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RAW MATERIAL SELECTION FOR CHILDREN'S KNITWEAR: SIGNIFICANCE AND STRUCTURE OF TEXTILE RAW MATERIALS

Yerzhanova Dilaram Zhalgasbaevna

Doctoral student at Bukhara State Technological University

E-mail: erjanov@internet.ru

Karimova Nelufar Khomid kizi

Doctoral student at Bukhara State Technological University

Mukhtarova Zilola Nusratovna

Doctoral student at Bukhara State Technological University

zilolamuxtorova13@gmail.com

Abstract: Children's knitwear stays in close contact with skin that is thinner and more reactive than adult skin, so the choice of raw material is probably the most important decision in the whole production chain. This article looks at how textile raw materials for children's knitted products are structured (fibre, yarn, knitted fabric) and how they can be chosen in a systematic way. We compared the common fibres using data from the literature and from test standards, and ranked seven candidate materials with a weighted scoring model built on six criteria. Combed cotton, organic cotton and modal gave the best results for garments worn next to the skin, while cotton with 3–5 % elastane or with polyester makes sense for active wear. Pure synthetic fibres and fine wool ranked lowest for infants. Practical advice for manufacturers is given at the end.

Keywords: children's knitwear; textile raw materials; fibre selection; yarn structure; knitted fabric; skin comfort; product safety.

Introduction and literature review

Babies are not small adults, and their clothes should not be treated as scaled-down adult clothes. Studies of infant skin show a thinner stratum corneum, higher water loss and a barrier that keeps maturing during the first years of life [7, 8]. Rough fibres, dye residues and trapped sweat therefore cause problems much more easily. Children also wear the same garment for many hours, often while sleeping.

Clothing comfort is usually divided into thermophysiological, sensorial and movement comfort [4, 5], and the raw material influences all three. Knitted structures dominate children's wear (bodysuits, T-shirts, pyjamas, leggings) because the loops give stretch, softness and good air permeability [3]. The price for this is a tendency towards shrinkage, spirality and pilling when fibre, yarn and structure are badly matched [3, 6].

Textile raw materials are grouped into natural fibres (cotton, flax, wool, silk) and man-made fibres, which are either regenerated cellulosic (viscose, modal, lyocell) or synthetic (polyester, polyamide, elastane) [1, 2]. Cotton is still the reference for children's knitwear, but blends are very common because they



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improve stretch recovery, wear resistance and price. Sustainability adds one more angle to the choice [9].

Regulation matters as well. REACH restricts azo dyes that can release certain aromatic amines [10], the “baby articles” class of OEKO-TEX® STANDARD 100 sets the strictest limits for formaldehyde and pH [11], TR CU 007/2011 covers products for children in the Eurasian region [12], and EN 14682 deals with cords and drawstrings [13]. These points have to be checked when the raw material is bought, because a problem in the fibre, dye or finish cannot be repaired in the finished garment.

Fibre properties and knitting technology are described well in separate sources, but practical guidance that links them to the age of the child and the end-use of the garment is hard to find. The aim of this article is to describe the structure of raw materials for children's knitwear, compare the main options on standard criteria and suggest a simple selection model.

Materials and methods

The work is a comparative analytical study in three steps. First, textbooks, studies on infant skin and safety documents [1–8, 10–13] were reviewed, and typical property values of fibres and knitted fabrics were collected at 20 °C and 65 % relative humidity. Second, the raw material of a knitted garment was split into three levels: fibre (chemical nature, fineness, moisture regain), yarn (spinning system, linear density in tex, twist, hairiness) and knitted fabric (structure, stitch density, mass per unit area). For each level we listed the indicators and test methods that matter most: pilling, abrasion, dimensional change, colour fastness, air permeability and pH of the aqueous extract [14].

Third, seven raw materials for single-jersey fabric of 140–180 g/m² were scored from 1 (unfavourable) to 5 (very favourable) on six criteria: C1 skin safety and chemical cleanliness, C2 comfort, C3 durability, C4 dimensional stability, C5 care and colour behaviour, C6 cost and availability. The weights were set for an infant garment worn next to the skin: 0.30, 0.25, 0.15, 0.10, 0.10 and 0.10. The integral index was calculated as $I = \sum(w_i \times s_i)$. The scores are expert estimates based on published typical values. They show how the method works and do not replace laboratory tests of a particular fabric lot.

1. Structure of the raw material

The quality of a children's knitted garment comes from a chain of linked decisions (Figure 1). At fibre level, the chemical nature sets hygroscopicity, static behaviour and dye affinity. At yarn level, the spinning system and twist decide softness, hairiness and pilling: combed ring-spun yarn has fewer short fibres, so it is smoother and stronger than carded yarn. Yarns for children's single jersey usually fall between 15 and 20 tex (about Ne 30/1–40/1, since $\text{tex} = 590.5/\text{Ne}$) with a lower twist than weaving yarn, which keeps the fabric soft and stretchy. At fabric level, the structure and stitch density control stretch, thickness, warmth and shape stability.

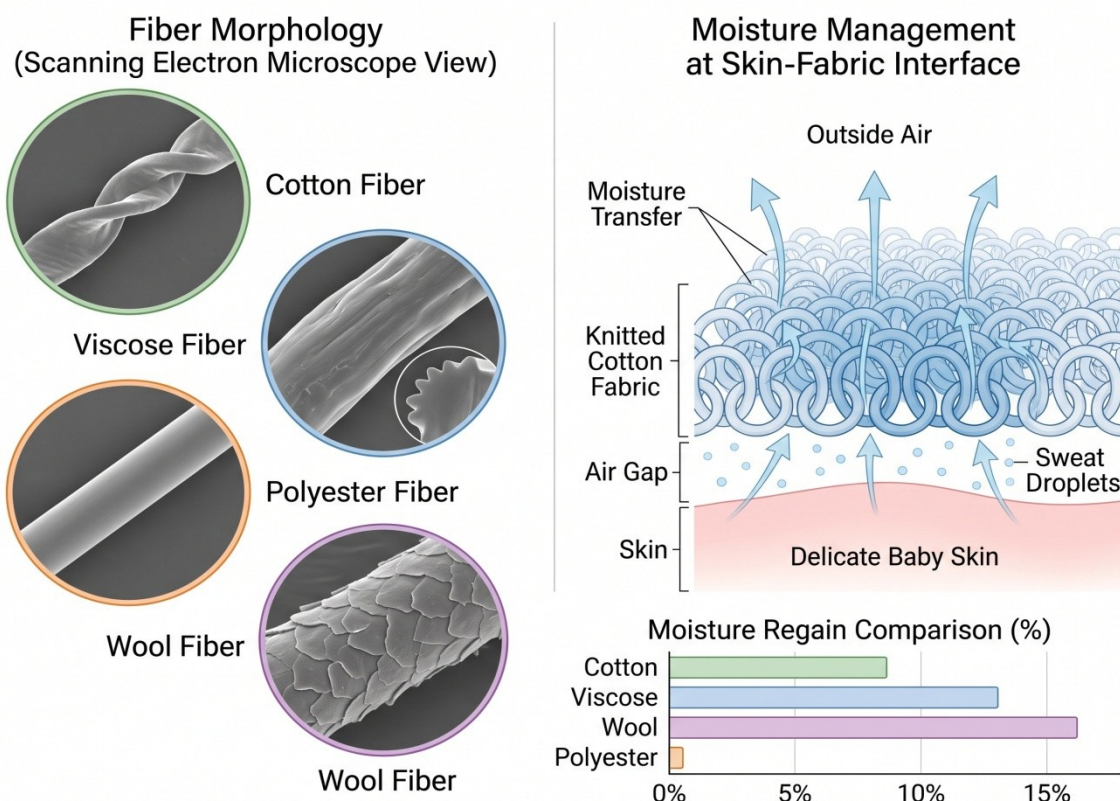


Figure 1. Structure of raw materials for children's knitwear: fibre – yarn – knitted fabric – garment

2. Fibres and knit structures

The fibres differ most in moisture regain, which decides how well sweat is absorbed and how dry the microclimate next to the skin stays (Table 1, Figure 2). Cotton and the regenerated cellulosic fibres combine high regain with softness and low irritation. Synthetics move moisture only by wicking, so they are useful in blends but weak as the only fibre in infant underwear and sleepwear. Fine merino wool regulates temperature well, but prickle, felting and care remain problems.

Properties of fibres for children's knitwear (typical values, 20 °C, 65 % RH)

Table 1.

Fibre	Moisture regain, %	Advantages	Limitations
Cotton	≈ 8.5	Soft, hydrophilic, low irritation	Shrinkage, wrinkling
Viscose	≈ 11–13	Very soft, absorbent	Low wet strength
Modal / Lyocell	≈ 11–13	Smooth, strong when wet	Higher price
Wool (merino)	≈ 13–16	Warm, elastic	Prickle, felting
Polyester	≈ 0.4	Strong, quick-drying	Low absorbency
Elastane	< 1	Stretch recovery	Only 3–5 % share

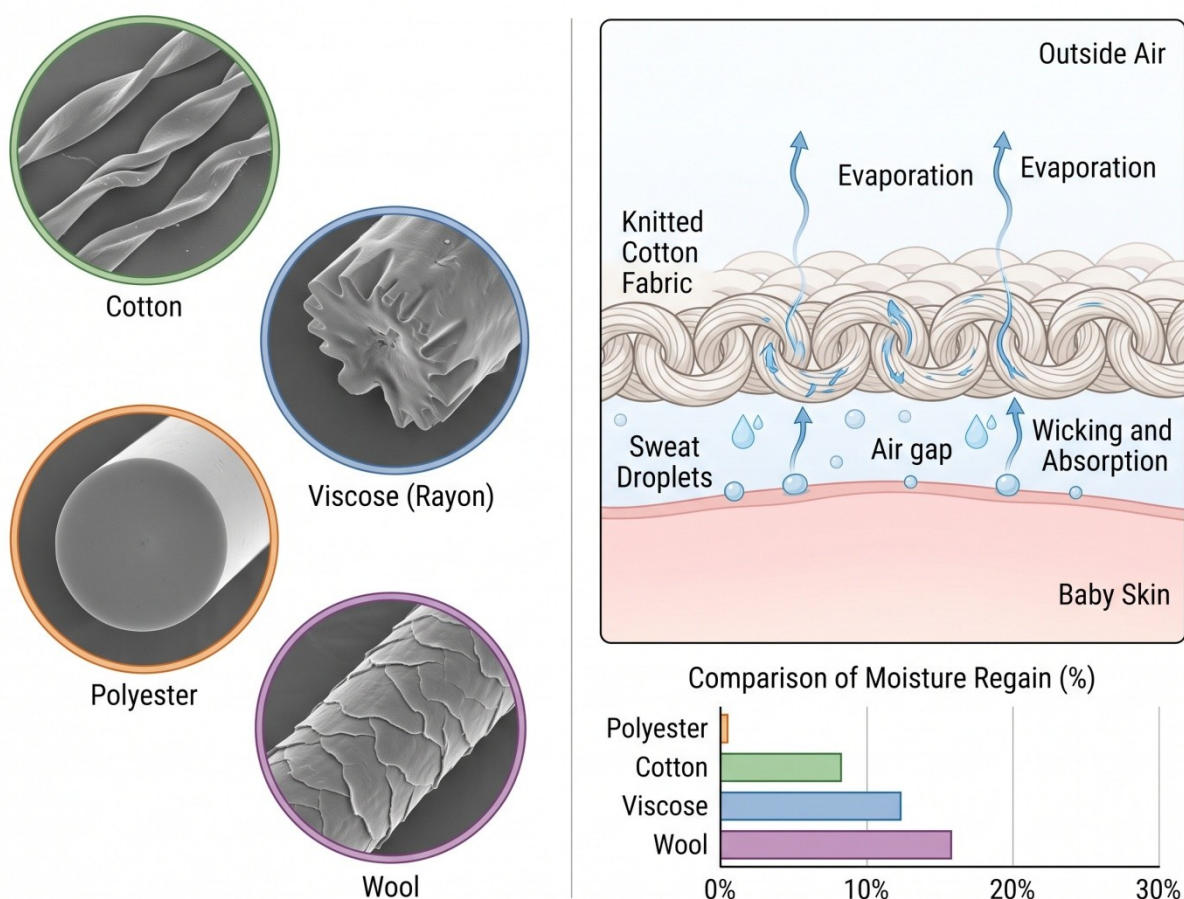


Figure 2. Fibre morphology and moisture transport at the skin–fabric interface

Knit structure changes the behaviour even when fibre and yarn stay the same (Table 2). Single jersey is light and cheap but curls and twists more easily, 1×1 rib stretches well sideways, and interlock is thicker and more stable, which is why it is common in sleepsuits. Brushed fleece is warm but needs yarns that resist pilling.

Knitted structures and their use

Table 2.

Structure	Mass, g/m ²	Recommended use
Single jersey	120–180	Bodysuits, T-shirts, summer wear
1×1 rib	180–240	Underwear, neckbands, cuffs
Interlock	200–260	Sleepsuits, pyjamas, baby sets
Brushed fleece	250–350	Sweatshirts, winter wear

3. Weighted evaluation

Combed cotton scored highest ($I = 4.30$), followed by organic cotton (4.20), modal (4.10) and cotton with 5 % elastane (4.00) (Table 3). The cotton/polyester blend (3.95) stays competitive thanks to stability, easy care and low cost, but it loses points for comfort. Polyester (3.65) and merino (3.25) came last for an infant garment. The ranking depends on end-use: for active preschool wear, durability and stability deserve more weight, and this moves the elastane and polyester blends up.

Weighted scores (scale 1–5; weights C1 0.30, C2 0.25, C3 0.15, C4 0.10, C5 0.10, C6 0.10)

Table 3.

Raw material	C1	C2	C3	C4	C5	C6	Index I
Combed cotton	5	5	3	3	4	4	4.30
Organic cotton	5	5	3	3	4	3	4.20
Modal	5	5	3	3	3	3	4.10
Cotton / elastane 95/5	4	4	4	4	4	4	4.00
Cotton / polyester	4	3	4	4	5	5	3.95
Polyester	3	2	5	5	5	5	3.65
Merino wool	4	4	3	2	2	2	3.25

Conclusions and recommendations

1. Raw material choice is a primary safety and quality decision, because it fixes skin compatibility, comfort and durability before design or sewing starts.

2. The material should be judged as a chain of fibre, yarn and fabric, not by fibre composition alone. For the youngest children, combed ring-spun yarn of about 15–20 tex with moderate twist is recommended for single jersey and interlock.

3. For newborns and infants (0–12 months), combed or organic cotton and modal are preferred. For toddlers, a small elastane share (3–5 %) or a cotton/polyester blend improves shape retention. For preschool children, durability and colour fastness gain weight, but layers touching the skin should stay cellulosic.

4. Pure synthetics and fine wool should not be the only component of underwear and sleepwear for infants.

5. Suppliers should provide certificates (OEKO-TEX® STANDARD 100 class I or equivalent, REACH compliance), and every lot should be checked for pH, colour fastness, shrinkage and pilling. Future work should replace the expert scores with measured data.

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