

# BORIS Publications

## Volltexte in BORIS

**Team BORIS, Digitale Dienste & Open Science, Universitätsbibliothek**  
im Oktober 2019

# Volltexte in BORIS

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## Weshalb?

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## Die Publikations-Versionen

### Pre-Print

Vom Autor beim Verlag eingereichte Version.

Diese Version ist noch nicht begutachtet.

Achtung: Pre-Prints werden in Fachrepositorien wie beispielsweise <https://arxiv.org/> abgelegt.

arXiv:1908.10951v1 [math.DG] 28 Aug 2019

#### HIGHER ORDER DISTANCE-LIKE FUNCTIONS AND SOBOLEV SPACES

DEBORA IMPERA, MICHELE RIMOLDI, AND GIONA VERONELLI

**ABSTRACT.** We consider complete Riemannian manifolds with a controlled growth of the covariant derivatives of Ricci curvatures up to order  $k - 2$  and a controlled decay of the injectivity radii. On such manifolds we construct distance-like functions with a control on covariant derivatives up to order  $k$ . Alternatively, the assumption on the injectivity radii can be replaced with the request of a controlled growth of the full curvature tensor at order 0. The control in the assumptions occur via non-necessarily polynomial growth functions. This construction largely extend previously known results in various directions, permitting to obtain consequences which are (in a sense) sharp.

A first main application is to the study of the density property for Sobolev spaces on Riemannian manifolds, namely the problem of guaranteeing the density of smooth compactly supported function in the Sobolev space  $W^{k,p}$ . Contrary to all previously known results this can be obtained also on manifolds with possibly unbounded geometry.

In the particular case  $p = 2$ , making use of the Weitzenböck formula for a Lichnerowicz Laplacian acting on the space of smooth section of the bundle of  $k$ -covariant symmetric tensors, we can weaken the assumptions needed to obtain the density property. Namely we prove that the control on the highest order derivative of curvature is not needed in this situation.

Beyond the density property we finally highlight some new applications of our results to disturbed Sobolev inequalities, disturbed  $L^p$ -Calderón-Zygmund inequalities and the full Omori-Yau maximum principle for the Hessian.

#### CONTENTS

1. Introduction and main results
  - 1.1. Higher order distance-like functions
  - 1.2. The density property for Sobolev spaces
  - 1.3. Sampson-Lichnerowicz Laplacian and the special case  $W^{k,2}(M)$
  - 1.4. Other applications
  - 1.5. Structure of the paper
2. Some notational conventions
3. Higher order distance-like functions
  - 3.1. On the assumptions
  - 3.2. A generalization of a result by Bianchi-Setti
  - 3.3. Proof of Theorem 1.2 case (a)
  - 3.4. Proof of Theorem 1.2 case (b)
4.  $k$ -th order cut-offs and application to the density problem
  - 4.1. Proof of the density result
  5. Case  $p=2$ 
    - 5.1.  $k$ -th order (rough) Laplacian cut-offs
    - 5.2. Weitzenböck formulas
    - 5.3. A Lichnerowicz Laplacian on symmetric  $(0, k)$ -tensors
    - 5.4. Proof of Theorem 1.2
    6. Some sharp applications

10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

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## Die Publikations-Versionen

### Post-Print (Akzeptiertes Manuskript)

Überarbeitete, vom Verlag final akzeptierte Version zur Publikation. Inhaltlich gleichwertig mit der publizierten Fassung.

#### Accepted Manuscript

Title: Personalized solutions for menopause through artificial intelligence: Are we there yet?

Authors: Zayne Milena Roa Diaz, Taulant Muka, Oscar H. Franco

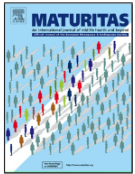
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## Die Publikations-Versionen

### Verlags-PDF

Publizierte Fassung mit Verlagslayout,  
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ELSEVIER

Personalized solutions for menopause through artificial intelligence: Are we there yet?

Artificial intelligence can not only mimic but also greatly extend human intelligence. Machine learning and in particular deep learning models based upon artificial neural networks can draw upon diverse data that include clinical images and medical notes, as well as sensor-generated and genomic data. Such models can iteratively learn from large clinical databases and bring to bear the expertise of multiple medical specialties upon the data of individuals. Thus can medical decisions and personalized therapy for a single patient be informed by vast, collective experience [1].

Artificial intelligence (AI) methods and algorithms are being applied in varying ways across clinical and research domains. Yet machine learning (ML) has only begun to be applied to the menopausal transition. The end of a woman's fertility is a physiological state that is part of aging, and it is accompanied by a myriad of symptoms that include hot flashes, disrupted sleep, loss of energy, anxiety, and feelings of sadness and loss. These can transition to pathological phenomena such as incremental bone loss, diabetes, and cardiovascular disease and mortality. The complexity of menopause challenges general practitioners, gynecologists, and women's health practitioners to provide comprehensive care [2].

By affording the analysis of very large amounts of clinical data, AI could improve the performance of diagnostic and prognostic models for the identification of health issues related to menopause and women at risk of developing complications, and assist physicians in the management of symptoms and health outcomes. ML could have a great impact upon the burden menopause places on health systems, the economy, and society. Although the implementation of AI is in an early phase, conditions such as osteoporosis that are prominent during and after menopause are being approached with deep learning (DL) models. Several studies have used a variety of neural network architectures using advanced algorithms and input parameters to identify groups at risk for osteoporosis, and positive results have been obtained with sensitivity values between 81 and 91% [3]. Image identification and recognition has also improved through the combination of bone density indicators and several texture parameters by models using feed forward

to assist physicians by combining a clustering algorithm with knowledge-based algorithms to recommend hormone therapy for peri- and postmenopausal women [5].

Limited use has been made of AI in the study of cardiovascular risk factors of menopausal women that affect long-term health, survival, and quality of life. Sabanović et al., combined methods that included data mining and decision model trees in the analysis of clinical data to evaluate and revise the standard definition of metabolic syndrome and the recognition of high cardiovascular risk among women who have hypertension and metabolic syndrome [6]. Gorodski et al., implemented a random survival forest model to analyze electrocardiograms (ECGs) and all-cause mortality in 33,144 postmenopausal women and identified 20 variables that independently predict long-term mortality, 14 of which were ECG biomarkers [7].

Even though there has been progress in the application of AI to the study of women's health during and after the menopausal transition, there is not yet evidence of its application in clinical practice. Translating AI to clinical care will require two lines of development. First, our understanding, identification, and measurement of mechanisms underlying menopausal metabolic traits must advance to get optimal input datasets. Second, robust algorithms and systems are needed along with access to larger datasets within an ethical framework that guarantees privacy and data protection. This has special importance for the application of DL models, which allow extraction of features and patterns that expose underlying, relevant characteristics through training with a large amount of data.

We close with a cautionary note. AI is far from being perfected, and even the most sophisticated ML methods will be only as good as the data upon which they are trained. And in women's health, high quality clinical data that include detailed information on all life stages and women's diversity and outcomes are essential. At the same time, research must be cautious with the introduction of historical data because algorithms can readily learn what health professionals do, which includes their mistakes, and they just as easily can incorporate biases induced by health systems inefficiencies [1]. Despite their empirical

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## Haben Sie Fragen?

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