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A Study on Factors and Evaluation for the Ergonomic Design of Military Backpack

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ABSTRACT

A new design of shoulder straps and frame of backpack is proposed for reducing compression and fatigue of shoulder. The stress reduction effects of a backpack equipped with the newly designed shoulder straps and frame have been analyzed statistically through various experiments. We show that the newly designed shoulder straps(wider than the conventional ones) is superior to existing shoulder straps in respect of RPE, task performance measure and physiological measure. The new frame is also proven to be superior to existing frame in respect of RPE and task performance measure. In conclusion, the proposed shoulder straps and frame are shown to enhance the task performance of soldiers.

Keyword: Military backpack, Stress reduction, Shoulder straps, Frame

1.

1

가

1 80

/

가

2

8.5cm

/

7.5cm

가

*

:
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1.



2.

1.

가	(가 x x)
90	가
16in x 16in x 4in	2
14in x 15in x 8in	가 1
10in x 8in x 5in	

2. / 가

2.1 / 가

(Mitchell, et

al., 1970; Legg, et al., 1985; Knapik, et al., 1990; Herman, et al., 1992).

2.2 / /

/ () 가

, , , , ,

, 가

2가 (A , B)

. A 6.5cm 8.5cm 가 B

11cm (, A , B)

2cm

가 가

가 80

가

가 가

3,

4

2.3 /

가



3. , A , B



4. , /

RPE(Ratings Perceived Exertion:), 가, 가 .

3. / 가

3.1

. 2 1 가

가 . 2 1

/ 가 /

3.2

3.2.1 (Independent Variable)

3.2.2 (Dependent Variable)

_____ 가

가 / 가 . 1 가 RPE

20 , 6 가

2 2가 3 가

RPE (가

) 2가 40 가

_____ 가

tapping test . Tapping test 가

19.7kg

40 tapping 50 tapping 5

. 5 tapping tapping

test 50 tapping

_____ 가

가 가

가 40 Polar S-

810 .

3.2.3

1 , 8 2 20 12

3.2.4

_____ (3).

3, 4).
 19.7kg
 (electrocardiogram, ECG)
 S-810. Polar S-810 가
 () ()
Treadmill
 treadmill 24-72 Tierney
 , Polar S-810
 Polar Precision Performance SW 3 IR
 SAS

3.3
 3.3.1 1
 T- , +, -
 가 100
 Treadmill 40 treadmill tapping
 4km/h 5 50 tapping
 30 treadmill Tapping test가
 가 /
 RPE 가 RPE 가
 A B 30 RPE (1) 40
 가 RPE tapping test RPE
 가 가 40
 8 tapping test RPE 가
 RPE 가
 30 5
 12
 40
 5

4. /

4.1 1

4.1.1 1

1 8 RPE 가

A : B) F - 3가 (:
 (ANOVA) 5% .
 2 P - value가 0.003
 가 .

2. - A - B

ANOVA					
Data					
	Sum of squares	df	Mean square	F	Sig.
Between Groups	52.000	2	26.000	7.956	.003
Linear Term	25.000	1	25.000	7.650	.012
Deviation	27.000	1	27.000	8.262	.009
Within Groups	68.625	21	3.268		
Total	120.625	23			

가
 (Multiple comparison) , 3
 . 5% .
 GROUP 1 , GROUP 2 A,
 GROUP 3 B
 3 Tukey
 (A, B) 가 .
 A P - value 0.002 가
 , B P - value가 0.03
 . Scheffe .

4.1.2 1

RPE 가 A B
 가
 2cm

3. - A - B

Multiple Comparisons							
Dependent Variable: Data							
	(1) Group	(J) Group	Mean difference (I - J)	Std. Error	Sig.	95% Confidence interval	
						Lower Bound	Upper Bound
Tukey HSD	1	2	3.50 [*]	.904	.002	1.22	5.78
		3	2.50 [*]	.904	.030	.22	4.78
	2	1	-3.50 [*]	.904	.002	-5.78	-1.22
		3	-1.00	.904	.521	-3.28	1.28
	3	1	-2.50 [*]	.904	.030	-4.78	-.22
		2	1.00	.904	.521	-1.28	3.28
Scheffe	1	2	3.50 [*]	.904	.003	1.12	5.88
		3	2.50 [*]	.904	.038	.12	4.88
	2	1	-3.50 [*]	.904	.003	-5.88	-1.12
		3	-1.00	.904	.552	-3.38	1.38
	3	1	-2.50 [*]	.904	.038	-4.88	-.12
		2	1.00	.904	.552	-1.38	3.38

*The mean difference is significant at the 0.05 level

4. A - B

	T	P - value
A	9.38	1.60
B	10.38	1.92

A
 B (11cm)
 가
 가 A
 가
 B A
 가

4.2 2

4.2.1

5%

Tapping test

5 50 tapping score

5

5. - tapping score

			T	P - value
5 tapping	39.08	1.73	- 1.48	0.083
	39.42	2.19		
50 tapping	312.75	18.69	- 2.56	0.013
	324.42	14.70		

5 tapping 가 가 tapping 50 tapping 가 tapping 가

6 가 1 가

6. - 가

			T	P - value
	14.58	1.3114	10.83	0.000
	10.58	0.9962		

2가 7 (,) 가 가 5 tapping test 가 / 가

7. -

			T	P - value
HR (beats/min)	108.75	7.641	2.25	0.023
	103.75	9.026		
(kcal)	194.417	21.258	2.68	0.011
	179.667	32.388		

4.2.2

5%

Tapping test

5 /50 tapping score

8

8. - tapping score

Tapping score			T	P - value
5	39.08	1.73	- 1.30	0.110
	39.42	2.27		
50	312.75	18.69	- 3.46	0.003
	324.33	18.01		

5 tapping 가 50 tapping test 가 가

가 가 9

9. - 가

			T	P - value
	14.58	1.31	7.24	0.000
	12.50	0.90		

가 (,)

10

10. -

			T	P - value
HR (beats/min)	108.75	7.64	1.34	0.104
	105.83	6.79		
(kcal)	194.42	21.26	1.59	0.070
	182.83	38.66		

가 .

4.2.3 2

2

11.

가	Tapping test		가
	5	50	
x		x	x

(x: , : , :)

12.

가	tapping test		가
	5	50	
x		x	

(x: , : , :)

11 12 5 tapping
test tapping 가
(5 tapping test)
가 가

5.

/

가 . 1

가 . / 가 A
(: 8.5cm) B (: 11cm)

가
가 가 .

2
가, 가, 가 /
가 가 .

cm 2

가, 가
가

,
, / 가 (,
) 가 . 가

가
가

treadmill
가
EMG(electromyography) BPMS(body pressure measurement system)

7-10(), 1993.
Bessen, J., Belcher, W. and Franklin, J., "Rucksack Paralysis with and without rucksack frames", *Military Medicine*, 1987.
Cook, T. M. and Neumann, D. A., "The effect of load placement on the

- EMG activity of the low back muscles during load carrying by men and women", *Ergonomics*, 1987.
- Goslin, B. R. and Rorke, S. C., "The Perception of Exertion during Load Carriage", *Ergonomics*, 1986.
- Herman, E., Han, K. H., Frykman, P., Johnson, M., Russel, F. and Rosenstein, M., "The effects on gait timing, kinetics and muscle activity of various loads carried on the back", *Medicine and Science in Sports and Exercise*, 1992.
- Holewijn, M. and Lotens, W. A., "The Influence of Backpack Design on Physical Performance", *Ergonomics*, 1992.
- Knapik, J., Bahrke, M., Staab, J., Reynolds, K Vogel, J. and O'Connor, J. "Frequency of loaded road march", *US Army Research Institute of Environmental Medicine*, 1990.
- Knapik, J., Herman, E. and Reynolds, K., "Load carriage using packs: A review of physiological, biomechanical and medical aspects", *Applied Ergonomics*, 1996.
- Legg, S. J., "Comparison of Different Methods of Load Carriage", *Ergonomics*, 1985.
- Mitchell, A. V., Crawford, I. B. and Robberson, J. D., "Camp Counseling", 1970.
- Quesade, P. M., Melgelkoch, M. J., Hale, R. and Denniston, N., "Kinetic assessment of marching while wearing military style backpacks", *Gait & Posture*, 1996.
- Yu, Y. and Lu, S., "The Acceptable Load while Marching at a Speed of 5km/h for Young Chinese Males", *Ergonomics*, 1990.
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