

**Supplementary Material**

**Dysbiosis of skin microbiota in psoriatic patients: co-occurrence of fungal and bacterial communities**

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1. SUPPLEMENTARY TABLES AND FIGURES

1.1. Tables related to Material and methods

Table S1. Characteristics of patients and controls in the study.

|                  | Range (average ± SD) |                  |                  |
|------------------|----------------------|------------------|------------------|
|                  | Age                  | BMI              | PASI             | PGA               |
| **Psoriasis**    |                      |                  |                  |                  |
| Female           |                      |                  |                  |                  |
| n = 6            | 24 – 49 (37,2 ± 7,8) | 22 – 37 (29,1 ± 5,3) | 0,5 – 32 (10,5 ± 10,3) | 1 – 4 (2,5 ± 0,96) |
| Male             |                      |                  |                  |                  |
| n = 28           | 23 – 70 (46,4 ± 11,9) | 22 – 49 (29,7 ± 5,9) | 0 – 20 (5,1 ± 5,6) | 0 – 4 (1,9 ± 1) |
| **Total**        |                      |                  |                  |                  |
| n = 34           | 23 – 70 (44,8 ± 11,9) | 22 – 49 (29,6 ± 5,8) | 0 – 32 (6,1 ± 6,9) | 0 – 4 (2 ± 1) |
| **Controls**     |                      |                  |                  |                  |
| Female           |                      |                  |                  |                  |
| n = 14           | 27 – 72 (41,7 ± 14,8) | –                | –                | –                |
| Male             |                      |                  |                  |                  |
| n = 13           | 22 – 69 (42,6 ± 14,6) | –                | –                | –                |
| **Total**        |                      |                  |                  |                  |
| n = 27           | 22 – 72 (44 ± 13,3)  | –                | –                | –                |
Table S2. Medical and sampling history of psoriatic patients.

| Patient ID | Biological | Systemic | None | Other | Swab | Scraping | Biopsy |
|------------|------------|----------|------|-------|------|----------|--------|
| P1         | x          | –        | –    | –     | x    | x        | –      |
| P2         | x          | –        | –    | –     | x    | x        | x      |
| P7         | –          | x        | –    | –     | x    | x        | –      |
| P8         | –          | x        | –    | –     | x    | x        | –      |
| P9         | x          | –        | –    | –     | x    | x        | x      |
| P10        | –          | –        | –    | x     | x    | x        | –      |
| P11        | x          | –        | –    | –     | x    | x        | x      |
| P12        | –          | x        | –    | –     | x    | x        | x      |
| P13        | –          | –        | –    | x     | x    | x        | x      |
| P14        | –          | –        | –    | x     | x    | x        | x      |
| P15        | –          | –        | x    | –     | x    | x        | x      |
| P16        | x          | –        | –    | –     | x    | x        | x      |
| P17        | x          | –        | –    | –     | x    | x        | x      |
| P18        | x          | –        | –    | –     | x    | x        | –      |
| P19        | x          | –        | –    | –     | x    | x        | –      |
| P22        | –          | x        | –    | –     | x    | x        | –      |
| P23        | x          | –        | –    | –     | x    | x        | –      |
| P26        | –          | x        | –    | –     | x    | x        | –      |
| P31        | –          | –        | x    | –     | x    | x        | –      |
| P32        | x          | –        | –    | –     | x    | x        | –      |
| P33        | –          | –        | x    | –     | x    | x        | –      |
| P35        | x          | –        | –    | –     | x    | x        | –      |
| P36        | x          | –        | –    | –     | x    | x        | –      |
| P37        | x          | –        | –    | –     | x    | x        | –      |
| P41        | x          | –        | –    | –     | x    | x        | –      |
| P44        | –          | –        | –    | x     | x    | x        | –      |
| P46        | –          | –        | –    | x     | x    | x        | –      |
| P50        | –          | –        | x    | –     | x    | x        | –      |
| P51        | –          | –        | x    | –     | x    | x        | –      |
| P52        | –          | –        | x    | –     | x    | x        | –      |
| P54        | –          | –        | x    | –     | x    | x        | –      |
| P55        | –          | –        | x    | –     | x    | x        | –      |
| P56        | –          | –        | x    | –     | x    | x        | –      |
| P57        | –          | –        | x    | –     | x    | x        | –      |

Total patients 14 5 8 7 34 34 9
Table S3. Sampling of psoriatic, unaffected psoriatic and healthy skin.

| Localization | Psoriatic | Unaffected | Healthy |
|--------------|-----------|------------|---------|
|              | Back      | Elbow      | Total count |
| Psoriasis    | 25        | 9          | 34       |
| swabs        | 25        | 9          | 34       |
| scraping     | 10        | 0          | 10       |
| Unaffected   | 25        | 9          | 34       |
| swabs        | 25        | 9          | 34       |
| scraping     | 9         | 0          | 9        |
| Controls     | 17        | 8          | 25       |
| swabs        | 15        | 8          | 23       |
| biopsy       | 7         | 1          | 8        |
| Number of patients | 25 | 9 | 34 |
| Number of controls  | 19 | 8 | 27 |
1.2 Figures and tables related to Results

Figure S1. (related to Figure 1) **Differences in microbiota composition due to sequencing of V1V2 and V3V4 16S rRNA regions. (A)** PCoA of Weighted and Unweighted UniFrac distances (beta diversity) between the respective regions and type of sampling (swabs, scraping, biopsy). Statistical significance was confirmed using PERMANOVA. *p < 0.05; **p < 0.01, and ***p < 0.001. See the table above. Type of sampling: Swa, swab; Scr, scraping; Bio, biopsy.
Figure S2. (related to Table 1) **Different sampling approaches result in similar bacterial diversity but differ in genera abundance in back.** (A) Alpha diversity (PD whole tree, Observed OTU’s, Gini-Simpson, Shannon and Chao1 index) and beta diversity indices (weighted and unweighted PCoA analysis) of psoriatic skin showing microbial richness and distribution in relation to swab, scraping and biopsy sampling approach. (B) Alpha and beta diversity indices of unaffected psoriatic skin showing microbial richness and distribution in relation to swab, scraping and biopsy sampling approach. (C) Alpha and beta diversity indices of healthy skin showing microbial richness and distribution in relation to swab, scraping and biopsy sampling approach. Statistical significance was confirmed using Kruskal–Wallis test with Dunn’s multiple comparison test and PERMANOVA. Sampling approaches: Swa, swabs; Scr, scrapings; Bio, biopsies. Significant differences are noted by *p < 0.05, **p < 0.01, and ***p < 0.001.
A

Weighted
PC2 (13.31%)

Unweighted
PC2 (5.24%)

B

Weighted
PC2 (13.31%)

Unweighted
PC2 (5.24%)

C

Weighted
PC2 (13.31%)

Unweighted
PC2 (5.24%)
Figure S3. (related to Table 1) Different sampling approaches result in similar microbial diversity but differ in genera abundance in elbow. (A) Alpha diversity (PD whole tree, Observed OTU’s, Gini-Simpson, Shannon and Chao1 index) and beta diversity indices (weighted and unweighted PCoA analysis) of psoriatic skin showing microbial richness and distribution in relation to swab and scraping sampling approach. (B) Alpha and beta diversity indices of unaffected psoriatic skin showing microbial richness and distribution in relation to swab and scraping sampling approach. (C) Alpha and beta diversity indices of healthy skin showing microbial richness and distribution in relation to swab and scraping sampling approach. Statistical significance was confirmed using Mann-Whitney test and PERMANOVA. Sampling approaches: Swa, swabs; Scr, scrapings. Significant differences are noted by *p < 0.05, **p < 0.01, and ***p < 0.001.
Table S4. (related to Table 1) **Differences in bacterial distribution related to sampling approach.** (Swa, swabs; Scr, scrapings; Bio, biopsies).

|         | Streptococcus | Propionibacterium | Actinobacteria | Staphylococcus |
|---------|---------------|-------------------|----------------|----------------|
|         | Back          | Psoriatic         | Unaffected     | Healthy        |
|         |               | Swa 3.1          | 20.0           | 52.8           | 20.3           |
|         |               | Scr 3.5          | 30.6           | 58.9           | 14.6           |
|         |               | Bio 0.5          | 37.0           | 55.4           | 12.1           |
|         |               | Psoriatic         |                |                |                |
|         |               | Swa 2.6          | 18.4           | 46.4           | 26.6           |
|         |               | Scr 5.3          | 20.4           | 41.9           | 31.7           |
|         |               | Bio 0.7          | 25.2           | 44.8           | 4.6            |
|         |               | Unaffected        |                |                |                |
|         |               | Swa 1.8          | 28.3           | 43.3           | 26.9           |
|         |               | Scr 0.7          | 51.3           | 61.4           | 19.5           |
|         |               | Bio 0.4          | 8.0            | 15.2           | 55.4           |
|         |               | Healthy          |                |                |                |
|         |               | Swa 4.8          | 8.3            | 29.3           | 18.7           |
|         |               | Scr 6.7          | 11.3           | 27.9           | 13.7           |
|         |               | Psoriatic         |                |                |                |
|         |               | Swa 2.5          | 15.8           | 39.5           | 20.4           |
|         |               | Scr 3.2          | 13.8           | 33.3           | 26.5           |
|         |               | Unaffected        |                |                |                |
|         |               | Swa 2.7          | 22.9           | 53.5           | 20.5           |
|         |               | Scr 3.8          | 23.5           | 49.4           | 25.8           |
|         |               | Healthy          |                |                |                |
Table S5. (related to Table 1) The main discriminative bacterial features related to sampling approaches of V1V2 region.

| Sample site | Sample type      | Swabs                     | Scrapings                  |
|-------------|------------------|---------------------------|----------------------------|
|             |                  |                           |                            |
| Back        |                  |                           |                            |
| Psoriatic   |                  | Bacillus                  | Moraxellaceae              |
|             |                  |                           | Comamonas                 |
|             |                  |                           | Burkholderia              |
|             |                  |                           | Veillonella                |
|             |                  |                           | Pseudomonadales            |
|             |                  |                           | Gammaproteobacteria        |
|             |                  |                           | Burkholderiales            |
| Unaffected  | Lachnospiraceae  | Neisseria                 | Granullicatella            |
|             |                  |                           | Gammaproteobacteria        |
|             |                  |                           | Oxalobacteraceae           |
|             |                  |                           | Burkholderiales            |
| Healthy     |                  |                           | Comamonadaceae             |
|             |                  |                           |                            |
Figure S4. (related to Figure 2) Analysis of bacterial communities isolated from swabs using the V3V4 region of the 16S rRNA gene. (A) Alpha diversity (PD whole tree, Observed OTU’s, Gini-Simpson, Shannon and Chao1 index) and beta diversity indices (weighted and unweighted PCoA analysis) of psoriatic, unaffected psoriatic and healthy control skin in back samples. (B) Alpha diversity (PD whole tree, Observed OTU’s, Gini-Simpson, Shannon and Chao1 index) and beta diversity indices (weighted and unweighted PCoA analysis) of psoriatic, unaffected psoriatic and healthy control skin in elbow samples. Disease status: Ps, psoriatic; Un, unaffected; He, healthy skin. Statistical significance was confirmed using Kruskal–Wallis test with Dunn’s multiple comparison test and PERMANOVA. Significant differences are noted by *p < 0.05, **p < 0.01, and ***p < 0.001.
Figure S5. (related to Figure 2) Analysis of bacterial communities isolated from swabs using the V1V2 region of the 16S rRNA gene. (A) LEfSe analysis showed microbial patterns that were significantly differentially abundant in back samples. (B) Predicted functional profiles of metabolic pathways in back samples associated with psoriatic, unaffected or healthy control skin. Heat map include only KEGG pathways with abundance above 1% for each localization and disease status. The differences are shown by color code depending on the relative abundance of metabolic pathway. Red: High abundance; Blue: Low abundance. (C) LEfSe analysis displaying discriminative metabolic patterns in back samples. Disease status: Ps, psoriatic; Un, unaffected; He, healthy skin.
Figure S6. (related to Table 2) **Different sampling approaches result in similar fungal diversity but differ in genera abundance in back.** (A) Alpha diversity (PD whole tree, Observed OTU’s, Gini-Simpson, Shannon and Chao1 index) and beta diversity indices (weighted and unweighted PCoA analysis) of psoriatic skin showing fungal richness and distribution in relation to swab, scraping and biopsy sampling approach. (B) Alpha and beta diversity indices of unaffected psoriatic skin showing fungal richness and distribution in relation to swab, scraping and biopsy sampling approach. (C) Alpha and beta diversity indices of healthy skin showing fungal richness and distribution in relation to swab, scraping and biopsy sampling approach. Statistical significance was confirmed using Kruskal–Wallis test with Dunn’s multiple comparison test and PERMANOVA. Sampling approaches: Swa, swabs; Scr, scrapings; Bio, biopsies. Significant differences are noted by *p < 0.05, **p < 0.01, and ***p < 0.001.
Figure S7. (related to Table 2) Different sampling approaches result in similar fungal diversity but differ in genera abundance in elbow. (A) Alpha diversity (PD whole tree, Observed OTU’s, Gini-Simpson, Shannon and Chao1 index) and beta diversity indices (Bray-Curtis, Binary-Jaccard) of psoriatic skin showing fungal richness and distribution in relation to swab and scraping sampling approach. (B) Alpha and beta diversity indices of unaffected psoriatic skin showing fungal richness and distribution in relation to swab and scraping sampling approach. (C) Alpha and beta diversity indices of healthy skin showing fungal richness and distribution in relation to swab and scraping sampling approach. Statistical significance was confirmed using Mann-Whitney test and PERMANOVA. Sampling approaches: Swa, swabs; Scr, scrapings. Significant differences are noted by *p < 0.05, **p < 0.01, and ***p < 0.001.

Figure S8. (related to Figure 3) Analysis of fungal communities isolated from swabs. (A) Alpha diversity (PD whole tree, Observed OTU’s, Gini-Simpson, Shannon and Chao1 index)
and beta diversity metrics (Bray-Curtis, Binary-Jaccard) of psoriatic, unaffected psoriatic and healthy control skin in back samples. (B) Alpha and beta diversity indices of psoriatic, unaffected psoriatic and healthy control skin in elbow samples. Disease status: Ps, psoriatic; Un, unaffected; He, healthy skin. Statistical significance was confirmed using Kruskal–Wallis test with Dunn’s multiple comparison test and PERMANOVA. Significant differences are noted by *p < 0.05; **p < 0.01, and ***p < 0.001.

Figure S9. Different proportion of females and males does not result in differences in alpha diversity in bacterial communities (A) Alpha diversity (PD whole tree, Observed OTU’s, Gini-Simpson, Shannon and Chao1 index) of psoriatic in swabs of back samples. (B) Alpha diversity (PD whole tree, Observed OTU’s, Gini-Simpson, Shannon and Chao1 index) of psoriatic in scrappings of back samples. (C) Alpha diversity (PD whole tree, Observed OTU’s, Gini-Simpson, Shannon and Chao1 index) of psoriatic in biopsies of back samples. Statistical significance was confirmed using Mann-Whitney test. Significant differences are noted by *p < 0.05; **p < 0.01, and ***p < 0.001.