

Impact of n-3 polyunsaturated fatty acids on the gut microbiome in patients with type 2 diabetes mellitus: A randomized controlled trial

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ABSTRACT

Method: A randomized, double-blind, parallel, controlled trial was conducted in patients with type 2 diabetes mellitus. The primary endpoint was the change in muscle mass over 12 weeks. Secondary endpoints included changes in body composition, insulin sensitivity, and quality of life. The trial was registered at ClinicalTrials.gov (NCT04104713).

1. Background

Disease modification (DM) is a concept that refers to the use of interventions to prevent or delay the onset of complications in patients with type 2 diabetes mellitus. One of the most common complications of type 2 diabetes mellitus is muscle mass loss, which is associated with increased mortality and morbidity. The aim of this study was to evaluate the effect of n-3 polyunsaturated fatty acids on muscle mass and body composition in patients with type 2 diabetes mellitus.

Malnutrition is a common problem in patients with type 2 diabetes mellitus, and it is associated with increased mortality and morbidity. The aim of this study was to evaluate the effect of n-3 polyunsaturated fatty acids on muscle mass and body composition in patients with type 2 diabetes mellitus. The trial was registered at ClinicalTrials.gov (NCT04104713).

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wi tcl a n c e s y s t e m f a m m a t e a r c y f i o g u e t r u e n d o r - h o s t s u f n e d u p p l e o n e o b f i s o r t w i f t o t h e g a a - 3 g i n i n e , i n t e r a a c s v e t a h s h a d v e e f s e e d n t s u b y d d i f f e m e n t l e u c p - r h e y , d r j o m e y t h y l b (u f t M y B o) a n t u e l e d t r i t h e e - s e t u m b o r e a t n i e h e t e s s u l m e i t a d u b i l s i c r i d e c r i t u h e v e l v i o m o s n t l h a s t l h y o v h e o r e f u t s e a l k t h e N S p r e g r o a n t o p m e o n f n s u r l e i s r i s t a o c e l a i s p e a d l l y s p o i x d i , d a v i i t o m b r e a s t f v e e m b i a m g u a t i w h n p s e s e a n n e d e c o r r i g n y t o l l o s t o d f y a i n c r e p a r s o e t e a i t n a b o v i i t t o r e f u s o m l a e s s , e r a r t e a e n g f t h i e n g r e d i f t h e f e b s m u v l e a e s s c l u d e d . a n d n c r e a a c s u e t e - p r h o a t p e e i o n d u c t t i e o s n e . t o k i n e - i n p u a c t e d m e t e s q u i r e d t v i e t h i t e n r u a t l r i o t p i a o r n e t e r a l m e t a b o h a a g u e s i d n e u r t r i t r i e c o a d e f r t y e r d i o a l t e r i n u t r i a t i n g y o i d n u t r i t i e n t e r v e h o v i h e c h i , d o t t o l e r a t e t i o t h a e a t (A e o n y t a s j a i l 2 0)) . H e r e a f t e r t e m p t o s d u l a t t e h e r o d a o t h o w s e d n g e s e e e d a o m e N S p e d a y e r e s u o r t e t a b o h a a r g e e s t d d e i n t e g r a t e t e t r e a t m e a n t t w i t h d i f a o t n h s e t u d y . p a t i w i n t t h a n c e r e (A v e r e d a s l 2 0)) 7

S t a n d a r t d i m a o a g e f m e p n a t t i w i n t h a n d a e s e e n 2 . R e c o r d e d d a b l e s p r o v e d n a v a e o s i i t m p v a e n t h e c i l r i n p i r c o a g l (G e a s c i a - L u n a e a l 2 0)) N u t r i t i r e a d i n h e a n s t e r n d i v d i d u a t a d r v i c e T h r v e i e s v i e t r b e e l d d i r i t m e g h t i w e e k v p e n t i l o a d . t o n e e r t e q u i r d r i e h i n t s a s u i s e s u f f n e i d e i m e t a , l r i t i t o n a h e a s e v i i s t e h p a t i e m f o r m a l t e w a n g i v e t m e t r e a t s n e m u b l e d r e s c w i t t h e d a i o n b j e c t i v e s e n t i n g o r c m e n d s f e o n t r v a s i g n e e d m o g r a p d l i c n v i a c r a i l a b l e s o r c o r r e e d t t i n g i t i e o a l e i n m p r e s t v o h g r t a c n r e i - n e w e r r e e c o r a d a d d a n d o m i t z a q u i a d n e 2 h e l a d e i g v h e t e k s p l a s t r i e a t a n e d i m p r o o b t i n g u s c a r e i t a l 2 1 0 i) L i k e u p o n o m p l e o f t b a n t e r v e a m t u i t o r i , t a i s o r e a s a m e d n t w i s n e u t r i o e s n p t e s c i f o c a c c o i m p e o u t m o s b d u l s a y t s e t e m e a l u a b i o c d o y o m p o s i d y i n a m o m e d l o b y , o c h e p m a c a l i n f a m m a n i d b r e t a b o h a i n d g e a s t c o m p a n y a t l b e o r a m e t a e n r d h , y s a c a l w e r p e r f o r t h e d o l l o a v s i s n e g s s a d m i n i s t h e e r c o r d m u l s a s y p a t i w i n t h a n c e r e s u a l l n y e n t w e r a u s e d o d e t e r m i m e e m p a o f n u t r i t i o n a h i g h - p h o t o g r a h e d n r e a v i e s t h e c r i f t e r i e i n c o s s u p p l e m e n t a t i o n . s a p e n t a e r i (e i p a) d o c o s a h e x a c i e d i s s u p p l e m e n t a t a r o a s s o c i a t i o n d r e a s o a y e i g m i t e a s s a v e l l

a s e n e r a g y p r o t i e n t n a k u e r p e h y l 2 0 1 5 ; n c h e z e t l a r , a 2 0 1 5 p a p a l e a t a l d 2 0 1 5 u e t a l 2 0 2 2 z a e l a a l 2 0) 1 L i k e v i s u s p e , l e m e o f a n i t i a o h s d u s a h e u c c i a n e n c r e a s e v e m a l n u t r i t i o n) . o A n t h r o p o s n t e u t o v i c g (h c t u r a e d s u a h l e) i , g B h M I , , 2 0) p g l u a a p o s l y s a c a v i a i r m i n d u e n s o r e g f u l n a c t o i r o y n s p e r c e m f w e g i e g l h o t s a s r , m i r c u m f e r e o s e k p i s n f o l d l p a t i w i n t h a n c e r e s i u r p l e m e m a t s a e t a r n o c v i a t t e d t h i c k k a n e a s r m u s c a l r e a . d e c r e l a e s v e o p s o i n f a m y a t t o k a i n e e l a s i m p r o v e m e n t B o d y c o m p o s i a t s i o n g : l e - f (f e q u e z h i c o y i m p e d a n c i n s y m p t o m e o l (O s t a d r a t a i l 2 0 1 0 s t a d r a t a i l m i , 2 0 1 4 p o s t a r e a s 2 0) 0

T h i s t u v l a y d e s i g n e s d e l e s f e c t o f a s p e e s O S F S c e n r i c h e p a d , H A I , e u c a m p e g l u o a t r h e u t r i s t i o n a s , o A n t h r o p o s n t e u t o v i c g (h c t u r a e d s u a h l e) i , g B h M I , , f u n c t i o n a d o s c y o m p o s a n d o m e f a g r o o p a t i w i n t t h s p e r c e m f w e g i e g l h o t s a s r , m i r c u m f e r e o s e k p i s n f o l d c a n e a n h a l n u t u n d e i o g u a i t r p a d a r e d e r e a t m e n t . t h i c k k a n e a s r m u s c a l r e a . B o d y c o m p o s i a t s i o n g : l e - f (f e q u e z h i c o y i m p e d a n c (B I A k e e , A k e S n I P . i , s l a t , a a r y a l y v i e n t e a s u r e d r e s i s t e a c e a m p h a s e g v a l u e s e t d a s s e s s b o d y c o m p o s i t h i e q r p e n d i s k u e l l a n d s a d i l n e d e a t m a s l e a n n a s a n d o c y e t h a s v a l u e s o e b t a i n e d . o F u n c t i o n a t h a s g r i s p r e v e g t h e a s u b r y e n d a n o s d y n a m o m e s t i r a n g A M A H R A N d y n a m o m l e a s u r e m e n t v s r e a k e t m r t e m i e r e a d h a n a l l , t e r m a n t d e h l e y , m e a o n t h e n s e e a s u r e w a e n a t s c u l a t e d .

2. Methods

2. Design

T h i r s a n d o m i d z e d d l e - p b a l r i a n d l o e n t , r a n t u l l e t d i , c e n t c l i n t r i a d a l s o n d u f t e m a r 2 1 0 2 t 1 d M a y 2 0 2 2 t v a s e e o r r a e n g e r d o r (a s y m p t o v i n a t h i o u r t i t 1 5) d e a d) . T h b i o c h e p m a r c a r h e f t e o r t s a r l o t a l i l u m p i r e , a l b u m i n , r e t i n o l p b b o t h a n t h g t c a h l o l e s v e e r e e o d s u r s e i d n g t h e 5 O n t o d u l f e h e o b e 6 0 O d e v i (R e d h e a g n o s t l i . c s S p a i n) .

2. Subjects

A d u d u t p a t i i e a r g t w i s t e h e n (e a r t y p v e h) o a s t a r t e d t i o p h a y s A c a i l Q u e s t y i o (n l p a a o r) o n v e t r o l e d (o v e r g e o i n t e g t a m t h e o l l o n v o i n t e h n) t i n e o t p r e a a s t t m e c n m i n u t e s / w e e k . A d h e r e n c e u t r i t r e a a t h e d a i l l n y t a l i n u t r i t i o n a s u p p l e m e n t a l u a i t a s e l f - c o m p e d e r e d t h e p a t i e n t .

P a t i e n t w e r p a r t i c i p n e t h e g i n t c a l v e s e e x c l u a s e d r t e h o v e r n e o r b i o d l e y s b o d y s i n d e x 2 . N u t r i t i n b e a v e n t i o n (B M I > 3 0 k g / m 2) m t h o v s h e n d e r i w e m t n s e u n t g (e a i r y h e i r o n c o l o g r i e a t h a d b e e n x c l u s s i w r e g i y t l a o y v a o P a t i e n t e n s t r t u c a t l e o p a c k a d g e r e s h a n o C n e S d r r e q u i r e d t v i e t h i t e n r u a t l r i o t p i a o r n e n r e t r a i l t t h i o o s n e s t a n d a l s i d a i f l o y r i g v h e t e (T s a b 1) e

d i a g n o s i t e h e f r a c c a t o h r e a x n i d a h , o v h e o p r e s e v n i t e h e l v e i f e f e o t a i n o m f e d t h e d e q u h o s p i t a P a z a w i n t h e . • E n h a n c e m e n t B i A 1 i s e ; A o v e r p h i a a r n i p a i A n p o t y o t h e i r a g n o s o e h e i a b e n e e s b o r s u s e r o i d h i y r d e r u g e g y m e r i h d . g h - p a o n t h e i g r h , - c a N S v i r i t f e b e E P A D H A , c e m i i a r e a t v i e t i n t h s u l v i h n o s i e s e v a a s p e o r c l o y n t r o l l e d e u c a m p e g l u c a n s . • S t a n d a r d B i c o n t 2 r . O A d v e r p h i a a r n i p a i S r t) a : n d a r d c a r d i e s p i r o a l t i o v d e y s e a s e v e l / a c c r t a u e o i m m u n e p o l y m e r i g b , p h o t o g r a h e a n S v i r t l e f o l u e t r . d i s e a s e s m e n t e i r a e l e a c l u r i a e t d i . e a c e i O v N S o g a r t i f u i t a l t h i e o u n i t e s u s p e a n t l e a b n o r m a l e f o r e A d d i t i o n a l p a t t i y e , e n d e s i v e d a a d r v i t o n c r e a e g y t h s t a o r f t h e s t u d y r a e l e a c l u a s v e r t e h o v e c h a d a n p r o t i e n t n a l v e l a l s e c o m m e n d a p t h i y o s n e s e a f e i n s e ,

Table 1. Composition of the products with the following abbreviations: ENE (Energy), S (Sodium), and D (Dextrose).

Table with 3 columns: Component, ENE (kJ/100g), and S (mg/100g). Rows include Energy, Protein, Carbohydrate, Sugars, Fiber, and Osmolality.

Energy: 200 kJ/100g. Protein: 1.0g/100g. Carbohydrate: 18.2g/100g. Sugars: 8.5g/100g. Fiber: 1.8g/100g. Osmolality: 390 mOsm/kg.

2. Statistical analysis

The data were analyzed using SPSS 25.0 software. The results are presented as mean ± SD. Statistical significance was determined by p < 0.05.

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obtained in the present study. The results are presented as mean ± SD. Statistical significance was determined by p < 0.05.

3. Results

3.1. Study population

Sixty participants were recruited from the local community. The study was conducted over a period of 12 weeks. The results are presented as mean ± SD.

The data were analyzed using SPSS 25.0 software. The results are presented as mean ± SD. Statistical significance was determined by p < 0.05.

3.2. Nutritional status

The nutritional status of the participants was assessed using a validated questionnaire. The results are presented as mean ± SD.

The data were analyzed using SPSS 25.0 software. The results are presented as mean ± SD. Statistical significance was determined by p < 0.05.

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3.3. Functional properties

The functional properties of the products were evaluated using various methods. The results are presented as mean ± SD. Statistical significance was determined by p < 0.05.

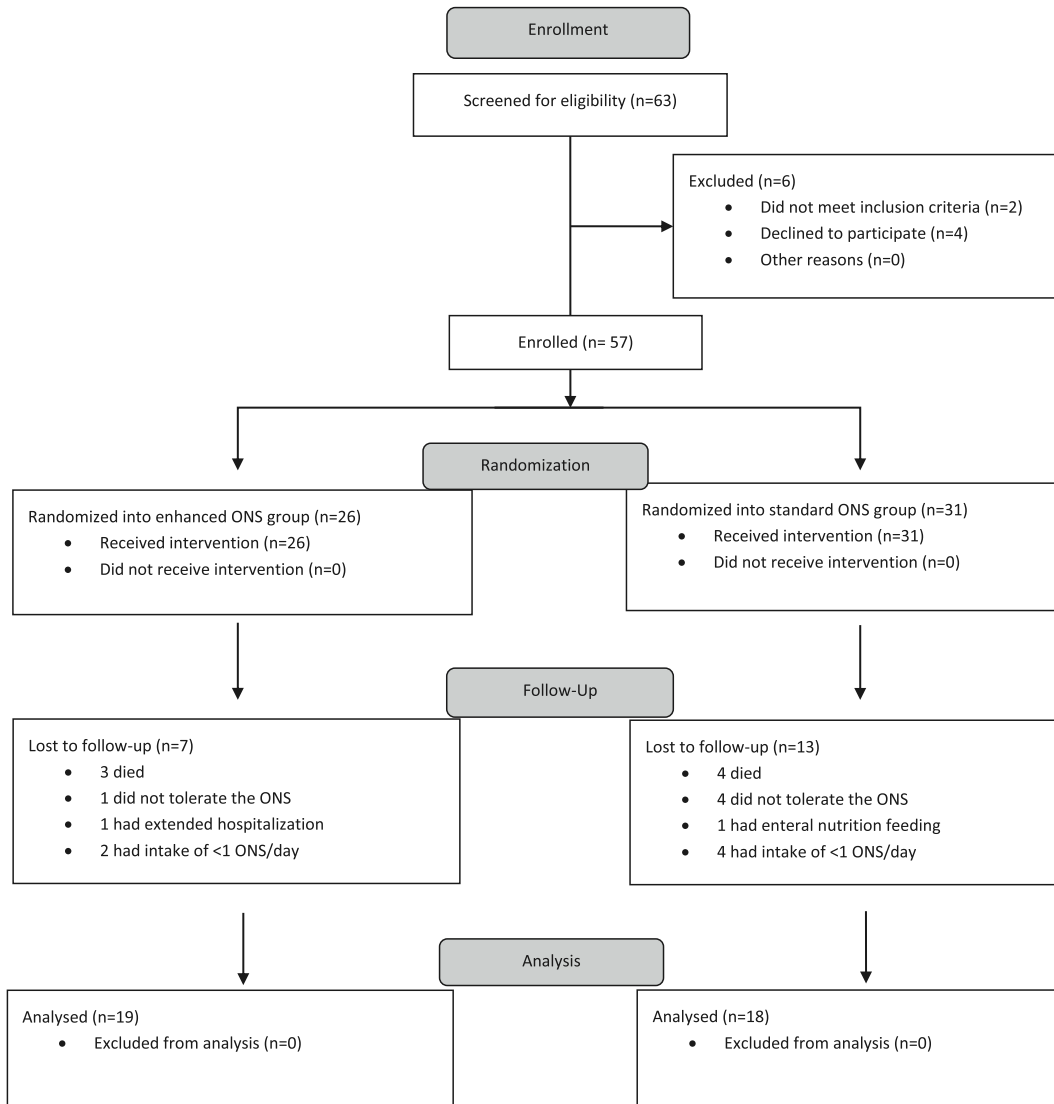


Fig. Flowchart of the trial design for a randomized controlled trial on nutritional supplement.

enhanced ONS group (n=26) compared to the standard ONS group (n=31). The primary outcome was the proportion of patients who died during the study. The secondary outcomes were the proportion of patients who were hospitalized, the proportion of patients who were discharged to home, and the proportion of patients who were discharged to a nursing home.

At the end of the study, the enhanced ONS group had a significantly higher proportion of patients who were discharged to home compared to the standard ONS group (p=0.03). The proportion of patients who were discharged to a nursing home was significantly higher in the standard ONS group (p=0.01). There were no significant differences between the two groups in terms of the proportion of patients who died during the study.

4. Discussion

Specific nutritional supplements, such as omega-3 fatty acids, may be beneficial for patients with advanced cancer. This study shows that the enhanced ONS group had a significantly higher proportion of patients who were discharged to home compared to the standard ONS group.

Multispecialty care is essential for patients with advanced cancer. The enhanced ONS group had a significantly higher proportion of patients who were discharged to home compared to the standard ONS group.

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Table
 Inid e a t r i c p t i n a r e d a e l m o g r a p h i a b l e s .

	Enhanced ONS (n=26)	Standard ONS (n=31)	p
Age (years (SD))	65.1 (8.2)	62.9 (12.1)	0.427
Sex (female)	1 (3.8%)	1 (3.2%)	0.805
Alcohol	3 (11%)	9 (29%)	0.107
Tobacco	3 (11%)	4 (12%)	0.876
Tumour type			0.144
Head and neck	1 (3.8%)	3 (9.7%)	
Upper gastrointestinal (oesophagus and stomach)	4 (15%)	4 (12%)	
Lower gastrointestinal (colorectal)	1 (3.8%)	8 (25%)	
Lung	4 (15%)	4 (12%)	
Gynaecological (ovary)	5 (19%)	2 (6%)	
Urological (prostate)			
Other (endocrine, lymphomas)			
Stage			0.665
I	0 (0%)	1 (2.2%)	
II	5 (19%)	4 (12%)	
III	5 (19%)	5 (16%)	
IV	1 (3.8%)	1 (3%)	
Extent			0.696
Invasion	4 (15%)	4 (12%)	
Metastasis	1 (3.8%)	2 (6%)	
Preventive surgery	1 (3.8%)	1 (3.2%)	
Active treatment	2 (7.7%)	3 (9.4%)	
Chemotherapy	1 (3.8%)	1 (3.2%)	
Radiotherapy	1 (3.8%)	0 (0%)	
Immunotherapy	4 (15%)	2 (6%)	
Combined	7 (26%)	1 (3.2%)	
Concomitant diseases			0.537
DM	3 (11%)	4 (12%)	
HT	1 (3.8%)	1 (3.2%)	
Dyslipidaemia	5 (19%)	7 (22%)	
COPD	2 (7.7%)	6 (19%)	
Gastrointestinal	3 (11%)	3 (9.4%)	
Thyroid disease	7 (26%)	4 (12%)	
Other diseases	1 (3.8%)	1 (3.2%)	

COPD: chronic obstructive pulmonary disease; HT: hypertension; DM: diabetes mellitus; HT: hypertension; DM: diabetes mellitus; HT: hypertension; DM: diabetes mellitus.

specific health care services in a patient who is severely malnourished. The enhanced ONS group was significantly more likely to be well nourished at baseline compared to the standard ONS group.

from the various branches of medicine. The enhanced ONS group was significantly more likely to be well nourished at baseline compared to the standard ONS group.

Regarding the impact of the intervention on the nutritional status of the patients, the enhanced ONS group was significantly more likely to be well nourished at baseline compared to the standard ONS group.

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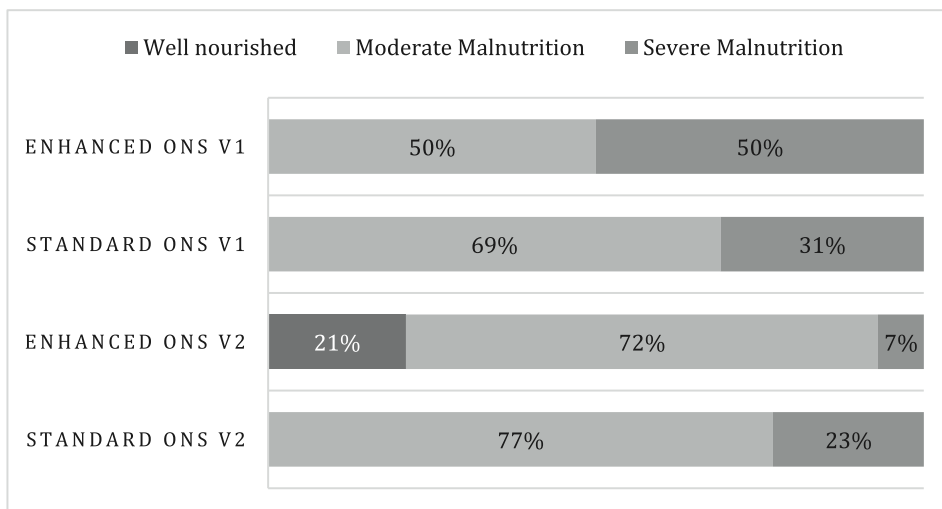


Figure 2. Evolution of nutritional status in the enhanced ONS group.

Table
Change in anthropometric characteristics in trial in both groups (mean ± standard deviation)] .

	Enhanced			Standard			p (between groups)
	V1	V2	Differences	V1	V2	Differences	
Usual weight (kg)	78. (21. 19)	-	-	76. (484. 56)	-	-	-
Weight in trousers (kg)	75. (158. 95)	-	-	73. (375. 13)	-	-	-
Weight (kg)	65. (126. 14)	6. (416. 47)	0. 32 (4. 01)	65. (73. 1)	65. (192. 2)	-0. 51 (2. 74)	0. 104
Weight loss (%)	-12. (96. 78)	-	-	10. (29. 61)	-	-	-
Height (cm)	1. (40. 08)	-	-	1. (40. 1)	-	-	-
BMI (kg/m ²)	23. (67. 49)	24. (15. 9)	0. 49 (1. 45)	23. (79. 86)	23. (93. 89)	0. 17 (1. 6)	0. 534
Middle circumference (cm)	25. (68. 76)	26. (54. 26)	0. 91 (2. 49)	26. (62. 11)	26. (73. 87)	0. 12 (2. 5)	0. 336
Triceps skinfold thickness	9. (48. 48)	9. (75. 44)	0. 31 (2. 59)	11. (03. 79)	11. (46. 07)	0. 41 (2. 58)	0. 603
Muscular hypertrophy	22. (65. 94)	23. (47. 26)	0. 81 (2. 55)	23. (13. 88)	23. (13. 58)	-0. 01 (1. 95)	0. 273
Waist circumference (cm)	91. (814. 55)	93. (514. 63)	0. 75 (2. 84)	87. (821. 05)	9. (62. 3)	1. 84 (9. 44)	0. 452
Calf circumference (cm)	32. (53. 9)	32. (73. 84)	0. 13 (2. 38)	31. (23. 91)	32. (13. 95)	0. 93 (3. 3)	0. 448
Dynamometer handgrip	24. (50. 09)	23. (68. 91)	-0. 88 (4. 77)	25. (791. 8)	25. (980. 73)	0. 19 (10. 21)	0. 220
Dynamometer handgrip	22. (5. 87)	21. (48. 92)	-1. (25. 56)	26. (20. 29)	26. (021. 53)	0. (7. 93)	0. 382

BMI: body mass index; ON: Omega-3 fatty acid supplement.

Table
Change in lipid profile characteristics in trial in both groups (mean ± standard deviation)] .

	Enhanced			Standard			p (between groups)
	V1	V2	Differences	V1	V2	Differences	
Resistins (ng/ml)	581. (3101)	562. (693. 48)	6. (661. 65)	59. (622. 15)	70. (4911. 56)	0. (750. 30)	1. 21
Reactins (ng/ml)	44. (94. 11)	48. (10. 23)	3. (25. 92)	49. (28. 87)	51. (850. 75)	2. (50. 9)	0. 410
Phasins (ng/ml)	4. (89. 17)	4. (60. 8)	-0. (20. 63)	5. (11. 04)	5. (33. 59)	0. (22. 03)	0. 185
Total cholesterol	35. (44. 95)	36. (18. 37)	0. (22. 96)	35. (48. 56)	35. (06. 31)	-0. (42. 95)	0. 190
Extracellular matrix	18. (23. 42)	19. (13. 13)	0. (911. 62)	17. (92. 97)	17. (22. 42)	-0. (72. 8)	0. 008
Intracellular matrix	17. (15. 44)	17. (03. 97)	-0. (12. 35)	17. (44. 57)	17. (55. 62)	0. (12. 62)	0. 735
Appendix cell count (sk g)	18. (67. 73)	20. (68. 23)	1. (92. 32)	20. (53. 72)	19. (9. 37)	-0. (48. 45)	0. 009
Leukocytes (sk g)	47. (99. 24)	48. (37. 78)	0. (35. 43)	48. (05. 03)	47. (83. 99)	-0. (23. 17)	0. 615
Fat cells (sk g)	17. (282. 71)	18. (474. 22)	1. (98. 44)	15. (20. 68)	15. (46. 7)	0. (12. 47)	0. 321
Appendix cell count (sk g)	16. (05. 4)	16. (35. 31)	0. (31. 27)	15. (69. 46)	15. (67. 5)	-0. (22. 11)	0. 438

*p < 0. 005.

ON: Omega-3 fatty acid supplement.

Table
Change in cholesterol characteristics in trial in both groups (mean ± standard deviation)] .

	Enhanced			Standard			p (between groups)
	V1	V2	Differences	V1	V2	Differences	
Total cholesterol (mg/dl)	189. (238. 89)	194. (046. 19)	4. (327. 07)	156. (4311. 49)	164. (7367. 6)	-0. (249. 13)	0. 719
Total protein (mg/dl)	6. (80. 4)	6. (94. 48)	0. (10. 46)	6. (75. 43)	6. (75. 49)	0 (0. 52)	0. 545
Albumin (mg/dl)	4. (20. 37)	4. (20. 39)	0. (00. 3)	4. (17 (0. 54)	4. (14. 36)	-0. (00. 48)	0. 433
Prealbumin (mg/dl)	22. (09. 33)	23. (52. 42)	1. (47. 85)	20. (56. 48)	21. (80. 62)	1. (14. 66)	0. 486
Retinol protein (mg/dl)	4. (52. 68)	5. (22. 55)	0. (71. 91)	3. (31. 45)	3. (511. 75)	0. (211. 07)	0. 428

ON: Omega-3 fatty acid supplement.

Last, this study found that the use of omega-3 fatty acid supplement can reduce the risk of cardiovascular disease.

As a result, the use of omega-3 fatty acid supplement is a promising

parameter for the composition of the diet, as shown in the

all-omega-3 fatty acid supplement trial.

The main conclusion of this study is that the use of omega-3 fatty acid supplement can reduce the risk of cardiovascular disease.

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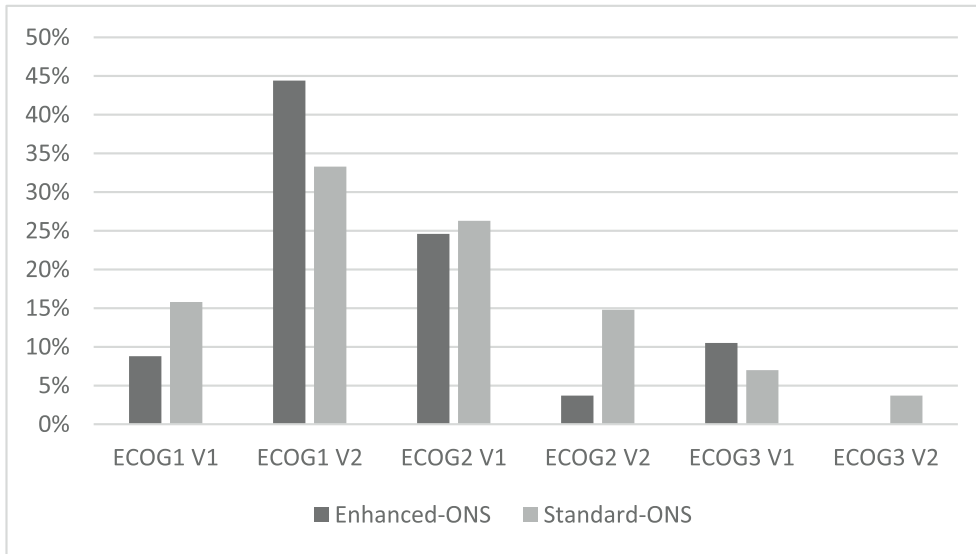


Fig. Changing functional components as a result of ErgoGoVON: Soya L-tri supplement.

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References:
 1. García-Pérez, R.; López, J.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.
 2. López, J.; García-Pérez, R.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.

3. López, J.; García-Pérez, R.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.
 4. López, J.; García-Pérez, R.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.

5. López, J.; García-Pérez, R.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.
 6. López, J.; García-Pérez, R.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.

7. López, J.; García-Pérez, R.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.
 8. López, J.; García-Pérez, R.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.

9. López, J.; García-Pérez, R.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.
 10. López, J.; García-Pérez, R.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.

11. López, J.; García-Pérez, R.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.
 12. López, J.; García-Pérez, R.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.

13. López, J.; García-Pérez, R.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.
 14. López, J.; García-Pérez, R.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.

15. López, J.; García-Pérez, R.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.
 16. López, J.; García-Pérez, R.; Martínez, J.; et al. (2018) Effect of L-tryptophan on the gut microbiota and its relationship with the immune system. *Journal of Functional Foods*, 41, 1-10.

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