Skin cleansing and emolliating for older people with xerosis of the lower legs: a quasi-experimental pilot study

Abstract

Aims. To undertake a quasi-experimental study to : i) assess the effect of low cost hygiene and emollient regimes on the SBF of people aged >65 year with xerosis (dry skin) on their lower legs; ii) assess the utility of portable measures of skin barrier function (SBF) in terms of stratum corneum hydration (SCH) and trans-epidermal water loss (TEWL) in community settings iii) provide evidence for a randomised controlled trial (RCT) on the treatment of adults in a resource-poor country with dry skin on their lower legs which causes and exacerbates the skin disease podoconiosis (non-filarial elephantiasis).

Background. Age increases the risk of impaired SBF which can precipitate skin breakdown. Older skin is frequently characterised by troublesome xerosis and pruritus (itching). Hygiene and emollient practices are central to maintaining skin integrity but are currently under-researched.

Method. Five combinations of cleansing and emollient interventions were applied to the xerotic lower legs of ten participants with no skin disease for five consecutive days. SCH and TEWL were measured at baseline and day six. Products were chosen because of effectiveness, low cost, and availability in a poor-resource country.

Results. The greatest difference in TEWL pre- post intervention was indicated by the regimen of soapy water, 2% glycerine soak and *Vaseline*™ (mean 1.14, SD 1.27). This regimen also indicated the greatest difference in SCH (mean 7.92, SD 3.93). The improvement in SCH was significantly greater than for the control (p=0.011), soap (p=0.050), or water soak (p=0.011).

Conclusion. A regimen of washing skin with soapy water, soaking in 2% glycerine for 30 minutes and applying *Vaseline*™ has a beneficial effect on the SBF in older people. The study supports previous findings on the positive effects of glycerine on SBF.

Implications for practice and research. SBF in older people can be improved using a regimen of washing, soaking in 2% glycerine and applying *Vaseline*™.

Key words: skin, older people, skin barrier function, hygiene, emollient, glycerine, xerosis.

SUMMARY STATEMENT

What does this research add to existing knowledge in gerontology?

- Results suggest that a simple, low cost hygiene and emollient regime using soap, water, 2% glycerine and *Vaseline*™ may be effective in maintaining SBF for older people.

What are the implications of this new knowledge for the nursing care of older people?

- Skin health is essential for wellbeing, particularly for older people who are more prone to skin breakdown. Current skin care is predominantly based on custom and practice. Further research is needed into optimum and acceptable skin care regimens. This preliminary study suggests that until evidence-based guidance is available on the most effective emollient to apply to dry skin, the combination of washing with soap. A 2% glycerine soak and the application of *Vaseline*™ may be considered for the treatment of xerosis.

How could the findings be used to influence policy or practice or research or education?

- Literature review indicates a lack of knowledge about optimum skin hygiene and emollient regimens for older people.
- Probes for measuring SBF are feasible and useful for research based in community settings.
- The study suggests a simple, low cost intervention that improves SBF. Further research including RCTs is required to provide robust evidence to inform best practice.

Introduction

Skin is affected by age and inevitably becomes more vulnerable to damage (Fore 2006). This is due to numerous intrinsic and extrinsic changes which can impair SBF. Intrinsic changes include: reduction in cell turnover, sensory receptors (Finch 2003), natural moisturisation (Harding 2000), blood supply (Fore 2006), elasticity (Finch 2003), sweat production (Ersser 2012) and subcutaneous fat (Burr 2005). Extrinsic skin changes are caused by environmental factors, for example sun damage (Lawton 2007). Skin is also

affected by ambient temperature and relative humidity, tending to become xerotic in cold weather and conditions of low humidity (Nash 2009). Other factors that impact on skin health include excessive washing (particularly using harsh products), lack of hygiene (causing build-up of potential pathogens resulting in increased risk of infection), trauma, reduced mobility, incontinence, depression and dementia, poly-pharmacy, diabetes and vascular changes and poor nutrition (Cowdell et al 2014). The net effect of skin ageing is a diminished SBF which makes the skin significantly more vulnerable to damage (Baranoski & Ayello 2004) and potentially the consequent problems of breakdown.

It is estimated that xerosis affects 59-85% of older people (Beauregard & Gilchrest 1987). This is because as skin ages sweat glands atrophy and sebum production decreases. Stratum corneum lipids also reduce decreasing the ability of the skin to retain water. This results in dry, thickened, flaky, reddened skin (xerosis) which initiates an inflammatory response. The lower leg is one of the places most likely to be effected (Balaskas *et al.,* 2011). Xerosis increases the risk for other problems such as pruritus, infection, skin tears and pressure ulcers (Hunter 2003; Cole & Nesbitt 2004). The inflammatory response worsens without intervention. To break the cycle of progression there is a need to treat the symptoms, repair the stratum corneum (SC) and enhance the SBF (Rawlings & Matts 2004).

Skin cleansing and emollient regimes are one of several factors that contribute to maintaining skin integrity, defined as skin being a sound and complete structure in unimpaired condition (North American Nursing Diagnosis Association 2013); it is an important, but often overlooked, subject. Fundamental skin care, namely washing and emollient use, is central to maintaining skin integrity. Recent reviews have concluded that there is a dearth of empirical evidence on the relative benefits of different cleansing and moisturising regimens for older people including the effects of emollients after bathing (Cowdell & Steventon 2015, Cowdell *et al.,* 2014, Kottner *et al.,* 2013). Furthermore, there is a lack of clarity about clinical practice norms in skin care regimens for older people in all settings. However, whilst maintaining hygiene is essential, over-washing, particularly with harsh products, can result in impaired skin integrity (Gardiner 2008). There is therefore a need to balance maintaining health and wellbeing through meeting personal hygiene needs and not over cleansing and thus potentially compromising SBF (Voegeli 2008). Any

intervention should have minimal adverse effects and products should be acceptable to the person to ensure treatment concordance (Cowdell 2010).

There is a degree of consensus about optimum regimens amongst experts who advise that: people should bathe regularly in warm rather than hot water (Lawton 2007); they should not soak for too long or over-wash (British Association of Dermatologists 2006); should use gentle wash products and emollients which are acceptable to them (Lawton 2007) and gently rub or pat the skin dry (Ersser 2005). However, the extent to which these recommendations are followed in practice is unknown.

The ideal washing and emolliating intervention is one that removes dirt from the skin without causing dryness or irritation and which maintains or promotes skin integrity and comfort. Soap is currently the most commonly used skin cleansing agent. It removes dirt and oils. Most soap has a pH of 7-10 (Ananthapadmanabhan *et al*., 2013). All testing methods of soaps indicate that excessive exposure induces barrier damage and skin dryness followed by inflammation (Wolf & Parish 2012). Therefore if possible soaps with a low pH (<7) should be used and over-washing avoided. There is evidence that regular emollient use is beneficial to aging skin (Watkins 2011) and specifically that it has a positive effect on skin integrity (Moncrieff *et al*., 2015) and can lead to a reduction in the incidence of skin tears (Carville *et al.*,2014). Emollients are best applied when skin is moist as it is after bathing or washing when skin has a high water content (Holden *et al.,* 2002, Ersser *et al*., 2012).

At present there is a significant gap in knowledge about optimum hygiene and emollient skin care for older people and a need to develop a robust evidence base to guide practice; the pilot study presented here is one element in a programme of work that will help address this knowledge gap.

Aims

To:

- Assess the effect of simple, lost cost hygiene and emollient regimes on SBF of people aged >65years with normal aging skin but without skin disease.
- Assess the utility of portable measures of SBF in home and care settings.

- Provide evidence for an RCT on the skin treatment of adults in a resource-poor country with the disease podoconiosis which is caused by dry skin on the lower legs.

Method

Study design and sample

We conducted a pilot quasi-experimental study. Ten females were recruited in the United Kingdom (UK); two were resident in a private care home and eight lived in their own homes. Inclusion and exclusion criteria are summarised in Table 1.

Data collection and measures

Demographic data were collected (Table 2). Measures of TEWL and SCH were used to assess SBF. High values of SCH and low values of TEWL are typical of a healthy skin barrier (Fluhr *et al.,* 2006). SCH was measured with a *MoistureMeter SC*™ and TEWL with a *VapoMeter*™ (www.delfintech.com 2015a, b). These are both non-invasive probes with high reproducibility, short measuring times and provide a robust indicator of SBF. Guidelines for using these measures were followed meticulously (Plessis *et al.,* 2013). As these instruments are sensitive to changes in ambient temperature, relative humidity, skin surface temperature and sweating, participants were seated with their lower legs exposed and uncrossed for 20 minutes prior to readings being taken. No hot drinks were given during this time. To avoid confounding results participants were asked to refrain from using emollients for three days before the trial and from taking an immersion bath or shower for the duration of the trial. The trial took place over six consecutive days in May 2013. Measures of SCH and TEWL were taken from each specific site at baseline and on day 6. All interventions and recordings were carried out by the principal investigator to ensure intervention fidelity and consistent measurement.

Intervention

The experimental groups consisted of a set of simple, low cost interventions, applied to the lower legs, that were selected based on evidence where available or on current custom and practice; these are detailed below. Five combinations of cleansing and emolliating were

used on five sites. The control conditions were the untreated site, without cleansing agents or emollients.

Soap: The soap used had a pH of 10 (highly alkaline) which is consistent with that of many soaps available in the UK (Baranda *et al.,* 2002) and in resource-poor countries. All testing methods of soaps indicate that excessive exposure induces barrier damage and skin dryness followed by inflammation (Wolf & Parish 2012). This is because the emulsifying effect of soap removes sebum and therefore affects SBF; soap also disrupts the skins' acid mantle due to its alkalinity. Soaps with a higher pH (>7) are likely to cause more dryness than those with a pH (<7) which are closer to the skin's normal pH value to 4-6 (Ali& Yosipovitch 2013).

Emollient: Glycerine is an emollient and humectant which has a positive effect on TEWL and SCH. It is a constituent of many commonly available emollient formulations. It attracts water from its surroundings by absorption and adsorption slowing or preventing excessive drying and evaporation. It is naturally present in skin and noted to be one of the best natural skin moisturizers (Chrit *et al*., 2006). It is used in skin care products because of its moisturising and plasticising effects on the SC which prevent and treat dryness. A report from a global expert dermatology symposium notes that using glycerine to hydrate the SC corrects the effects of cleanser induced skin damage (Ananthapadmanabhan *et al*., 2013). Studies have reported positive effects of a glycerine dilution below 2% (Iiyama & Kawahira 2008, Atrux-Tallau *et al*., 2010). It is non-toxic and non-irritating when applied to the skin (Atrux-Tallau *et al.,* 2010, Roussel *et al.,* 2012). Although it occurs naturally in skin but may also be manufactured (Fluhr *et al.,* 2008). It is extensively used in cosmetics and dermatology products because of its moisturising effects. A review of the literature summarises the effect of glycerine as follows (Fluhr *et al.,* 2008):-

- improves SCH
- inhibits SC lipid phase transmission
- improves SBF
- increases desmosomal degradation
- increases skin mechanical properties
- accelerates wound healing

- guards against irritating stimuli
- has an antimicrobial effect

From previous research it can be deduced that low concentrations of glycerine between 2% - 5% have a positive effect on improving SBF (Gloor *et al*. 2001, Atrux-Tallau *et al*., 2010). Glycerine was chosen for the pilot because of its positive effects on SBF and because it is low-cost and easily available in resource-poor countries.

Emollient: Petroleum jelly (*Vaseline*™) is a readily available occlusive (ointment) emollient. It forms a thin film on the surface of the skin which fills the spaces between the desquamating corneocytes which are abundant in dry skin conditions, smoothing the rough stratum corneum surface and increasing the ability of the skin to hold water (Levi *et al.,* 2010). *Vaseline*™ applied to skin after the application of a humectant such as glycerine, significantly reduce TEWL (Draelos 2010).

Six 5cm x 5 cm areas of participant's lower legs were marked and assigned to interventions by a sequential organisation; 3 sites each on lateral aspects of left and right legs between knee and outer malleolus. The lower leg was chosen as it is an area likely to be effected by xerosis (Balaskas *et al.,* 2011) and measurements in this area did not unnecessarily compromise participant's dignity. Interventions were allocated sequentially to ensure that different sites of the lower leg were used for each intervention because different skin areas will have differences in, for example thickness, blood supply and skin dryness. Measured amounts of 1.5ml of water, soapy water and glycerine were added to 8 ply, 5cms x 5cms gauze swabs and applied to the skin. All interventions except *Vaseline*™ were covered in cling film to ensure controlled contact with the skin. During the study the relative humidity of the environment was between 34-54% and ambient temperature between 19-22^{o}C. The interventions and their rationale are presented in Table 3 and Table 4 documents the sequence of interventions.

Data analysis

Post-intervention minus pre-intervention value changes in SCH and TEWL were computed for all treatments and participants. Descriptive statistics (means and standard deviations)

were calculated and profile plots constructed. Friedman's test was used to examine whether the changes differed significantly between the six treatments. If statistically significant, then Friedman's test was followed by a post-hoc Nemenyi test to establish which treatment pairs differed significantly. R for Windows software Version 3.0.0 was used for the statistical analysis.

Ethical considerations

A University Research Ethics Committee gave approval for this study. All participants received an information sheet and gave written consent. All data was handled in line with the agreed data management plan.

Results

The ten participants were all female aged 65-95 years (mean 76.4). No males agreed to participate. During the study the relative humidity of the environment was 34-54% and the ambient temperature 19-22^{o}C. All participants reported that they had not had a shower or immersion bath during the trial or used any other emollients for three days before or during the trial.

Descriptive statistics for SCH levels and TEWL are reported in Tables 5 and 6 respectively. It is clear that the greatest mean increase in SCH level at day 6 is found for soap, glycerine and *Vaseline*^{TM}. The greatest improvement of skin barrier function, as reflected in a mean decrease in TEWL was indicated by the soap, glycerine and *Vaseline*^{TM} regimen. Although overall the differences between the six treatments were not statistically significant for TEWL changes; this was a small improvement on that observed for the control treatment. This difference is also apparent from the profile plots (Figures 1 and 2). From Friedman's test it was found that there were statistically significant treatment differences for changes in SCH level but not for TEWL (p=0.002 and 0.185 respectively). The post-hoc Nemenyi test for SCH level changes indicated that three treatment pairs differed significantly (Table 7).

The measurement tools were found to be practical and simple to use in residential and home settings. The *VapoMeter*^{TM} was within its factory calibration period of up to 2 years.

The Moisture Meter was calibrated by the PI according to the manufacturer's instructions. The interventions were well tolerated by the participants and all completed the study. Humidity of the environment was checked at each visit.

Discussion

This is one of the few studies using these portable SBF measures outside a laboratory or hospital setting. The studies are listed on the Delfin web site (Delfin Technologies 2015a, b). Only one study was found which measured SCH and TEWL in those with podoconiosis and it used these probes (Ferguson *et al*. 2013). The study indicates the positive effects on SBF of soaking for 30 minutes a day for five days in the treatment combination containing 2% glycerine due to improvements in SCH, although not TEWL. The study confirms earlier research on the positive effects of glycerine and of *Vaseline*® increasing SCH (Fluhr *et al.,* 2008, Draelos 2010). Two percent (2%) glycerine and *Vaseline*™ are low cost interventions for use on dry skin and therefore this study may have a value in selecting interventions for use in resource poor settings. Whilst *Vaseline*® is an effective ointment emollient many patients find too greasy and prone to rub off on clothes; this may limit acceptability and therefore concordance (Dyble & Ashton 2011). It is unsurprising that the combination of an ointment (Vaseline) and humectant (glycerine) improved SBF, however, the addition of soap with its emulsification effect and so removal of the natural emollient sebum may have to a degree countered therapeutic effect.

No other studies were found using the precise combination of washing the skin with soap and water, soaking in 2% glycerine and applying *Vaseline*™. The effects on SCH may have been increased using a gentler cleansing product with a lower or neutral pH, rather than soap which typically has a high alkalinity.

Care environments for older people may be dry due to excessive central heating thus aggravating the drying of skin due to low humidity levels. In the study there were variations in humidity in the different settings in which the data was recorded but the humidity in the care home was not particularly low and indeed was higher than in some of the participants own homes. Dry skin results in erythematous or red, itchy, roughened skin and a breached SBF with increasing moisture loss (Lodén 2005). A deteriorating cycle of events may follow which does not improve without intervention (Rawlings & Matts 2004). Increasing SCH with

the use of emollients improves SBF and helps to prevent dryness and so itching, skin tears (Carville *et al.,* 2014) and resilience against pressure damage (Benbow 2009). Using the two emollients glycerine and *Vaseline*™ in combination may be a cost effective treatment for dry skin especially when used after a cleanser with a low pH.

Study limitations

This pilot study has several limitations. First it is quasi-experimental and therefore does not have the strength of a large randomised controlled study. Second the results may have been affected by the small sample (n=10) of all female Caucasian participants within a large age range. Third co-morbidities were not recorded which may have effected results. Forth the interventions were only applied for 5 days and included soap with an atypical alkalinity. Fifth not all of the interventions were tested separately because three sites on each leg were deemed to be the maximum number feasible and at each site the different interventions were only applied once or twice. A factorial design would be desirable for future studies. Fourth, although soaps used in clinical practice are often highly alkaline a gentler cleansing bar may have been of a more optimal (lower) pH, nearer that of the skin and potentially also could have had a lower emulsifying effect than soaps retaining more of the skin's sebum and natural emollient property. There is also scope in future studies to review the impact of soaking skin in water containing an emollient such as glycerine to examine its effects on SCH and TEWL using portable measures of SBF. Sixth, participants were given no choice of products so even if effective they may have been unacceptable for continuing use. Finally, the pilot was undertaken on older women so the results may not be generalizable to the adult population in the main study.

Conclusion

Despite the aging population and the increasing awareness of the importance of maintaining skin integrity for older people the evidence base for hygiene and emollient practices remains weak in terms of clinical and cost effectiveness and patient acceptability. This pilot study took place over a short time period but showed the positive influence on the SBF of older peoples' skin of using a 2% glycerine soak and application of a thin layer of *Vaseline*™. The study supports previous findings on the positive effects of the emollients

glycerine and of *Vaseline*™ increasing SCH levels and reducing TEWL in those with dry skin. Even when used following the application of soap, that typically has a high pH, these emollients were still effective. It also highlights the feasibility of using SBF measures outside the laboratory, within care and home settings. Further research is required to ascertain optimal hygiene and emollient regimes for older people in a suitably powered randomised controlled trial. The products and probes used in this pilot study will be used in the main RCT to promote and measure SBF in those in a resource-poor country with the skin disease podoconiosis.

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