



Yifan Hua (Autor)

Biomarkers of acid-base status and their interrelationships with body fatness, glucocorticoids, and height

**Biomarkers of acid-base status
and their interrelationships with
body fatness, glucocorticoids,
and height**

Yifan Hua



Cuvillier Verlag Göttingen
Internationaler wissenschaftlicher Fachverlag

<https://cuvillier.de/de/shop/publications/8636>

Copyright:

Cuvillier Verlag, Inhaberin Annette Jentsch-Cuvillier, Nonnenstieg 8, 37075 Göttingen, Germany

Telefon: +49 (0)551 54724-0, E-Mail: info@cuvillier.de, Website: <https://cuvillier.de>

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	V
SUMMARY	VI
ZUSAMMENFASSUNG	VII
LIST OF PUBLICATIONS	VIII
TABLE OF CONTENTS	IX
LIST OF TABLES	XII
LIST OF FIGURES	XIII
LIST OF ABBREVIATIONS	XIV
1 INTRODUCTION	1
2 THEORETICAL BACKGROUNDS	3
2.1 Acid-base balance	3
2.1.1 Endogenous buffer system	3
2.1.2 The kidney	4
2.1.2.1 Function of proximal tubule and its response to acid loads	5
2.1.2.2 Net acid excretion and urine pH	8
2.1.2.3 Net acid excretion capacity	8
2.1.3 Dietary influences on acid-base status	10
2.1.3.1 Protein- vs. fruits and vegetables-rich diet	10
2.1.3.2 Urinary potential renal acid load	11
2.1.3.3 Dietary potential renal acid load	12
2.1.3.4 Citric acid and its relation to the kidney	13
2.1.4 Low-grade metabolic acidosis	14
2.2 Modulation of acid-base function	15
2.2.1 Body fatness	15
2.2.1.1 Childhood overweight and obesity	15
2.2.1.2 Adipose tissue	15
2.2.1.3 Adipo–renal axis	16
2.2.2 Adipose-derived adipokines	17
2.2.2.1 Leptin and soluble intercellular adhesion molecule-1	17
2.2.2.2 Adiponectin	19
2.2.2.3 Body fat–inflammation–acid-base relationship	20
2.2.3 Glucocorticoids	21
2.2.3.1 Biological background of glucocorticoids	21

2.2.3.2 Glucocorticoid–acid-base relationship	24
2.3 Higher protein intake and dietary alkalinity as anabolic stimuli	25
2.3.1 Higher protein intake	25
2.3.2 Dietary alkalinity	27
3 RESEARCH QUESTIONS.....	29
4 GENERAL METHODOLOGIES.....	30
4.1 Study population and the DONALD Study.....	30
4.2 Anthropometric measurement	31
4.3 Pubertal stage assessment	31
4.4 Dietary assessment.....	32
4.5 Urinary measurement	32
4.5.1 Acid-base biomarkers	32
4.5.2 Glucocorticoids	33
4.6 Blood measurement.....	33
4.7 Statistical analysis	34
4.7.1 Differences between two populations.....	34
4.7.2 Multi-linear regression analysis (PROC GLM in SAS)	35
4.7.3 Mixed linear regression analysis (PROC MIXED in SAS).....	36
4.7.4 Mediation analysis	36
4.7.4.1 Baron and Kenny's steps for mediation analysis (PROC GLM in SAS).....	37
4.7.4.2 Causal mediation analysis (PROC CAUSALMED in SAS).....	37
4.7.5 Confounders and covariates	38
4.7.6 Overview of statistical analyses	40
5 STUDIES.....	41
5.1 Study I — On the existence of the adipo-renal axis: increased body fatness adversely relates to 24-h urine pH already from childhood onward	41
5.1.1 Abstract	41
5.1.2 Introduction.....	42
5.1.3 Methods.....	42
5.1.4 Results.....	45
5.1.5 Discussion	49
5.2 Study II — Inflammatory mediators in the adipo-renal axis: leptin, adiponectin, and soluble ICAM-1	52
5.2.1 Abstract	52
5.2.2 Introduction.....	53

5.2.3 Methods.....	54
5.2.4 Results	56
5.2.5 Discussion	60
5.3 Study III — Glucocorticoids within the physiological range inversely associate with renal citrate excretion in prepubertal children.....	63
5.3.1 Abstract	63
5.3.2 Introduction.....	64
5.3.3 Methods.....	64
5.3.4 Results	65
5.3.5 Discussion	69
5.4 Study IV — Adult stature and protein intake during childhood and adolescence from 3 years onward.....	71
5.4.1 Abstract	71
5.4.2 Introduction.....	72
5.4.3 Methods.....	72
5.4.4 Results	74
5.4.5 Discussion	79
6 GENERAL DISCUSSIONS.....	82
6.1 Methodological considerations.....	82
6.1.1 DONALD design and participants	82
6.1.2 Anthropometric assessment	83
6.1.3 Dietary assessment	84
6.1.4 24-h urine collection and assessment	84
6.2 Interpretation and implication of results	86
6.2.1 Body fatness, inflammation, and acid-base status (Study I and Study II).....	86
6.2.2 Glucocorticoids and acid-base status (Study III).....	89
6.2.3 Protein intake, acid-base status, and adult stature (Study IV).....	91
6.3 Conclusion and perspectives.....	95
7 References	97