of Weight (Kg) in EG during post-test was 1.70±.483. Sum was 17.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .233. The Mean and Standard Deviation of Plasma Renin Activity (PRA) in EG during post-test was 2.46±.371. Sum was 24.60. Minimum Range was 2.30, Maximum Range was 3.50. Variance was .138.

Table no 4.3 Shows the Statistics of Pre and Post test Results Experimental Group (EG) in term of Anthropometric Attributes and Plasma Renin Level.

Descriptive Statistics

Testing Variables	**N**	**Range**	**Minimum**	**Maximum**	**Sum**	**Mean**	**Std. Deviation**	**Variance**
Participant	10	9.00	1.00	10.00	55.00	5.5000	3.02765	9.167
Age	10	1.00	1.00	2.00	15.00	1.5000	.52705	.278
Wtpre	10	1.00	1.00	2.00	14.00	1.4000	.51640	.267
Wtpost	10	1.00	1.00	2.00	17.00	1.7000	.48305	.233
PRApost	10	1.20	2.30	3.50	24.60	2.4600	.37178	.138
PRApre	10	.30	2.30	2.60	24.40	2.4400	.10750	.012
Valid N (listwise)	10							

The above table 4.3 presents a Descriptive Analysis of Pre and Post-test results for the Experimental Group (EG) focusing on anthropometric attributes and plasma renin level. The total numbers of respondents were 10. The Mean and Standard Deviation of participant in EG during pre and post-test was 5.50±3.027. Sum was 55.00. Minimum Range was 1.00, Maximum Range was 10.00. Variance was 9.167. The Mean and Standard Deviation of age in EG during pre and post-test was 1.50±.527. Sum was 15.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .278. The Mean and Standard Deviation of Weight (Kg) in EG during pre-test was 1.40±.516. Sum was 14.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .267. The mean and Standard Deviation of Weight (Kg) in EG during post-test was 1.70±.483. Sum was 17.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .233. The Mean and Standard Deviation of Plasma Renin Activity (PRA)

in EG during post-test was 2.46±.371. Sum was 24.60. Minimum Range was 2.30, Maximum Range was 3.50. Variance was .138. The Mean and Standard Deviation of Plasma Renin Activity (PRA) in EG during pre-test was 2.44±.107. Sum was 24.40. Minimum Range was 2.30, Maximum Range was 2.60. Variance was .012.

Table no 4.4 T-Test shows the differences of Pre and Post test Results Experimental Group (EG) in term of Anthropometric Attributes and Plasma Renin Level.

T-Test

Paired Samples Statistics					
		Mean	**N**	**Std. Deviation**	**Std. Error Mean**
Pair 1	Wtpre	1.4000	10	.51640	.16330
	Wtpost	1.7000	10	.48305	.15275
Pair 2	PRApre	2.4400	10	.10750	.03399
	PRApost	2.4600	10	.37178	.11757

Paired Samples Correlations				
		N	**Correlation**	**Sig.**
Pair 1	wtpre & wtpost	10	.535	.111
Pair 2	PRApre & PRApost	10	.656	.039

Paired Samples Test

		Paired Differences					**t**	**df**	**Sig. (2-tailed)**
		Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
					Lower	**Upper**			
Pair 1	wtpre - wtpost	-.30000	.48305	.15275	-.64555	.04555	-1.964	9	.081
Pair 2	PRApre – PRApost	-.02000	.31198	.09866	-.24318	.20318	-.203	9	.844

The above table 4.4 indicates the differences of pre and post-test results Experimental Group in term of anthropometric attributes and Plasma Renin Activity Level. The total number of respondents were 10. The Mean and Standard Deviation of EG during pre-test in term of Weight was 1.40±.516. Standard Error Mean was .163. The Mean and Standard Deviation of EG during post-test in term of Weight was 1.70±.483. Standard Error Mean was .152. The Mean and Standard Deviation of Plasma Renin Activity Level in EG during pre-test was 2.44±.107. Standard Error Mean was .339. The Mean and Standard Deviation of Plasma Renin Level in EG during post-test was 2.46±.371. Standard Error Mean was .117. Mean and Standard Deviation of difference between pre and post-test in terms of Weight was -.300 ± .152. t-value was -1.964, the degree of freedom was 9, and level of significant was .081. Mean and Standard Deviation of difference between pre and post-test in terms of Plasma Renin Activity Level was -.200 ± .311. t-value was -.203, the degree of freedom was 9, and level of significant was .844.

Table no 4.5 Shows the Descriptive Statistics of Pre-test Results Control Group (CG) in term of Anthropometric Attributes and Plasma Renin Level.

Descriptive Statistics								
Testing Variables	**N**	**Range**	**Minimum**	**Maximum**	**Sum**	**Mean**	**Std. Deviation**	**Variance**

Participant	10	9.00	1.00	10.00	55.00	5.5000	3.02765	9.167
Age	10	1.00	1.00	2.00	12.00	1.2000	.42164	.178
Wtpre	10	1.00	1.00	2.00	14.00	1.4000	.51640	.267
Wtpost	10	1.00	1.00	2.00	16.00	1.6000	.51640	.267
PRApre	10	.70	2.30	3.00	25.00	2.5000	.27487	.076
Valid N (listwise)	10							

The above table 4.5 presents a Descriptive Analysis of the Pre-test results for the Control Group (EG) focusing on anthropometric attributes and plasma renin level. The total numbers of respondents were 10. The Mean and Standard Deviation of participant in CG during pretest was 5.50±3.027. Sum was 55.00. Minimum Range was 1.00, Maximum Range was 10.00. Variance was 9.167. The Mean and Standard Deviation of age in CG during pre-test was 1.2±.421. Sum was 12.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .178. The Mean and Standard Deviation of Weight (Kg) in CG during pretest was 1.40±.516. Sum was 14.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .267. The mean and Standard Deviation of Weight (Kg) in CG during post-test was 1.60±.516. Sum was 16.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .267. The Mean and Standard Deviation of Plasma Renin Activity (PRA) in CG during pre-test was 2.50±.274. Sum was 25.00. Minimum Range was 2.30, Maximum Range was 3.00. Variance was .076.

Table no 4.6 shows the Descriptive Statistics of Post test Results Control Group (CG) in term of Anthropometric Attributes and Plasma Renin Level.

Descriptive Statistics								
Testing Variables	**N**	**Range**	**Minimum**	**Maximum**	**Sum**	**Mean**	**Std. Deviation**	**Variance**
Participant	10	9.00	1.00	10.00	55.00	5.5000	3.02765	9.167
Age	10	1.00	1.00	2.00	12.00	1.2000	.42164	.178
Wtpre	10	1.00	1.00	2.00	14.00	1.4000	.51640	.267
Wtpost	10	1.00	1.00	2.00	16.00	1.6000	.51640	.267
PRApost	10	.70	2.30	3.00	25.00	2.5000	.27487	.076
Valid N (listwise)	10							

The above table 4.6 presents a Descriptive Analysis of the Post-test results for the Control Group (CG) focusing on anthropometric attributes and plasma renin level. The total numbers of respondents were 10. The Mean and Standard Deviation of participant in CG during post-test was 5.50±3.027. Sum was 55.00. Minimum Range was 1.00, Maximum Range was 10.00. Variance was 9.167. The Mean and Standard Deviation of age in CG during post-test was 1.20±.421. Sum was 12.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .178. The Mean and Standard Deviation of Weight (Kg) in CG during pre-test was 1.40±.516. Sum was 14.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .267. The mean and Standard Deviation of Weight (Kg) in CG during post-test was 1.60±.516. Sum was 16.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .267. The Mean and Standard Deviation of Plasma Renin Activity (PRA) in CG during post-test was 2.50±.274. Sum was 25.00. Minimum Range was 2.30, Maximum Range was 3.00. Variance was .076.

Table no 4.7 Shows the Descriptive Statistics of Pre and Post test Results Control Group (CG) in term of Anthropometric Attributes and Plasma Renin Level.

Descriptive Statistics								
Testing Variables	**N**	**Range**	**Minimum**	**Maximum**	**Sum**	**Mean**	**Std. Deviation**	**Variance**
Participant	10	9.00	1.00	10.00	55.00	5.5000	3.02765	9.167
Age	10	1.00	1.00	2.00	12.00	1.2000	.42164	.178
Wtpre	10	1.00	1.00	2.00	14.00	1.4000	.51640	.267
Wtpost	10	1.00	1.00	2.00	16.00	1.6000	.51640	.267
PRApost	10	.70	2.30	3.00	25.00	2.5000	.27487	.076
PRApre	10	.70	2.30	3.00	25.00	2.5000	.27487	.076
Valid N (listwise)	10							

The above table 4.7 presents a Descriptive Analysis of Pre and Post-test results for the Control Group (CG) focusing on anthropometric attributes and plasma renin level. The total numbers of respondents were 10. The Mean and Standard Deviation of participant in CG during pre and post-test was 5.50±3.027. Sum was 55.00. Minimum Range was 1.00, Maximum Range was 10.00. Variance was 9.167. The Mean and Standard Deviation of age in CG during pre and post-test was 1.20±.421. Sum was 12.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .178. The Mean and Standard Deviation of Weight (Kg) in CG during pre-test was 1.40±.516. Sum was 14.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .267. The Mean and Standard Deviation of Weight (Kg) in CG during post-test was 1.60±.516. Sum was 16.00. Minimum Range was 1.00, Maximum Range was 2.00. Variance was .267 The Mean and Standard Deviation of Plasma Renin Activity (PRA) in CG during post-test was 2.50±.274. Sum was 25.00. Minimum Range was 2.30, Maximum Range was 3.00. Variance was .076. The Mean and Standard Deviation of Plasma Renin Activity (PRA) in CG during pre-test was 2.50±.107. Sum was 25.00. Minimum Range was 2.30, Maximum Range was 3.00. Variance was .076.

Table no 4.9 T-Test shows the differences of Pre and Post test Results Control Group (CG) in term of Anthropometric Attributes and Plasma Renin Level.

T-test

Paired Samples Statistics					
		Mean	**N**	**Std. Deviation**	**Std. Error Mean**
Pair 1	PRApre	2.5000[a]	10	.27487	.08692
	PRApost	2.5000[a]	10	.27487	.08692
Pair 2	Wtpre	1.4000	10	.51640	.16330
	Wtpost	1.6000	10	.51640	.16330
a. The correlation and t cannot be computed because the standard error of the difference is 0.					

Paired Samples Correlations

		N	**Correlation**	**Sig.**
Pair 2	Wtpre & Wtpost	10	.667	.035

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 2	Wtpre – Wtpost	-.2000 0	.42164	.13333	-.50162	.10162	-1.500	9	.168

The above table 4.9 indicates the differences of pre and post-test results Experimental Group in term of anthropometric attributes and Plasma Renin Activity Level. The total number of respondents were 10. The Mean and Standard Deviation of CG during pre-test in term of Weight was 1.40±.516. Standard Error Mean was .163. The Mean and Standard Deviation of CG during post-test in term of Weight was 1.60±.516. Standard Error Mean was .163. The Mean and Standard Deviation of Plasma Renin Activity Level in CG during pre-test was 2.50±.274. Standard Error Mean was .086. The Mean and Standard Deviation of Plasma Renin Level in CG during post-test was 2.50±.274. Standard Error Mean was .086. Mean and Standard Deviation of difference between pre and post-test in terms of Weight was -.200 ± .421. t-value was -1.50, the degree of freedom was 9, and level of significant was .168.

Discussion:

The aim of this research study to access the impact of moderate intensity exercise on renin angiotensin system among females. In this study, the researcher randomly selected 20 active female participants and engage them in exercise sessions of moderate intensity for 8 weeks. The significant demographic variable of this study was renin activity level which was measured through plasma renin direct test. After careful analysis of the study, the researcher indicates that exercise has a positive influence on renin angiotensin system among females.

This study describes that there is as significant interaction between exercise and the renin-angiotensin system (RAS), which shows that physical activity influences the cardiovascular and kidney health. Consistent exercise is a powerful tool to reduce harmful health diseases, improve muscle functions, lower blood pressure, and provide protection to heart and kidneys. This empowers the level of exercise as a non-pharmacological strategy to reduce RAS related cardiovascular and kidney diseases (Cunha et al. 2016).

A research study by Azadpour, Tartibian, and Kosar (2016) describes the effects of regular exercise change angiotensin II responsible for blood pressure regulation in obese postmenopausal women with high blood pressure. It reduces body fat and maintains body composition in females. The study explains that exercise regulates blood pressure and improve metabolic health in females by regulating hormones.

Maresh et al (1985) reported that women often experience a greater increase in plasma renin levels due to the hormonal and physiological differences in renin angiotensin system than men during maximal exercise.

Cardiovascular diseases consider the life-threatening disorders all over the world but this study shows that renin-angiotensin system RAS is not a simple chain of biochemical reaction but it also helps to regulate blood pressure, fluid balance, electrolyte homeostasis and decrease the risk of cardiovascular diseases is supported by (Martyniak and Tomasik 2022).

The study by Winslow and Hall (2019) supported the current study findings shows that exercise gradually increases the Plasma renin level in Renin angiotensin system RAS. exercise change the balance of the RAS by decreasing the harmful classical pathway while enhancing the protective non classical pathway. This helps prevent muscle loss, supports muscle regeneration and improves metabolic health. Overall, the findings

suggest that exercise is an effective strategy to improve muscle wasting by restoring a balance within the RAS.

Frantz et al (2018) explains that exercise sessions affect the function of muscles particularly skeletal muscles and adipose tissues. Exercise has the tendency to change the pattern of angiotensin II pathway and enhance the function of protective angiotensin 1–7. These changes decrease inflammation, better muscle function, repair adipose tissue and improve overall health.

Conclusion:

After careful analysis, the researcher arrived at conclusion that moderate intensity has a positive impact on renin angiotensin system among females.

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