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Effectiveness of Administrating a Food-Supplement on Improving the Physical Performance and Immunological Profile of Swimmers

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Abstract:

The current research aims to identify the effects of administering food supplement (Ω^3) and the effects of physical effort after administering food supplement (Ω^3) on all physical performance and immunity variables in swimmers. The researchers used the experimental (one-group) approach with pre- and post-measurements. The researchers purposefully chose (10) swimmers (15-21 years) from Smouha Sports Club who were all registered in the Egyptian Federation of Swimming with training experience of at least (2) years. Table (1) shows characteristics of participants. The researchers measured the following variables (HR – $VO2_{max}$ – WBCs – Immunoglobulins – Hematocrit – Ca) before and after effort without having (Ω^3) and before and after effort with having (Ω^3) as food supplement. Results indicated that:

- *There are statistically significant differences on all physical performance variables (HR, $VO2_{max}$, Hematocrit and Ca) after effort with administering (Ω^3). This improved the physical performance level of swimmers.*
- *There are statistically significant differences on all immunological variables (WBCS – IgG – IgM - IgA) after effort with administering (Ω^3). This improved the physical performance level of swimmers.*

Key words: *Hematocrit - Calcium (Ca) – Ω^3– WBCs – Immunoglobulins*

Introduction:

Functional preparedness and adaptations of the human body with training doses is a major indicator that the body is able to fulfill the tasks, especially when considering the athlete's age as an Olympic medalist depends on good functional, motor and technical preparation of body systems to continue and maintain the same level

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later on. This clearly indicates the importance of administering food supplements. Fish, and its oil, is rich with two major types of unsaturated fatty acids, Ω^3 and Ω^6, that help eliminating the risk factors of cardiovascular diseases (Kenler et al. 1996).

Due to Ω^3 and Ω^6 that work with different mechanisms, fish oil is very useful (Martin et al. 1985). It decreases high blood pressure through moderating systolic and diastolic blood pressure (Robergs& Roberts 1997). Ω^3 improves liver and kidney functions through decreasing prostaglandin levels (Tvede et al. 1989). In addition, fish oil helps decreasing fats, especially cholesterol, and this modifies blood clotting (Yoshino & Ellis 1997).

Ω^3found in fish oil can penetrate the fatty membranes of tissues and improve the immunological processes of the human body (Roulette et al. 1997). This may help decreasing inflammation and increasing energy production with huge amounts. This means it can be used instead of dextrose, especially after surgical procedures. Ω^3also increases glycogen levels in muscles (Yoshino & Ellis 1987).

According to the researchers' knowledge in the sports field, they noticed that most researchers concentrate on the physical and physiological aspects while they rarely study the value of using alternative food supplements with its high value in improving human body functions without harm or side-effects. Researchers also rarely study the use of these supplements by athletes with the aim of improving physical performance as each substance or group of substances have specific effects effects on muscles. It is well-documented that metabolism of specific nutrients may increase the muscular cross-section and fats can be used as a high-caloric source of energy instead of carbohydrates (Heshmat 1999). One of these values is the use of Ω^3 as an unsaturated fatty acid that does no harm to body systems and increases energy production, among other uses including antiinflammation, and immunological improvement in addition to wound healing and stopping hemorrhage (Heshmat&Shalaby 2003). Accordingly, the researchers concluded that this topic worth studying and may improve athletic performance, especially in swimmers.

Aims:

The current research aims to identify:

1. The effects of administering food supplement (Ω^3) on improving the physical performance and immunity of swimmers.
2. The effects of physical effort after administering food supplement (Ω^3) on all physical performance and immunity variables in swimmers.

Hypotheses:

1. There are statistically significant differences between pre- and post-effort measurements before administering food supplement (Ω^3) on improving the physical performance and immunity of swimmers.
2. There are statistically significant differences between pre- and post-effort measurements after administering food supplement (Ω^3) on improving the physical performance and immunity of swimmers.

3. There are statistically significant differences between post-effort measurements before and after administering food supplement (Ω^3) on improving the physical performance and immunity of swimmers.

4. There are statistically significant differences among the four pre- and post-effort measurements before and after administering food supplement (Ω^3) in favor of post-effort after administering food supplement.

Methods:

Approach:

The researchers used the experimental (one-group) approach with pre- and post-measurements.

Participants:

The researchers purposefully chose (10) swimmers (15-21 years) from Smouha Sports Club who were all registered in the Egyptian Federation of Swimming with training experience of at least (2) years. Table (1) shows characteristics of participants.

Table (1): Mean, SD and Squewness on Growth Factors of Participants (n=10)

Variables	Measurement	Mean	**SD±**	Minimum	Maximum	Squewness
Age	Month/year	18.14	1.64	15.00	21.00	-0.520
Height	Cm	170.50	2.59	168.00	174.00	0.598
Weight	Kg	68.60	3.60	65.00	74.00	0.335
Training experience	Year	6.40	0.70	5.00	7.00	-0.780

Table (1) showed that squewness values ranged from (-0.780) to (0.598). this means the values are between (±3) which indicates sample homogeneity on all growth factors before the main experiment.

Measurements:

The researchers measured the following variables (HR – $VO2_{max}$ – WBCs – Immunoglobulins – Hematocrit – Ca) before and after effort without having (Ω^3) and before and after effort with having (Ω^3) as food supplement.

Statistical treatments:

The researchers used SPSS Software to calculate the following: Mean – SD – Squewness – Wilcoxon Test – Variance Analysis (Kruskal-Wallis) – X^2.

Results:

Table (2): difference Significance among Measurements Before and After Effort in Physical Improvement Variables Before Administering (Ω^3) (n=10)

Variables	Measurements	Pre-effort		Post-effort		Z	P
		Mean	SD±	Mean	SD±		
HR	Bpm	72.70	2.11	167.40	2.84	-2.809	0.005**
$VO2_{max}$	L/min	0.00	0.00	2.25	0.42	-2.812	0.005**
Hematocrit	%	40.70	2.21	41.00	2.16	-1.732	0.083
Ca	Mg/dl	9.09	0.04	9.37	0.09	-2.814	0.005**

***** P ≤ 0.05 as both parties are significant***

**** Z = ±1.96 on P ≤ 0.05 (as both parties are significant***

Table (2) showed difference significance according to Wilcoxon Test for all participants before and after effort on the following variables: HR - $VO2_{max}$ – Hematocrit – Ca. P value was less than 0.05. This indicates statistically significant differences between pre- and post-effort in favor of post-effort before administering (Ω^3) for all variables except for Hematocrit as P value was higher than 0.05.

Table (3): difference Significance among Measurements Before and After Effort in Immunological Variables Before Administering (Ω^3) (n=10)

Variables		Measurements	Pre-effort		Post-effort		Z	P
			Mean	SD±	Mean	SD±		
WBCs		$1000/cm^3$	6027.20	690.14	6310.10	642.41	-1.276	0.202
Immunoglobulins	IgG	Mg%	1009.60	13.34	1084.50	6.80	-2.805	0.000**
	IgA	Mg%	163.40	4.33	174.40	6.17	-2.807	0.005**
	IgM	Mg%	105.50	6.87	117.40	4.70	-2.810	0.005**

***** P ≤ 0.05 as both parties are significant***

**** Z = ±1.96 on P ≤ 0.05 (as both parties are significant***

Table (3) showed difference significance according to Wilcoxon Test for all participants before and after effort on the following variables: WBCs – IgA – IgG - IgM. P value was less than 0.05. This indicates statistically significant differences between pre- and post-effort in favor of post-effort before administering (Ω^3) for all variables except for WBCs as P value was higher than 0.05.

Table (4): difference Significance among Measurements Before and After Effort in Physical Improvement Variables After Administering (Ω^3) (n=10)

Variables	Measurements	Pre-effort		Post-effort		Z	P
		Mean	SD±	Mean	SD±		
HR	Bpm	70.10	1.52	157.50	5.30	-2.818	0.005**
$VO2_{max}$	L/min	0.00	0.00	2.76	0.31	-2.809	0.005**
Hematocrit	%	42.50	1.84	43.80	1.62	-1.908	0.056
Ca	Mg/dl	9.19	0.21	9.90	0.30	-2.805	0.005**

***** P ≤ 0.05 as both parties are significant***

**** Z = ±1.96 on P ≤ 0.05 (as both parties are significant***

Table (4) showed difference significance according to Wilcoxon Test for all participants before and after effort on the following variables: HR - $VO2_{max}$ – Hematocrit – Ca. P value was less than 0.05. This indicates statistically significant differences between pre- and post-effort in favor of post-effort after administering (Ω^3) for all variables except for Hematocrit as P value was higher than 0.05.

Table (5): difference Significance among Measurements Before and After Effort in Immunological Variables After Administering (Ω^3) (n=10)

Variables		Measurements	Pre-effort		Post-effort		Z	P
			Mean	SD±	Mean	SD±		
WBCs		$1000/cm^3$	7706.60	628.11	8038.70	678.09	-2.091	0.037**
Immunoglobulins	IgG	Mg%	1043.00	18.07	1117.30	9.45	-2.814	0.000**
	IgA	Mg%	171.30	4.27	188.50	5.66	-2.829	0.005**
	IgM	Mg%	120.70	8.71	135.30	8.49	-2.549	0.011**

***** P ≤ 0.05 as both parties are significant***

**** Z = ±1.96 on P ≤ 0.05 (as both parties are significant***

Table (5) showed difference significance according to Wilcoxon Test for all participants before and after effort on the following variables: WBCs – IgA – IgG - IgM. P value was less than 0.05. This indicates statistically significant differences between pre- and post-effort in favor of post-effort after administering (Ω^3) for all variables.

Table (6): difference Significance among Measurements After Effort on Physical Improvement Variables Before and After Administering (Ω^3) (n=10)

Variables	Measurements	Before (Ω^3)		After (Ω^3)		Z	P
		Mean	SD±	Mean	SD±		
HR	Bpm	167.40	2.84	157.50	5.30	-2.812	0.005**
VO2 $_{max}$	L/min	2.25	0.42	2.76	0.31	-2.507	0.012**
Hematocrit	%	41.00	2.16	43.80	1.62	-2.831	0.005**
Ca	Mg/dl	9.37	0.09	9.90	0.30	-2.805	0.005**

***** P ≤ 0.05 as both parties are significant***

**** Z = ±1.96 on P ≤ 0.05 (as both parties are significant***

Table (6) showed difference significance according to Wilcoxon Test for all participants after effort on the following variables: HR - VO2 $_{max}$ – Hematocrit – Ca. P value was less than 0.05. This indicates statistically significant differences between post-effort before and after administering (Ω^3) in favor of post-effort after administering (Ω^3) for all variables.

Table (7): difference Significance among Measurements After Effort in Immunological Variables Before and After Administering (Ω^3) (n=10)

Variables		Measurements	Before (Ω^3)		After (Ω^3)		Z	P
			Mean	SD±	Mean	SD±		
WBCs		1000/cm^3	6310.10	642.41	8038.70	678.09	-2.805	0.005**
Immunoglobulins	IgG	Mg%	1084.50	6.80	1117.30	9.45	-2.807	0.005**
	IgA	Mg%	174.40	6.17	188.50	5.66	-2.809	0.005**

	IgM	Mg%	117.40	4.70	135.30	8.49	-2.703	0.007**

***** P ≤ 0.05 as both parties are significant***

**** Z = ±1.96 on P ≤ 0.05 (as both parties are significant***

Table (7) showed difference significance according to Wilcoxon Test for all participants after effort on the following variables: WBCs – IgA – IgG - IgM. P value was less than 0.05. This indicates statistically significant differences between post-effort before and after administering (Ω^3) in favor of post-effort after administering (Ω^3) for all variables.

Table (8): Variance Analysis (Kruskal- Wallis) among the Four Measurements on Physical Improvement of Swimmers (n=10)

Measurements		Number	Mean of ranks	X^2	Freedom degree	P
HR	Before effort – before Ω^3	10	13.75	33.454	3	0.000**
	After effort – before Ω^3		34.65			
	Before effort – after Ω^3		7.25			
	After effort – after Ω^3		26.35			
VO_{2max}	Before effort – before Ω^3	10	10.50	34.780	3	0.000**
	After effort – before Ω^3		27.75			
	Before effort – after Ω^3		10.50			
	After effort – after Ω^3		33.25			
Hematocrit	Before effort – before Ω^3	10	14.25	11.071	3	0.011**
	After effort – before Ω^3		15.45			
	Before effort – after Ω^3		23.00			
	After effort – after Ω^3		29.30			

Ca	Before effort – before Ω^3	8	9.35	26.596	3	0.000**
	After effort – before Ω^3		23.45			
	Before effort – after Ω^3		14.70			
	After effort – after Ω^3		34.50			

***** P ≤ 0.05 as both parties are significant***

Table (8) indicated statistically significant differences among the physical variables under investigation in favor of post-effort after administering (Ω^3) as $P \leq 0.05$.

Table (9): Variance Analysis (Kruskal- Wallis) among the Four Measurements on Immunological Variables of Swimmers (n=10)

Measurements			Number	Mean of ranks	X^2	Freedom degree	P
WBCs		Before effort – before Ω^3	10	7.90	28.955	3	0.000**
		After effort – before Ω^3		13.90			
		Before effort – after Ω^3		28.00			
		After effort – after Ω^3		32.20			
Immunoglobulins	IgG	Before effort – before Ω^3	10	6.50	35.315	3	0.000**
		After effort – before Ω^3		25.50			
		Before effort – after Ω^3		14.50			
		After effort – after Ω^3		35.50			
	IgA	Before effort – before Ω^3	10	7.05	28.952	3	0.000**
		After effort – before Ω^3		21.95			
		Before effort – after Ω^3		18.15			
		After effort – after Ω^3		34.85			

	IgM	Before effort – before Ω^3	10	7.00	26.503	3	0.000**
		After effort – before Ω^3		19.30			
		Before effort – after Ω^3		21.95			
		After effort – after Ω^3		33.75			

***** $P \leq 0.05$ as both parties are significant***

Table (9) indicated statistically significant differences among the immunological variables under investigation in favor of post-effort after administering (Ω^3) as $P \leq 0.05$.

Discussion:

Tables (2) and (3) showed a decrease in HR after administering (Ω^3)at rest and after effort. Physical effort increased Hr. $VO2_{max}$ increased after administering (Ω^3). This indicates the link between HR and the activation of the sympathetic system that affects the cardiac activity (Jonathan et al. 2000).

Contraction of skeletal muscles increases venues blood flow which in turn increases heart rate (HR), with activation of the sympathetic system that induces the secretion of hormonal regulators that affect the heart through increasing heart rate. The researchers think that the decreased rest heart rate is due to the effect of the sympathetic system which is considered as an indicator of high physical fitness of the athlete. Increases in $VO2_{max}$ are due to the positive effects of administering (Ω^3) in increasing RBCs which in turn increases hematocrit. Increased VO2 max is an indicator of improved aerobic fitness of the swimmer. VO2 max increases as each cell consumes oxygen to metabolize nutrients into energy in the form of ATP. This increases oxygen consumption with effort. One study indicated that performance duration increased after (3-4) weeks of administering (Ω^3)as this improved physical performance, physical conditions and oxygen consumption for producing more energy (Kamath et al. 1991).

This is consistent with Shaw et al. (2016) who indicated that Australian swimmers who consumed (Ω^3) as part of their dietary regimen were more able to achieve higher digital records due to the improvements in their metabolic abilities to generate more power. (Shaw et al. 2016).

Tables (2) and (4) showed increased values in Hematocrit levels after effort, compared with rest values either before or after administering (Ω^3). Hematocrit levels increased after (3-4) weeks of administering (Ω^3) compared with not administering (Ω^3). Table (6) asserted the increase in Hematocrit levels after effort and after administering (Ω^3). Hematocrit represents the relative volume of RBCs (RBCs to total blood volume). This increase may be real if it represents the increase of RBCs number or even relative due to the decrease of plasma volume. The increase of Hematocrit and RBCs are due to the outflow of fluids off the circulatory system due to effort and this decreases plasma volume (Robergs& Roberts 1997).

This increase of Hematocrit levels due to administering (Ω3) improves the swimming performance as effort requires more Red Blood Cells to move oxygen around the body cells to be consumed and then used for metabolism and energy production. One study noticed that speed swimmers and runners need to consume more energy to sustain speed during their short-to-middle distance race and in case of administering (Ω3) they managed to increase their digital records significantly (Philpott et al. 2019).

Tables (2), (4) and (6) indicated an increase in Calcium (Ca) concentrations after effort either before or after administering (Ω^3). After administering (Ω^3), (Ca) concentrations increased, compared to before administering (Ω^3). Calcium contributes in muscular contractions during physical activity and exercise. In addition, the nervous system needs Calcium to function properly. Furthermore, Calcium is very important for bone density and hormonal regulation of parathyroid and calcitonin. Calcium changes the shape of blood platelets from the discus to the serrated circular shape in addition to secretion of platelets' contents and forming the right surface for clotting (Ashby et al. 1990). The increase of blood pressure during sports effort leads to increased concentrations of Calcium in the sympathetic system leading to increased levels of sympathetic activation. Increased blood pressure during physical effort increases calcium flow into blood vessels causing them to contract. These contractions increase energy production and improve performance (Buhler and Resnik 1988).

Tables (3), (5) and (7) indicated an increase in WBCs count and the concentration of immunoglobulins after effort and after administering (Ω^3). For (3-4) weeks in swimmers. This increase in immune cells and globulins is due to Erythropoietin, a hormone that increases with the decrease of oxygen in blood during physical exercise. This leads stem cells to proliferate into WBCs in bone marrow, especially to lymphatic cells that produce immunoglobulins (IgG, IgA and IgM) (Ganong 1991).

Unsaturated fatty acids of (Ω^3) play a major part in the immunoregulation and cell proliferation into immune cells. Metabolism of (Ω^3) stimulates the production of immunological hormones that increase the cell proliferation rate in bone marrow as this mechanism consumes more oxygen leaving the surrounding environment very suitable for such proliferation. (Gligor&Glior 2016).

Tables (7), (8) and (9) indicated statistically significant differences among the measurement before and after effort and before and after administering (Ω^3) in all research variables that included WBCs, immunoglobulins (IgG – IgM – IgA), HR, $VO2_{max}$, Hematocrit and Ca as P value was less than 0.05 in favor of post-effort after administering (Ω^3). As blood viscosity increases with training, fish oil with (Ω^3) may improve training results and energy production (Martin et al 1985). It may also increase immunoglobulins through increasing cortisol and ACTH in addition to internal morphine. These increases happen during high intensities compared with low intensities (Tvede et al 1989

Consuming (Ω^3) as part of the dietary regimen is accompanied with major benefits for athletic performance, especially in digital sports like running and swimming. As an unsaturated fatty acid, (Ω^3) improves the hematological profile of athletes through increasing several hematological indicators like RBCs, WBCs and Hematocrit. (Shei et al 2014).

In addition, the benefits of increasing $VO2_{max}$ and heart rate due to consuming (Ω^3) improve the athletic performance that requires increased levels of energy production to maintain speed for short-tomoderate durations. Furthermore, the established valuable effects of (Ω^3) on the immune response of athletes and its positive effects and safe administration makes it a good alternative as a safe food supplements for swimmers (Gammone et al. 2019).). This improves the physical performance level and immune response of swimmers.

Conclusions:

According to this research aims, hypotheses, methods and results, the researchers concluded the following:

1. Administering (Ω^3) as food supplement for swimmers improved HR, $VO2_{max}$, Hematocrit and Ca, leading to improvements in physical performance.
2. Administering (Ω^3) as food supplement for swimmers decreased HR while increasing $VO2_{max}$. It improved RBCs count in Hematocrit and Ca concertation that are essential for muscular contraction.
3. Administering (Ω^3) as food supplement for swimmers improved immune response through increasing WBCs and immunoglobulin concentrations (IgG – IgM – IgA).
4. There are statistically significant differences on all physical performance variables (HR, $VO2_{max}$, Hematocrit and Ca) after effort with administering (Ω^3). This improved the physical performance level of swimmers.
5. There are statistically significant differences on all immunological variables (WBCS – IgG – IgM - IgA) after effort with administering (Ω^3). This improved the physical performance level of swimmers.

Recommendations:

According to these conclusions, the researchers recommend the following:

- Using (Ω^3) as food supplement for athletes due to its benefits in improving sports activities that require high intensity effort like swimming.
- Using (Ω^3) as food supplement for athletes and swimmers due to its benefits in improving general health and the immune response.
- Performing more studies on other types of food supplements that improve sports performance, general health and immune response of athletes.

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