

University of Groningen

Health-economics of vaccines in Ethiopia

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DOI:
[10.33612/diss.206070529](https://doi.org/10.33612/diss.206070529)

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Document Version
Publisher's PDF, also known as Version of record

Publication date:
2022

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):
Dagne, A. (2022). *Health-economics of vaccines in Ethiopia: equity considerations and cost-effectiveness analysis*. [Thesis fully internal (DIV), University of Groningen]. University of Groningen.
<https://doi.org/10.33612/diss.206070529>

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Summary

Vaccine-preventable diseases (VPDs) continue to pose a significant public health burden in Ethiopia, four decades after the expanded immunization program (EPI) was implemented in 1980. In Ethiopia, the number of vaccines included in the EPI has grown over time; currently, twelve antigens are part of the country's routine immunization program. Although Ethiopia's vaccination program has been largely successful in reducing morbidity and mortality from VPDs, a large proportion of children were left unvaccinated and thus remain vulnerable. This thesis aimed to examine the drivers of change in childhood vaccination coverage and factors associated with vaccination coverage in Ethiopia, investigate the extent and trend of socioeconomic inequalities in vaccination coverage, and analyze the cost-effectiveness of the human papillomavirus (HPV) vaccine in Ethiopia.

This dissertation is divided into two parts. Part I focuses on overall childhood vaccination coverage and vaccination equity in Ethiopia. Chapter 2 used the Oaxaca-Blinder decomposition method to investigate the drivers of the changes in full childhood vaccination coverage in Ethiopia between 2000 and 2016 using Demographic and Health Survey datasets. The increase in vaccination coverage is mainly driven by the change in the effect of explanatory variables in the model over time and other unmeasured characteristics. The compositional change of certain variables such as maternal education and maternal health care utilization also significantly contributed to the rise in vaccination coverage in Ethiopia between 2000 and 2016. Future research is needed to provide further insight, as unknown factors account for a significant portion of the increase in vaccination coverage in the country. Chapter 3 presents findings from the cross-sectional study aiming to assess factors associated with the uptake of rotavirus vaccine (RVV) and pneumococcal conjugate vaccine (PCV) in Ethiopia. The study found that RVV and PCV uptake was strongly associated with maternal antenatal care use. The uptake of the vaccines was also appeared to vary across the administrative regions and socioeconomic status of the household. Children living in Afar and Somali regional states and those from relatively poorest families were less likely to be vaccinated with the complete schedule of RVV and PCV. The fourth chapter aims to quantify socioeconomic inequality in rotavirus vaccine uptake in Ethiopia using a concentration curve and the concentration index. It also intends to use decomposition analysis to identify factors contributing to socioeconomic inequality. The findings show a significant socioeconomic disparity in rotavirus vaccine uptake in Ethiopia, favoring groups with a higher socioeconomic status. According to decomposition analyses, the inequalities were attributed to the underlining inequalities in antenatal care use, institutional delivery, media exposure,

and maternal education. Chapter 5 looked at the trend in the socioeconomic status-based inequality in measles vaccine uptake in Ethiopia between 2005 and 2016. The results showed that socioeconomic inequality persisted over time. In part II, we deal with the health economics of HPV vaccination. Chapter 6 argued that an estimated benefit from the HPV vaccine can be further maximized if cross-protection, one-dose schedule, and protection against noncervical cancers were taken into account. Chapter 7 presents the result of a cost-effectiveness analysis of the nonavalent HPV vaccine in Ethiopia compared to the current vaccination program with the quadrivalent vaccine. The finding suggests that switching from the quadrivalent HPV vaccine to the nonavalent one is a very cost-effective decision in Ethiopia.

Nederlandse samenvatting

Ziekten die door vaccinatie te voorkomen zijn (vaccine-preventable diseases; VPD's) vormen nog steeds een aanzienlijke last voor de volksgezondheid in Ethiopië vier decennia nadat het uitgebreide immunisatieprogramma (expanded immunization program; EPI) werd geïmplementeerd. In Ethiopië is het aantal vaccins dat in het EPI is opgenomen in de loop van de tijd toegenomen; momenteel maken twaalf antigenen deel uit van het routinematige immunisatieprogramma van het land. Hoewel het vaccinatieprogramma van Ethiopië grotendeels succesvol is geweest in het verminderen van de morbiditeit en mortaliteit als gevolg van VPD's, werd een groot deel van de kinderen niet gevaccineerd en blijven deze kinderen dus kwetsbaar voor VPD's. In dit proefschrift worden de volgende aspecten beschreven met betrekking tot vaccinaties in Ethiopië:

- drijvende krachten achter verandering in de vaccinatiegraad bij kinderen en factoren die verband houden met de vaccinatiegraad in Ethiopië;
- omvang en trend van sociaaleconomische ongelijkheden in de vaccinatiegraad;
- kosteneffectiviteit van het humaan papillomavirus (HPV) vaccin in Ethiopië.

Dit proefschrift is bestaat uit twee delen. Deel I richt zich op de algemene vaccinatiegraad bij kinderen en vaccinatiegelijkheid in Ethiopië. In hoofdstuk 2 is de Oaxaca-Blinder-decompositiemethode gebruikt om de oorzaken te onderzoeken van de veranderingen in de volledige vaccinatiegraad van kinderen in Ethiopië tussen 2000 en 2016 met behulp van datasets van landelijke demografische en gezondheidsenquêtes. De toename van de vaccinatiegraad wordt voornamelijk bepaald door de verandering in het effect van verklarende variabelen in het model in de tijd en andere ongemeten kenmerken. De verandering in samenstelling van bepaalde variabelen, zoals de toegang tot onderwijs van moeders en het toegenomen gebruik van de gezondheidszorg door moeders, heeft ook aanzienlijk bijgedragen aan de stijging van de vaccinatiegraad in Ethiopië tussen 2000 en 2016. Toekomstig onderzoek is nodig om meer inzicht te verschaffen, aangezien onbekende factoren een aanzienlijk deel van de verhoging van de vaccinatiegraad in het land bepalen. In hoofdstuk 3 zijn bevindingen gepresenteerd van een cross-sectionele studie die gericht is op het beoordelen van factoren die verband houden met het gebruik van rotavirusvaccin (RVV) en pneumokokkenconjugaatvaccin (PCV) in Ethiopië. Uit de studie bleek dat de RVV en PCV-vaccinatiegraad sterk geassocieerd was met het gebruik van prenatale zorg door de moeder. De vaccinatiegraad bleek ook te variëren tussen de administratieve regio's en de sociaaleconomische status van het huishouden. Kinderen die in de regionale staten Afar en Somalië woonden en kinderen

uit relatief arme gezinnen werden minder snel gevaccineerd met het volledige schema van RVV en PCV. In het vierde hoofdstuk is de sociaaleconomische ongelijkheid in de rotavirusvaccins vaccinatiegraad in Ethiopië gekwantificeerd met behulp van een concentratiecurve en de concentratie-index. Daarbij is ook een decompositieanalyse uitgevoerd om factoren te identificeren die bijdragen aan sociaaleconomische ongelijkheid.

De bevindingen laten een significante sociaaleconomische ongelijkheid zien in de rotavirusvaccins vaccinatiegraad in Ethiopië, waarbij groepen met een hogere sociaaleconomische status een hogere vaccinatiegraad hebben. Met behulp van decompositieanalyses kon de ongelijkheid in vaccinatiegraad toegeschreven worden aan het gebruik van prenatale zorg, bevalling in het ziekenhuis of kraamkliniek, media-aandacht en onderwijs aan moeders. In hoofdstuk 5 is de trend beschreven in de sociaal-economische status-gebaseerde ongelijkheid in de mate waarin de populatie tegen mazelen is ingeënt in Ethiopië tussen 2005 en 2016. De resultaten lieten zien dat de sociaaleconomische ongelijkheid in de loop van de tijd aanhield.

In deel II behandelen we de gezondheidseconomie van HPV-vaccinatie. In hoofdstuk 6 wordt betoogd dat een geschat voordeel van het HPV-vaccin verder kan worden gemaximaliseerd als rekening wordt gehouden met kruisbescherming tegen andere varianten, één-dosisschema en bescherming tegen niet-cervicale kankersoorten. In hoofdstuk 7 wordt het resultaat gepresenteerd van een kosteneffectiviteitsanalyse van het nonavalente HPV-vaccin in Ethiopië in vergelijking met het huidige vaccinatieprogramma met het quadrivalente vaccin. Dit onderzoek laat zien dat het overschakelen van het quadrivalente HPV-vaccin naar het nonavalente vaccin een zeer kosteneffectieve strategie is in Ethiopië.

Acknowledgments

First and foremost, I thank the almighty God for being the source of my strength throughout my life and for the numerous blessings that have shaped me into the person I am today. Several individuals and organizations have contributed to the success of my Ph.D. I want to express my heartfelt appreciation to each and every one of them.

Prof. dr. Maarten J. Postma, I am incredibly grateful to have you as my supervisor. Dear Maarten, your guidance, kindness, and unwavering support, as well as your warm encouragement, were critical to the successful completion of my Ph.D. study. Every time we had a meeting, I felt a surge of energy that inspired me to keep going. You know how to simplify things, and you have taught me a lot about being flexible. I would also like to appreciate your fast response to my email, which really helped me move forward. All the international congresses and courses that you generously allowed me to attend significantly aided me in becoming an independent researcher in my field of study and introduced me to several scientists who were authorities in health economics. You are such a friendly person and invited me to watch FC Groningen with you at the Euroborg; I am fortunate that Groningen has never lost any of the games I have watched. In addition to health economics, you taught me how to be an excellent mentor.

I am also deeply grateful to my second supervisor Dr. René van Hulst. Above all, René, you taught me how to be a structured researcher. You also gradually provided me with all the necessary skills and knowledge required for decision modeling for health economic analysis. During our regular meetings, I received a plethora of insightful comments and suggestions.

I would like to express my deepest gratitude to the members of the reading committee: Prof. dr. T.S. van der Werf, Prof. dr. C. Boersma, and Prof. dr. R. Baltussen for their time and constructive feedback.

I would also like to thank the co-authors of my papers: Derek Asuman, Jos Lutjjeboer, Josué Almansa, Jurjen van der Schans, Prof. Jan C. Wilschut, and Qi Cao, for your insightful advice. It is a great pleasure to collaborate with you and benefit from your expertise.

Tanja and Sisay, my paranympths, I am so grateful for everything that you have done for me.

I warmly thank all my colleagues and friends from the Global Health Unit: Afifah Machlaurin Florian Zeevat, Jurjen van der Schans, Khairul Rizki Purba, Rifqi Rokhman, Simon van der Pol, Simon van der Schans, and Tanja Fens for creating a friendly working environment. I am also grateful to Hanneke, Janneke, and Obbe from the Department of Health Sciences for their prompt administrative assistance.

Many thanks also to current and former members of the Unit of Pharmacotherapy, Pharmacoepidemiology, and Pharmacoeconomics, including Prof. Bob, Prof. Elko, Dr. Talitha, Akbar, Bert, Christian, Didik, Doti, Fajri, Ira, Ivan, Jannie, Jugo, Jurjen, Lusi, Neily, Pepijn, Pieter, Qi, Riswandy, Sofa, Sylvi, Taichi, Thea, Tia, Ury, and Yuan. It has been an absolute pleasure getting to know you all. I have learned a lot from our monthly Pharmaceutical Study Group meetings, for which I am grateful.

Abera, Andrias, Balewugize, Beza, Daniel, Derebew, Fitsum, Kebede, Kenean, Mintesinote, Mulugeta, Niguse, Sisay, Tadesse, Tesfa, Tesfamichael, Tilahun, and Thatcher were all wonderful Ethiopian friends in Groningen who made my stay in the Netherlands so enjoyable. Thank you so much for all of the holiday parties and dinners that made me feel at home. Dera, I cannot thank you enough for your assistance during my first year of Ph.D. studies. I cannot imagine how life would be in Groningen, the city of bicycles, if you had not taken the time to teach me how to ride a bike. Abera, who drew my attention to the use of data from the Ethiopian Demographic and Health Survey, deserves special thanks as well.

I am grateful to the Netherlands Organization for International Cooperation in Higher Education (NUFFIC) for funding my Ph.D. Mainly, I want to express my deep gratitude to Wiebe Zijlstra and Esme Bakker from the Department of International Strategy and Relations for managing my Ph.D. grant. Nobody else could be as compassionate as you two.

I would like to express my gratitude to Asc Academics, market access, and health economics consultancy company based in Groningen, for allowing me to attend their public health economics winter school free of charge for two consecutive years.

My close friends, Biruk Mekonnen, Fantahun Molla, and Tadesse Teferi, I will never forget the encouragement you gave me during my scholarship application and Ph.D. study.

Finally, I would like to express my whole-hearted gratitude to my whole family. Mom, thank you for your unwavering love, self-sacrifices, and unending prayer, which have

Supplements

opened many doors for me and made everything possible. My dear sisters, you are all incredible. You are so selfless and kind. Dear Etalem, you are my second mother; thank you for your guidance and for being by my side at every single stage of my life. My elder brother, Fikeremaryam, without your encouragement and '*Tselote-Etan*,' the road to my Ph.D. would have been steeper and steeper. Thank you so much for everything you have done for me. I have no words to express how grateful I am to my wife for being my support, comfort, and source of energy. Fiker, you have always been there to help me out when I am stressed. My dear, I would not be where I am without you. My lovely children, Zemaryam, Esetemaryam, and Beademaryam, you are a source of inspiration for me. My little angels, please forgive me for ignoring you at times when you needed me.

List of publications

In Groningen and Before Groningen

1. **Wondimu, A.**, Postma, M. J., & van Hulst, M. (2022). Cost-effectiveness analysis of quadrivalent and nonavalent human papillomavirus vaccines in Ethiopia. *Vaccine* 2022 (Accepted).
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Biography

Abrham Wondimu Dagne was born on September 12, 1984 in Shishinda, Ethiopia. He obtained a Bachelor Degree in Pharmacy (B.Pharm.) from Jimma University in 2006. After his graduation, he joined Mekelle University as Graduate Assistant. Then he obtained M.Sc. degree in Pharmaceutics from Addis Ababa University in 2010 before he started to work as a lecturer at Mekelle University. In September 2016 he moved to the Netherlands to pursue his Ph.D at University of Groningen, Department of Health Sciences, Global Health Economics unit with a scholarship awarded from Netherlands Organization for International Cooperation in Higher Education (Nuffic) under the supervision of Prof. dr. Maarten J. Postma and Dr. M. René van Hulst. His doctoral research focused on investigating the equity aspects and cost-effectiveness of vaccines in Ethiopia. During his Ph.D study, he authored a number of original articles and gave presentations at a number of international conferences. After submitting his dissertation, he started working at University of Gondar, School Pharmacy. Currently he is serving as the head of the School of Pharmacy.

Research Institute SHARE

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