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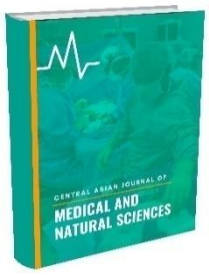

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Energy Costs and Energy Needs of Women in the Cotton Spinning and Weaving Industry

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Abstract: Literature data on the organization of rational nutrition for women in textile production is insufficient and contradictory (N.T. Todua; S.G. Yagodinskaya and N.I. Martynenko; I.I. Nikitchenko and S.A. Efanova; V.I. Smolyar and et al.; N.K. Babakhodzhaeva et al.; L.V. Sobakar et al.). In this regard, we pursued the goal of developing hygienic principles of energy adequacy of nutrition for female workers in cotton spinning and weaving production based on bioenergy research in the production and living conditions of a highly mechanized cotton mill. At the same time, the following tasks were set: to study the energy costs of female workers in the main workshops of cotton spinning and weaving production when performing regulated labor operations and processes; determine the total energy expenditure of female workers in the cotton spinning and weaving industry in certain periods of the day (sleep, work, activities outside of work) and per day in a cycle; to develop recommended values for the energy needs of women in the cotton spinning and weaving industry by groups of professions.

Research methods: The energy expenditure of women was studied using the Douglas-Holden gasometric method (N.K. Witte and N.M. Petrun). The study involved 66 practically healthy women from the main professions of spinning and weaving with work experience at this enterprise from 3 to 9 years. 182 regulated labor operations and processes were studied. Energy costs during non-working periods were determined using the time-table method (56 types of activities). The daily time budget (222 people) was determined using the method of interviewing and timing. Working conditions—microclimate, production noise, air dust, illumination—were studied using generally accepted methods in 10 main workshops of cotton spinning and weaving production: sorting-raking, carding, banding, spinning, winding, weft-rewinding, warping, sizing, weaving and goods sorting.

It was established that the air temperature in the main workshops of the spinning and weaving production was close to the norms of the microclimatic comfort zone, with the exception of the warping, sizing, weaving and grading shops, where it exceeded the maximum permissible parameters by 1.5-4.5 °C. Relative air humidity was 4.5-14% higher than normal in the weft-rewinding, warping and weaving shops. The air speed in all spinning and weaving workshops was in the range of 0.11-

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0.32 m/s. The average dust content in the air of the working area turned out to be 0.7-2.6 mg/m^3 higher than the permissible parameters in the sorting and raking, carbon monoxide, weaving and weft-rewinding shops. The illumination of workplaces in the studied production workshops, as a rule, was below recommended standards. Industrial noise is a constantly operating unfavorable factor in most spinning and weaving workshops. The highest noise parameters were recorded in the winding, spinning and weaving shops (5.9-14.9 dBA above the permissible limit). Only in the belt, sizing and product rejecting shops were noise levels within acceptable values.

Of the complex of production factors, energy metabolism can be most influenced by the temperature and humidity conditions of spinning and weaving production. Taking as a basis GOST 120.005-76 "Air of the working area. General sanitary and hygienic requirements and taking into account the recommendations of the FAO/WHO International Expert Group on "Energy and Protein Requirements" (1974), as well as the views of Soviet scientists on the classification of the severity of work for women (A.O. Navakatikyan and co.), when assessing the degree the severity of labor operations and processes, we used the following classification of work intensity: 1st group - energy costs up to 1.5 kcal/kg.h (very light work), 2nd from 1.5 to 2.5 kcal/kg.h (light work), 3rd - from 2, 5 to 3.5 kcal/kg.h (moderate work), 4th - from 3.5 to 4.5 kcal/kg.h (work above average), 5th - from 4.5 to 5 .5 kcal/kg.h (hard work), 6th group - energy costs 5.5 kcal/kg.h and more (very hard work).

It has been established that almost all women in the studied professions alternate between types of activities of varying severity throughout the work shift (Table 1)

From Table 1 it is clear that mixers perform only the work of the 2nd and 3rd groups. The work activity of scooping machine operators is characterized by varying degrees of work severity - from very light to heavy. In terms of time, labor operations and processes of average and above average severity predominate. The energy costs of fume developers do not go beyond the average level, since they mainly perform light work. The production activities of ventilation filter cleaners are dominated by medium-heavy work. Working on carding machines requires a lot of energy and is classified as work of more than average difficulty, while individual work operations are classified as heavy.

Table 1. Professional and energy structure of regulated types of activities of women in the spinning and weaving industry, as a percentage of working time

Profession	Labor severity group					
	1st	2nd	3rd	4th	5th	6th
Spinning production						
Displacers:						
Feeder-mixer with automatic loading of bales (AKP-3)	- 69,3	30,7	-	-	-	
Feeder-mixer with manual loading of cotton (P-1)	-	100,0	-	-	-	-
Rippers of frenzy	16,1	15,8	27,4	27,4	13,3	-
Developers of fumes	-	78,7	21,3	-	-	-
Ventilation filter cleaners	-	-	78,0	22,0	-	-
carders	-	-	-	92,6	7,4	-
ribbon girls	-	-	100,0	-	-	-
rovings	-	3,0	89,8	7,2	-	-
renters	-	-	71,7	28,3	-	-
Spinners:						
Ring spinning machine P-66-5M	-	36,3	33,0	-	30,7	-
Spinning and twisting machine ST-100M	-	26,7	46,4	26,9	-	-

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Spinners-pullers:						
Ring spinning machine P-66-5M	-	-	40,6	59,4	-	-
Spinning and twisting machine ST-100M	-	-	-60,0	20,0	9,1	10,7
Weaving production						
Winders:						
Winding machine M-50-2 without mobile chair	-	58,0	42,0	-	-	-
Winding machine M-150-2 with a mobile chair	-	18,7	81,3	-	-	-
Main-winding automatic machine "Autosuk" (Czechoslovakia)	-	7,2	92,8	-	-	-
Winders:						
Weft-winding automatic machine WA-300-3M	-	64,3	27,2	8,5	-	-
warpers	-	27,6	72,4	-	-	-
Sizing workers	11,3	48,9	30,4	9,4	-	-
Knotters:						
younger	-	-	75,0	12,2	-	12,8
older	-	70,0	30,0	-	-	-
Weavers	-	19,2	76,5	4,3	-	-
shearers	-	6,7	58,9	34,6	-	-
controllers	-	96,1	3,9	-	-	-

Throughout the entire shift, tape workers perform only moderately heavy work. In contrast, the work performed by roving workers is, in most cases, light and above moderate. Tenants, as well as cleaners, carders and rovers, spend the bulk of their work shift doing moderately heavy work. Spinners engage in types of work ranging from light to heavy. When working on a spinning-twisting machine, energy costs are lower than with classic ring spinning. For spinners-pullers, the energy cost of working operations is generally higher and belongs to the 3rd and 4th groups; when servicing a spinning-twisting machine, up to 20% of the time is spent on performing heavy and very heavy working operations.

The professional and energy structure of the activities of the weaving industry has some differences from those of the spinning industry. The energy structure of labor operations and processes among women in the studied weaving professions is more homogeneous. As a rule, female workers of all studied professions are busy performing work of groups 2, 3 and 4. Only for junior knotters the work also involves performing very difficult operations (6th group). Sizers spend about 10% of their working time doing very light work.

The labor operations and processes performed by workers in the spinning and weaving industry are considered to be of moderate severity in 51.1% of cases (Table 2). Light and above moderate severity are 28.0 and 15.4% of all work performed, respectively. Only 1.1% of the output of work activity is classified as very light and very heavy work. The specific amount of work with energy costs of more than 3.5 kcal/kg.h is higher in the spinning industry than in the weaving industry.

The total energy costs of women of the main professional groups of spinning and weaving production during working hours (8 hours) fluctuate in the range of 918-1819 kcal per 60 kg b (1.91-3.03 kcal/kg.h), during non-working hours (16 hours) average 1438 kcal per 60 kg (1.49 kcal/kg.h).

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Table 2. The share of labor operations and processes of varying severity in cotton spinning and weaving production, % of the total number of types of work studied

Production	Labor severity group					
	1st	2nd	3rd	4th	5th	6th
Spinning weaving	1,0(1) 1,2(1)	16,3(16) 41,7(35)	52,2(52) 48,8(41)	22,4 (22) 7,1(6)	6,1(6) -	1,0(1) 1,2(1)
Total	1,1(2)	28,0(51)	51,1(93)	15,4(28)	3,3(6)	1,1(2)

Note. In brackets is the number of operations and processes

Based on the determination of energy costs in certain periods of the day (sleep, work, activities outside of work), the daily energy requirement of women of various spinning and weaving professions was calculated. The total daily energy expenditure of the studied biosocial population of women, depending on the nature of the work performed, ranges from 2356-3277 kcal. According to the energy nutritional needs, women in the spinning and weaving industry belong to groups I-III of professions (with an interval of 400 kcal; Table 3). A longer interval is not justified. A systematic imbalance in energy metabolism of more than 200 kcal in one direction or another from the norm relatively quickly negatively affects the energy status of the body, especially with little physical activity (V.D. Vanhanen et al.).

Table 3. The daily energy requirement of women in the spinning and weaving industry, depending on daily energy costs

Group of professions	Profession	Daily energy requirement	
		Kcal per 1 kg	Kcal per 60 kg
1st group - very easy and easy work	Fiber mixer on an automatic feeder (APK-3), fiber mixer on a manual feeder (P-1), waste developer, controller	35-42	2100-2500
2nd group - work of average and above average difficulty	Ventilation filter cleaner, ribbon weaver, roving weaver, doffer, spinner on the PK-100 M spinning-twisting machine, spinner-doffer on the P-66-5M ring spinning machine, winder on the M-50-2 winding machine without a movable chair, winder on the winder machine M-150-2 with a mobile chair, a winder on a warp-winding machine "Autosuuk", a winder on a weft-winding machine UA-300-3M, a warper, a sizing worker, a senior knotter, a weaver, a shearer	42-48	2500-2900
3rd group - hard work	Tretter, carder, spinner on the ring spinning machine P-66-5M, spinner-docker on the spinning-twisting machine PK-100M, junior knotter	48-55	2900-3300

Table 3 shows that most of the professions of women working in spinning and weaving (15 out of 24 professions studied) in terms of energy needs belong to group 2 (work of average and above average difficulty).

Conclusions:

1. A study of the professional and energy structure of regulated types of activities showed that the labor operations and processes performed by women spinning and weaving workers, in terms of

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severity, in 51.1% of cases are classified as work of medium severity; light and above moderate severity are 28.0 and 15.4% of all work performed, respectively; Only 1.1% of types of work activity are classified as very light and very heavy. The share of work with energy costs of more than 3.5 kcal/kg.h is higher in the spinning industry (29.5%) than in the weaving industry (19.8%).

2. The total energy costs of women of the main professional groups of spinning and weaving production during working hours (8 hours) fluctuate in the range of 918-1819 kcal per 60 kg, during non-working hours (16 hours) they average 1438 kcal per 60 kg.
3. Based on daily energy nutritional needs, female spinning and weaving workers are divided into 3 groups of professions (with an interval of 400 kcal).
4. The results of the study can be used in determining the nutritional needs of women textile workers (daily energy costs) and planning priority measures for mechanization and automation of the most difficult types of work (energy costs when performing regulated labor operations and processes).

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