

Designing a suit using Electro muscular stimulation Technology (EMS) to raise physical efficiency and improve vital functions

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Abstract

Recently, the use of electrical muscle stimulation (EMS) suits during exercise has become widespread, as they save time. As the trainee only needs to exercise for 20 minutes twice a week to train all the muscles of the body, instead of exercising for an hour daily. It is a sports suit embedded with a number of electrodes. The electrodes emit electrical pulses that help to stimulate the body's cells and muscles with less effort and in a shorter time, the trainer can increase or decrease the intensity of the pulses and determine the amount of electrical stimulation for the muscles he wants to target more, depending on the nature of the trainee's body. This study examined the design of electrical muscle stimulation suit, its use, and the results of training while wearing it to measure the effectiveness of the electrical stimulation suit as a type of smart and functional clothing. Then a lower-cost electrical muscle stimulation suit was designed and tested and its effect on the body was conducted after using it for 12 sessions, twice a week for 20 minutes. The results showed the effectiveness of this suit in reducing weight, decreasing fat percentage, controlling body measurements, and significantly improving muscle activity

Keywords

Smart Clothing, Effectiveness, EMS, Electrical Muscle Stimulation Suit, physical efficiency

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1- Introduction:

Despite the importance of sports and the health and psychological benefits it achieves from improving physical fitness and stimulating blood circulation, some people find it difficult to maintain a healthy lifestyle and do not have enough time to practice daily due to lack of time, work conditions, and many daily obligations, so they resort to surgical operations or follow a strict diet to get a perfect healthy body, it may be harmful and cause complications, diseases and serious health problems. Here comes the role of science, by employing smart clothing equipped with EMS technology or the electrical muscle stimulation suit, which is a sports suit with a number of electrodes integrated into it directed at the main muscle centers in the body, such as the chest, abdomen, upper and lower back, arms, feet and buttocks. It relies on electrical pulses that stimulate the body's muscle cells and requires only 20 minutes per week

Research Problem:

- The research problem can be formulated into the following questions.
- Is it possible to determine the functional performance characteristics of an EMS suit?
- What is the feasibility of designing an EMS suit?
- Is it possible to determine the optimal application of an EMS suit for weight loss, reducing body fat, improving physical fitness, enhancing muscle activity, and increasing muscle mass?
- Is it possible to determine the effectiveness of using an EMS suit in increasing physical efficiency and improving vital functions?

Research Objectives:

- To determine the functional performance characteristics of an (EMS) suit and design another one.
- To determine the optimal application of an (EMS) suit for weight loss, reducing body fat,

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improving physical fitness, enhancing muscle activity, and increasing muscle mass.

- To determine the effectiveness of using an (EMS) suit in increasing physical performance and quality of life.

Significance of the Research:

- This study developed a training program based on the use of applied (EMS) suit to enhance physical performance and quality of life.
- Contribute to laying the scientific foundation for the manufacture of the (EMS) suit in Egypt and the Arab world.
- Provide Arab libraries with a study on electronic clothing to enable them to keep pace with the tremendous scientific and technological advancements taking place worldwide in this field.
- Keep pace with scientific technologies in the sportswear industry as one of the applications of smart clothing.
- Provide researchers with the opportunity to conduct further applied studies on smart sportswear.

Research Limits:

- Subject Limits: This research is limited to studying the use of electrical muscle stimulation (EMS) suits to enhance physical performance and quality of life.

Research Methodology:

- Descriptive Method,
- Experimental Method

Research results:

- The results of using the applied EMS suit were almost the same results of using the EMS suit available at the gym centers

Theoretical frameworks

Electrical muscle stimulation (EMS) is a type of electrotherapy stimulates a muscle contraction using electrical impulses in order strengthen weak muscles, reduce swelling, relieve pain and help heal wounds.

usage of Electrical muscle stimulation (EMS)

There are several uses for EMS which include:

1- Pain relief:

EMS can be used at low levels to reduce the amount of pain you experience.

This can be done by modulating the amount of pain signals to the brain or releasing natural pain-killers called endorphins.

2- Muscle contraction:

EMS can be used at different intensities to stimulate a muscle or help maintain muscle tone.

1.2 Benefits of EMS

- Decreasing pain
- Promote tissue healing
- Increase muscle strength
- Maintaining and regaining muscle activity
- Treatment of neurological conditions such as Stroke, Multiple Sclerosis, and Cerebral Palsy to decrease spasticity and help maintain muscle strength for as long as possible.

Electrical muscle stimulation suit (EMS Suit):

EMS fitness suit is a wearable exercise technology that sends electrical pulses to the muscles during exercise.

The product is made of soft, breathable material and comes with a rechargeable battery.

The suit has a control box that regulates the intensity of the electrical pulses, ensuring that the trainer get a safe and adequate workout.

1.3 Components of an electrical muscle stimulation suit



Figure (1) The components of EMS suit

- Ems Fitness Clothes
- Power Control Box
- Charger
- User Manual
- Control App
- Electrodes

2. Experimental work

2.1 Ems suit study

EMS suit analysis includes Product design, number and location of electrode pads and device shape.

Three types of EMS smart clothing were selected and analyzed :

- whole body suits (WB)
- Shirt and pants (Sp)
- Pants (P)

2.1.1 Ems Fitness Clothes

The training vest is made of high-quality special materials such as spandex/cotton/silver fiber/silica gel, which is very fine and has a certain high resistance and comfort.

2.1.2 Electrodes

There are different types of electrodes.

- Superficial
- Internal needle or wire
- Flexible
- Implantable: Micro-metallic,

2.2 Ems suit usage

Training using the EMS suit is once a week, especially in Strength EMS exercises because the muscle fibers Need an average of 4 to 5 days to recover, and there are some cases in which the trainee is training twice a week, when The exercise is a Strength exercise session and the second session is Cardio.

2.3 Training programs using the electrical stimulation suit:

There are two training programs using the electrical stimulation suit:

1- The first is an intermittent program:

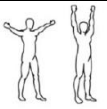
where the electrical pulses are sent for a minute then stop for four seconds so that the person performs sports movements while sending the electrical pulses then stops to rest for four seconds then completes another set of exercises and the duration of the pulses varies according to the person's endurance.

2- The second is a continuous program:

where the pulses are sent in a continuous and direct manner without stopping.

The strength of the pulses varies according to the program as they range from two to nine watts.

Table (1) Explanation of exercises on device

Item	Exercise	Device mode	Running time (Min)
1	 Dumbbell press	Strength	1
2	 Squat	Strength	1
3	 Crunch	Aerobic	1
4	 Jumping jack	Massage	1
5	 Rest	Massage	2

2.4 Designing EMS suit

2.4.1 EMS suit sketch

2.4.1.1 EMS suit sketch “Front view”



Figure (2) EMS suit sketch “Front view”

2.4.1.2 EMS suit sketch “Side view”:

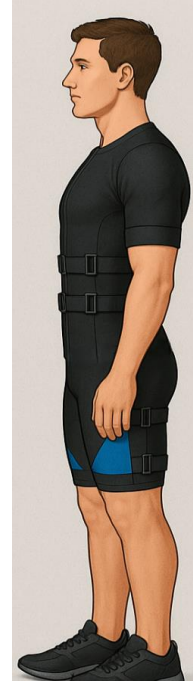


Figure (3) EMS suit sketch “Side view”

2.4.2 The applied EMS suit:

2.4.2.1:



Figure (4) The applied Ems suit shape from outside



Figure (5) The applied Ems suit shape from inside “Front side”



Figure (6) The applied Ems suit shape from inside “Back side”

The applied EMS suit photo shoot



Figure (7) The applied Ems suit photo shoot "Front view"

Table (2) The specifications of the Applied EMS suit

Item	WB
Type	Whole body suit (WB)
Closure type	Zipper
Neck line	Round
Sleeve shape	A separated sleeve installed during training
Size adjuster	Bands with buckles
Number of EMS pads	18 pads
EMS pad placement	Trapezius, Biceps, Deltoid, Pectoralis, Latissimus dorsi, Abdominal muscles, Lumborum, Gluteus, Femoral muscles
Device	Every way EMS device



2.5 The applied suit test

The measurements and specifications of the research sample trainee was determined then the "In Body" test was conducted to determine the measurement of body components, and External measurements of the trainee's body using a tape measure and The following table shows the trainee's internal and external body measurements before Training using an electrical stimulation suit.



Figure (8) The applied Ems suit photo shoot "Side view"

2.6 The specifications of the research sample trainee:

Table (3) The specifications of the research sample trainee

Gender	Female
Age	36 years
weight	88 kg

Table (4) The training program

The duration of the program	12 weeks
The number of training units per week	2 units
The time of the training unit	20 minutes

2.7 Training:

The duration of the program is 6 weeks, twice a week for 20 minutes a day. The electrical muscle stimulation suit was put on, and exercises were started warm up for 5 minutes, then exercise for 20 minutes, then 10 minutes at the end for muscle and body comfort. The applied study was conducted by comparing the results of body measurements "The external and internal components of the trainee before and after training" by Using an electrical muscle stimulation suit.

3- Results and discussion:

In this section, the results of the external and internal body measurements of the trainee will be presented and analyzed before and after exercise using the electrical muscle stimulation suit, and then the study results will be reached as follows:

3.1 First : Results of external measurements (In Body):

3.1.1 Arm circumference measurement:

Table (5) The Arm circumference measurement before and after using EMS suit

variable	Before using EMS suit	After using EMS suit
Right arm circumference	40.5 cm	38.25 cm
Left arm circumference	40.25 cm	38.75 cm

3.1.2 Thigh circumference measurement:

Table (6) The Thigh circumference measurement before and after using EMS suit

Variable	Before using EMS suit	After using EMS suit
Right thigh circumference	74.5 cm	67cm
Left thigh circumference	74.25	67.25 cm

3.1.3Chest, abdominal and pelvic circumferences

Table (7) The Chest, abdominal and pelvic circumference measurements before and after using EMS suit

variable	Before using EMS suit	After using EMS suit
Chest circumference	110 cm	101 cm
Abdominal circumference	106 cm	93 cm
Pelvic circumference	110 cm	102 cm

3.2 Second: Results of internal measurements (In Body):

3.2.1 Measuring fat percentage:

Table (8) The fat percentage before and after using EMS suit

Variable	Before using EMS suit	After using EMS suit
Full Body fat percentage	34.6 kg	20.5 kg
Percentage of fat in the upper limp	14 kg	9.8 kg
Percentage of fat in the lower limp	21.4 kg	14.6 kg

3.2.2 Measuring the percentage of water, muscle and protein:

Table (9) The water ratio , muscle and protein percentage before and after using EMS suit

Variable	Before using EMS suit	After using EMS suit
Water ratio	40.4 liter	34.4 liter
Muscle percentage	8.3 kg	9.8 kg
Protein percentage	10.5 kg	11.6 kg

3.2.3 Measuring weight and body mass index:

Table (10) The weight and body mass index before and after using EMS suit

variable	Before using EMS suit	After using EMS suit
Body weight	88 kg	74 kg
Muscle mass index	30.5 kg	37.7 kg

Conclusion

The results of this study can be concluded as follows:

- The EMS suit achieved the desired functional performance when used during exercise, burning calories more effectively, reducing weight, and achieving consistent body measurements in less time than usual.
- The applied EMS suit achieved the goal of saving money, as manufacturing the suit locally costs much less money than importing it from abroad.
- Manufacturing the EMS suit locally at a lower price than importing it from abroad could open the door to manufacturing it in large quantities, which could lead not only to limiting its import but also to exporting it.
- Exercising with the EMS suit helps to lose weight with less effort and in a shorter time than exercising without it.
- The suit can be used as a post-workout recovery tool for athletes because it increases blood flow in the body and thus sends the necessary nutrients to the muscles, helping to get rid of muscle inflammation.

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