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Determining Effects of Superfine Sheep wool in INfantile Eczema (DESSINE): a randomized paediatric cross over study

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What's already known about this topic?

- There are few published reports of the effects of wool on atopic dermatitis, and these papers date back the to the 1950s when reporting did not meet current standards. Since then, improvements in specification of wool fibre diameter and in wool processing have enabled production of less irritant clothing, which is also less contaminated by allergens.
- There is up to now little available clinical evidence for adverse or beneficial effects of superfine wool.

What does this study add?

- This study challenges generalizations that wool is to be avoided by children with eczema.
- It is the first original clinical study examining the clinical effects of superfine merino wool on (childhood) atopic dermatitis and highlights the need for further studies on the effects of clothing and of the microenvironment between clothing and the skin on atopic dermatitis.

Abstract

Introduction

Despite limited evidence, woollen clothing has traditionally been considered to be an irritant that should be avoided by individuals with atopic dermatitis (AD). Wool fibres come in a range of diameters, and have beneficial thermodynamic and moisture transport properties. This study examines the effects of superfine merino wool on symptoms in participants with mild-moderate AD.

Methods

The trial was a 12-week randomized assessor-blinded cross-over prospective cohort study of 39 patients aged 4 weeks to 3 years with mild-moderate AD, comparing superfine merino wool ensembles with standard cotton clothing chosen by parents. Participants were assigned to wool or cotton clothing and assessed 3 weekly for 6 weeks, before crossing over to wear the other clothing material for a further 6-week period, with similar 3 weekly reviews. The primary endpoint was the SCORing Atopic Dermatitis index (SCORAD) after each 6-week period, with Atopic Dermatitis Severity Index (ADSI), Infant's Dermatitis Quality Of Life index (IDQOL) and topical steroid use as secondary endpoints to measure AD severity and quality of life.

Results

Overall, compared with baseline, superfine wool ensembles were associated with a reduction in mean SCORAD of 2.5 (95%CI=-4.7,-0.4) at 3 weeks and 7.6 (95%CI= -10.4,-4.8) at 6 weeks when compared to the cotton ensembles. A similar change was observed in ADSI and IDQOL scores for the same period. Body steroid use was also reduced. Conversely, changing ensembles from wool to cotton resulted in an increase in scores.

Conclusion

Superfine merino wool may assist in the management of childhood atopic dermatitis. (Clinicaltrials.gov Identifier:NCT02534428).

INTRODUCTION

Background

Atopic dermatitis (AD) is a chronic relapsing, pruritic skin condition usually presenting early in childhood.[1] AD affects around 30% of children. Its prevalence varies geographically and is increasing in many countries.[2,3,4] Itch, sleeplessness, behavioural change and effects on activities of daily living contribute to disease burden. AD severity correlates inversely with quality of life. The familial impact of moderate and severe AD has been shown to exceed that of diabetes.[5,6]

Genetic, inflammatory, microbial and environmental factors contribute to the skin barrier defect in AD, which predisposes to allergen sensitization. AD is potentially the first step of the 'atopic march', leading to asthma and allergic rhinitis.[7,8] Given the prevalence, burden, and complications of AD, minimizing adverse environmental triggers could greatly benefit individuals, families, and healthcare systems.[9] Management is complex: irritant and allergen identification and avoidance, moisturisers, anti-inflammatories, bleach baths, antibiotics, wet dressings and sometimes systemic immunosuppression. Poor compliance, due to costs, time constraints and fear, complicates treatment. Better strategies for primary and secondary prevention are required.

Triggers for AD include heat, irritants and adverse climate.[10, 11] Few studies have examined effects of clothing in AD. Patients are advised to avoid woollen clothing, as early commentaries indiscriminately described wool as 'spiky', overheating and irritant; these papers failed to distinguish between fibre types.[12,13,14] Rajka and Hanifin included 'wool' intolerance in their AD diagnostic criteria.[15] 39% of UK schoolchildren with AD believe that 'wool' exacerbates AD.[16] However, wool fibres vary in thickness. Improved fibre diameter specification and advanced processing have refined garment properties.[17] More itching is induced by contact with fibres of mean diameter 36μm compared with those of 20μm.[18,] Prickle and itch are generally not sensed if woollen garment mean fibre diameters are under 19-21μm.[19, 20, 21] Merino wool is generally less than 24 micron (μm) in diameter. Basic Merino types include: strong (broad) wool 23-24.5μm, medium wool 19.6–22.9μm, fine 18.6–19.5μm, superfine 15.0–18.5μm and ultrafine <15μm.[22]

Wool fibres, composed of keratin, are the most hygroscopic of the common apparel fibres, allowing ready absorption and release of moisture vapour in the clothing microclimate to buffer humidity changes.[23] They hold up to 35% of their own weight in water, compared to ~25% for cotton and 2-3% for polyester.[24] Wool demonstrates superior properties of insulation, water absorbency, fire resistance and liquid repellency compared with other natural and manmade fibers.[25] Its thermoregulatory and moisture transport properties may possibly benefit AD patients, as skin barrier dysfunction leads to moisture and temperature dysregulation.[26]

A recent study supported the tolerability and possible benefit of merino wool clothing in adult AD.[27] The present study examines the effectiveness of superfine merino wool clothing in reducing AD severity in children aged 0-3 years compared with cotton clothing and assesses its tolerability and effect on quality of life in paediatric AD.

METHODS

Study Approval

The study was approved by the Royal Children's Hospital (RCH) institutional ethics committee (HREC34037A). Each parent or legal guardian provided written informed consent before any study-related procedures began. The trial is registered on the clinicaltrials.gov PRS system (Identifier:NCT02534428).

Study Population

Patients were recruited from the RCH Melbourne dermatology clinic, a tertiary care center. Patients 0 to 3 years with mild to moderate AD, determined by a SCORing Atopic Dermatitis index (SCORAD) >1 and ≤50, with a legally acceptable representative capable of understanding the informed consent document and providing consent on their behalf, were eligible. Exclusion criteria were past adverse reactions to merino wool, anticipated inability to attend visits, and unstable eczema, defined by treatment escalation or increased topical anti-inflammatory use during the previous two months.

Study Design

A single-center, randomized, outcome assessor-blinded, cross-over, prospective cohort study was conducted. Participants in the wool-first arm received 6 weeks of superfine merino wool clothing followed by six weeks of standard clothing whereas the cotton-first arm participants began with standard clothing followed by superfine merino wool. The standard clothing of all participants was made of cotton.

Demographic and contact details were ascertained at the initial appointment. Children were reviewed 3-weekly. Participants in the wool-first group received 5 ensembles of 100% superfine merino wool clothing to be worn for at least 6 hours a day, based on realistic wear patterns, and Eco wool wash™ detergent. A further ensemble was given at Week 3. Participants in the cotton-first group received superfine merino wool clothing

at Week 6 (5 ensembles) and at Week 9 (1 ensemble). At each review, clothing type, duration of daily wear and AD treatments used during the preceding 3 weeks, were recorded. At 6 weeks, children in the wool-first group changed from wool to cotton clothing, with recollection of wool ensembles, while those in the cotton-first group changed from cotton to wool. At week 12, Merino ensembles were returned to families. Travel expenses were reimbursed.

AD management was standardised to minimise confounding variables. Standard RCH AD management includes moisturisation of the full skin surface at least twice daily, including after daily baths, hydrocortisone 1% ointment, pimecrolimus (in infants >3months) or tacrolimus (in children > 2years) to facial eczema twice daily as required, and mometasone (0.1%) or methylprednisolone (0.1%) to body eczema, wet dressings, and anti-bacterial measures as required.

Randomization and blinding

Patients were assigned by a non-scoring investigator (RD,EL,LT), using a computer-generated random allocation list by block randomization with variable block size between 4 and 8 on a 1:1 schedule (SD,RD), to the wool-first or cotton-first arm. Participants were assigned a study number, 1-40, during screening. The allocation list, sequentially numbered de-identified patient files, and corresponding clothing ensembles were locked in a departmental cabinet, only accessed by non-scoring investigators (RD,EL,LT). Participants were allocated to an unblinded dermatology nurse (EL,LT) for consultations. A separate blinded, trained researcher assessed each patient's SCORAD and the Atopic Dermatitis Severity Index (ADSI), at recruitment and on review (SH,JS). Where possible, the same investigator who performed the baseline score scored the child on reviews. During assessments, the nurse stored clothing away to prevent unblinding of assessors. Participants and guardians were unblinded but instructed to conceal their study arm from assessors.

Assessments

The primary outcome was change in AD severity, measured using the objective components of the SCORAD (oSCORAD) after six weeks of intervention. Secondary Outcomes were eczema severity using the oSCORAD after three weeks and ADSI and

quality of life assessment using the Infant's Dermatitis Quality of Life Index (IDQOL) after three and six weeks of intervention. At the initial appointment and at each review, parents completed the IDQOL survey. An independent, blinded assessor administered the SCORAD and ADSI. Topical steroid (TS) use was recorded at each review.

The SCORAD is the most tested measure of AD severity, with reliability and validity shown by fifteen studies.[28,29] It measures global severity with a scale from 0-103, based on disease extent, six morphological parameters and two subjective markers.[29]

The ADSI assesses localized eczema severity and complements SCORAD by scoring a particular target area; the assessor selected the most severely affected area reliably in contact with clothing. Erythema, pruritus, exudation, excoriation, and lichenification are scored on a scale of 0 to 3 to give a maximum score of 15, high scores indicating increased severity. It has demonstrated sensitivity and correlates well with instrumental AD measurements including transepidermal water loss. [28, 29]

The IDQOL score adapted the Dermatology Quality of Life Index (DLQI) for children below four years of age.[25] Caregivers rate a child's AD severity using subjective domains like eating, bathing, mood change and sleep disturbance.[28, 31] The total score for ten questions ranges from 0 to 30; higher scores indicate greater disease burden.

Compliance was assessed, by noting the frequency and daily duration of garment use at each review for the preceding 3-week period. Daily diaries were supplied to document garment use and collected at each review.

Sample size calculation

A sample size of 36 (18 participants per group) was selected to allow the detection of a clinically important greater reduction in SCORAD from baseline to six weeks of 8.2 units[32] in the wool ensemble clothes compared to the cotton clothes, assuming a standard deviation for change of 8.7, based on previously published estimates, power of 0.8, and an alpha level of 0.05.[32] To allow for a drop-out rate of up to 10%, a total of 20 participants per group was required.[33]

Statistical analysis

All analyses were performed using the intention-to-treat principle. The mean oSCORAD, ADSI and IDQOL were examined. As the change in SCORAD scores were normally distributed, independent group t-tests using mean differences were used. A secondary analysis using non-parametric Mann-Whitney U test was also performed for SCORAD, ADSI and IDQOL, and the results were similar. Additionally, a generalized linear model was used (using a Gaussian family and an identity link function) to estimate the effect of wool on change in SCORAD from baseline, whilst adjusting for the child's sex and age. An interaction term was fitted with the group (wool vs cotton first) to test if the effect varied by order of treatment.

RESULTS

Recruitment

39 patients with mild to moderate AD were enrolled between 10 June 2014 and 10 February 2015. 20 were assigned to the wool-first arm and 19 to the cotton-first arm. Participants ranged in age from 1 month to 3 years at the time of recruitment. Figure 1 shows the consort flow diagram.

Baseline data

At baseline, there were some differences between the cotton-first and wool-first groups (Table 1). Children in the wool-first group were younger and had a greater proportion with fathers with a history of hay-fever. Gender and markers of AD severity appeared similar between the groups.

Compliance with clothing use

During the 6-week treatment period, woollen clothing use was reasonably high. Of children with available data in the wool-first group, 17/18 at 3 weeks and 15/15 at 6 weeks reported daily woollen garment use. Similarly, the figures for the cotton-first (wool-second) group were 15/17 and 13/16 at 9 and 12 weeks. Daily usage diaries were properly completed at 3 and 6 weeks for 16/18 and 12/15 children respectively of the wool-first group and 11/17 and 10/16 children respectively of the cotton-first group. According to diaries, 6-hour-minimum daily wear-times were satisfied in over 85% of participant-days in both groups.

Outcomes

Primary outcome: SCORAD

SCORAD decreased from baseline to week 12 in both groups, but this was more pronounced in the cotton-first group (Fig. 3, Table 3). There was limited improvement in SCORAD from baseline to week 6 in both groups (Table 2) with no evidence that the SCORAD change was different between the two groups (Table 3). The cotton-first group showed substantial reduction in eczema severity after changing to wool, from 6 to 9 and again to 12 weeks (mean of 11 to 13 point reduction). No improvement occurred in the wool-first group after changing to cotton, with a trend towards worsening AD from 6 to 12 weeks (Table 2, Fig. 2).

Generalized linear modelling confirmed these findings. Combining the wool period data of both groups, the magnitude of SCORAD reduction from baseline was greater at six weeks of treatment (-7.6, 95%CI=-10.4, -4.8) than at three weeks (-2.5, 95%CI= -4.7,-0.4). Neither age at enrolment (p=0.69) nor sex of the child (p=0.99) were associated with change in SCORAD, while higher baseline SCORAD values were associated with greater reduction in SCORAD (p<0.01) during the follow-up. These effects were not greatly altered when adjusted for age, sex, and baseline severity (-2.6, 95%CI= -4.6,-0.62 at three weeks and-7.2, 95%CI=-9.4,-5.0). While the impact of the wool garments appeared greater in the cotton-first group than the wool-first group, this was not significantly different at either Week 3 (p=.198) or Week 6 (p=0.634).

Secondary outcomes

ADSI (Table 2)

In parallel with the SCORAD observations, wool garment use was associated with a significant ADSI score reduction, particularly for the cotton-first group. Comparing the combined wool period data of both groups with baseline, a median ADSI score reduction of -1 (IQR -2,0) at 3 weeks (p<0.01) and -2 (-3, -1) at 6 weeks of use was observed (p<0.01). There was a trend towards worsening ADSI scores in the wool-first group when changed over to cotton.

IDQOL

Significant falls in IDQOL scores were seen during wool intervention for the cotton-first group (Table 3). After combination of both groups, a reduction in mean and median scores during wool intervention remained (median= -1, IQR= -4.5, 0.5 at 3 weeks, p=0.03 and -2, IQR= -4.5, -0.5 at 6 weeks, p=0.01). Again, the wool-first group showed a rise in IDQOL scores when participants changed over to cotton (Table 2).

TS use (Table 4)

Daily use of TS on the body was reduced when wearing wool, particularly for the cotton-first group. When combined across the time periods, children wearing wool had approximately a halving of daily body steroid use (OR=0.44, 95%CI=0.23-0.83), compared with wearing cotton. Facial TS use was inconsistently associated with wool garment wear. Moisturiser use, measured by daily frequency of applications, by contrast, did not consistently correlate with or overall significantly change with wool garment use.

Adverse Events

No untoward medical occurrence was observed in this study, regardless of its causal relationship to study treatment, except for one child who withdrew after experiencing study-unrelated food allergy.

Discussion

In this randomized cross over trial, wearing fine merino wool garments reduced oSCORAD with statistical significance and reduced TS use in mild and moderate AD. Children with severe AD were excluded due to its complications that could affect compliance and clothing effects in a short study. Eczema reduction was more pronounced in the cotton-first group, but remained significant when both groups were combined. No observed difference in garment use explained this possible difference between groups; compliance was high in both groups.

Various reasons may explain why wool garment effects appeared more substantial in the cotton-first group. First, the median age of children in the cotton-first group was 12 months older than those in the wool-first group. While AD severity naturally decreases

with increasing age, any age-related improvement in eczema generally takes years to occur and is unlikely to significantly impact a study with a 3-month follow-up period.

Second, patients in the cotton-first group completed more visits by the time they changed to wool, compared to the wool-first group. This may have created a run-in effect. Benefits of wool may thus possibly be greater when skin inflammation is less. Children in the cotton-first group benefited from a longer period of optimizing routine management before wool was introduced.

Third, environmental factors may have confounded results. Temperature variations may trigger AD flares. As the study ran from winter to summer, the cotton-first group would have tended to wear wool in warmer months; this may have influenced differences in the effects observed between the two groups. However, the mean daily temperatures between the groups were similar and could not explain these differences observed (Table 1). By contrast, children in the cotton-first group, who improved the most during treatment, had lower mean ($p=0.06$) and maximum ($p=0.03$) humidity levels during treatment. To formally test the contribution of humidity, we fitted an interaction between the treatment and humidity during the treatment period but did not find evidence that humidity modified the effectiveness of wool ($p=0.60$). However, as power of our study was limited, potential interaction between environmental conditions and the effects of wool should be explored in future studies.

Notably, during the second phase, children in the wool-first group showed a worsening of AD back to baseline values when they switched from wool to cotton, from 6 to 12 weeks. This may indicate that cessation of wool use, reverting to cotton, results in a relative worsening of eczema, the reverse of findings for the group that changed from cotton to wool.

This study demonstrated not only a statistically significant reduction in AD severity with use of fine merino wool ensembles, compared to cotton over a six-week period, but also, with reduction in oSCORAD that may be of clinical significance. The estimated effect of woollen garments after six weeks of use was a reduction in oSCORAD of -7.6

units (95%CI= -10.4, -4.8), while a clinically important reduction in the SCORAD has been estimated to be 8.2 units.[32]

There are limitations in this study. First, children with severe AD were not included. Second, minimum wear time was short, based on realistic wear patterns in Melbourne, where dramatic climate changes can occur anytime. There may be differences in the time of wear and longer wear may have greater impact; this was not captured in the data. Third, we cannot totally exclude recall bias. Diary cards were mostly well completed to verify garment use, but were not used to quantify topical treatments, a limitation to address in future studies. Fourth, weaknesses of the SCORAD, the primary outcome measure, include inter and intra-assessor variability that lowers accuracy and reproducibility, particularly in assessing disease extent. [29] The HOME group consensus recently advocated the EASI score to assess AD severity, having potentially higher inter-rater and intra-rater reliability. Future studies should use this scale.[34,35] Fifth, while the trend to a clinically significant reduction in SCORAD was clear, our sample size was small, resulting in imprecise estimates of the merino clothing effect on oSCORAD. In retrospect, inclusion of 7 children (5 wool-first, 2 cotton-first) with oSCORAD<8 possibly also compromised the power to show clinically important oSCORAD reduction. A larger trial is required to confirm findings. Sixth, the follow-up period was relatively short. A longer period may clarify the greater effect observed in the cotton-first group. Seventh, geographical climatic variations may limit the generalizability of results to other countries.

In this study, superfine merino wool clothing reduced the severity of paediatric mild-moderate AD as compared to cotton clothing, suggesting its potential place in childhood AD management. Therefore, traditional management guidelines classing all wool-based clothing as irritants should be modified to include superfine merino wool as a recommended clothing choice in childhood AD. Further areas to study include the interaction of environment and wool in paediatric AD and comparison studies with different textiles and fibre specifications. Future studies of superfine merino wool should consider children with severe AD, effects of longer wear times, other geographical climates and wool's potential to help prevent childhood AD.

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Table 1. Baseline characteristics of study participants.

	Cotton First	Wool first
Participant Characteristics		
% Males	68.4% (13/19)	60.0% (12/20)
Median (IQR) age at enrolment	22 (4-34)	10 (7-21)
Eczema Severity		
Median Baseline SCORAD (IQR)*	15.5 (10.5-20.5)	11 (7-19)
Mean Baseline SCORAD (sd)	16.6 (0.6)	13.4 (7.9)
Median Baseline ADSI (IQR)*	4 (2-5)	3 (2-4)
Median Baseline IDQOL (IQR)*	8.5 (5-10)	7 (4-11)
Comorbid disease		
% asthma	5.3% (1/19)	15.0% (3/20)
% hay fever	15.8% (3/19)	25.0% (5/20)
Family history		
Mother		
% Eczema (n/N)	42.1% (8/19)	35.0% (7/20)
% Asthma (n/N)	15.8% (3/19)	20.0% (4/20)
% Hay fever (n/N)	47.4% (9/19)	45.0% (9/20)
Father		
% Eczema (n/N)	31.6% (6/19)	45.0% (9/20)
% Asthma (n/N)	31.6% (6/19)	30.0% (6/20)
% Hay fever (n/N)	31.6% (6/19)	70.0% (14/20)
Sibling		
% Eczema (n/N)	42.1% (8/19)	30.0% (6/20)
% Asthma (n/N)	15.8% (3/19)	10.0% (2/20)
% Hay fever (n/N)	21.1% (4/19)	5.0% (1/20)
Mean (sd) daily environmental conditions*		
Temperature during treatment phase	18.2 (2.8)	19.2 (1.7)
Temperature during control phase	18.5 (2.6)	18.1 (2.7)
Humidity during treatment	64.9 (1.9)	66.9 (4.0)
Humidity during control	66.8 (3.7)	65.5 (2.4)

*Calculated as the mean daily temperature or humidity ((daily minimum + daily maximum)/2) for the six-week intervention or control period.

Table 2. Median (IQR) and Mean (sd) SCORAD, ADSI and IDQOLscore according to group of assignment. Area in grey indicates active treatment with wool ensemble.

Group		Baseline	3 weeks	6 weeks	9 weeks	12 weeks
Cotton First standard-wool SCORAD	Median (IQR)	15.5 (10.5-20.5)	10 (7-15)	11.5 (11-15)	4 (4-7)	2 (0-4)
	Mean (sd)	16.6 (8.7)	11.6 (8.5)	13.3 (8.2)	6.9 (6.6)	3.9 (7.0)
	n	16	18	18	17	16
Wool First wool-standard SCORAD	Median (IQR)	11 (7-19)	11 (4-14)	7 (4-11)	11 (7-12)	9.5 (7-19)
	Mean (sd)	13.4 (7.9)	10.3 (7.3)	8.1 (8.7)	11.6 (6.1)	13.5 (10.4)
	n	19	19	17	17	14
Cotton First ADSI	Median (IQR)	4 (2,5)	2 (1,4)	2 (1,3)	0 (0,2)	0 (0,0.5)
	Mean (sd)	3.7 (2.0)	2.4 (1.9)	2.4 (2.2)	1.1 (2.2)	0.7 (1.8)
	n	15	19	15	14	16
Wool First ADSI	Median (IQR)	3 (2,4)	0 (0,3)	1 (0,3)	1.5 (0,3)	2 (0,3)
	Mean (sd)	3.0 (1.6)	1.9 (2.7)	1.6 (2.3)	2.1 (2.5)	2.3 (2.4)
	n	15	17	14	14	14
Cotton First IDQOL	Median (IQR)	8.5 (5,10)	5.5 (4,8)	4 (3,5)	4 (3,5)	2 (1,5)
	Mean (sd)	8.2 (3.6)	6.7 (4.2)	4.4 (2.2)	4.3 (2.6)	3.0 (3.3)
	n	14	16	11	13	15
Wool First IDQOL	Median (IQR)	7 (4,11)	4 (2,6)	2 (2,8)	7 (3,10)	5 (2,8)
	Mean (sd)	7.6 (4.5)	4.8 (3.5)	4.5 (4.1)	6.8 (4.6)	5.8 (4.5)
	n	15	19	13	15	14

Table 3: Median (IQR) & mean (sd) Change in Objective SCORAD, ADSI and IDQOL FROM BASELINE according to group of assignment. Area in grey indicates active treatment with wool ensemble.

Group		3 weeks	6 weeks	9 weeks	12 weeks
Cotton First standard-wool SCORAD	Median (IQR)	-4.5 (-11, -3)	-4 (-7, 0)	-10.5 (-16, -7)	-13 (-17, -11)
	Mean (sd)	-6.6 (7.3)	-4.4 (8.6)	-11.0 (7.8)	-13.2 (6.8)
	n	16	15	14	13
Wool First wool-standard SCORAD	Median	-3 (-10, 4)	-6 (-13, 0)	-1 (-4, 4)	0 (-4, 7)
	Mean (sd)	-3.1 (8.4)	-6.2 (9.5)	-1.4 (6.4)	1.3 (6.1)
	n	19	17	17	14
	P value	0.20	0.56	<0.01	<0.01
Cotton First ADSI	Median (IQR)	-1 (-3.5,0)	-1 (-4,-1)	-3 (-4,-2)	-4 (-4,-3)
	Mean (sd)	-1.5 (2.4)	-2.2 (1.9)	-2.7 (1.5)	-3.4 (1.7)
	n	15	12	11	13
Wool First ADSI	Median	-1 (-3,0)	-2 (-4,0)	-1 (-3,0)	-1 (-2,0)
	Mean (sd)	-1.5 (2.0)	-2.1 (2.1)	-1.5 (2.0)	-0.9 (0.9)
	n	13	11	10	10
	P value*	0.89	0.90	0.12	<0.01
Cotton First IDQOL	Median (IQR)	-4 (-5,3)	-6 (-8,-4)	-6 (-7,-2)	-6 (-10,-4)
	Mean (sd)	-1.6 (5.6)	-5.9 (2.3)	-4.8 (3.0)	-6.0 (3.6)
	n	13	7	9	10
Wool First IDQOL	Median	-2 (-6,-1)	-6 (-8,-1)	-1 (-2,1)	-1 (-2,1)
	Mean (sd)	-3.3 (3.9)	-4.6 (4.5)	-0.6 (3.5)	-1.4 (2.8)
	n	15	9	11	10
	P value*	0.46	0.63	0.02	0.01

Table 4. Proportion treated at least daily with topic steroids according to group of assignment. Area in grey indicates active treatment with wool ensemble.

Steroid use on body					
Group		3 weeks	6 weeks	9 weeks	12 weeks
Cotton First	Proportion (n/N)	53% (10/19)	31% (5/16)	24% (4/17)	6% (1/16)
Wool first	Proportion (n/N)	28% (5/18)	33% (5/15)	41% (7/17)	33% (5/15)
	p	0.18	1	0.47	0.08
Steroid use on face					
Group		3 weeks	6 weeks	9 weeks	12 weeks
Cotton First	Proportion (n/N)	5% (1/19)	12.5% (2/16)	18% (3/17)	0% (0/16)
Wool first	Proportion (n/N)	11% (2/18)	27% (4/15)	41% (7/17)	27% (4/15)
	p	0.60	0.40	0.26	0.04

Figure 1 Consort flow diagram

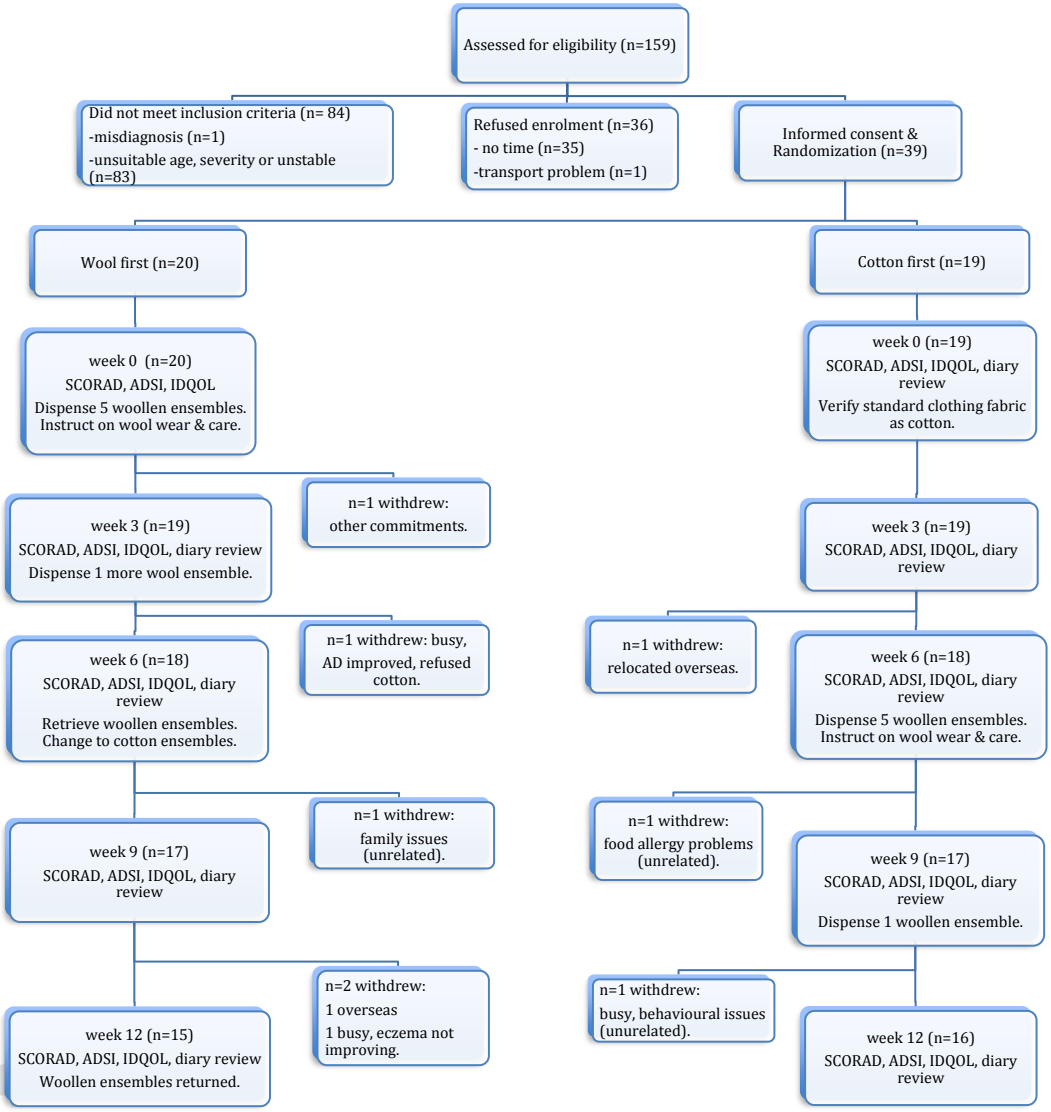

Figure 2: Mean (95%CI) Objective SCORAD according to group of assignment. Vertical lines indicate change over from cotton to wool or wool to cotton.

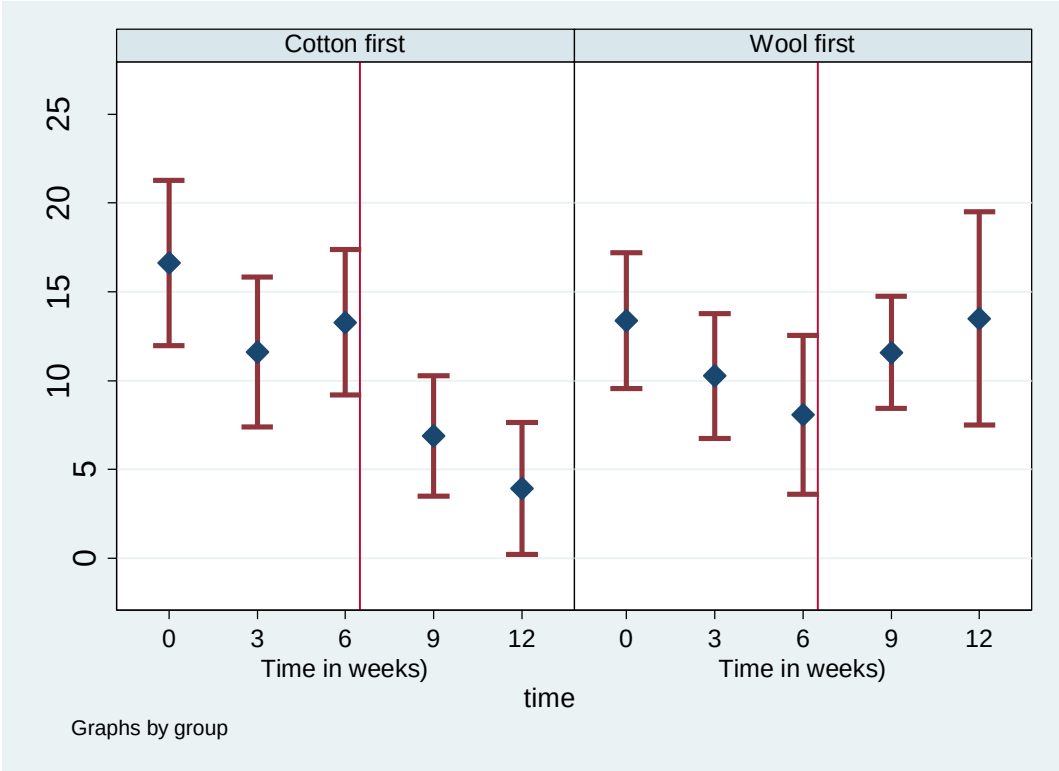

Figure 3: Mean (95%CI) change in Objective SCORAD FROM BASELINE according to group of assignment.