An investigation into the potential mechanisms that drive gender based differences in skin microbiota

Laura S. Weyrich, PhD
Australian Centre for Ancient DNA
University of Adelaide, Australia
Email: laura.weyrich@adelaide.edu.au
Twitter: @lweyrich
More than skin deep

• Up to 35 million microbes per square centimetre!

• Distinct and diverse communities extend into dermis, below basal membrane


Interactions between the skin microbiota and immunity

- Physical defence from invading pathogens
- Antimicrobial and bacterial competition to limit pathogen colonization
- Aid in skin shedding
- Established immune tolerance

Chen and Tsao, J. Am. Acad Dermatology, 2013
Disease Associations with skin microbial communities

**Skin Diseases**

- Atopic dermatitis
- Psoriasis
- Acne vulgaris
- Chronic wounds

**Systemic Diseases**

- Atopic sensitization


[WebMD.com](http://www.webmd.com)
Using NGS to investigate skin microbiota

Initial HMP studies:
Highly variable
Highest levels of intrapersonal variability over time

Costello et al., Science 326:1694, 2009
Mirrored diversity driven by physiology

- Unique body sites harbour unique microbiota
- Largely driven by physiology and host microorganisms
  - Sebum production
  - Moisture
  - pH
  - Others

Costello et al., Science 326:1694, 2009
Fungal and bacterial communities are equally impacted

- Fungal communities are driven by similar factors

- *M. restricta* (i; $\rho = 0.92$) and *M. globosa* (a; $\rho = -0.79$) are primary and opposing drivers of variation

- *Propionibacterium* (j; $\rho = 0.95$) contributes to sebaceous site variation; *Corynebacterium* (l; $\rho = -0.74$) and *Turicella* (q; $\rho = -0.56$) contribute to moist sites

Gender based skin microbiota differences

- Sex based differences exist in skin microbiota
- Female microbiota are more diverse, when accounting for hand washing
- Other factors may be more significant


Fierer, et al., *PNAS*, 2008
Factors that drive microbiota gender based differences

- Physiological
- Environmental
  - Handedness
  - Hygiene
  - Cosmetics
  - Environment
  - Ethnicity
- Others…
Evolutionary history may also contribute

- Different populations harbour unique microbiota
- Mirrors what is observed in other body sites
- Could play a role in sex based differences, *i.e.* Treponema sp. in Hadza female gut microbiota from tuber collection

Technical Limitations with 16S rRNA studies

- Skin swabs are typically ‘low biomass’ samples
- DNA recovery yields need to be maximised
- Contaminant taxa need to be assessed
  - Extraction blank controls (EBCs)
  - No template controls (NTCs)

Environmental exposure = increased diversity

- Prolonged environmental exposure increased overall diversity
- Increased exposure increased total obtained taxa
- Baseline reset after showering

Mills, et al., In preparation
Environmental microbiota transfer to the skin

- *Staphylococcus sp.* decreased
- Other taxa were obtained from the environment
- Dynamic interplay between taxa

Mills, et al., In preparation
Rewilding hypothesis

- Reinstate lost microbial diversity through environmental biodiversity exposure
- Impacts on immune dysfunction and loss of competitor species
- Mechanisms and potential pitfalls need to be explored, especially in the context of different genders

Looking to the future

- Probiotic development
  - Adverse effects must be tested in different age ranges: *Lactobacillus acidophilus*
  - Cosmetic based probiotics (Nerd skincare)
  - Microbial transplants for the skin?
  - Immune therapy through prebiotics?
  - Specific microbial correlates of skin disease

- Statnikov, et al., *Scientific Reports*, 2013
AUSTRALIAN CENTRE FOR ANCIENT DNA

The Wenner-Gren Foundation
For Anthropological Research, Inc.

laura.weyrich@adelaide.edu.au  @ACADAdelaide  @lsweyrich