DEVELOPMENT OF REHEATABLE THERMO JACKETS

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Abstract

Since the past two decades, there has been a constant increase in upper quadrant body pain among people of different age groups. Taking view of the effectiveness of heat therapy in curing pain, the present study was undertaken to develop reheatable thermo jackets using heating gel packs. A functional design consisting of pockets for insertion of gel packs in thermo jacket was created digitally. The jacket was developed using casement and PVC fabrics. Two jackets, one for male and female respectively were developed with variation in colours. To study the effectiveness of the developed jackets on the basis of functionality and cost, ten respondents suffering from upper quadrant pain were selected purposively and jacket was given to each one of them to use for five days. The results revealed that 60 percent male and 80 percent female respondents found the jacket to be extremely comfortable and relieved them off their pain even while at work. Majority of the respondents did not face any problem in heating and placing gel packs in the jacket and more than 60 percent of them were highly relieved from their pain and found the jackets to be functionally and cost effective. The jacket was highly appreciated by respondents as it proved to be a multi pain relaxer for them while the selected experts opined that jackets retained the heat of gel packs for a longer duration as compared to other commercially available substitutes.

Key words: Cost effective, functionality, rechargeable, thermo jackets, upper quadrant pain.

Introduction

In today's high-tech world, people are becoming so habitual of using different type of gadgets that they spend long hours in sitting in wrong postures or lying down and working on laptops, mobiles, tabs etc. This is accompanied by lack of exercise. This lethargic lifestyle has given rise to different types of upper quadrant pains like survical and spondylitis. These pains are related to the contraction of muscles and pressing of nerves. To cure such pains, thermotherapy is given in which heat is applied to the affected area. Many therapeutic devices are available in the market to apply heat like whirlpool bath, hot water bottles, gel packs,

ointments, infrared lamps etc. But, these therapeutic devices can only be used for shorter time periods while resting or in free slots leading to no or less work. So, need of developing a therapeutic reheatable garment was felt which could be used even while working and can apply heat simultaneously to many pain points for better and faster curing.

Objective of the study

To develop reheatable thermo jackets and study their effectiveness.

Methodology

a. Participants

Ten experts were selected randomly from Ludhiana city. These included five orthopedicians and five physiotherapists. Their expertise was taken through structured interviews and long interactions for understanding upper quadrant pain points for the construction of an appropriate design for thermo jacket. The designs were made digitally. For recording the effectiveness of thermo jackets, five male and five female respondents suffering from upper quadrant pains were selected purposively through snowball sampling technique.

Instruments

Heat gel was procured from Delhi and fabrics were procured from local markets in Ludhiana. The gel that was used was a mixture of propylene glycol and water. It also contained carbopol 940 as a thickening agent while few drops of fungistat methyl paraben was also an important constituent in the gel to avoid the growth of fungus. An interview schedule was made to collect data from the experts while an evaluation performa was designed to study the effectiveness of thermo jackets from the selected respondents.

b. Statistical Analysis

The data collected from the selected respondents through an evaluation performa was analyzed using graphs, pie diagrams and tables.

Results and Discussion

1. **Designing of thermo jacket**

There are few sensitive areas in upper human body where chances of pain existed to a maximum extent. These were identified after consultation with the experts. These were neck, shoulder, abdomen, back, waist etc. The material was selected purposively for thermo jackets according to their desirable comfort properties. For the inner side of the jacket, casement was selected due to its skin comforting property while PVC fabric was selected for outer layer as it is

good in heat retention. A functional design of jacket was developed using Corel Draw X4 as illustrated in Plate 1. It was designed with two vertical pockets in the center covering the area from the edge of collar till hem having the width similar to that of collar on back. Small horizontal pockets were given on each long side of the vertical pockets. All these pockets on back were fastened together using two concealed zippers. Also, the inner and outer fabrics on the shoulders were not attached creating a single pocket from front to back of the shoulders. The collar was not separated as it is included in the long vertical pockets on back.

Front Back

Plate 1 Design for thermo jacket

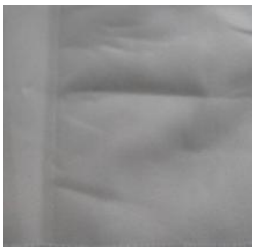
2. Development of thermo jackets

The selected material for thermo jacket was casement and PVC for inner and outer layer respectively. A visit was made to local market of Ludhiana and keeping in mind the ready availability of fabric and its aesthetic appeal, fabrics shown in Plate 2 and 3 were selected for the jackets.

PVC fabric: Navy Blue

Casement: Check

Plate2. Fabric for men's thermo jacket



PVC fabric: Cream **Casement:** Floral

Plate3. Fabric for women's thermo jacket

The heating gel was procured from wholesale market in Delhi and its packs were prepared using plastic envelopes in the Department of Apparel and Textile Science, PAU, Ludhiana. The jackets were constructed taking help from a local jacket manufacturing industry in Ludhiana city. The standard size of an adult male and female were used for construction of jackets. Plate 4 depicts the developed thermo jackets for the study.

Plate 4. Developed thermo jackets

3. Costing of thermo jacket

Cost play an important role in acceptability of any product, hence the costing of thermo jackets was done as shown in table 1.

Table 1. Cost of one thermo jacket

Material used	**Units used**	**Cost per unit (in Rs)**	**Total cost (in Rs)**
PVC Fabric	1.5 m	60	90
Casement	1.5 m	150	225

Plastic sheet	12 m	20	240
Gel packs	10 packs	180	1800
Stitching	1 jacket	1300	1300
Cost price of the thermo jacket			**3,655/-**
Profit (@30%)			**1095/-**
Selling price of a rechargeable thermo jacket			**4750/-**

4. Functioning of the developed thermo jacket

The gel packs were made according to individual size of each pocket and after heating gel packs in a microwave; they became hot and could be easily placed in the pockets for use. The chemical energy stored in the gel pack is released in the form of heat. The time duration of heat retention of gel packs inside the jacket is as below:

Table 2 Heat retention of gel packs after heating in a microwave of 9000 W

Heating time in a microwave (sec)	Heat Retention(min.)
60	85
50	70
40	60
30	45

The gel packs can be conveniently heated in a microwave and used in the jackets for obtaining warmth. Depending upon the wattage of microwave used in heating, the heating time may vary a little and can be standardized through preliminary trials. The gel packs were given reference number according to the tags provided in each pocket, so it was very easy to place them back after heating in their respective pockets. The gel pack once heated properly and put in the respective pockets provided warmth to the pain affected area for a long duration and thus patient feels relaxed.

Plate 5. Placing a heated gel in the jacket

5. Weight of developed thermo jacket

Weight is an essential aspect of the jacket as far as its use is concerned. So it was recorded with the help of a weighing machine.

Table 3 Weight of developed thermo jacket

Developed Jacket	**Weight (kg)**
Without any gel pack	0.43
With shoulder gel packs	1.03
With chest gel packs	1.22
With upper back and collar gel pack	1.03
With lower back gel pack	0.82
With upper back side gel packs	0.67
With all gel packs	3.9

It was observed that if the jacket was to be used as multi relaxant by placing all gel packs, it weighed 3.9 kilograms. But, when worn to treat any particular affected area then the weight gets reduced. Jacket with chest gel packs had the maximum weight (1.22 kg) followed by jacket with shoulder gel packs (1.03 kg) and upper back and collar gel pack (1.03 kg). The least weight of the jacket was found with the upper back side gel packs. The weight of the jacket with no gel pack was only 0.43 kg.

6. Effectiveness of developed thermo jacket

The selected respondents were given thermo jackets to use for five days after which its effectiveness was studied with the help of an evaluation sheet.

a. Comfort level of thermo jacket

The respondents were asked to grade the jacket on a four point scale on basis of its comfort.

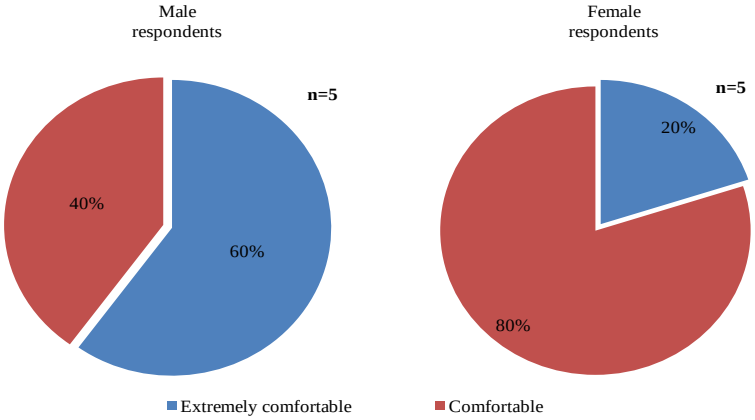


Fig.1. Comfort level of developed thermo jacket

Plate 6. A respondent wearing the thermo jacket

The results revealed that maximum of the male respondents (60%) were extremely comfortable wearing the jacket whereas maximum of the female respondents (80%) found the jacket to be comfortable.

b. Extent of bulkiness of thermo jacket

The main aspect of garment's comfort is its bulkiness. This is because if the garment is bulky, the wearer would find it difficult to carry on himself / herself. So, the respondents were asked

about the bulkiness of the jacket on a three point scale while donning and doffing and while using it.

Table 4 Extent of bulkiness of jacket while donning and doffing

Extent of bulkiness	**Male respondents (n=5)**	**Female respondents (n=5)**
Extremely bulky	1 (20)	2(40)
Bulky	3 (60)	3(60)
Not bulky	1 (20)	NIL

Figures in parentheses indicate percentages

Table 5 Extent of bulkiness of jacket while wearing

Extent of bulkiness	**Male respondents (n=5)**	**Female respondents (n=5)**
Bulky	NIL	1 (20)
Not bulky	5 (100)	4 (80)

Figures in parentheses indicate percentages

The data shows that maximum (60%) each of male and female respondents respectively found jacket to be bulky while donning and doffing while all the male respondents (100%) and maximum of the female respondents (80%) did not found jacket to be bulky while wearing.

c. Heating and placing gel packs inside the jacket

When the warmth of the gel packs decreased, they had to be taken out and again heated in a microwave and so the respondents were asked if handling of gel packs to remove and insert them again was easy for them or not.

Table 6 Heating and placing of gel packs

Handling of gel packs	**Male respondents (n=5)**	**Female respondents (n=5)**
Problem faced	Nil	1 (20)
Noproblem faced	5 (100)	4 (80)

Figures in parentheses indicate percentages

It is evident from the data that all male respondents (100%) and 80% of female respondents did not face any problem while heating and placing gel packs however 20% female respondents had problem in rearranging the gel packs into the jacket pockets. To solve this problem, the gel packs were labelled accordingly.

Plate 7. Respondent easily placing the heat gel in back pocket

d. Extent of relief felt by respondents on using thermo jacket

After using, the jackets the respondents were asked about the relief they felt and the results have been shown in table 7 on a three point scale.

Table 7 Extent of relief felt by respondents on using thermo jacket

Relief after treatment	Male respondents (n=5)	Female respondents (n=5)
Very much relieved	3 (60)	3 (60)
Somewhat relieved	2 (40)	1 (20)
Less relieved	NIL	1 (20)

Figures in parentheses indicate percentages

It was observed that maximum (60% each) of both male and female respondents felt very much relieved from their pain after using the thermo jacket.

e. Effectiveness of thermo jacket

The respondents were asked about the effectiveness of the thermo jacket on the basis of its functionality and cost. The results are presented in this section.

i. Functional effectiveness

The respondents were asked if the jackets provided to them were more effective than their previous treatment. All male and female respondents reported the jacket to be highly effective.

Table 8 Functional effectiveness of developed thermo jackets

Functional effectiveness of thermo jackets	Male respondents (n=5)	Female respondents (n=5)
Highly effective	4 (80)	3 (60)
Effective	1 (20)	2 (40)

Figures in parentheses indicate percentages

It was observed that according to 80 percent of male respondents and 60 percent of female respondents, the jacket was highly effective than their previous treatment.

ii. Cost effectiveness

To study the cost effectiveness of the jackets, the respondents were asked if they were willing to purchase it at the quoted selling price and whether jacket was cost effective or not. The results revealed that all male respondents were ready to purchase the jacket at the given price proving it to be cost effective and maximum of the female respondents (80%) were willing to buy it at given cost. Twenty percent of the female respondents considered cost of the jacket to be on a higher side and said that it was costly.

Table 9 Cost effectiveness of developed thermo jackets

Cost effectiveness of thermo jackets	Male respondents (n=5)	Female respondents (n=5)
Effective	5 (100)	4 (80)
Not effective	NIL	1(20)

Figures in parentheses indicate percentages

f. Preferred features in the thermo jacket

i. According to respondents

The respondents were provided with a list of features of thermo jacket and were asked to rank them according to their preferences from 1 to 5, where 5 was for the most preferred feature and 1 for the least preferred.

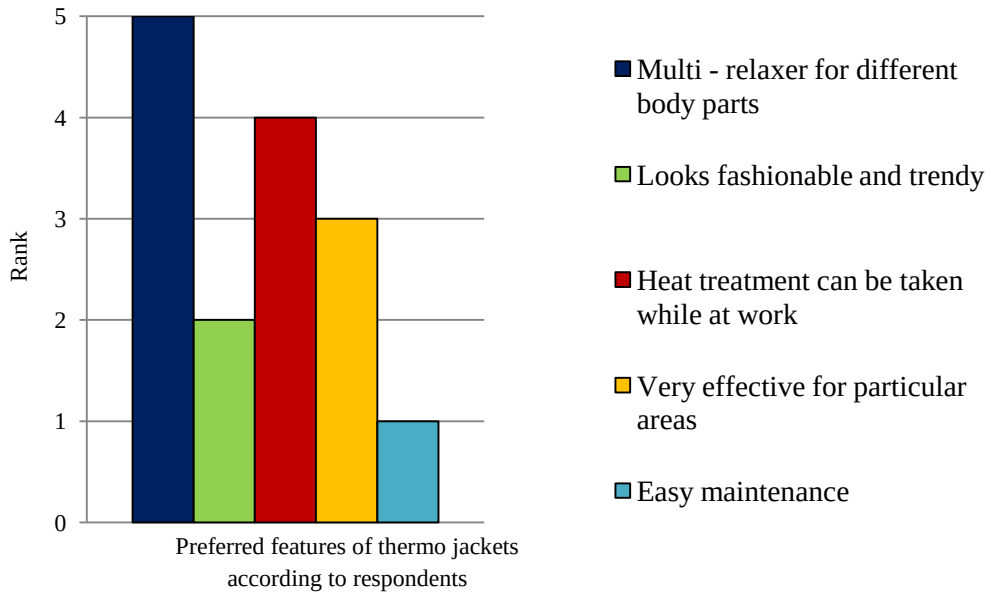


Fig. 2 Preferred features in the thermo jackets according to respondents

The results depict that the most preferred feature by the respondents was that the jacket worked as multi relaxer for different parts of body followed by convenience of taking heat treatment while working. The least preferred feature was ease in maintenance of the jacket.

ii. According to Experts

A similar ranking for the preferred features of thermo jacket was done by the experts also. The results are shown in figure 3.

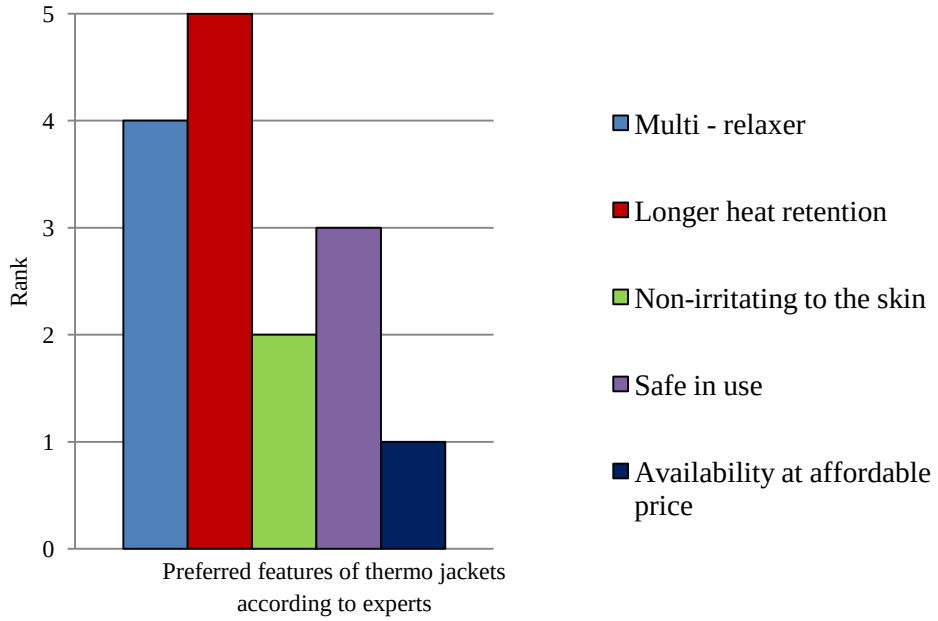


Fig. 3 Preferred features in the thermo jacket according to experts

It is evident that most of the experts preferred the feature of jacket providing heat for longer duration followed by it being beneficial for patients suffering from multiple upper quadrant pains. The least preferred feature was the availability of jackets at affordable price. The experts liked the thermo jackets to such an extent that they have started recommending it to their patients suffering from upper quadrant pains.

7. Conclusion

The developed reheatable thermo jackets were highly comfortable, relaxing and efficient in treatment for multiple upper quadrant pains as suggested by the selected respondents and the experts. Construction of reheatable thermo jackets can be taken up at commercial level to help people in getting rid of their upper quadrant pain and leading a comfortable life.

8. Research Limitations

- The developed jacket was to be given to each respondent to use for five days. So, keeping in mind the time available for data collection after development of the jackets, only 10 respondents were selected.
- The extent of relief by the patients suffering from multiple upper quadrant pains after the use of the developed jackets have been subjectively evaluated on the basis of pointers like very much relieved, somewhat relieved and less relieved. This is due to the absence of any known tool to measure the pain statistically.

9. Recommendations for future research:

As the developed reheatable thermo jacket was found to be highly effective for patients suffering from upper quadrant pains, similarly, research can be taken up in future for developing reheatable trousers for comforting patients who suffer from arthritis, lower leg pain, ankle pain, sciatica etc.

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