

Zink und Immunsystem oder was Casanova wusste und woran der Simplicissimus erkrankte

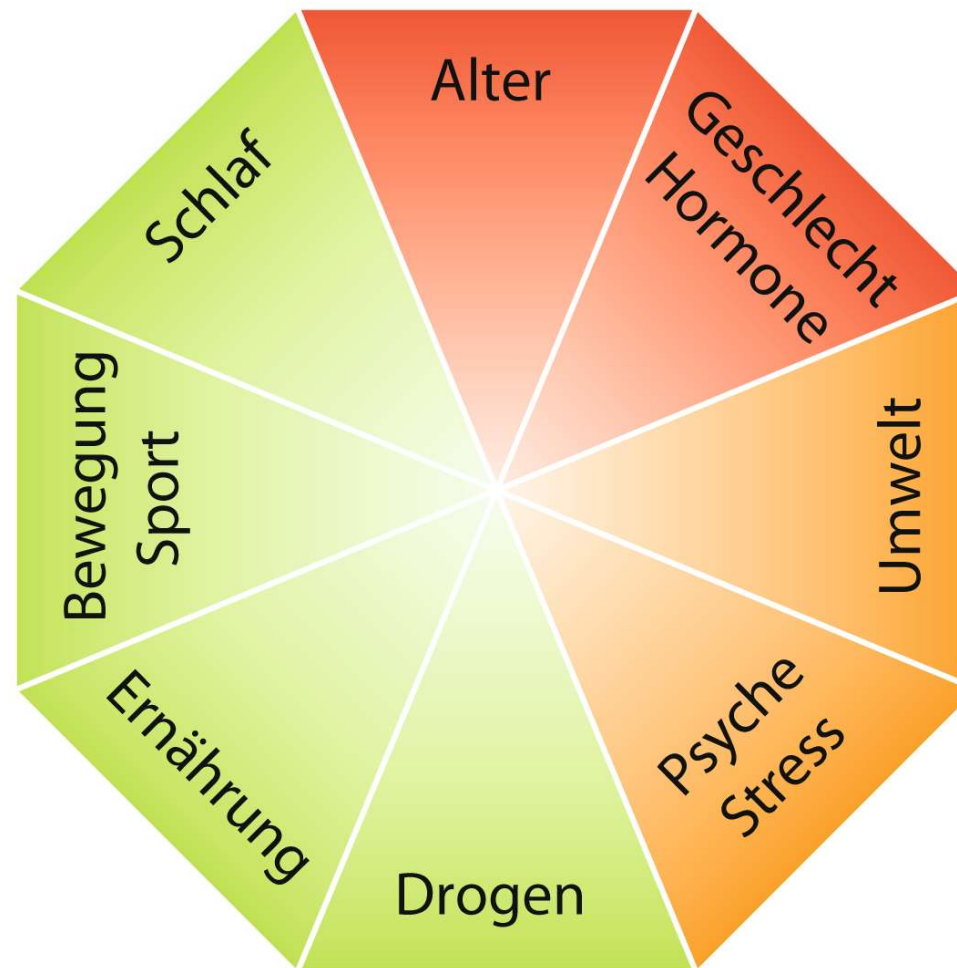
Lothar Rink

Institut für Immunologie

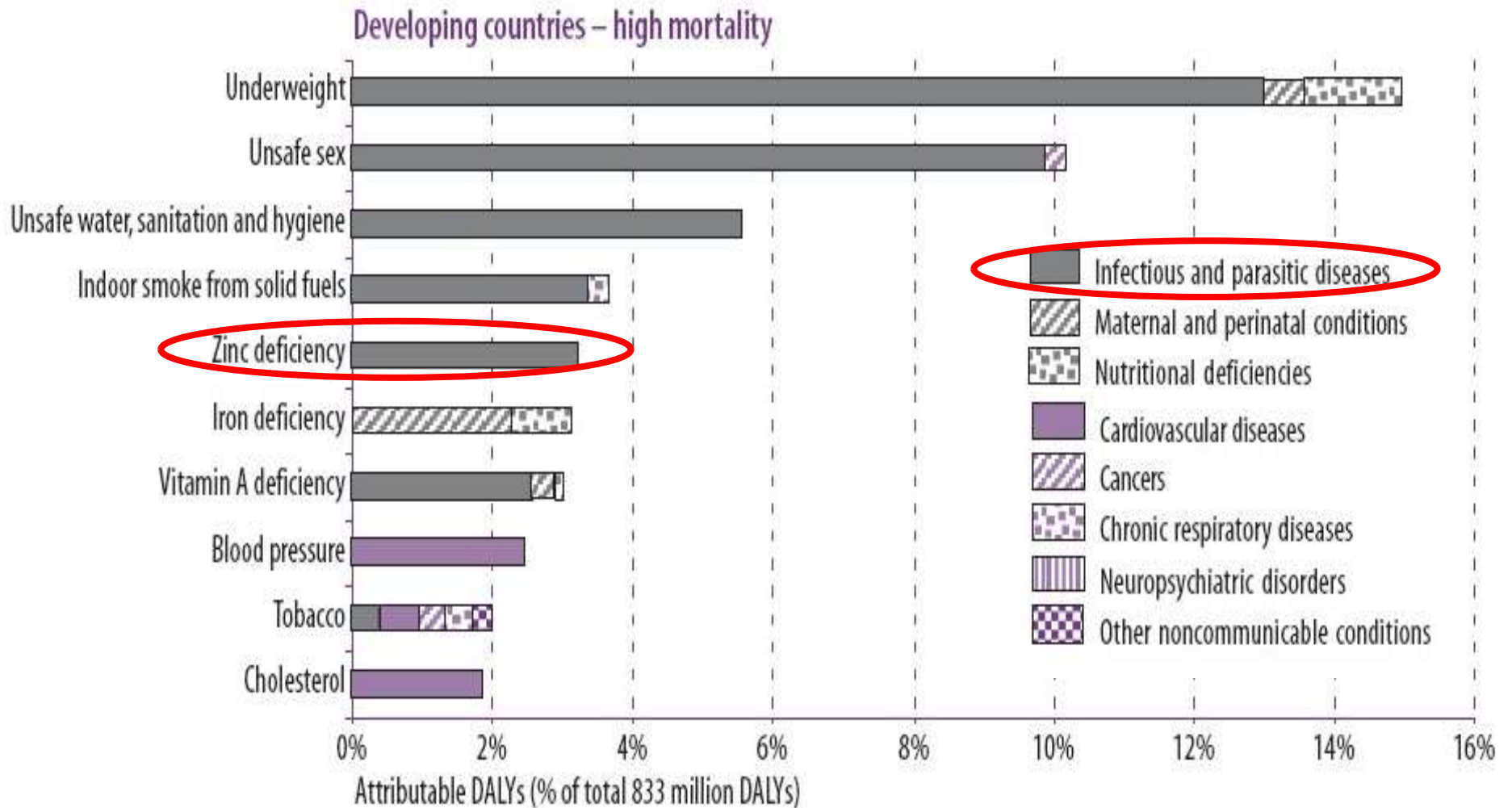
Universitätsklinikum



Einflüsse auf das Immunsystem



Zinkmangel



Zinkmangel in Industrieländern

Schwerer Zinkmangel

- 1-13% in Europa und Nordamerika [Brown et al. Food Nutr. Bull. 2001]

Latenter Zinkmangel

- >50% der Alten [Haase et al. Biogerontology 2006]
- Kinder, Teenager und Frauen [Ibs & Rink Humana Press 2004]

Sekundärer Zinkmangel

- Alkoholismus, Diabetes, Entzündliche Darmerkrankungen, Niereninsuffizienz usw. [Maret & Sandstead J. Trace Elem. Med. Biol. 2006]

Zinkmangel in Deutschland

Gesamtbevölkerung

- 32% der Männer und 21% der Frauen erreichen nicht die empfohlene Tagesmenge [Nationale Verzehrstudie II 2008]

Alte Menschen (65-80 Jahre)

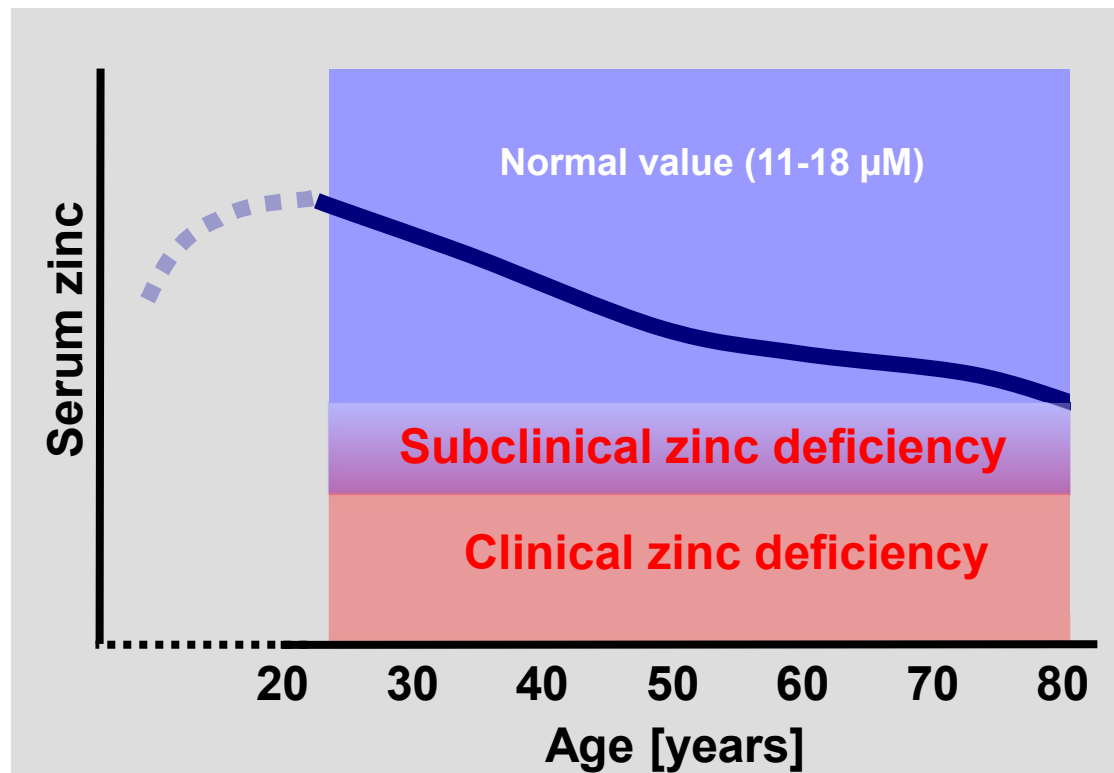
- 44% der Männer und 27% der Frauen erreichen nicht die empfohlene Tagesmenge [Nationale Verzehrstudie II 2008]
- **>75% der Alten Menschen sind im Zinkmangel, wenn man die Aufnahmeempfehlungen der EFSA zu Grunde legt**



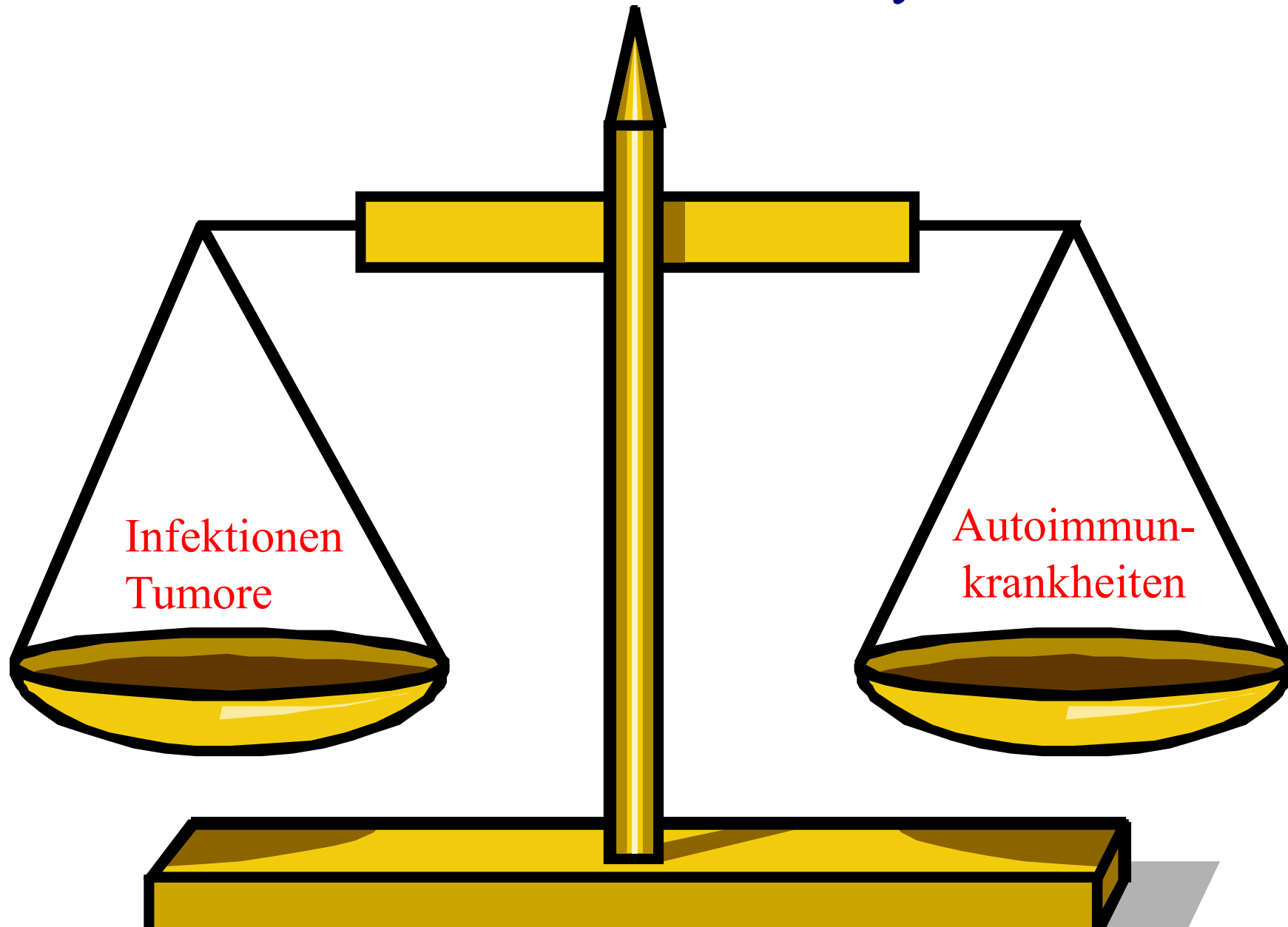
Hajo Haase



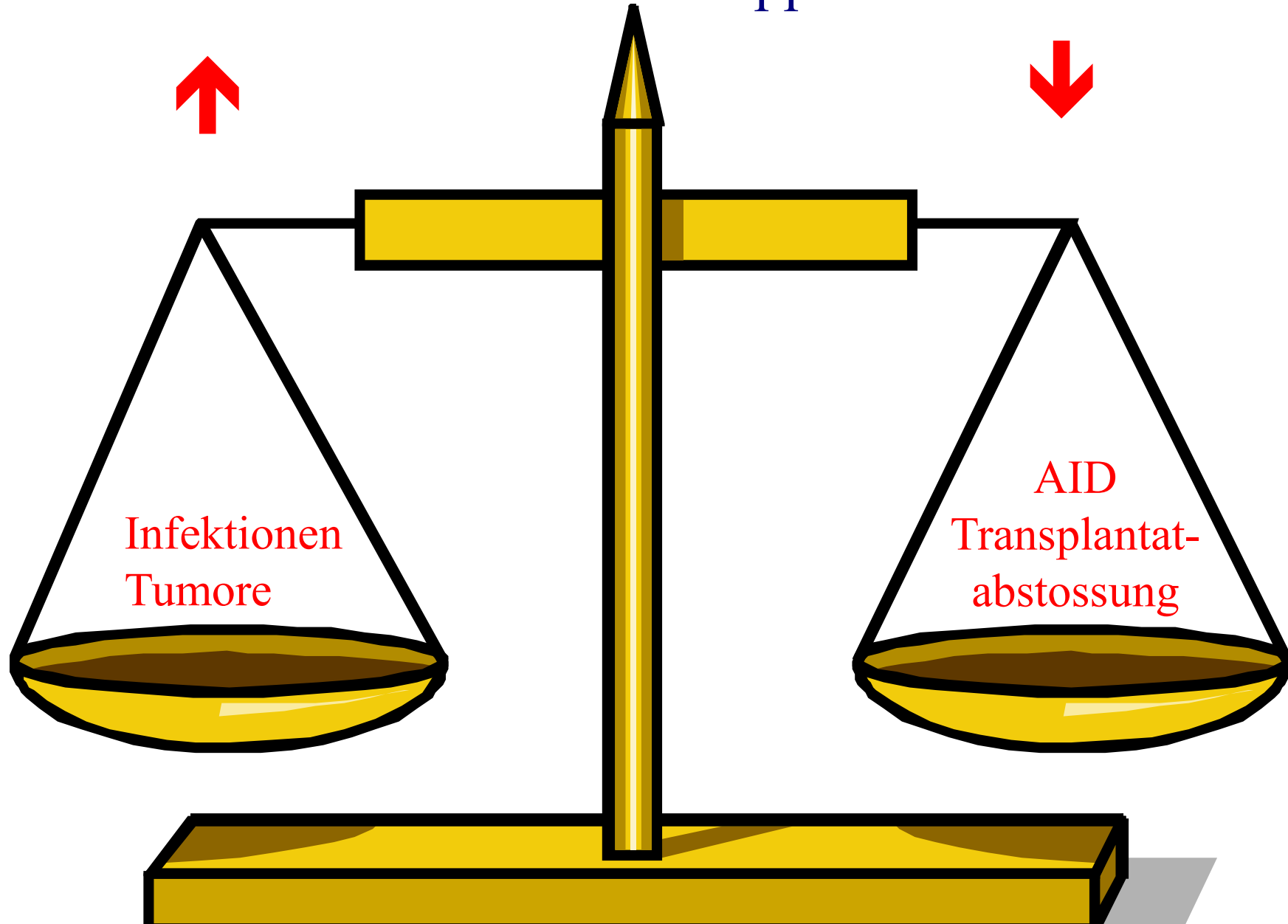
Altersabhängigkeit vom Serumzink



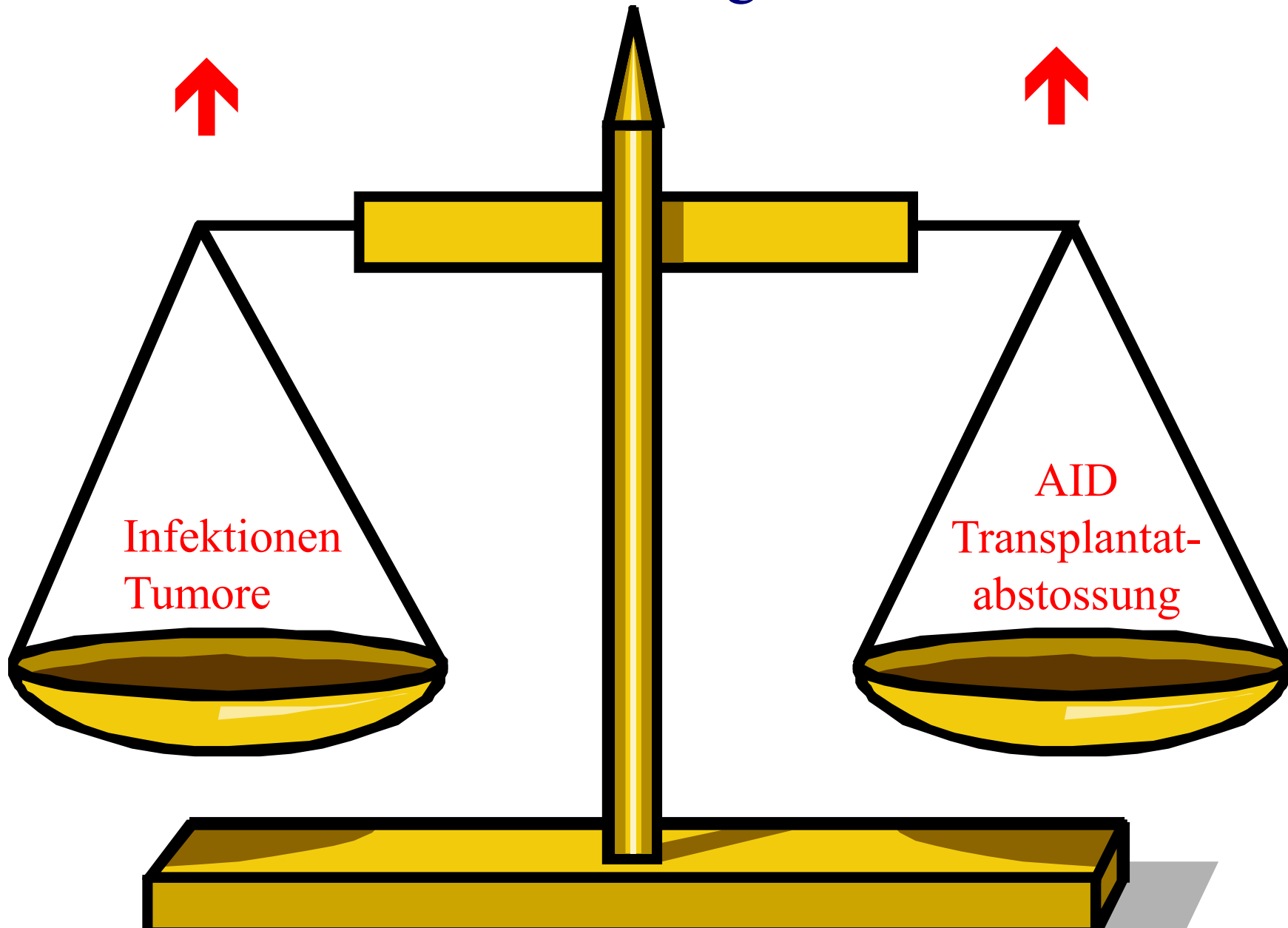
Homöostase des Immunsystems



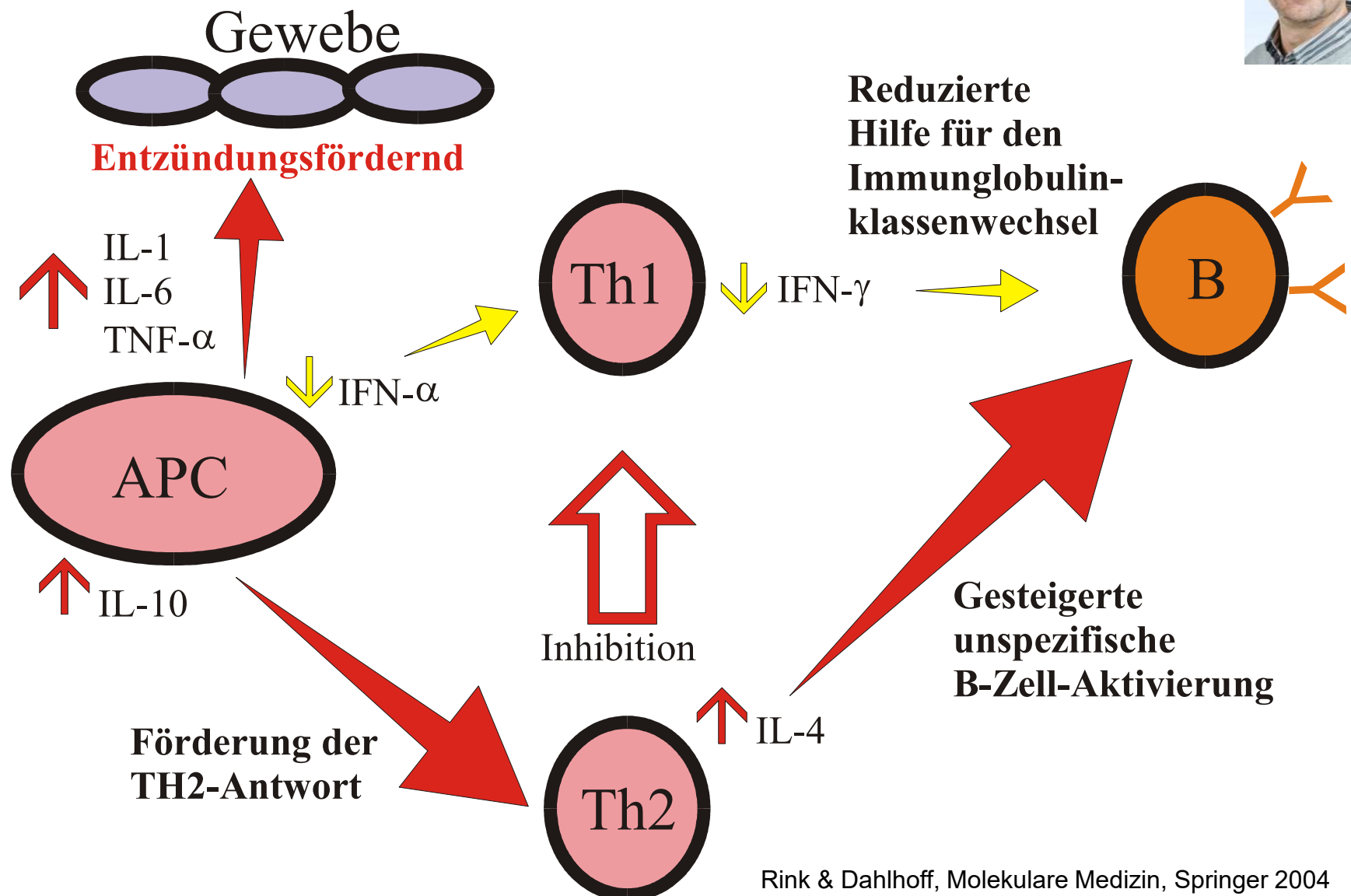
Anti-entzündliche oder immunsuppressive Medikamente



Zinkmangel



Gestörte Immunfunktion bei alten Menschen

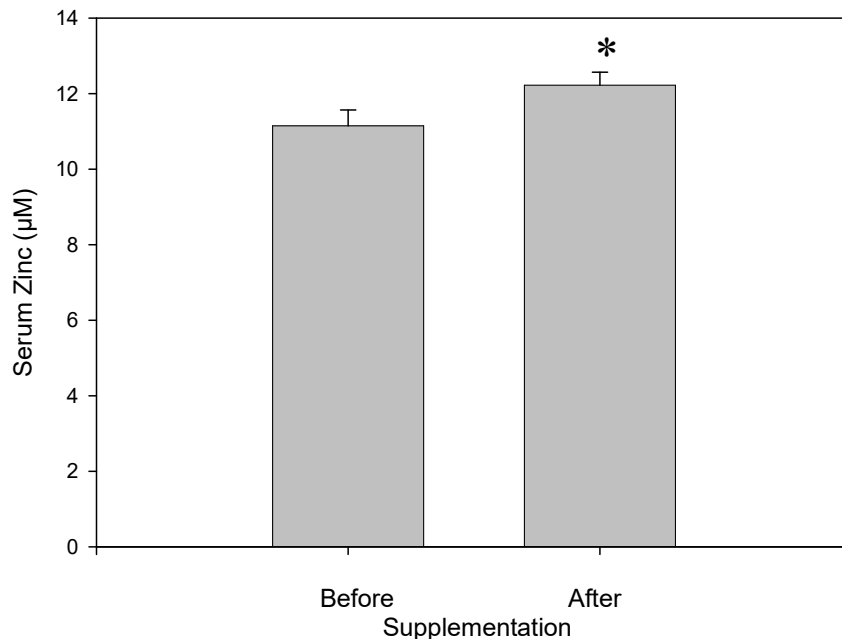


Zinkmessung nach Zinkgabe bei alten Menschen



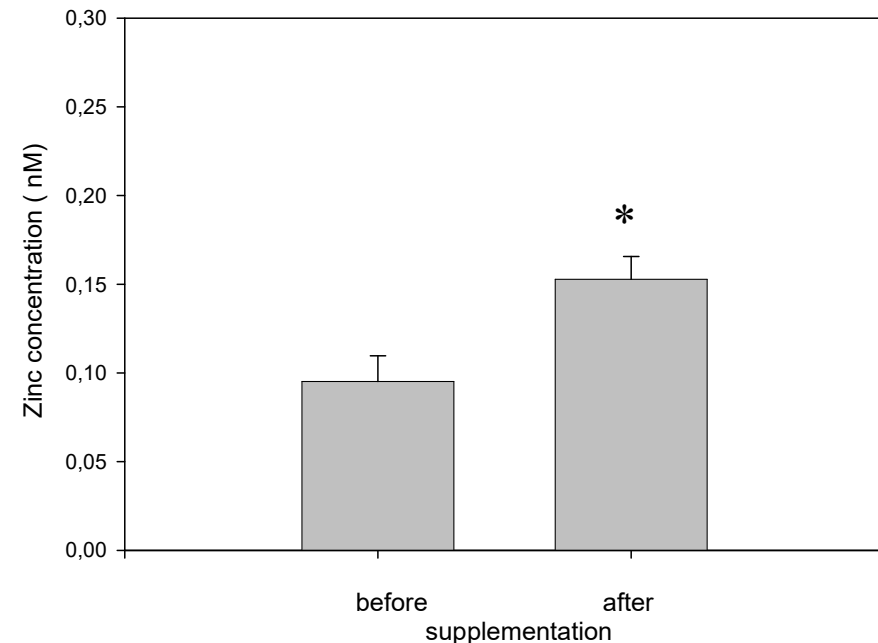
Laura Kahmann

Serumzink



11% Steigerung

Intrazelluläres Zink



61% Steigerung

Alle Leukozyten

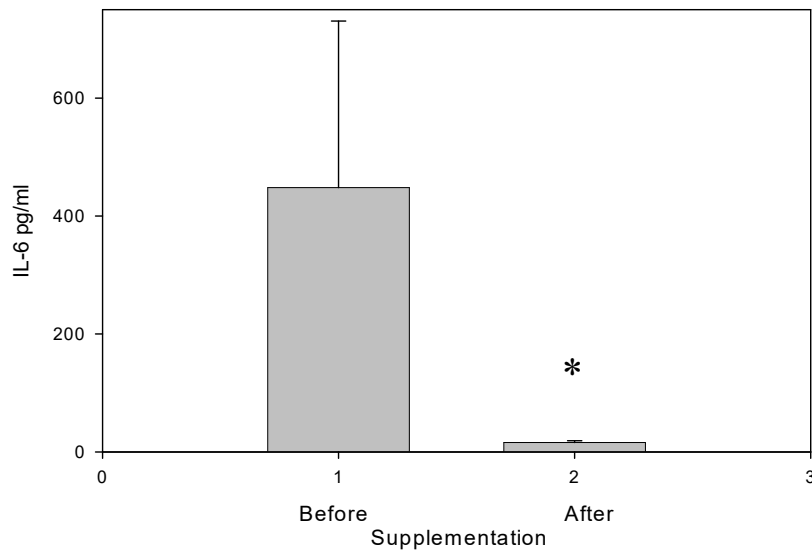
in vivo

Inhibition der spontanen IL-6-Produktion



Laura Kahmann

Spontane IL-6-Produktion



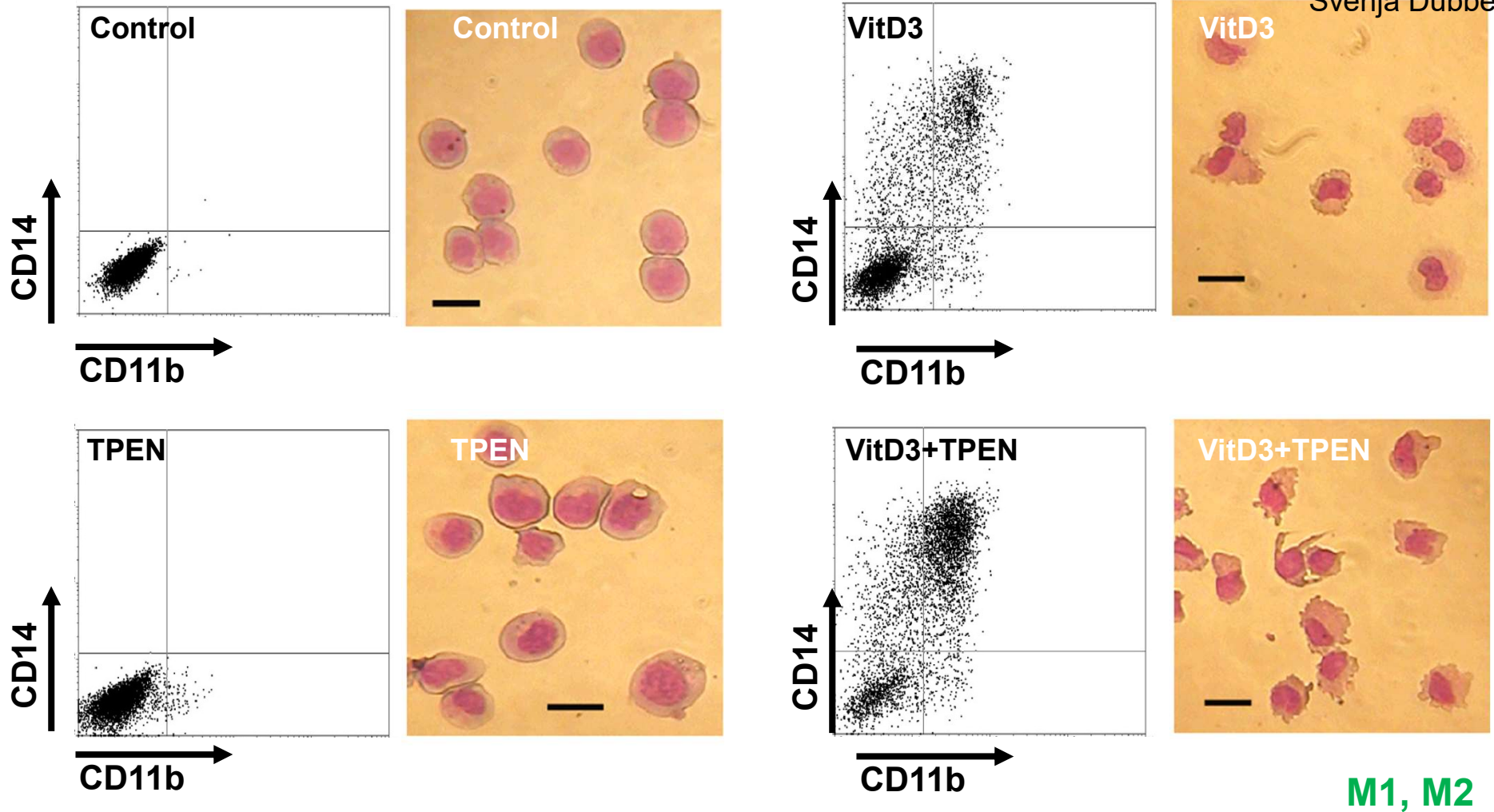
M1

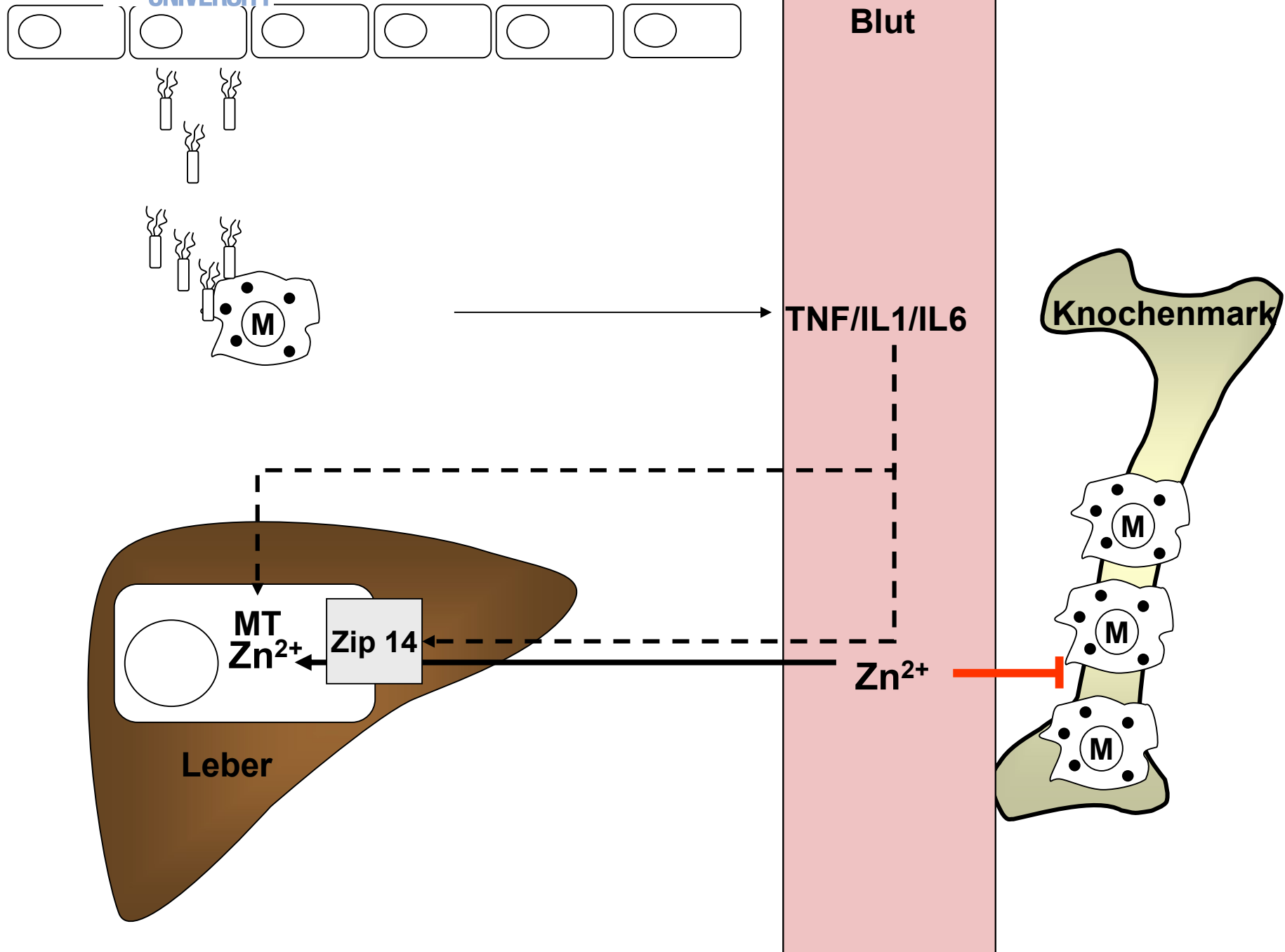
in vivo



Svenja Dubben

Zink und Monozytendifferenzierung

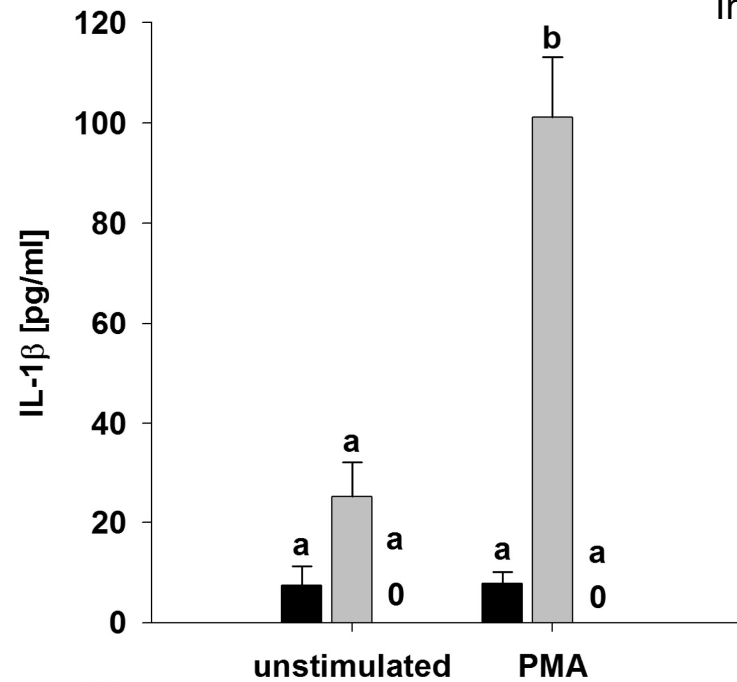
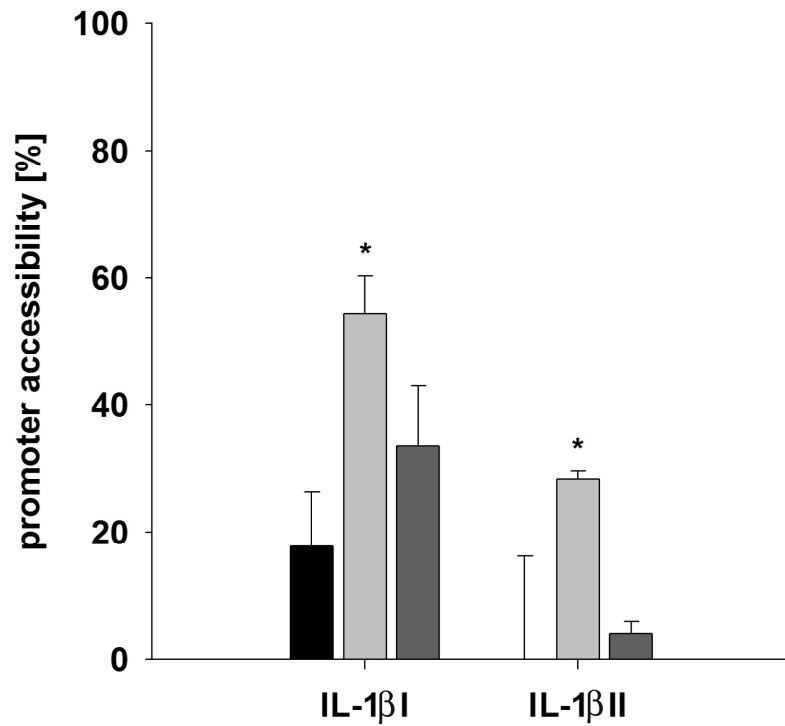






Inga Wessels

Zinkmangel öffnet den IL-1 β -Promotor



M1

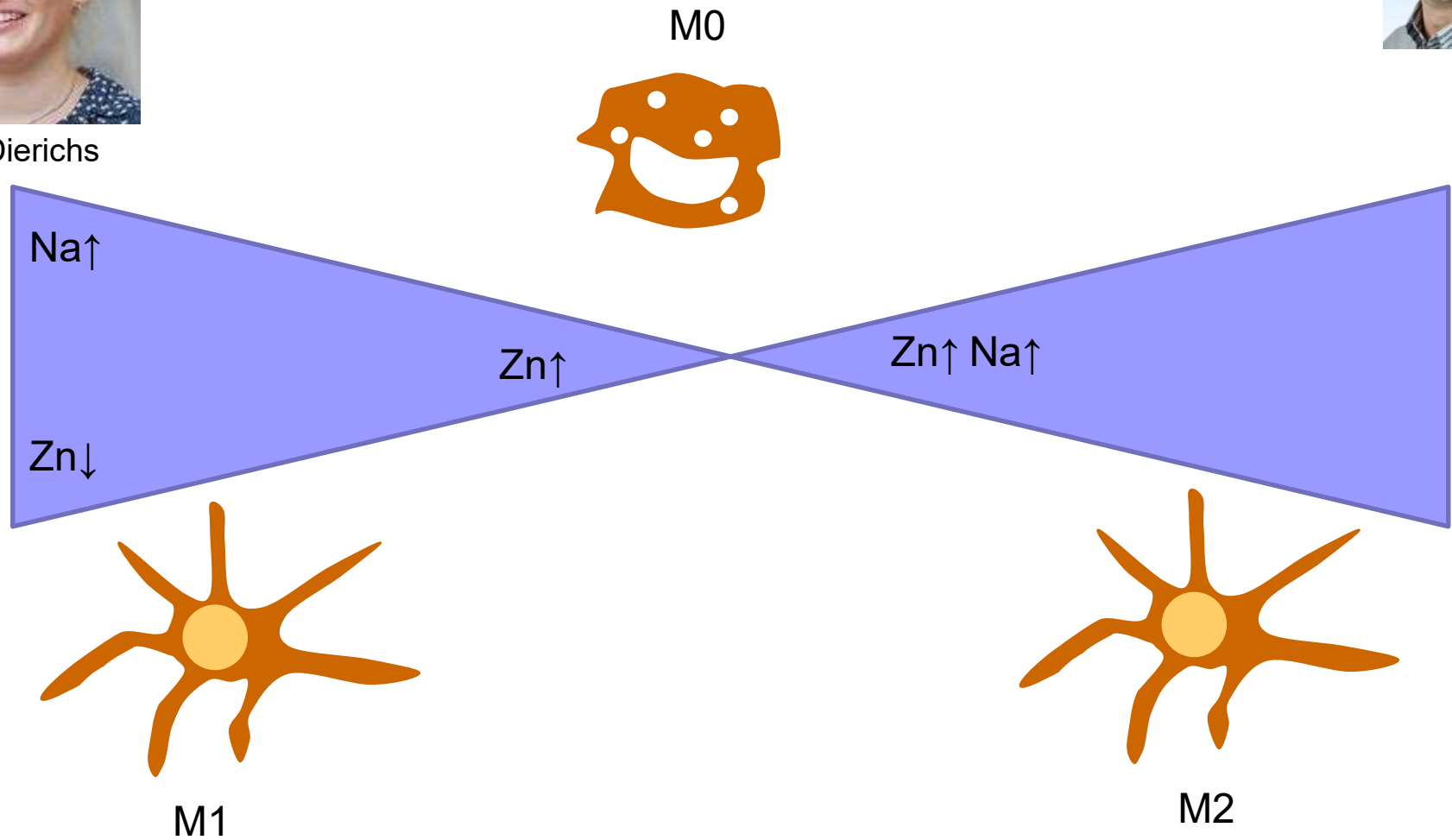
in vitro



Laura Dierichs



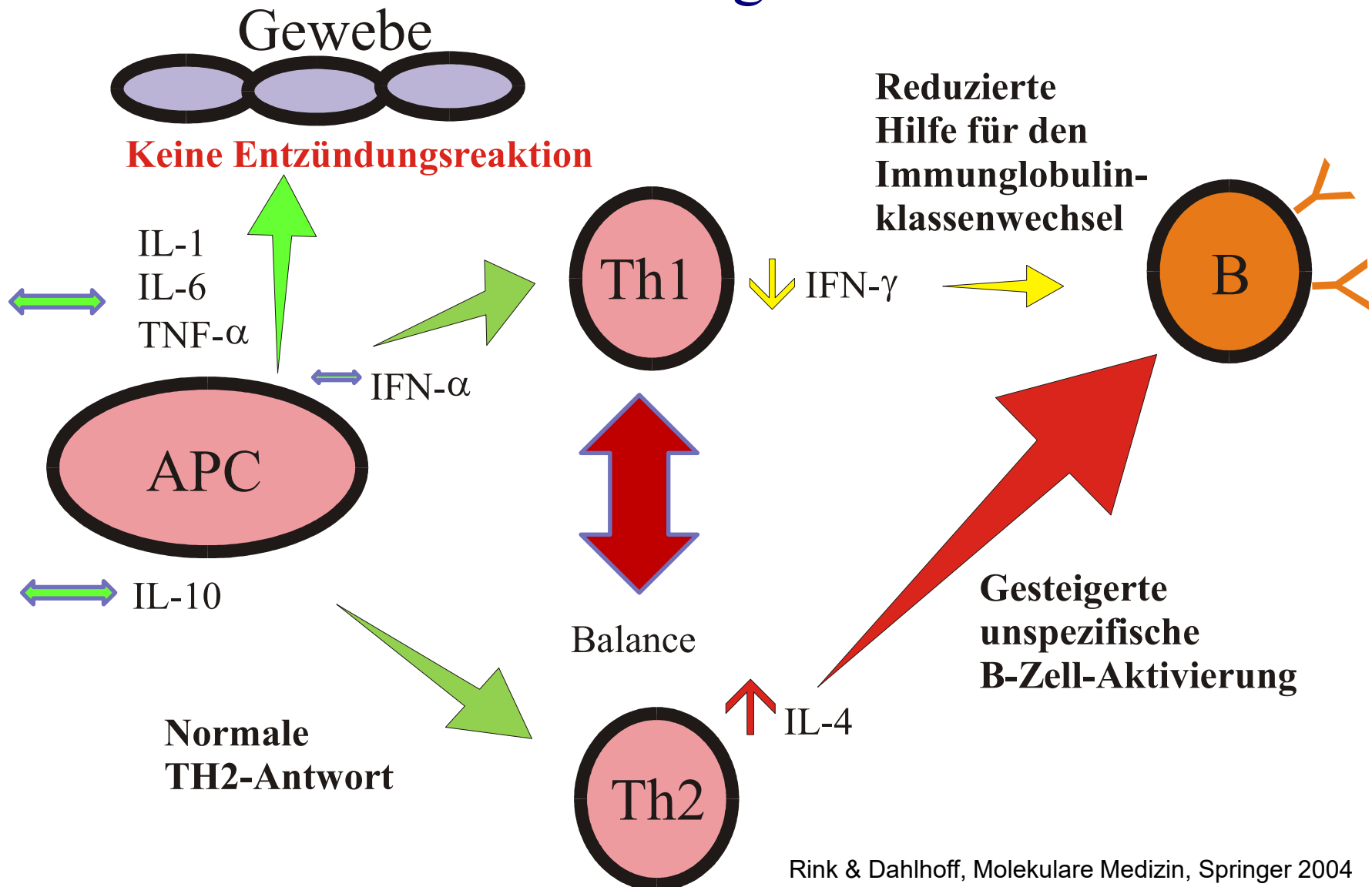
Zink-abhängige Makrophagenpolarisierung



M1, M2

in vitro

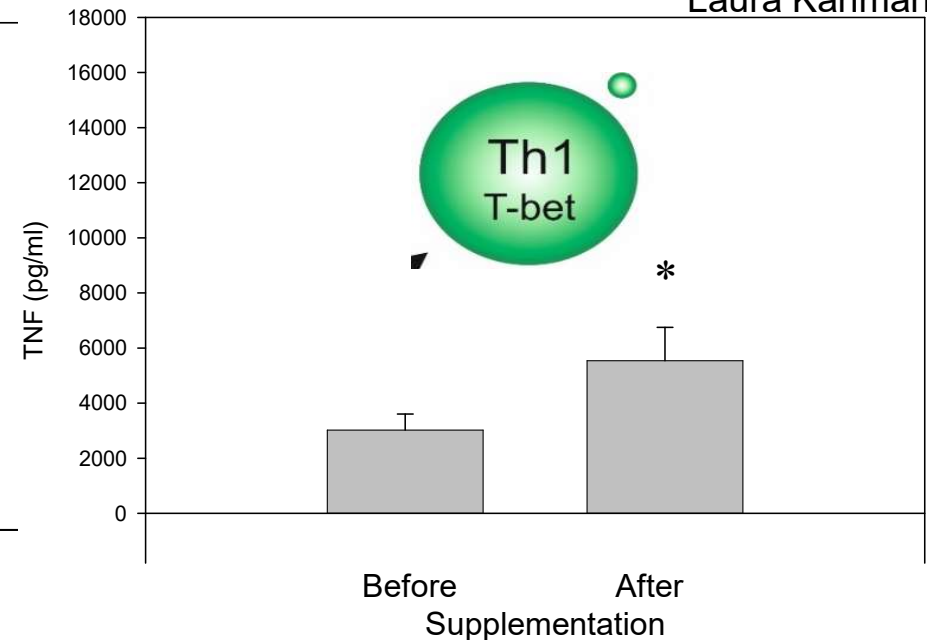
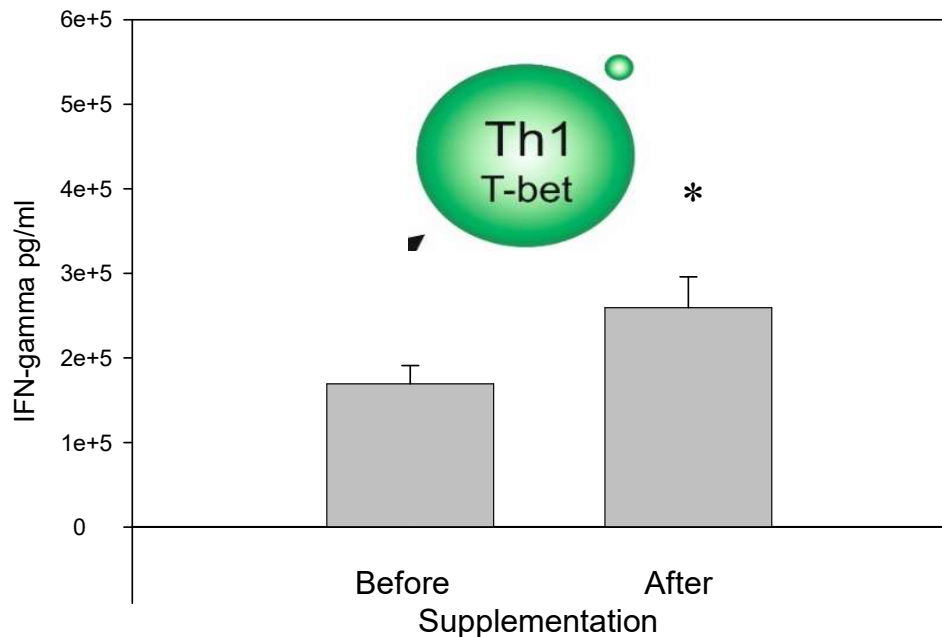
Ausgewogene Immunfunktion bei alten Menschen nach Zinkgabe





Gesteigerte Produktion von TH1-Zytokinen bei alten Menschen nach Zinkgabe

Laura Kahmann



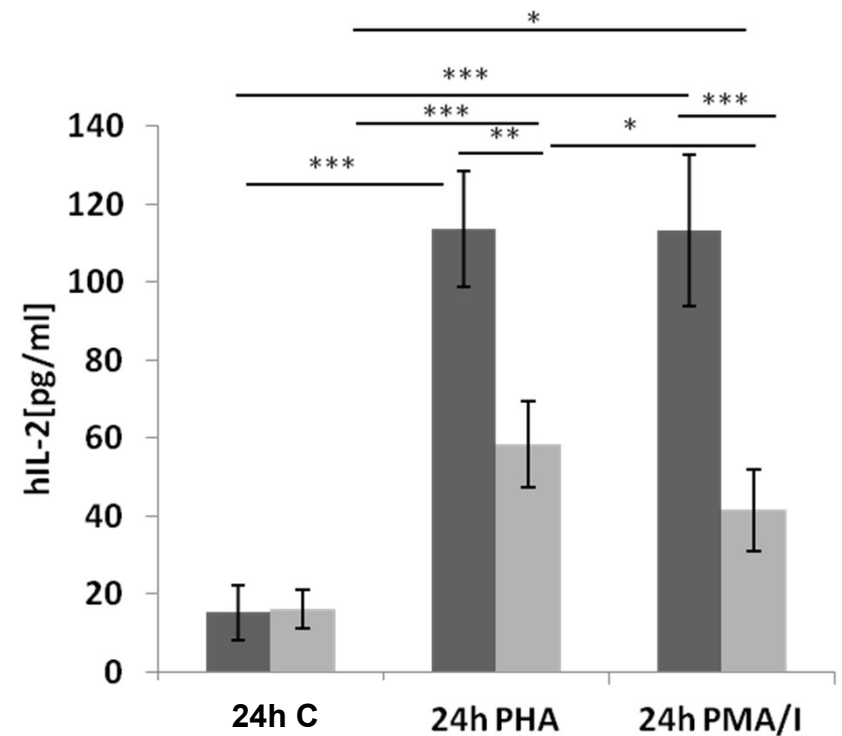
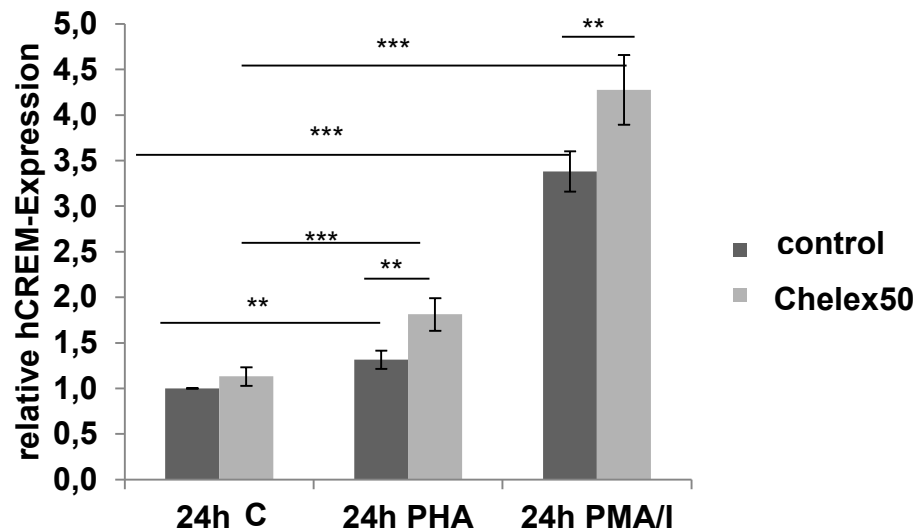
TH1

in vivo



Zink moduliert die IL-2 Produktion

Veronika Kloubert



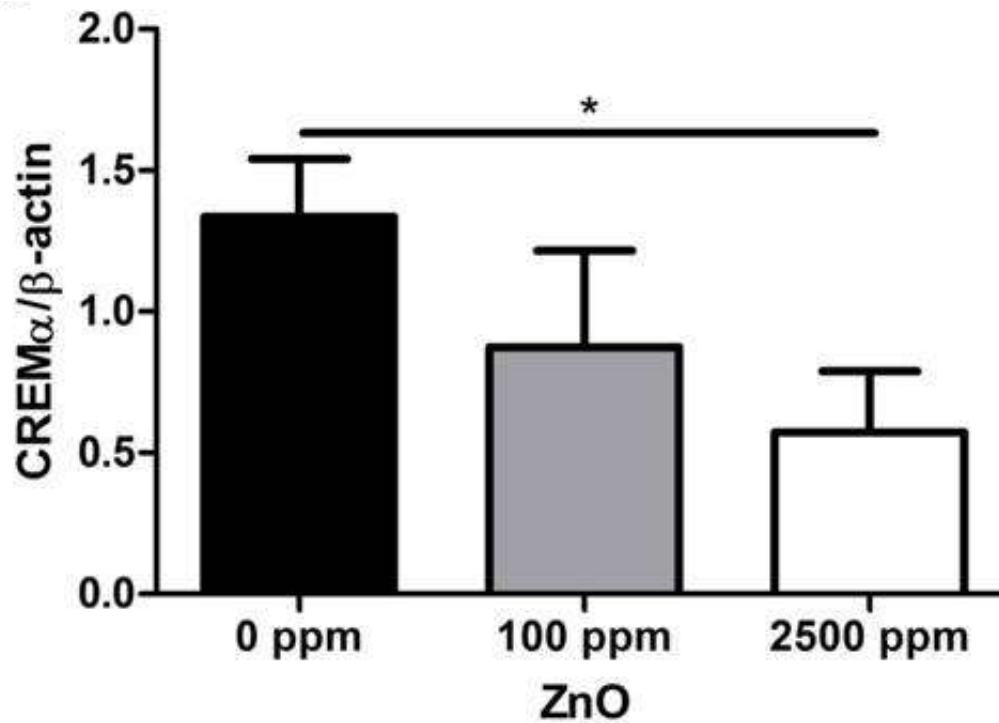
TH1, TH2, TH17, Treg

in vitro

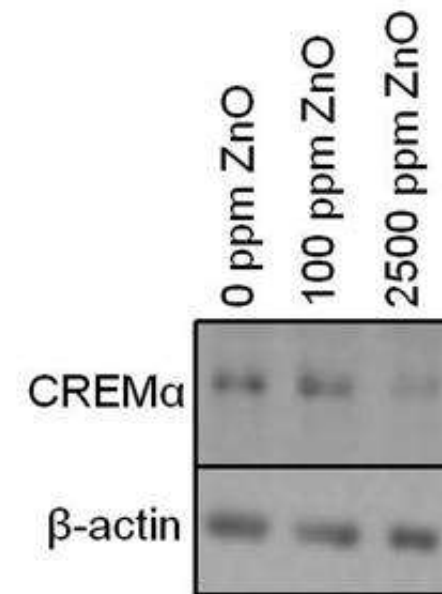


CREM α in Pigs after Zinc Supplementation

Veronika Kloubert



B



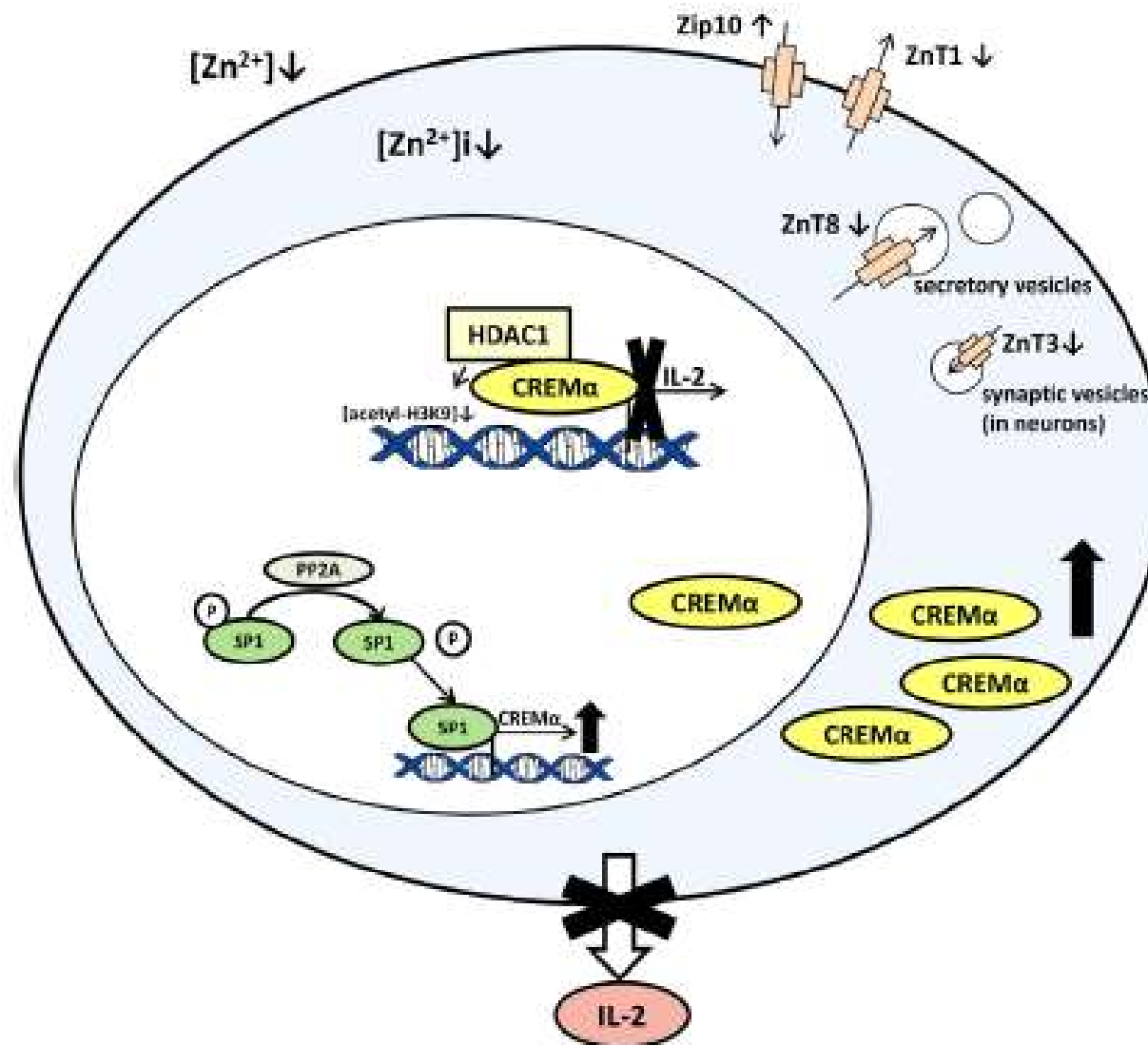
TH1, TH2, TH17, Treg

in vivo

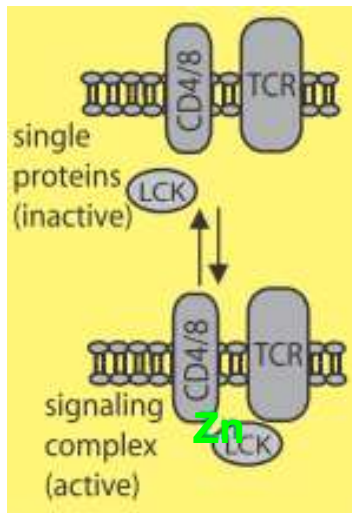
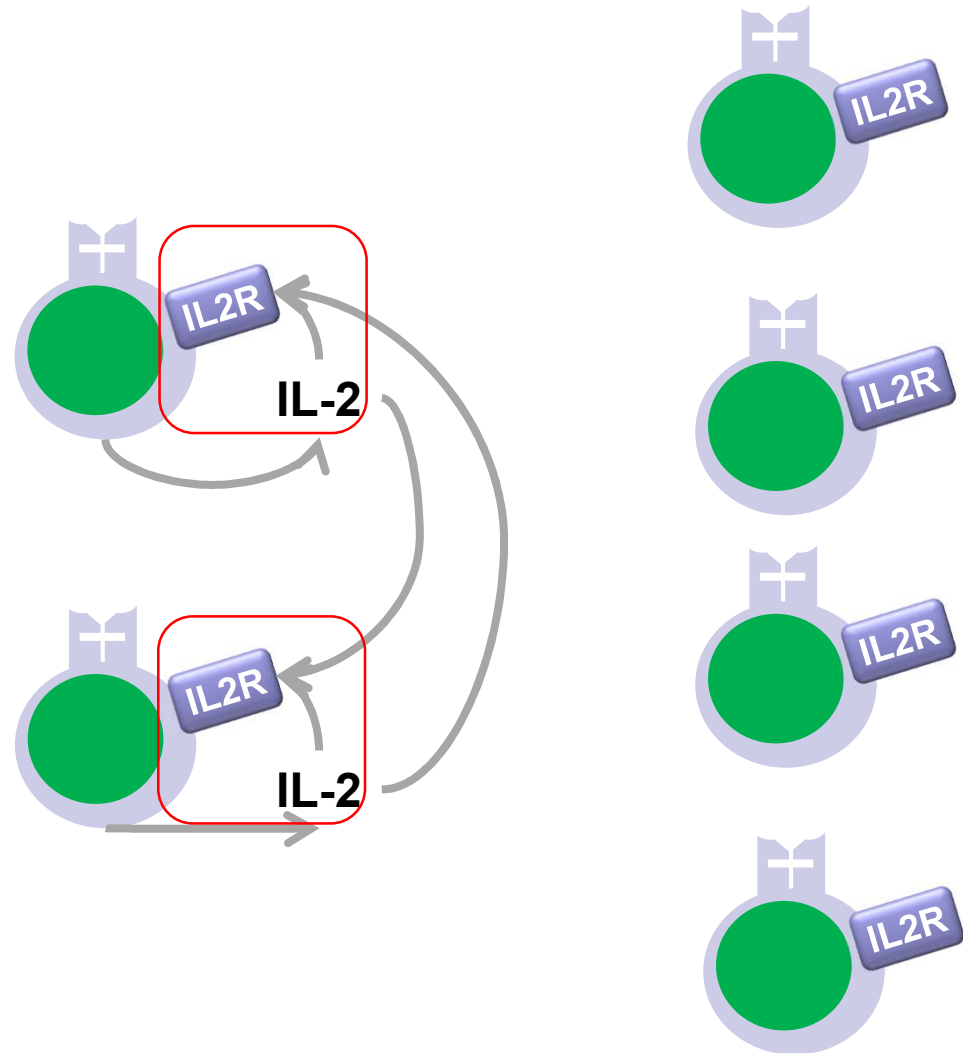
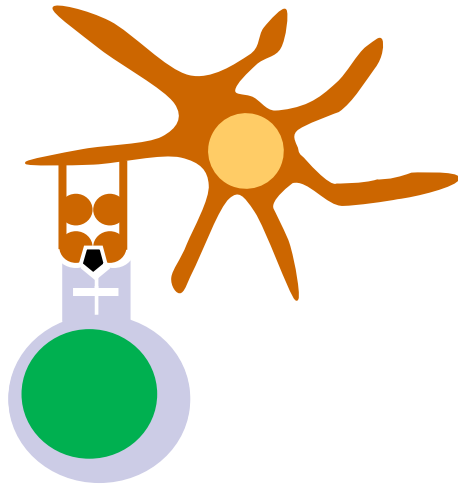


Veronika Kloubert

Teufelskreis des Zinkmangels

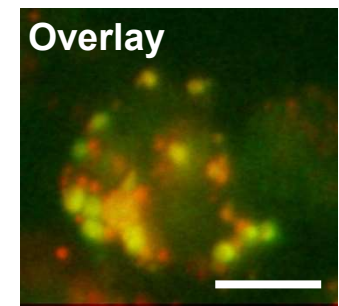
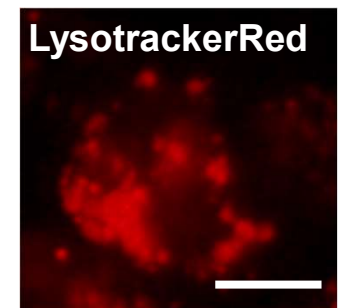
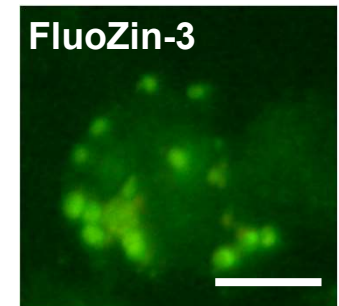
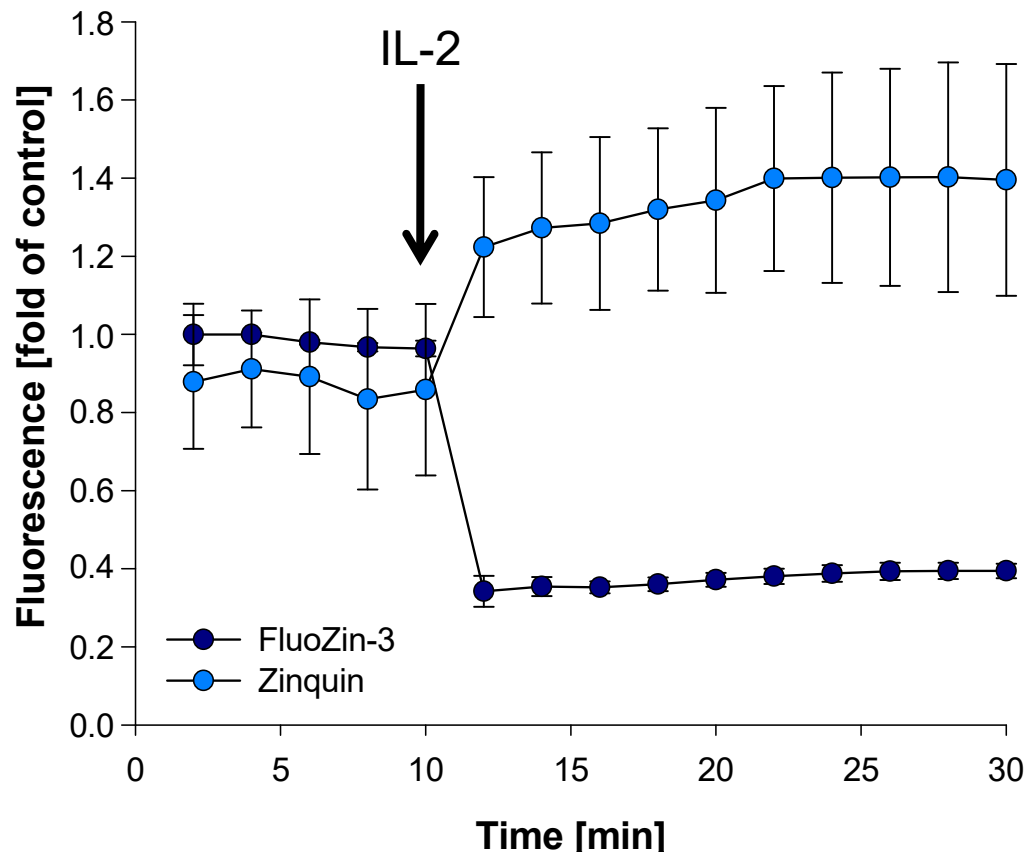
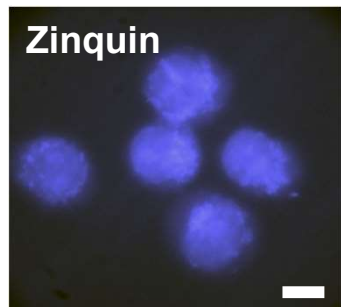
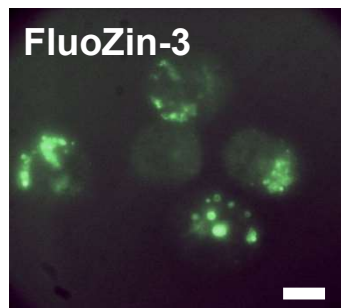
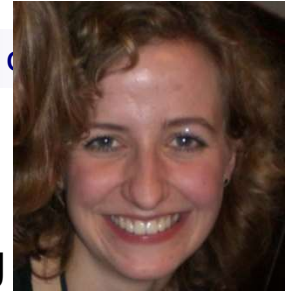


IL-2-abhängige T-Zell Proliferation



IL-2-induzierte Zn^{2+} -Signale

Jennifer Kaltenberg



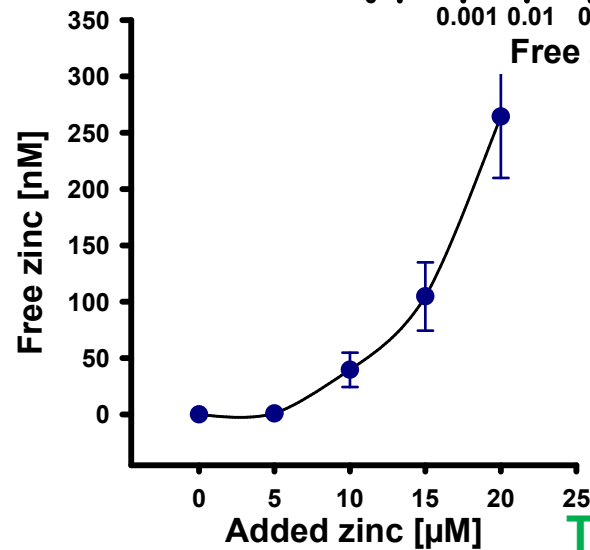
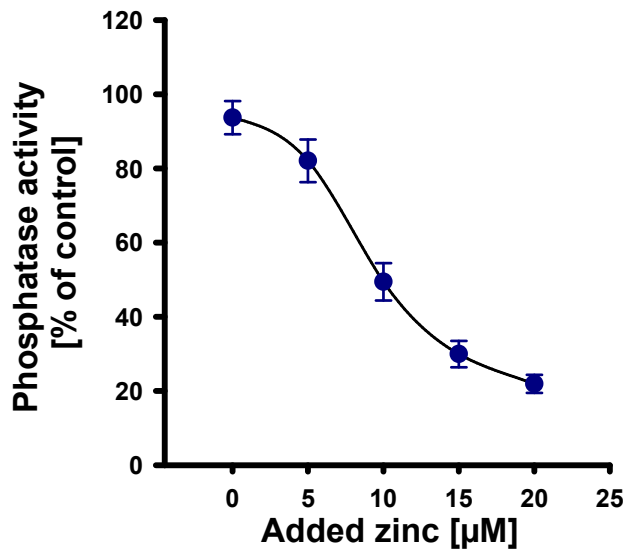
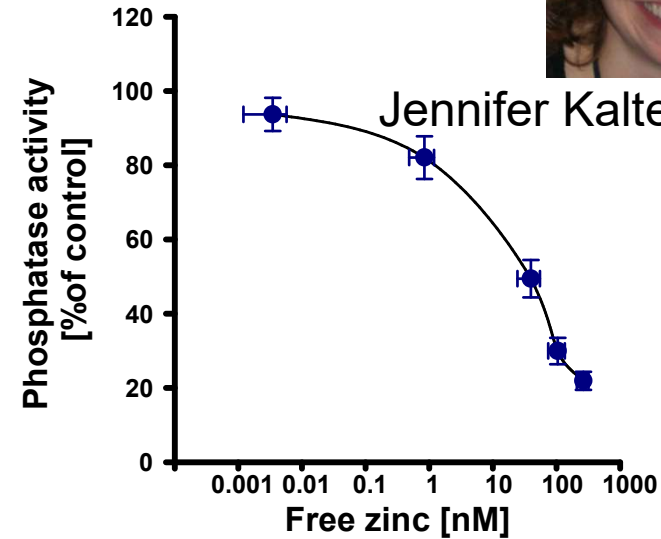
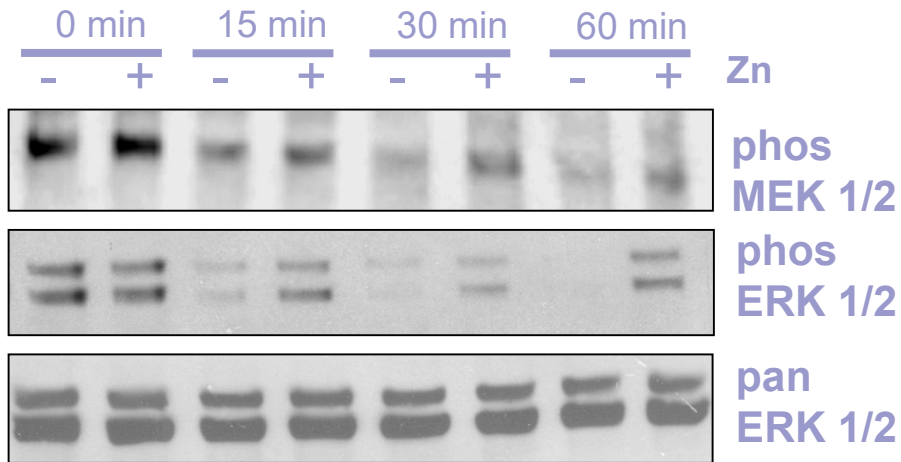
TH0, TH1, TH2, Treg

in vitro

Phosphatase Inhibition I



Jennifer Kaltenberg



TH0, TH1, TH2, Treg

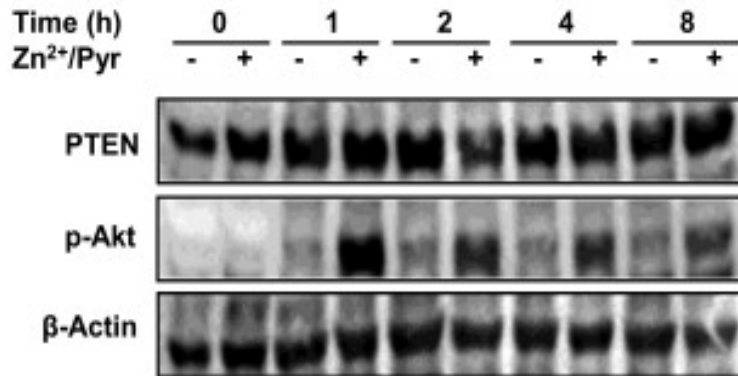
in vitro

Phosphatase Inhibition II

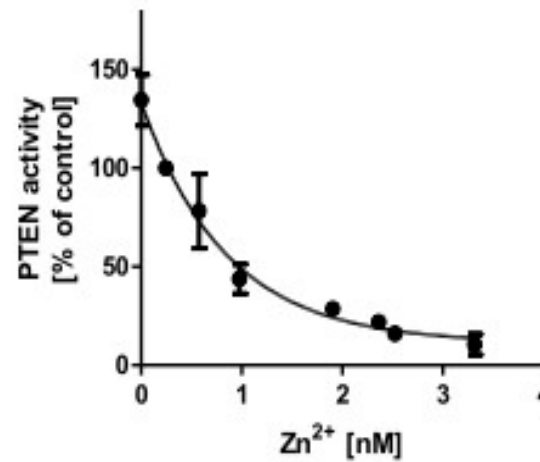


Laura Plum

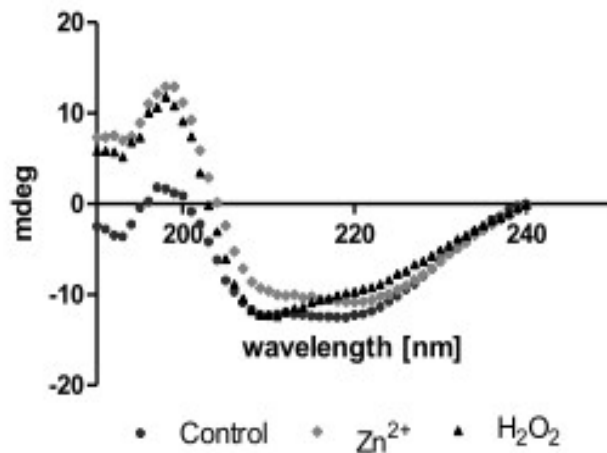
A



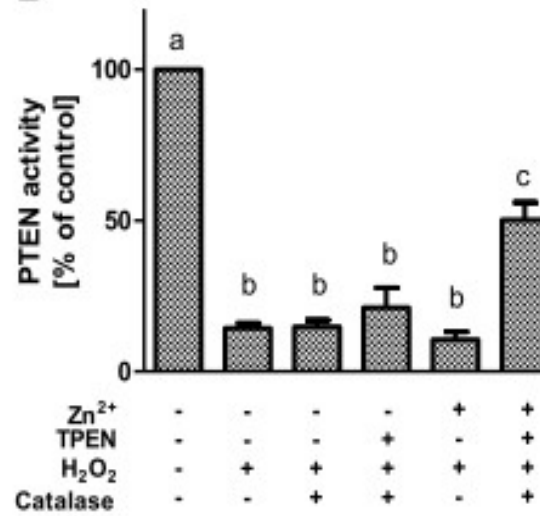
B



C



D



TH0, TH1, TH2, Treg

in vitro

Zink reguliert die IL-2-Signaltransduktion



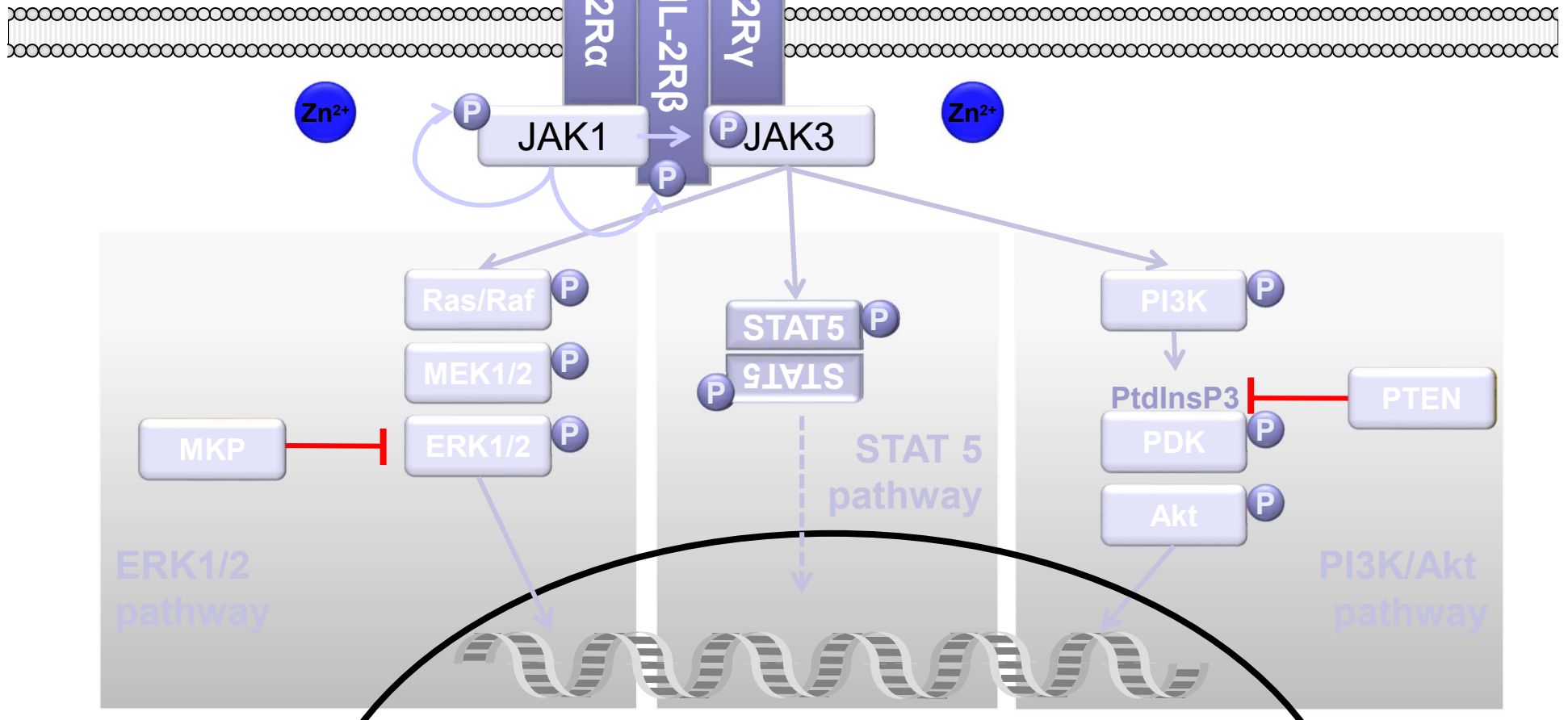
Jennifer Kaltenberg

Kaltenberg et al. Eur. J. Immunol. 2010



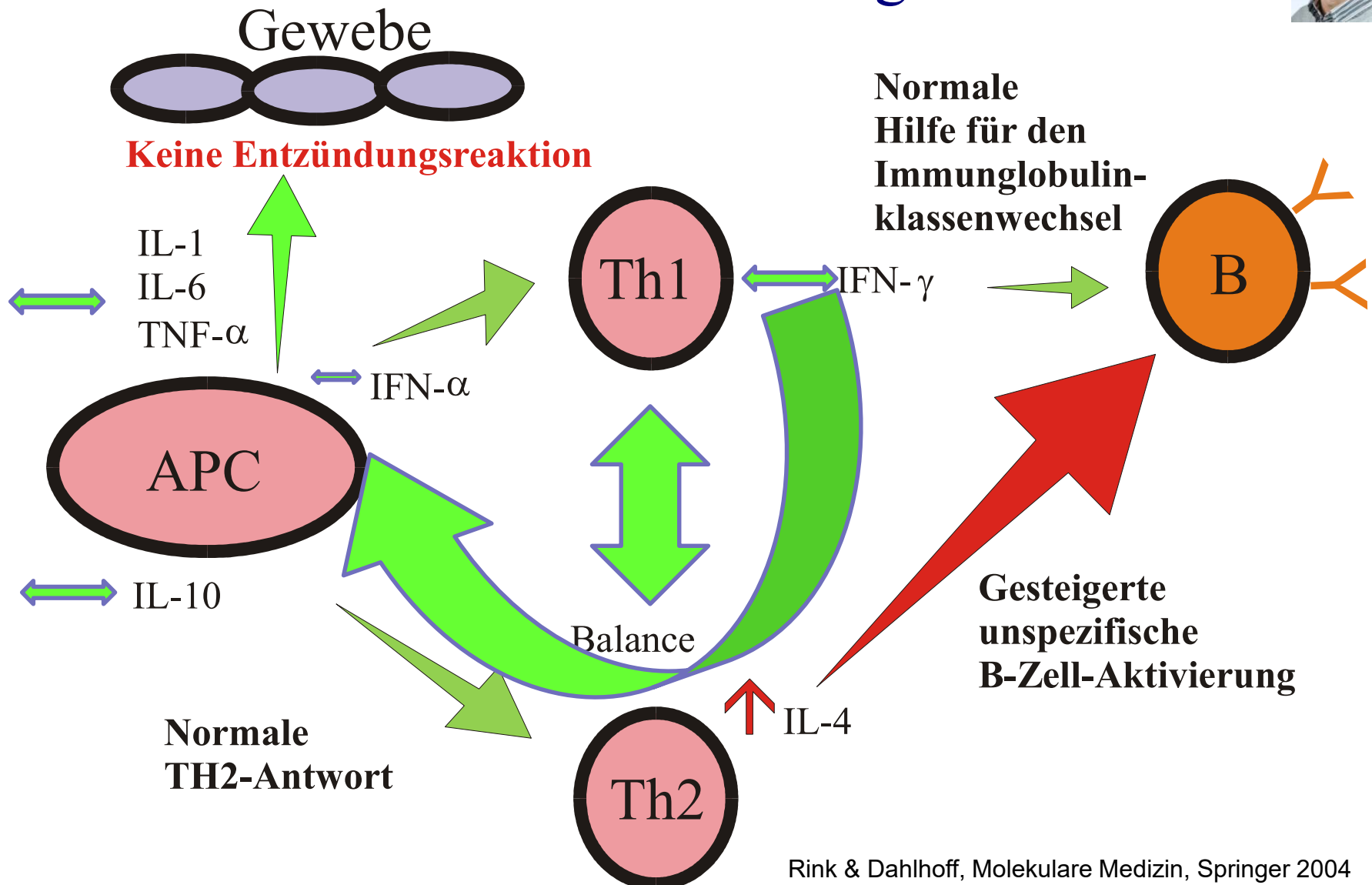
Laura Plum

Plum et al. Metallomics 2014





Ausgewogene Immunfunktion bei alten Menschen nach Zinkgabe

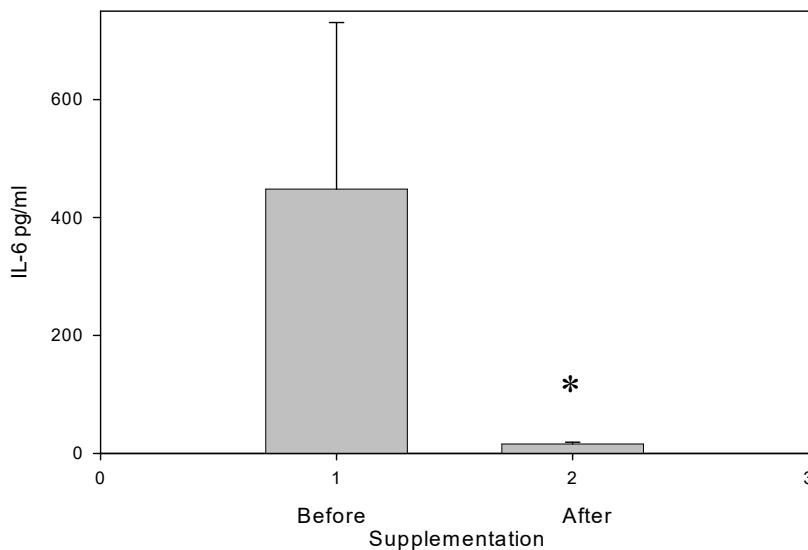


Inhibition der spontanen IL-6-Produktion bei Steigerung der induzierten IL-6-Produktion

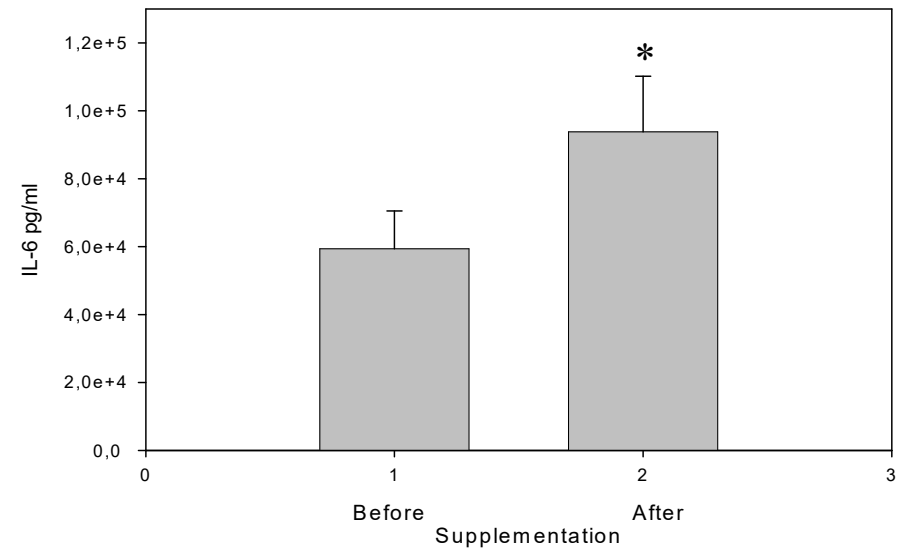


Laura Kahmann

Spontane IL-6-Produktion



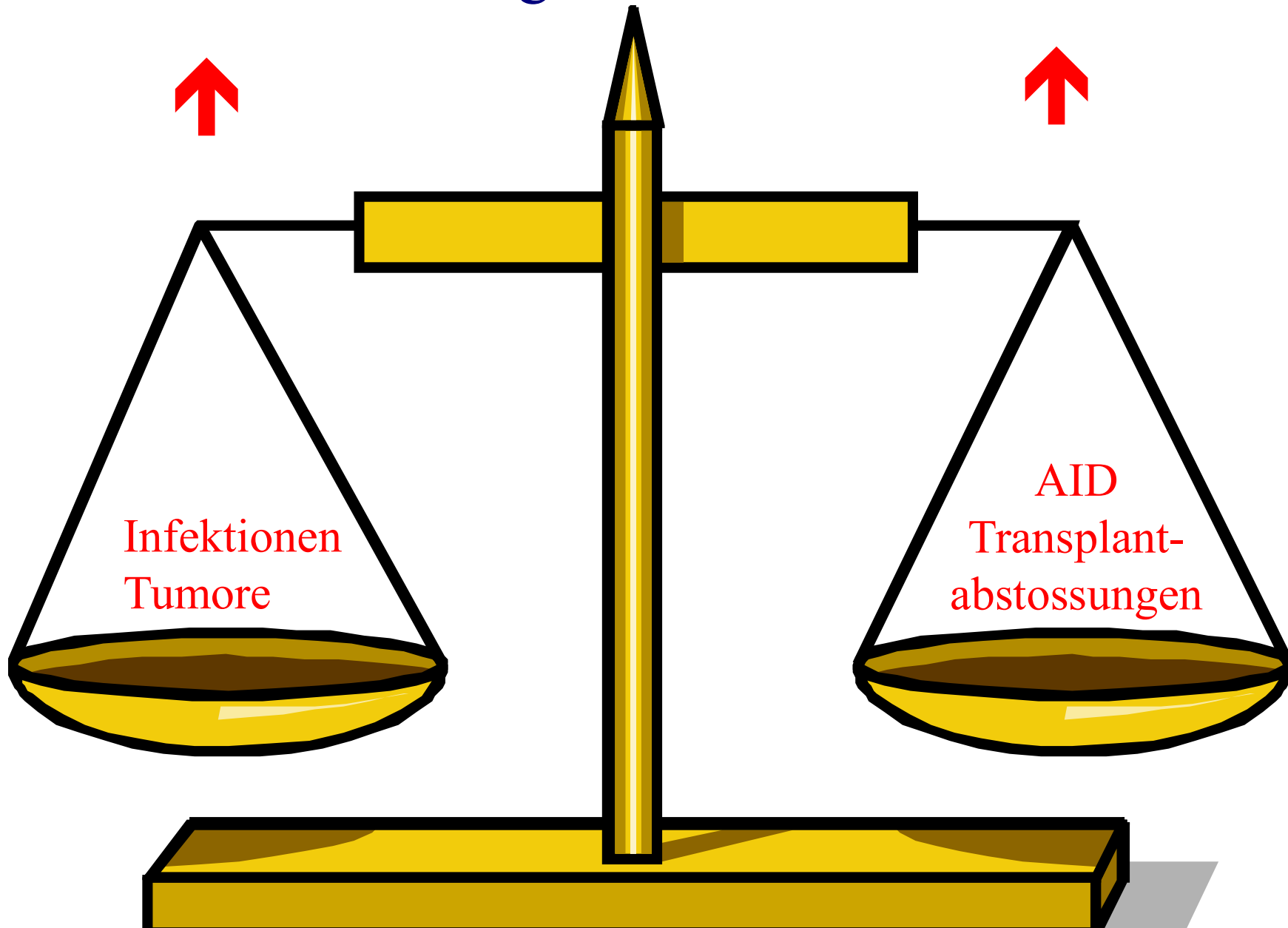
LPS-induzierte IL-6-Produktion



M1, TH1

in vivo

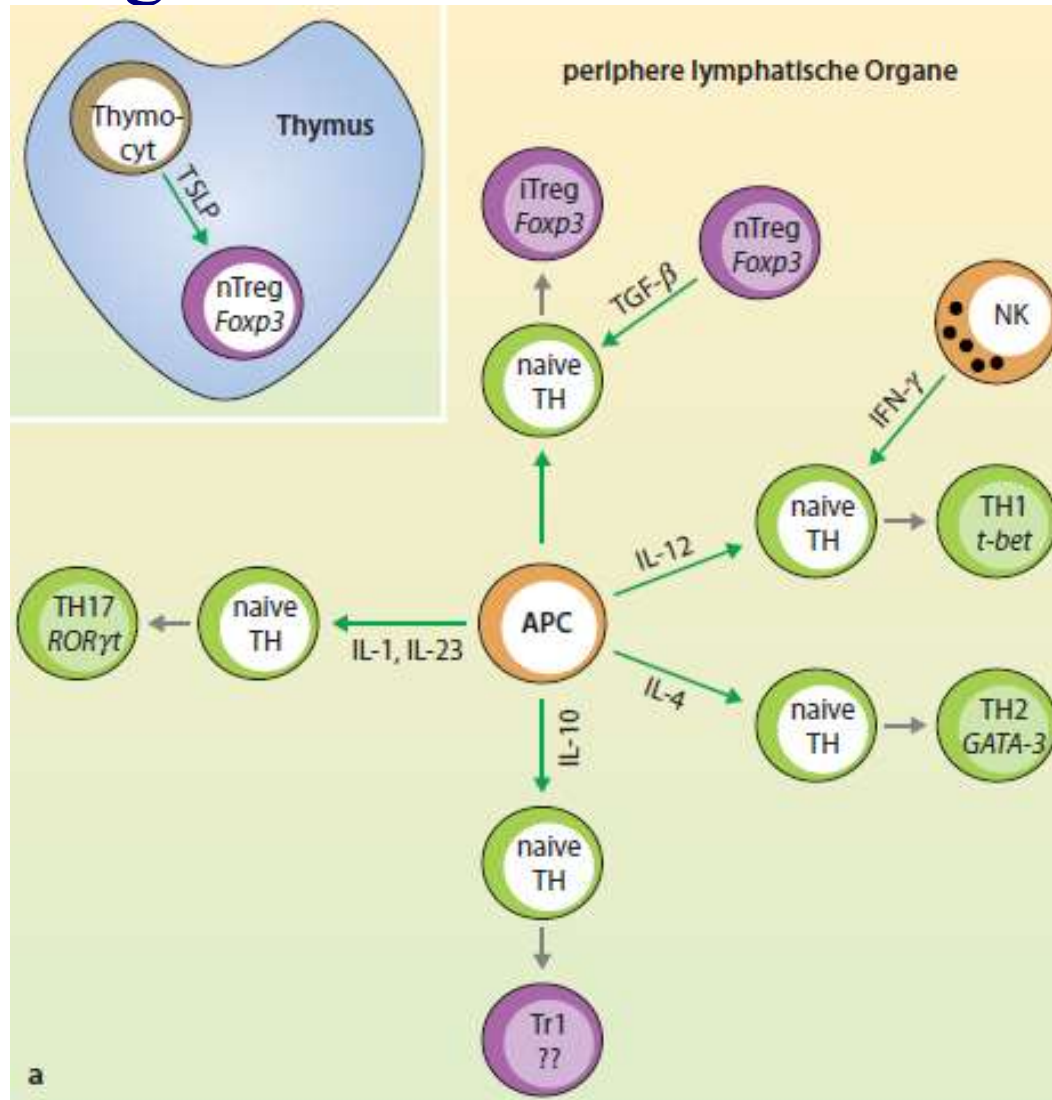
Zinkmangel / alte Menschen





Regulation der Immunantwort

Bakterienabwehr
(Autoimmunität)



Virenabwehr
(Autoimmunität)

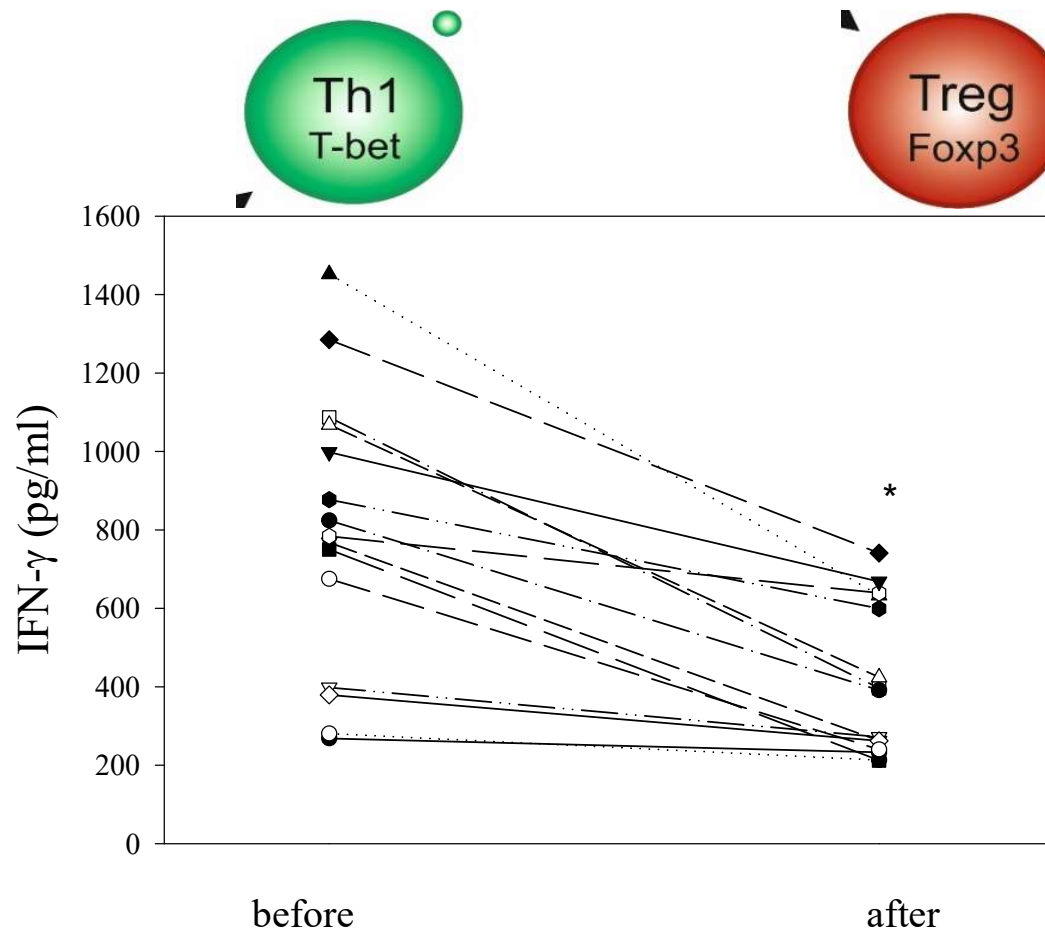
Parasitenabwehr
(Allergie)

Treg = regulatorische T-Zellen = Wächter der Immunantwort

Zinkeinnahme vermindert Alloreaktivität



Christian Faber



TH1

in vivo

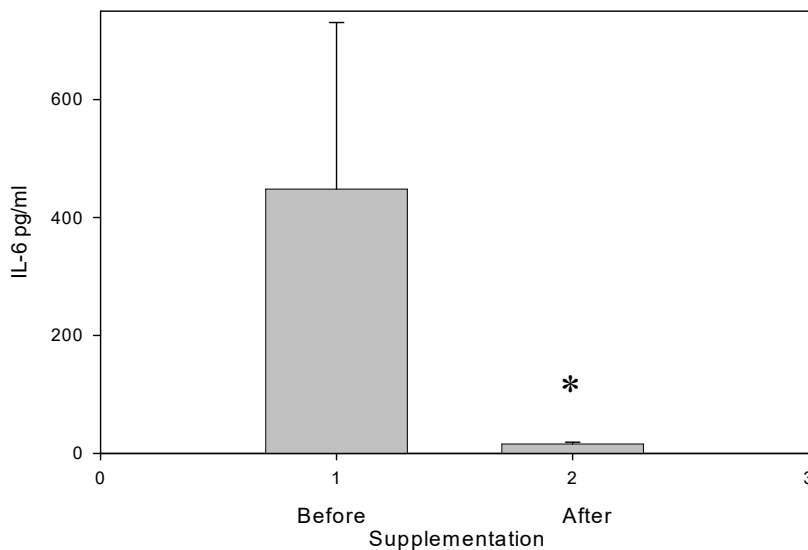
zinc intake

Inhibition der spontanen IL-6-Produktion bei Steigerung der induzierten IL-6-Produktion

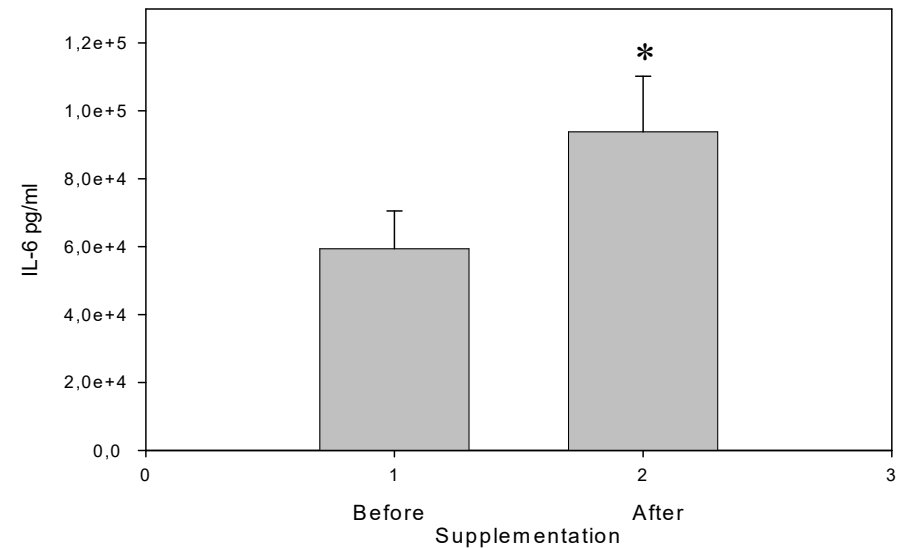


Laura Kahmann

Spontane IL-6-Produktion

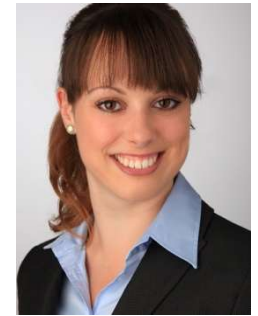


LPS-induzierte IL-6-Produktion

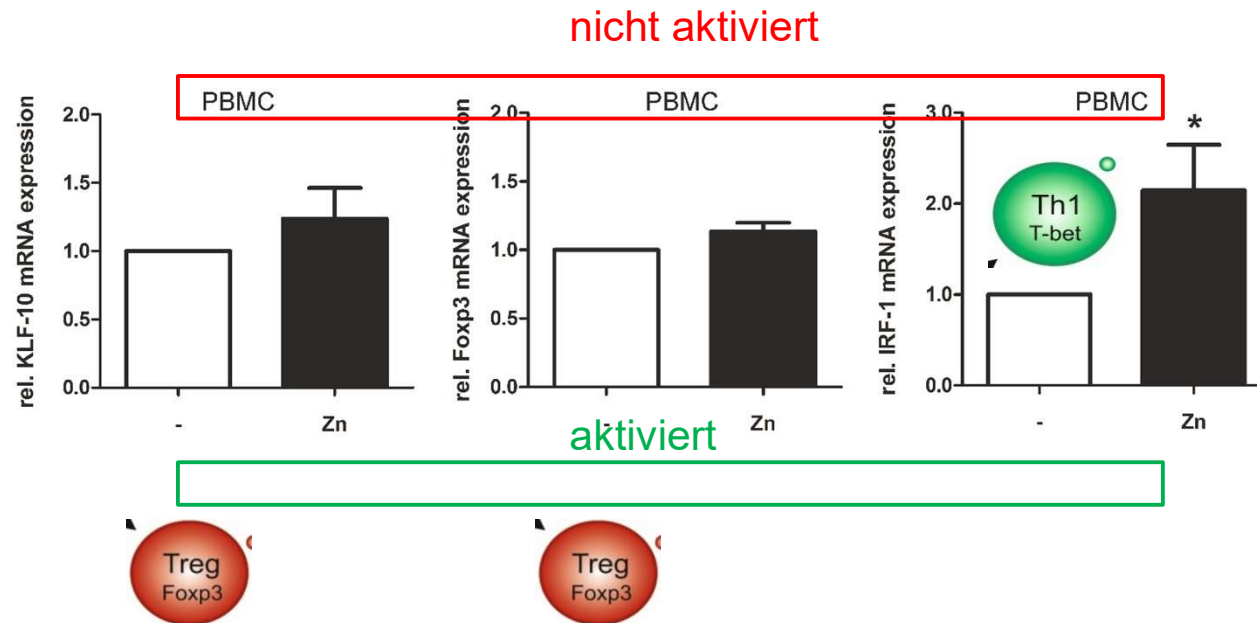


M1, TH1

in vivo



Martina Maywald



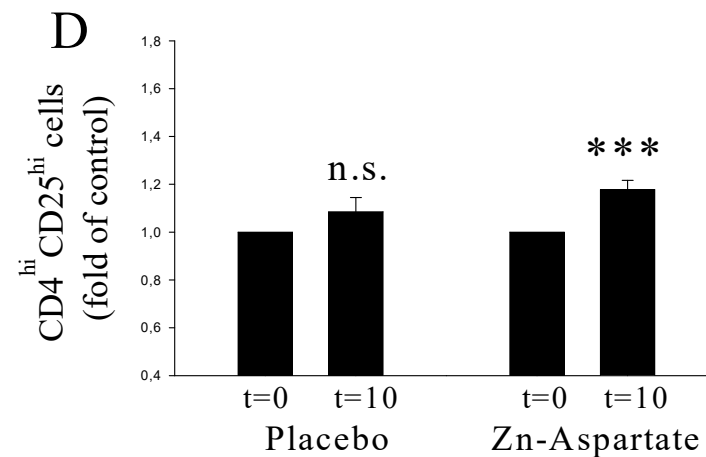
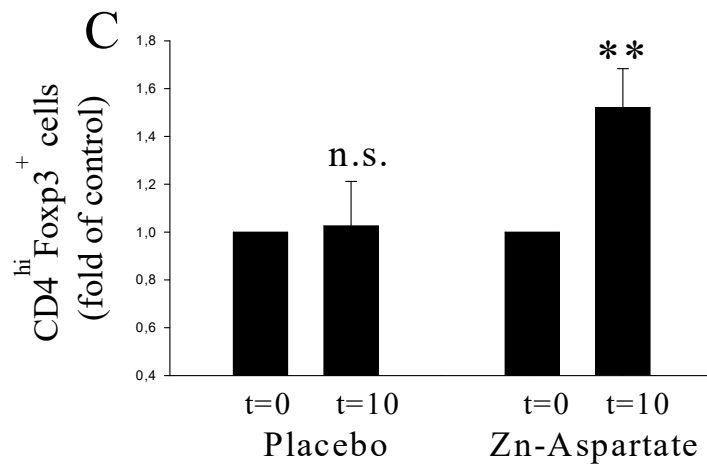
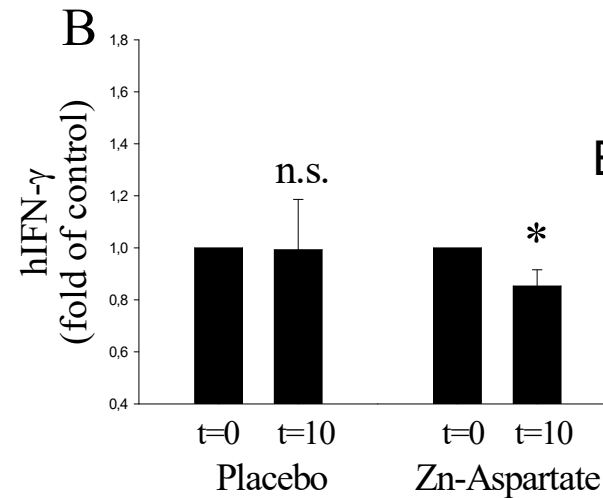
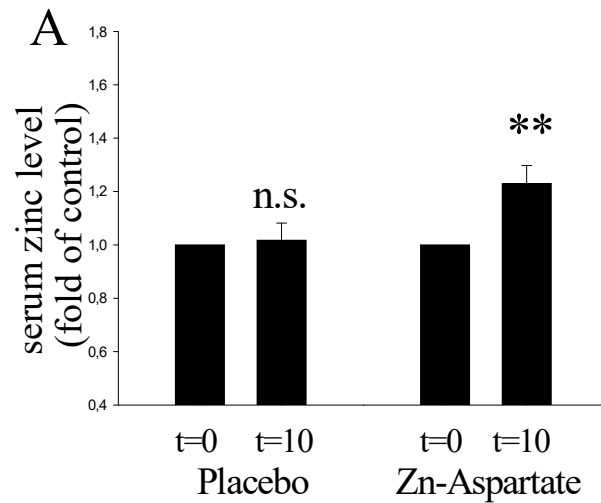
TH1, TH2, TH17, Treg

in vitro

Zink induziert regulatorische T-Zellen *in vivo*



Eva Rosenkranz

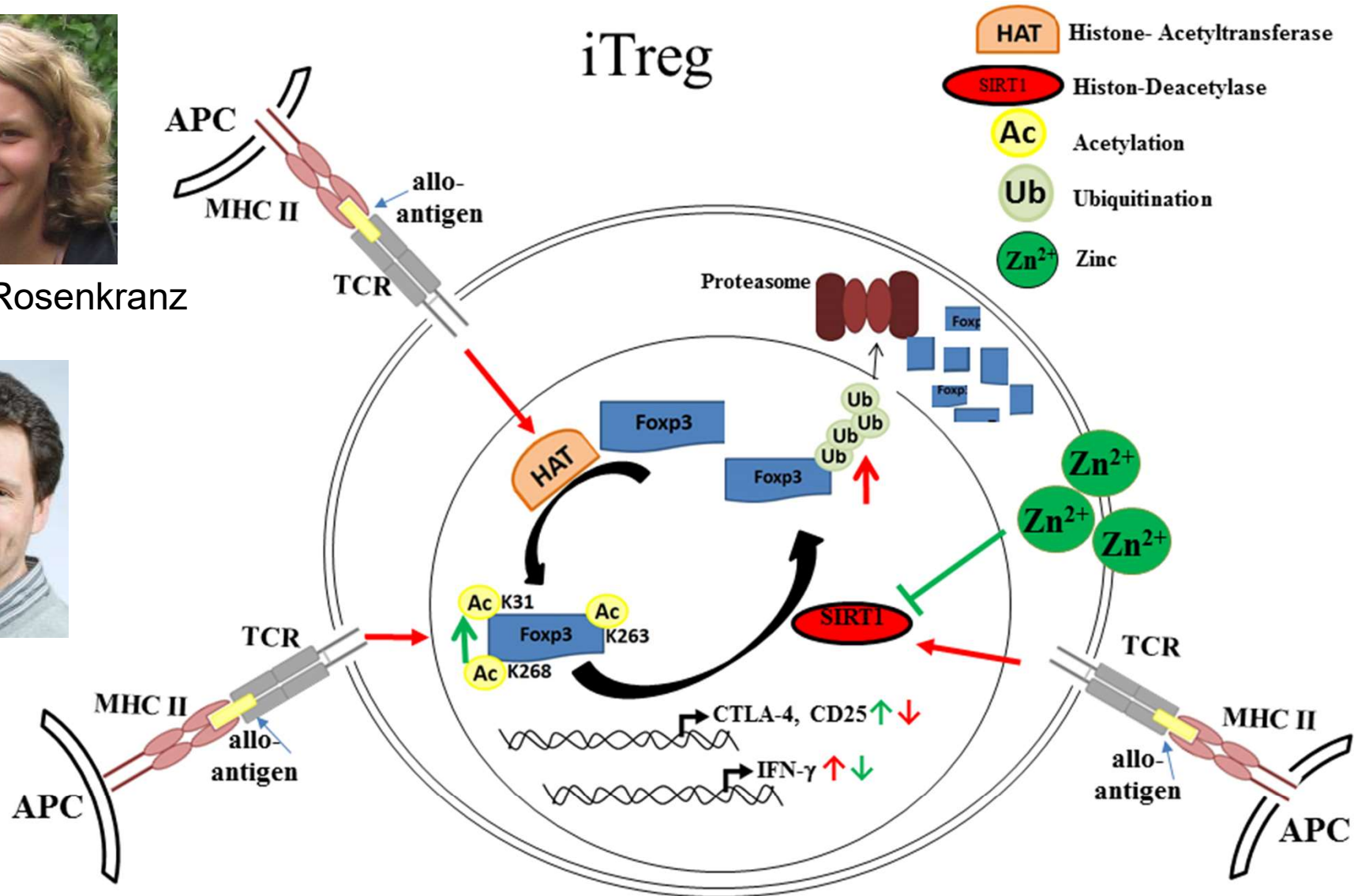


TH1

in vivo



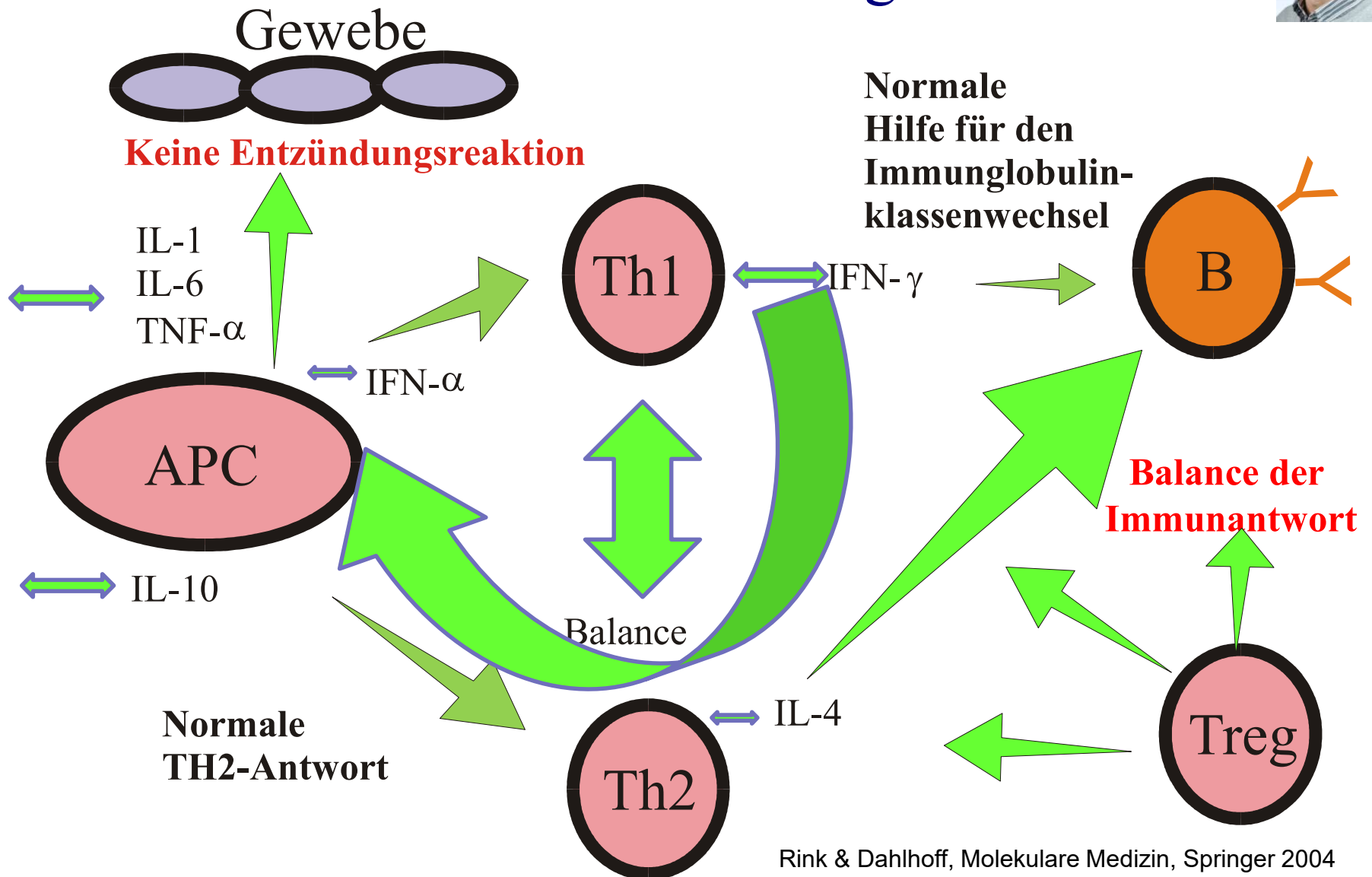
Eva Rosenkranz



APC: Antigen Presenting Cell; CD25: Clusters of Differentiation 25; CTLA-4: cytotoxic T-lymphocyte-associated protein 4; Foxp3: Forkhead-Box-Protein P3; IFN-γ: Interferone γ; K31: Lysine 31; MHC II: Major Histocompatibility Complex II; TCR: T cell receptor



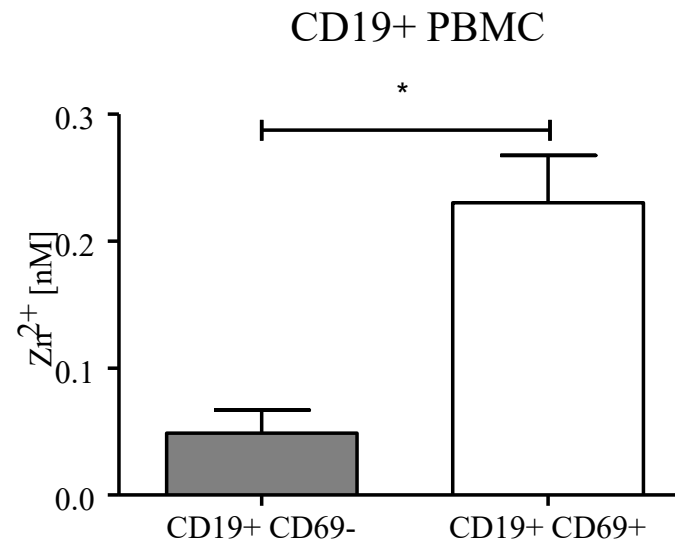
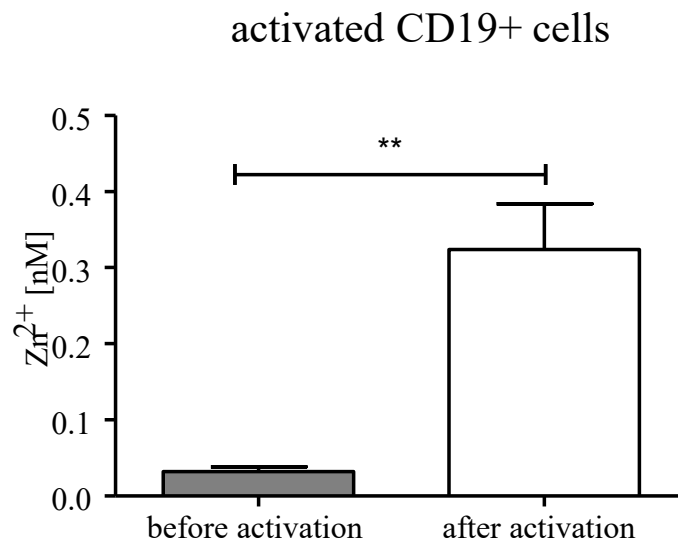
Ausgewogene Immunfunktion bei alten Menschen nach Zinkgabe



In vitro und *in vivo* aktivierte B-Zellen akkumulieren Zink



Johanna Ollig



B-Zellen

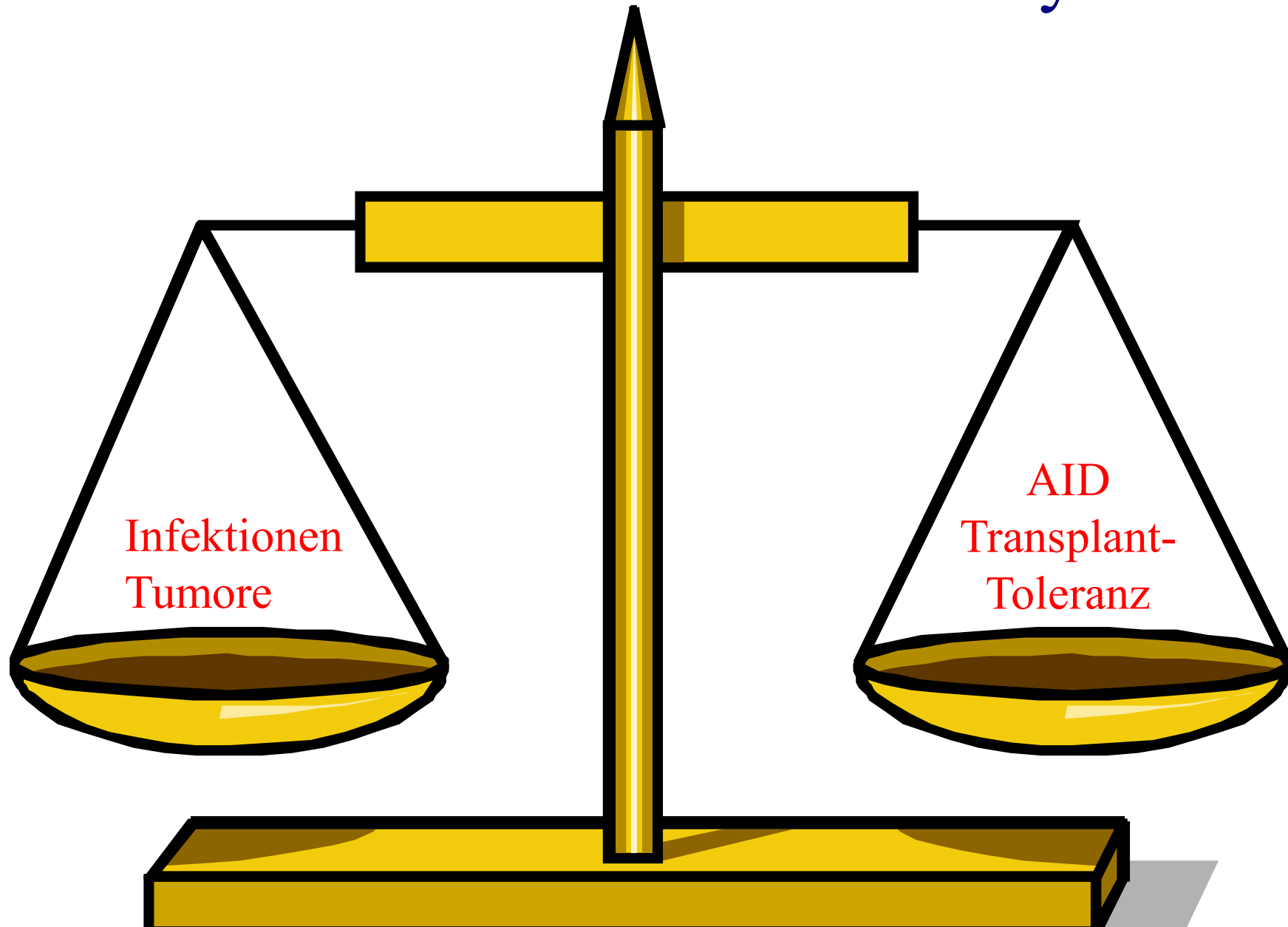
in vivo

Ollig et al. J. Nutr. Biochem. 2019

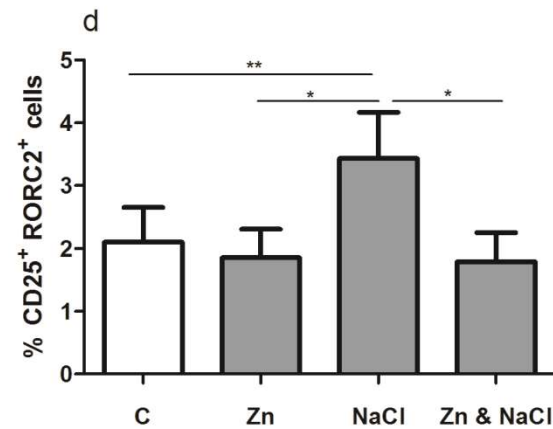
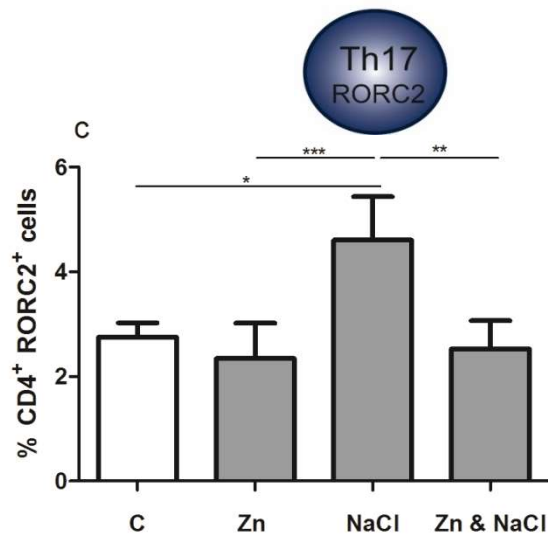
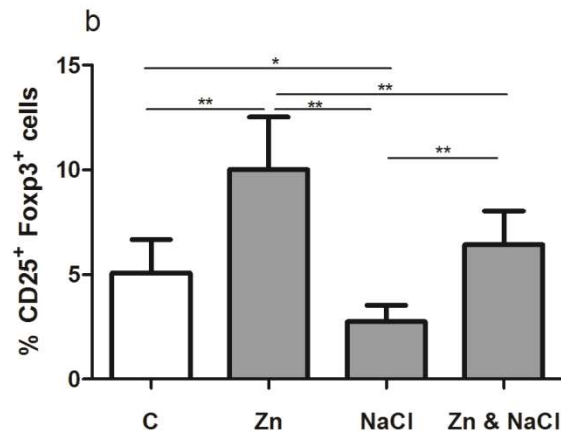
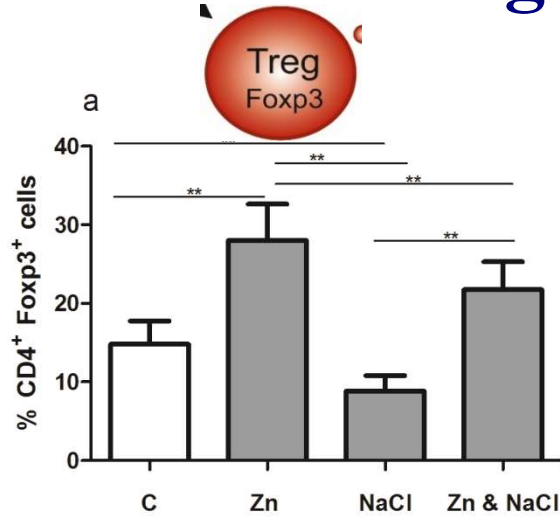
B-Zellen

in vitro

Zink-Homöostase und Immunsystem



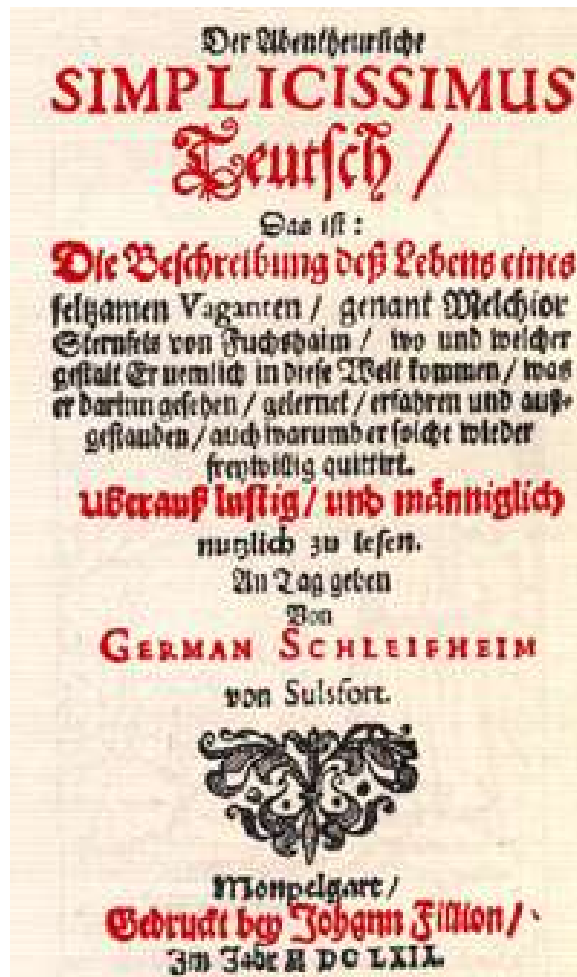
Wechselwirkung von Natrium und Zink in MLC



Sophie Dünkelberg

TH1, TH17

in vitro



Erstausgabe 1669

Aus der Zusammenfassung des *Simplicissimus*

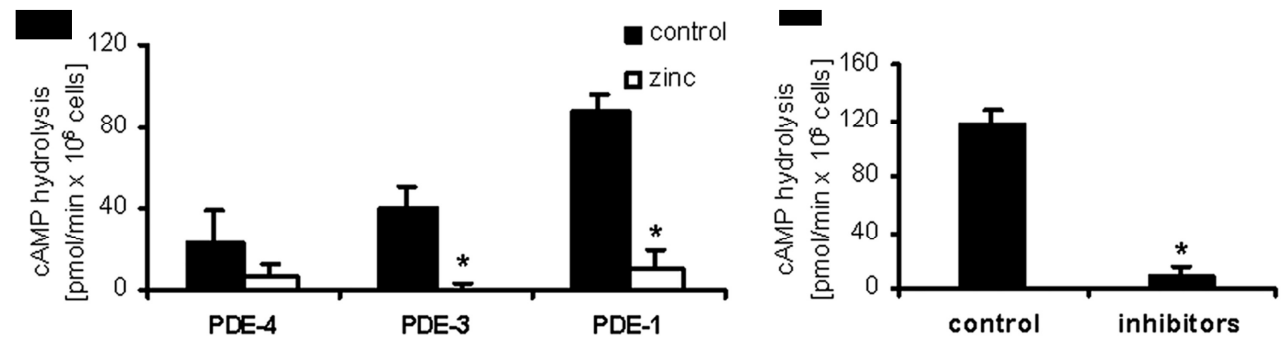
Der „Beau Alman“ muss hier den sittenlosen Gelüsten der vornehmen Damenwelt Genüge tun, bis er heimlich mit dem Gelde, das er „den gottlosen Weibsbildern durch schändliche Arbeit abverdient hat“, auf und davon geht.

Auf der Rückreise nach Deutschland trifft ihn das Unglück: er erkrankt an den „Kindsblattern“, die aus dem Meisterstück der Natur bald einen „gründigen Kuckuck“ machen.

Empfehlung Ihres Apothekers



Casanova empfahl in seinen Memoiren (1725-1798)





Inga Wessels



Martina Maywald



Zink als Schlüsselement der Immunfunktion

ZINKMANGEL

- Überproduktion pro-inflammatorischer Zytokine & Mediatoren
- Thymusatrophie
- T_H1 / T_H2 Imbalance
- weniger naive B-Zellen
- weniger T_{reg}
- mehr T_H17

ZINKHOMEOSTASE

- Balancierte Anzahl und Funktion von Immunzellen
- Balance zwischen Toleranz und Immunabwehr

ZINKÜBERSCHUSS

- Unterdrückung von T- & B-Zell-Funktionen
- Überschuss von T_{reg}
- direkte Aktivierung von Makrophagen

Zinkkonzentration

Former Group Members Active Group Members Collaborators

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Sophie Dünkelberg, MD

Dr. Martina Maywald

Dr. Veronika Kloubert

Dr. Johanna Ollig, MD

Dr. Eva Rosenkranz

Dr. Laura Plum

Jennifer Kaltenberg, MSc

Laura Dierichs, MSc

Dr. Svenja Dubben

Dr. Inga Weßels

Jana Wolf, MSc

University of Potsdam, Germany

Prof. Dr. Tanja Schwerdtle

Dr. Sören Meyer

Aarhus University, Denmark

Prof. Dr. Karoline Blaabjerg

Cardiff University, UK

Dr. Kathryn Taylor

KU Leuven, Belgium

Dr. Veerle Janssens

INRCA Ancona, Italy

Prof. Dr. Eugenio Mocchegiani

RWTH Aachen University

Prof. Dr. Ralf Weiskirchen

Prof. Dr. Wolfgang Wagner

Dr. Sabine Warmuth



36th GMS, 7th ISZB, TEMA17 and 13th ISTERH Joint Meeting

Online: August 1st - 6th 2021

On-Site: June 5th - 10th 2022

Aachen, Germany



International Conference
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Willkommen,
Bienvenue,
Welcome
Bienvenida
to Aachen
2021 online
and 2022 live



Be Our
Guests
and
Enjoy
Germany!!!

