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Multi-omics in research: epidemiology, methodology, and advanced data analysis

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Citation
Faquih, T. O. (2023, March 28). *Multi-omics in research: epidemiology, methodology, and advanced data analysis*. Retrieved from https://hdl.handle.net/1887/3589838

Version:	Publisher's Version
License:	Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden
Downloaded from:	https://hdl.handle.net/1887/3589838

Note: To cite this publication please use the final published version (if applicable).

Appendix

ACKNOWLEDGMENTS

I would like to express my deepest gratitude to my parents for their unwavering love, support, and encouragement throughout my life and academic journey. Their love and belief in me have been, and always will be, a constant source of inspiration and motivation. I also thank my sister Dr. Nada Faquih for her support and for assisting in translating the summary of findings of this thesis to Arabic.

I am also deeply grateful to my supervisors: My promotor Prof.dr. Ko Willemas van Dijk taught me valuable lessons on conducting research and writing scientific papers. He was always there for me and made time to aid in any matter I had, big or small; My co-supervisor Dr. Dennis O. Mook-Kanamori was my first contact for this PhD position. Without him I would have never had this life changing opportunity. He provided me the guidance and the creative freedoms to progressively become an independent epidemiological researcher; My co-supervisor Dr. Astid van Hylckama Vlieg for her supervision, support and her invaluable guidance and epidemiological knowledge. In these past 4 years I have learned so much from them about epidemiology, "OMICs" and conducting scientific research. Their expertise, dedication, support and kindness have been instrumental in the completion of this PhD thesis. I can truly say, thanks to them, I have transformed to a real epidemiologist and found my true calling for research. They are the best supervisors I could have asked for.

I would like to extend my thanks to the members of the Clinical Epidemiology department for their support and assistance throughout my studies. I want to particularly thank Dr. Ruifang Li-Gao for her feedback and suggestions, Prof.dr.Saskia le Cessie for always sparing the time to provide her insightful statistical knowledge, Dr. Renée de Mutsert for her support and input for all my NEO study related projects. Special thanks to Yvonne Souverein for her help in all organizational matters and Ingeborg de Jonge for providing the necessary NEO data for my projects. I also want to thank Prof.dr.Olaf Dekkers, Dr. Raymond Noordam, Dr. Jan van Klinken, Dr. Maarten van Smeden, Dr. Jelle Goeman for sharing their expertise that aided the completion of my projects.

Finally, I want to extend a special thanks to all my colleagues in the past four years for their encouragement and friendship. Not only were valuable colleagues, they were true friends. I am grateful for the memories we have shared together and the valuable lessons that I have learned from them.

This dissertation would not have been possible without the support of all of you. Thank you from the bottom of my heart.

CURRICULUM VITAE

Tariq Faquih was born on the 4th of September 1989 (4th Ṣafar 1410 Hijri) in Riyadh, Saudi Arabia. He received a scholarship from the King Abdullah Scholarship program to attend the faculty of Biological Sciences in the University of Leeds (United Kingdom) from 2007 to 2011. After he received a BSc degree in Human Genetics, he attended the Biochemistry department at Georgetown University (Washington DC, United States) from 2012-2013 and obtained a MSc degree in Bioinformatics. He subsequently worked at the King Faisal Specialist Hospital and Research Center (Riyadh, Saudi Arabia) as a bioinformatician with the Saudi Human Genome Project team from 2013-2018.

In 2018 he received a scholarship from the King Faisal Specialist Hospital and the King Abdullah Scholarship program to begin his PhD at the Clinical Epidemiology Department at the Leiden University Medical Center (LUMC). There, he was under the supervision of Prof.dr.ir. J.A.P. Willems van Dijk, Dr. Dennis O. Mook-Kanamori, and Dr. Astrid van Hylckama Vlieg. His work focused on the epidemiological applications of multi-OMICs in the study of a variety of diseases and outcomes. These OMICs included genomics, metabolomics, and proteomics. During his PhD he worked briefly as a visiting researcher at the University of Cambridge (Department of Public Health and Primary care) under the co-supervision of Dr. Praveen Surendran. He also collaborated with the Rhineland Study, DZNE (Germany), Pravastatin in elderly individuals at risk of vascular disease (PROSPER) study, the Thrombophilia, Hypercoagulability and Environmental Risks in Venous Thromboembolism (THE-VTE) study, and with the Cohorts for Heart and Aging Research in Genomic Epidemiology (CHARGE) consortium.

In January 2023 he began working as a postdoctoral research fellow in Medicine in the Division of Sleep and Circadian Disorders, Department of Medicine, Brigham and Women's Hospital (BWH) and Research Fellow at the Harvard Medical School, Harvard University (Boston, United States).

LIST OF PUBLICATIONS

Published articles included in this thesis

1. **Faquih T**, van Smeden M, Luo J, le Cessie S, Kastenmüller G, Krumsiek J, Noordam R, van Heemst D, Rosendaal FR, van Hylckama Vlieg A, Willems van Dijk K, Mook-Kanamori DO. **A Workflow for Missing Values Imputation of Untargeted Metabolomics Data.** Metabolites. 2020 Nov 26;10(12):486. doi: 10.3390/metabo10120486. PMID: 33256233; PMCID: PMC7761057.

2. **Faquih T**, Mook-Kanamori DO, Rosendaal FR, Baglin T, Willems van Dijk K, van Hylckama Vlieg A. **Agreement of aptamer proteomics with standard methods for measuring venous thrombosis biomarkers.** Res Pract Thromb Haemost. 2021 May 4;5(4):e12526. doi: 10.1002/rth2.12526. PMID: 34013156; PMCID: PMC8110437.

3. **Faquih TO**, Aziz NA, Gardiner SL, Li-Gao R, de Mutsert R, Milaneschi Y, Trompet S, Jukema JW, Rosendaal FR, Hylckama Vlieg A, Dijk KW, Mook-Kanamori DO. **Normal range CAG repeat size variations in the HTT gene are associated with an adverse lipoprotein profile partially mediated by body mass index.** Hum Mol Genet. 2023 Jan 30:ddad020. doi: 10.1093/hmg/ddad020. Epub ahead of print. PMID: 36715614.

Other publications

1. Shrine N, …, **Faquih T**, et al. **Multi-ancestry genome-wide association study improves resolution of genes, pathways and pleiotropy for lung function and chronic obstructive pulmonary disease.** medRxiv 2022.05.11.22274314; doi: https://doi.org/10.1101/2022.05.11.22274314 8.

2. Bedene A, van Dorp ELA, **Faquih T**, Cannegieter SC, Mook-Kanamori DO, Niesters M, van Velzen M, Gademan MGJ, Rosendaal FR, Bouvy ML, Dahan A, Lijfering WM. **Causes and consequences of the opioid epidemic in the Netherlands: a populationbased cohort study.** Sci Rep. 2020 Sep 17;10(1):15309. doi: 10.1038/s41598-020-72084-6. PMID: 32943678; PMCID: PMC7499208.

3. Loef M, **Faquih TO**, von Hegedus JH, Ghorasaini M, Ioan-Facsinay A, Kroon FPB, Giera M, Kloppenburg M. **The lipid profile for the prediction of prednisolone treatment response in patients with inflammatory hand osteoarthritis: The HOPE study.** Osteoarthr Cartil Open. 2021 Apr 22;3(4):100167. doi: 10.1016/j.ocarto.2021.100167. PMID: 36474761; PMCID: PMC9718086.

4. DiCorpo D, LeClair J, Cole JB, Sarnowski C, Ahmadizar F, Bielak LF, Blokstra A, Bottinger EP, Chaker L, Chen YI, Chen Y, de Vries PS, **Faquih T**, Ghanbari M, Gudmundsdottir V, Guo X, Hasbani NR, Ibi D, Ikram MA, Kavousi M, Leonard HL, Leong A, Mercader JM, Morrison AC, Nadkarni GN, Nalls MA, Noordam R, Preuss M, Smith JA, Trompet S, Vissink P, Yao J, Zhao W, Boerwinkle E, Goodarzi MO, Gudnason V, Jukema JW, Kardia SLR, Loos RJF, Liu CT, Manning AK, Mook-Kanamori D, Pankow JS, Picavet HSJ, Sattar N, Simonsick EM, Verschuren WMM, Willems van Dijk K, Florez JC, Rotter JI, Meigs JB, Dupuis J, Udler MS. **Type 2 Diabetes Partitioned Polygenic Scores Associate With Disease Outcomes in 454,193 Individuals Across 13 Cohorts.** Diabetes Care. 2022 Mar 1;45(3):674-683. doi: 10.2337/dc21-1395. PMID: 35085396; PMCID: PMC8918228.

Articles under preparation/Revision

1. **Faquih T**, Willems van Dijk K, van Hylckama Vlieg A., Mook-Kanamori DO., et al. **Hepatic triglyceride content is intricately associated with numerous metabolites and biochemical pathways.** Under revision. 2022.

2. **Faquih T**, Willems van Dijk K, van Hylckama Vlieg A., Mook-Kanamori DO., et al. **Robust metabolomic age prediction based on a wide selection of metabolites.** Under submission.

3. **Faquih T**[1], Landstra, E.N.*, et al. **PFAS concentrations are associated with an unfavorable cardio-metabolic risk profile: findings from two population cohorts.** Under submission.

4. **Faquih, T***, Imtiaz, M.A.*, et al. **Genome Wide Association on Missing Metabolite Measurements.** Under submission.

1 Shared first co-authorship

PHD PORTFOLIO

	Year	Hours
Mandatory courses		
- Basic Methods and Reasoning in Biostatistics (done)	2019	1.5
- PhD Introductory Meeting (including the workshop Scientific Conduct for PhDs) (done)	2019	5
- BROK Course (exempted)		
Generic/disciplinary courses		
- Epidemiology “An Introduction”	2018	3
- Meta-analyse 2019	2019	1
- ONLINE - Survival analysis (Advanced Biostatistics) 2021	2021	1.5
- Analysis of Repeated Measurements	2021	1.5
- Statistical Aspects of Clinical Trials 2022	2022	1
- Writing An Excellent Grant Proposal	2022	1
- International Course on Clinical Epidemiology	2019	2
- Prediction modelling and Intervention research	2019	3
- Causal Inference	2020	3
- Genetics in Drug Development	2022	0.5
Attended lectures, LUMC presentations, participation in meetings		
- Human Genetics work discussion	2019	
Congress attendance and poster or oral presentations		
- WEON 2022 conference ‘The art of Epidemiology’	2022	1.5
- Multiomics to Mechanisms - Challenges in Data Integration Symposium	2019	0.5
- The Dutch Society for Sleep-Wake Research (NSWO) and The Slaapgeneeskunde Vereniging Nederland (SVNL)	2021	0.5
TEACHING ACTIVITIES		
Lecturing, lab assistance, student supervision		
- AWV2: Academic and Scientific Training 2nd year medical students	2019	0.5
- AWV2: Academic and Scientific Training 2nd year medical students	2020	0.5
- Mendelian Randomization practicum/workshop	2019	0.5
- CRIP Clinical Research in Practice	2020	0.5
- CRIP Clinical Research in Practice	2019	0.5
- Critical Appraisal of a Topic Project	2020	1
- Design and Analysis of Biomedical Studies	2020	0.5
- Design and Analysis of Biomedical Studies	2021	0.5
TOTAL number of hours		**31**