

DSc (Epidemiology and Public Health)

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Applicant's view of the nature and significance of the work submitted

1. Introduction

The work selected for submission in support of this application for a DSc in Epidemiology and Public Health spans 15 years and reflects the application and further development of the applicant's academic expertise in the analysis of biological and social determinants of health. This ranges from work in physiology, through nutrition, maternal and child health, and inequalities in health, to lifecourse epidemiology and applied health services research.

The applicant has therefore organised the material under four main themes:

- maternal and child health;
- inequalities in health;
- lifecourse epidemiology; and
- health services research;

with an additional theme devoted to the interdisciplinary methodological syntheses in epidemiology and public health contained in the three published collections the applicant has edited to-date.

Linking each of these five themes run three analytical strands:

- interdisciplinarity;
- methodological innovation; and
- a focus on the socially-constructed nature of the scientific 'facts' these produce;

with a commentary that describes the academic career path through which each theme relates to the others, and that provides evidence as to why the work submitted:

- is considered to be of high distinction;
- constitutes an original and significant contribution to the advancement and application of knowledge; and
- establishes the applicant as a leading authority in epidemiology and public health;

augmented by the inclusion of citation indices in the Reference list (see under point 4, below) for each of the published papers covered by the Science Citation Index, and by reference to published book reviews for each of the three volumes included therein (see also theme 2.5, below)

2. An overview of the work submitted

2.1 *Maternal and child health*

2.1.1 Child growth and development

The applicant's interest in child growth and development arose out of the ecophysiological research they had conducted on mammalian climatic adaptation for their PhD at the Soogdier Navorsing Instituut at the Universiteit van Pretoria. This research provided substantial evidence of anatomical and physiological plasticity in response to environmental factors (both physical and biological), and prompted their interest in exploring the potential impact of these and other, uniquely human (i.e. social and cultural factors) on human growth and development. This work resulted in the first comprehensive study of child growth and development in sub-Saharan Africa (using data collected from the Birth to Ten Study),¹ and subsequent sub-group analyses of this cohort² examining variation in infant feeding practices that might account for population differences in growth, morbidity³ and infant mortality.⁴

A natural progression of this work, given the emerging 'Foetal Origins of Adult Disease' (FOAD) hypothesis (now known as the 'Developmental Origins of Health and Disease' hypothesis: DOHaD) developed by Professor David Barker and colleagues at the University of Southampton, was to explore the historical impact of nutritional insufficiency on growth and development^{5,6} – analyses that provided plausible evidence for the sorts of tangible developmental impacts thought to be responsible for an increased risk of chronic disease in later life (as proposed by the DOHaD hypothesis). This, in turn, led the applicant to specifically examine the link between birth weight and blood pressure amongst children in the Birth to Ten Study, and to establish the groundbreaking 'Channel Islands Occupation Birth Cohort Study' which has examined the longer term consequences of developmental delay on the health of Channel Islanders who had been subjected to the 1940-45 German occupation of the Channel Islands and the severe food shortages that ensued (see theme 2.3.1, below).

2.1.2 Antenatal and perinatal care

Meanwhile, the applicant's research on child growth and development, and the focus this brought to the interplay between biological and environmental determinants of child health and development, led them to examine in greater detail both antenatal and perinatal events (in particular how these might impact upon the subsequent health and development of children, and indeed their health in later life – as detailed in theme 2.3.1, below). Given that much of the data used for these analyses needed to be abstracted from clinical records and/or questionnaires administered to mothers postpartum, this body of work involved substantive research on the reliability and validity of these records.⁷⁻⁹

Moreover, this focus on the quality of routinely collected data (and how this might be improved) made a significant impact on the applicant's subsequent research in this area, by identifying which variables were most reliable for analysis, and generating an interest in potential improvements in health information systems,¹⁰ and related research into public health practice and how health services research is conducted (see themes 2.4.1 and 2.4.2, below).

This early health services research, focusing as it did on antenatal and perinatal health care, examined a range of putative determinants of perinatal and neonatal health, including predictors of place of birth,¹¹ type of delivery,¹² and the role of pre-pregnant weight measurements, weight measurements at booking¹³ and weight measurements during antenatal care on weight gain during pregnancy.^{14, 15} The latter was an issue to which the applicant subsequently returned with dedicated work on weight gain in pregnancy as a determinant of subsequent maternal obesity and as a critical debate surrounding the questionable utility of these measurements for screening during antenatal care (see themes 2.1.3 and 2.4.1, below).

In the meantime, as part and parcel of this work on perinatal and neonatal health, the applicant examined the social determinants of medical intervention at delivery to establish definitively, and for the first time, that within South Africa there were the highest rates of elective caesarean section in the world.¹⁶ Indeed, this work also established a strong association between elective caesarean sections and 'race' (as prescribed by South Africa's apartheid-era 'population group' classification), which ran counter to the available evidence of obstetric need or ability to pay.¹⁷ Together with earlier work on racial variation in child growth and development (see theme 2.1.1, above), this important finding was to have a profound influence on the applicant's subsequent substantive interest in racial and ethnic inequalities in health, and in the operationalisation of racial and ethnic categories in biomedical research (see theme 2.2.3, below).

2.1.3 Maternal obesity

Following on from work on the predictors of obstetric, perinatal and neonatal health (theme 2.1.2, above), the applicant undertook an extensive programme of research into the impact of pregnancy itself on subsequent obesity (so-called 'maternal obesity'). This proved to be a significant and important programme of research on several counts – first, because it addressed a growing concern relating to the biological and environmental determinants of obesity amongst women (and the health-related consequences thereof, not least type 2 diabetes and cardiovascular disease); second because this work built upon one of the very first 'systematic reviews' conducted on observational epidemiological studies of nutrition and health;¹⁸ third because the work sought to take into account a number of substantive methodological issues integral to this issue (particularly the timing and accuracy of pre- and post-natal weight measurements, on which net pregnancy-related weight gain measurements are based – an issue addressed in theme 2.1.2 above,¹³ and in dedicated work on antenatal weighing practices, see also theme 2.4.1 below); and finally because it sought to establish the relative importance of events prior to, during and after pregnancy on the retention and/or accumulation of weight gained during each of these periods.

The empirical basis for this work stems from retrospective longitudinal analyses of repeat pregnancies, using a dedicated obstetric database abstracted from medical records (as described earlier, in theme 2.1.2, above).⁷ These studies established for the first time that there was substantial variation in weight gain following pregnancy,¹⁹ and that the risk of weight gain was related to parity irrespective of maternal age.²⁰ Furthermore, this work was able to demonstrate that pre-existing overweight and obesity were powerful predictors of maternal obesity,²¹ and that there was a powerful interplay between postnatal environmental and social factors,²² as well as heritable factors (as indicated by grandmaternal anthropometry)²³ on the risk of mothers retaining and/or accumulating additional weight following pregnancy. This work was summarised for an invited commentary in the *Nutrition Bulletin* (published by the influential British Nutrition Foundation), alongside substantive recommendations for the measurement and assessment of maternal obesity for use in subsequent studies and maternity care practice.²⁴

2.2 Inequalities in health

2.2.1 Income inequality and health

Just as the applicant's interest in the Developmental Origins of Health and Disease Hypothesis (see theme 2.3.1, below) was fuelled by their early work on maternal and child health, and on the analytical challenges of using data abstracted from clinical records, so their early analyses of the biological and environmental determinants of maternal and child health led the applicant to take a greater interest in the social determinants of inequalities in health (and, in particular, the 'relative income hypothesis' proposed by Professor Richard Wilkinson at Nottingham University and championed, amongst others, by Professor Sir Michael Marmot in his recent Government-sponsored review *Fair Society, Healthy*

Lives).¹⁶⁻¹⁷ This natural progression in the applicant's work, together with their interests in health care research in South Africa, led to the first comparative analysis of income inequality and health focussing on South Africa – a country with one of the highest levels of income inequality in the world.² However, this analysis posed more questions than it answered (not least the impact of racially discriminatory policies on income inequalities and health – a theme to which the applicant subsequently returned with a substantive body of work, summarised in 2.2.2 and 2.2.3, below) – which led them to explore in greater depth the empirical basis upon which the 'relative income hypothesis' was based.

To this end the applicant offered a preliminary assessment of contemporary critiques (based upon the statistical artefact generated by extrapolating between curvilinear relationships between income and health at the individual level and at the population level, and the ways in which individual-level curvilinear relationships create artefactual relationships between income inequality and population health),²⁶ followed by a keynote critique which was published in *Social Science and Medicine* at the request of the Editor-in-Chief.²⁷ This paper not only demonstrated conclusively the power of the artefact but also, importantly, offered a paradigm-shifting reprieve for the hypothesis by indicating the various ways in which differences in the height, slope and curvilinearity of individual-level relationships between income and health in different populations might create the mechanism required to uphold the basic epidemiological tenets of the 'relative income hypothesis'.²⁷ To-date the applicant remains the only person to have tested this mechanism (using individual-level data from the World Values Survey), to establish that this mechanism might be the means through which 'social trust' – as both a determinant and a consequence of policies responsible for income inequality – might generate the differences in population health observed.²⁸⁻²⁹

2.2.2 Racial inequalities in health in South Africa

The applicant's analysis of the potential role of income inequality in health inequity within South Africa²⁵ was, in part, an attempt to better understand some of the potential structural factors responsible for the racialisation of health and health care, and the role of race in health inequalities in pre- and post-apartheid South Africa. In the process of exploring population-based variation in maternal and child health within South Africa (see themes 2.1.1 and 2.1.2, above),^{1,2,5,16,17} it became necessary to explore in greater depth not only the potential role of 'race' itself (in terms of apartheid's official 'population group classifications'), but also how this was operationalised and applied by researchers addressing racial inequalities in health and health care. These questions initiated intense debate, not least amongst colleagues working on the Birth to Ten Study, for many of whom racialised analyses were an integral yet shallowly theorised component of their work. These debates led the *South African Medical Journal* to commission a 'special article' to address the meaning and potential utility of racialised health data within a de-racialised democratic South Africa.³⁰ The resulting article proved to be a milestone, both within South African health research (where it received a number of challenging responses in the media and medical press),³¹⁻³³ and in the subsequent direction of the applicant's research (as detailed in theme 2.2.3, below).

To answer those who questioned the thesis contained in the *South African Medical Journal*³⁰ – that the (mis)use of racial categories in health research ran the risk of reifying the racialised attitudes and beliefs responsible for generating much of the racial inequalities in health and healthcare observed – the candidate subsequently conducted two systematic reviews of articles published in the *South African Medical Journal* – the first examining the way in which racial categories were used and interpreted in contemporary research (1992-1996),³⁴ and the second exploring the content of the *Journal* in each of the five decades of apartheid (1950-1990; a review that formed an integral part of the important submission by the Health and Human Rights Project to the Health Sector Hearings of the South African Truth and Reconciliation Commission).³⁵

This work was followed up with more theoretical³⁶ and empirical work³⁷ on the philosophical and conceptual underpinnings of racial prejudice and the formalisation of racialised 'population group'

categories under apartheid. And, in turn, this work led to the key role the applicant played in the analytical deconstruction of Satoshi Kanazawa's infamous "Savanna Hypothesis", which claims that contemporary African populations score poorly on Euro-centric IQ tests because the emergence of *Homo sapiens* in Africa meant that populations who remained resident in Africa would not have been subjected to selection pressure for intelligence – a pernicious argument which the applicant was able to demonstrate to be based on a specious thesis, poor data and substantial methodological, analytical and representational flaws.³⁸ Moreover, this work has led to an enduring interest in the operationalisation of racialised categories by biomedical and health researchers which remains a key focus of the applicant's research to this day (as detailed in the following theme 2.2.3, below).

2.2.3 Operationalisation of race and ethnicity in biomedical research

It is perhaps unsurprising that the applicant's research on maternal and child health in South Africa has led to their enduring interest in racial and ethnic inequalities in health, and thereafter to in-depth analyses of the ways in which race and ethnicity are conceptualised and operationalised in biomedical research^{30,34-35} (and, indeed, their subsequent impact on healthcare policies and practice – see particularly their work on Bidil® in theme 2.4, below). This has involved a number of detailed theoretical and methodological papers,³⁹⁻⁴¹ as well as empirical work exploring both the experiences⁴²⁻⁴⁴ and practices⁴⁵⁻⁴⁷ of biomedical researchers, and assessing their potential consequences⁴⁶⁻⁴⁸ and the potential role of journal editors as gatekeepers of best practice.⁴⁹⁻⁵¹

This research has made a substantial impact on our understanding of biomedical research practices, and has offered a pragmatic explanation as to why racialised categories retain such salience to biomedical researchers.⁴⁴ It has taken the debate beyond the narrow confines of social constructivist critiques, to identify both the presumed^{42,43} and potential⁴⁰ analytical utility of (routinely collected) statutory and bespoke racial and ethnic categories in current and future biomedical research. The applicant's seminal contribution in this area has been to take much of the heat out of the issue and allow a more rational (and ultimately more practicable) synthesis of prevailing critiques. This has involved recognising that race and ethnicity can mean many different things to researchers from different disciplines and, if thoughtfully applied, can offer substantive analytical insights into both the prevalence of inequalities based on race/ethnicity and the underlying causes involved.³⁹ As such this research has involved a substantive development in the applicant's own understanding and beliefs regarding the meaning(s) and potential utility of racialised categories – moving on from what, in retrospect, appears a rather obvious critique of categories (falsely) assumed to be essential and bioculturally-determined,³⁰ to a more nuanced epidemiological critique of how such categories can be used and when they are likely to do more good than harm.^{41, 48}

This research continues to be a focus of the applicant's academic work, with recent and ongoing collaborative research projects on: the potential development of guidance to improve the ability of social policy research to address race and ethnicity;⁵²⁻⁵⁷ and on the production and application of data on racial and ethnic health needs to inform the commissioning of healthcare services (see: <http://research.shu.ac.uk/eic/index.html>; and theme 2.4.2, below).

2.3 Lifecourse epidemiology

2.3.1 Developmental origins of health in later life

As described earlier (see theme 2.1.1, above), the applicant's epidemiological and public health research on maternal and child health provided a firm basis for exploring the emerging 'Developmental Origins of Health and Disease' (DOHaD) hypothesis using, first, data from children enrolled in the Birth to Ten Study⁵⁸ (which provided the first demonstration of an association between birth weight and subsequent blood pressure to have been conducted outside of Europe and North America) and,

second, to the Channel Islands Birth Cohort Study (which the applicant established in 1999 to explore the potential impact of the 1940-45 German occupation and siege on the long-term health of Channel Islanders).⁵⁹ The latter was the first to systematically document the deteriorating conditions for civilians who were trapped on the islands during the occupation and siege,⁶⁰ and the first to explore and demonstrate the impact of the occupation on childhood growth⁶ and development,⁶¹ and thereafter on disease in later life.⁶²⁻⁶³

However, just as the applicant's earlier work on weight gain during and after pregnancy (see theme 2.1.3, above) required a detailed exploration of the potential errors and biases common to that research (see theme 2.4.1, below) so their work on the developmental origins of health and disease led them to question the utility of accepted approaches for analysing⁶⁴ and understanding⁶⁵ health in later life; as well as the routinely-used markers for undernutrition in early life (in particular, self-reported birth weight,⁶⁶ and indeed birth weight itself⁶⁷) – work which extended to a detailed critique of statistical methods that had hitherto been used to establish the very associations (i.e. those between birth weight and chronic disease in later life) on which the Developmental Origins of Health and Disease hypothesis had been based (see 2.3.2, below).

2.3.2 Statistical critiques of the developmental origins of disease hypothesis

Once again, just as their research on maternal and child health in South Africa led the applicant to explore the conceptualisation and meaning(s) of race and ethnicity in epidemiology and public health research (see theme 2.2.3, above), so their research on the Developmental Origins of Health and Disease hypothesis threw up a number of crucial methodological challenges. The most significant of these was the observation that Simpson's paradox (the creation of an inverse association between dependent and independent variables after adjustment for variables on the causal pathway between the two) might be responsible for the statistical association between low birth weight (as a marker for developmental delay *in utero*) and health in later life when the models used adjust for adult body size⁶⁸ (as most such analyses do). This work has opened up a fissure in the evidence underpinning the Developmental Origins of Health and Disease hypothesis, which remains largely based on flawed analyses that adjust for current size (i.e. adult weight, height and/or body mass index) to demonstrate the relationship (alas, an artefactual relationship) between birth weight and disease in later life. Indeed, the applicant's work in this area generated intense interest and substantial debate (including an invited Commentary in the top-ranked epidemiology journal, the *American Journal of Epidemiology*),⁶⁹⁻⁷¹ and led the applicant to further confirmatory research which demonstrated how the paradox/statistical artefact operates using: meta-analyses of published research,⁷²⁻⁷⁴ and the innovative application of vector geometry.⁷⁵

This work demonstrates how interdisciplinary methodological critiques have linked the applicant's research in epidemiology and public health – drawing on expertise from a range of disciplines to identify fundamental flaws and develop new methodological advances to overcome these. Moreover, this work has recently been extended to a re-analysis of Fisher's classic feline dataset to expose the very different results obtained when analysing categorical data using ratio index variables of general linear modelling (ANCOVA)⁷⁶ – work that has fuelled renewed interest in the 'Population Mixing' hypothesis underlying the putative infectious causes of leukaemia and a range of other chronic diseases.

2.4 Health services research

2.4.1 The evaluation of health care interventions

Whilst the applicant's training as a natural scientist led them initially to engage with epidemiology and public health from a biological standpoint, the application of their ecophysiological expertise to human health has led them to explore not only the social and cultural processes underpinning the production

of health and the production of scientific knowledge, but also to the application of epidemiological research to public health. This link, between aetiological and applied research, can be traced back to the earliest studies the applicant undertook on maternal and child health, where their use (and exploration of) the production of the health service data on which these epidemiological studies were based,^{8-9,77} also generated tangible benefits for public health policy and practice.¹⁴ This early research led to important recommendations on the measurement and recording of prenatal body weight,⁷⁸⁻⁷⁹ just as the applicant's research on the (mis)conceptualisation of race and ethnicity in biomedical research (see theme 2.3.3, above) have led to substantive critiques of 'racial medicine' as manifest in the United States' Food and Drug Administration's decision to license the heart failure drug BiDil® for use only in patients of African heritage.⁸⁰⁻⁸¹

These *applications* of epidemiological research to public health have also stimulated a third key strand in the applicant's research, focusing directly on the evaluation of health care interventions. Amongst these have been studies of continuing professional development for health care practitioners,⁸² and the impact of new health care roles in the diversifying NHS⁸³⁻⁸⁴ (with, importantly, a key focus on the experiences of health service users themselves⁸⁵⁻⁸⁶ – an important contemporary focus with potential to radically affect our understanding of what works *for* rather than *on* patients).

This has also drawn on work initiated whilst the applicant was Research Manager at the Institute of Urban Primary Health Care at Alexandra Health Centre and University Clinic (University of the Witwatersrand, South Africa), building on their interests in HIV and AIDS⁸⁷⁻⁸⁸ (see also, theme 2.4.2, below) to explore a range of interventions for reducing the transmission of HIV/AIDS and other sexually transmitted diseases through: community radio;⁸⁹ audiovisual presentations;⁹⁰ occupational health interventions;⁹¹ and a definitive randomised control trial exploring the impact of lay counsellors and nurse-educators on partner notification in a primary care clinic.⁹²⁻⁹³ The last of these was the first of its kind and one that stimulated a keen interest in evidence-based policy and practice, and once again the fundamental weaknesses of accepted epidemiological practices (in this instance, in secondary research) that require additional context-sensitive methodological development and application (as described in the next theme 2.4.2, below).

2.4.2 Evidence-based health care policy and practice

To a large extent, the applicant's work on evidence-based health care and policy represents the culmination of their empirical research (in maternal and child health, and lifecourse epidemiology) and applied health services research, together with the critical interdisciplinary gaze they have brought to bear on the both the analysis of health and health care, and the production of knowledge in these areas. From the applicant's perspective it is, perhaps, only with an experienced and reflective eye that it is possible to understand why so much epidemiological and public health research fails to have an impact on health care policy and practice – whether as a result of methodological introspection or an unwillingness to understand the context in which health care practitioners and policy makers are obliged to engage with and apply research as evidence for decision-making.

Indeed, there are particular challenges to overcoming the 'evidence-practice gap' which are complicated by the difficulties researchers face in producing evidence that is relevant to health service delivery.⁹⁴ There are also challenges within health services themselves, despite renewed efforts to transcend professional boundaries in multi-sector working for public health partnership.⁹⁵ The applicant's work in this area has involved developing tools and materials⁹⁶ for enabling practitioners and policy-makers to make what the applicant has dubbed 'evidence-informed' decisions – decisions in the absence of definitive evidence. These resources have been tested and evaluated, drawing on research with workshop trainees in South Africa⁹⁷ and elsewhere,⁹⁵ to develop an approach which offers rapid evidence-informed responses to critical health service questions,⁹⁸ – an approach which adopts a realist (and realistic) stance on the potential for epidemiological research to play a substantive role in public health decision-making in the future.

2.5 Interdisciplinarity, methodological innovation and the social construction of scientific 'facts'

In concluding this application for a DSc in epidemiology and Public Health, the applicant would like to draw to the attention of the University's Research Degrees Committee Higher Doctorates Sub-Committee, and the external examiners, the three seminal collections they have edited to-date – on HIV/AIDS,⁹⁹ childhood obesity,¹⁰⁰ and human biology.¹⁰¹

All three provide evidence of the interdisciplinary syntheses the applicant has brought to bear in the field of epidemiology and public health, reaching out beyond traditional disciplinary and professional boundaries, and charting new methodological innovations to explore both: what has been learnt about each of these topics from alternative epistemological traditions; as well as what more we still need to know (particularly to expose and populate the contradictions and spaces that emerge in between).

All three volumes have been well-received (as the book reviews listed after each in the references that follow attest), and all include substantive introductory chapters¹⁰²⁻¹⁰⁴ written to explore, expose and synthesise the benefits of an interdisciplinary gaze on the methodological development of epidemiology and public health research. These offer a fitting endnote to the applicant's career to-date in these uniquely challenging and engaging fields.

3. Extent of the applicant's contribution to collaborative work submitted

Notwithstanding the large number of single author publications included in this application, the majority of these have, by their very nature (as interdisciplinary explorations of methodological issues in epidemiology and public health), involved collaborations with colleagues across a range of disciplines and professions.

Nonetheless, in each of these the applicant has played an integral role (as defined by the International Journal of Medical Journal Editors; www.icmje.org/ethical_1author.html), whether as first (lead) author, last (senior) author or co-author.

In this regard the applicant has made substantial contributions to the conceptualisation, data collection and analysis (where appropriate), interpretation and synthesis of all of these publications, and have defended each during peer-review and publication.