

# **Ernährung und Schlaganfallrisiko: 8. Pathomechanismen und praktische Konsequenzen**

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**D/E**

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Abteilung für Endokrinologie, Diabetes und Ernährungsmedizin**

 **CAMPUS BENJAMIN FRANKLIN**

# Wie kann Ernährung das Schlaganfallrisiko beeinflussen?

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- Steuerung von Risikofaktoren für Schlaganfall, z.B. Blutdruck, Gerinnung
- Steuerung von Risikofaktoren für Atherosklerose, z.B. Cholesterinstoffwechsel
- Steuerung von metabolischen Risikofaktoren, z.B., Glucose, Fructose, Harnsäure, Gallensäuren
- Steuerung immunologischer Prozesse, z.B. T<sub>reg</sub>-Zellen, IL-10 Produktion oder Effektor T-Zellen, z.B.  $\gamma\delta$ T-Zellen, IL-17 Produktion.
- Steuerung endokriner Regulatoren, z.B. Insulin, Glucagon, FGF21
- Steuerung zirkadianer Rhythmen

**Fettmenge oder Fett-Typen sind in aktuellen Meta-Analysen nicht mit dem Schlaganfall-Risiko verknüpft nach Korrektur für Risikofaktoren wie Hypertonie, Diabetes und 10 andere (hier Beispiel Schwedische Mammographie Studie 1998 – 2008)**



S.C. Larsson et al. / Atherosclerosis 221 (2012) 282– 286



Variable (median)

Total stroke

	Cases	Person-years	Age-adjusted RR	Multivariable RR <sup>a</sup>
Total fat, g/d				
47.1	340	72,014	1.00	1.00
54.6	297	72,133	0.85 (0.73–0.99)	0.84 (0.71–0.99)
59.8	308	71,968	0.90 (0.77–1.05)	0.87 (0.71–1.00)
64.9	355	71,916	1.03 (0.89–1.19)	0.97 (0.81–1.15)
72.7	380	70,982	1.14 (0.99–1.32)	1.01 (0.84–1.22)
<i>P</i> for trend			0.01	0.38
Saturated fat, g/d				
19.5	299	71,373	1.00	1.00
23.8	321	72,285	0.99 (0.84–1.15)	1.03 (0.86–1.22)
26.9	313	71,503	0.96 (0.82–1.12)	0.97 (0.80–1.19)
30.3	365	73,488	1.07 (0.92–1.25)	1.03 (0.83–1.27)
35.5	382	70,364	1.18 (1.01–1.37)	1.04 (0.82–1.32)
<i>P</i> for trend			0.01	0.62

# Langkettige Omega-3 Fettsäuren reduzieren das Schlaganfall-Risiko nach Korrektur für Risikofaktoren wie Hypertonie, Diabetes und 10 andere (hier Beispiel Schwedische Mammographie Studie 1998 – 2008)

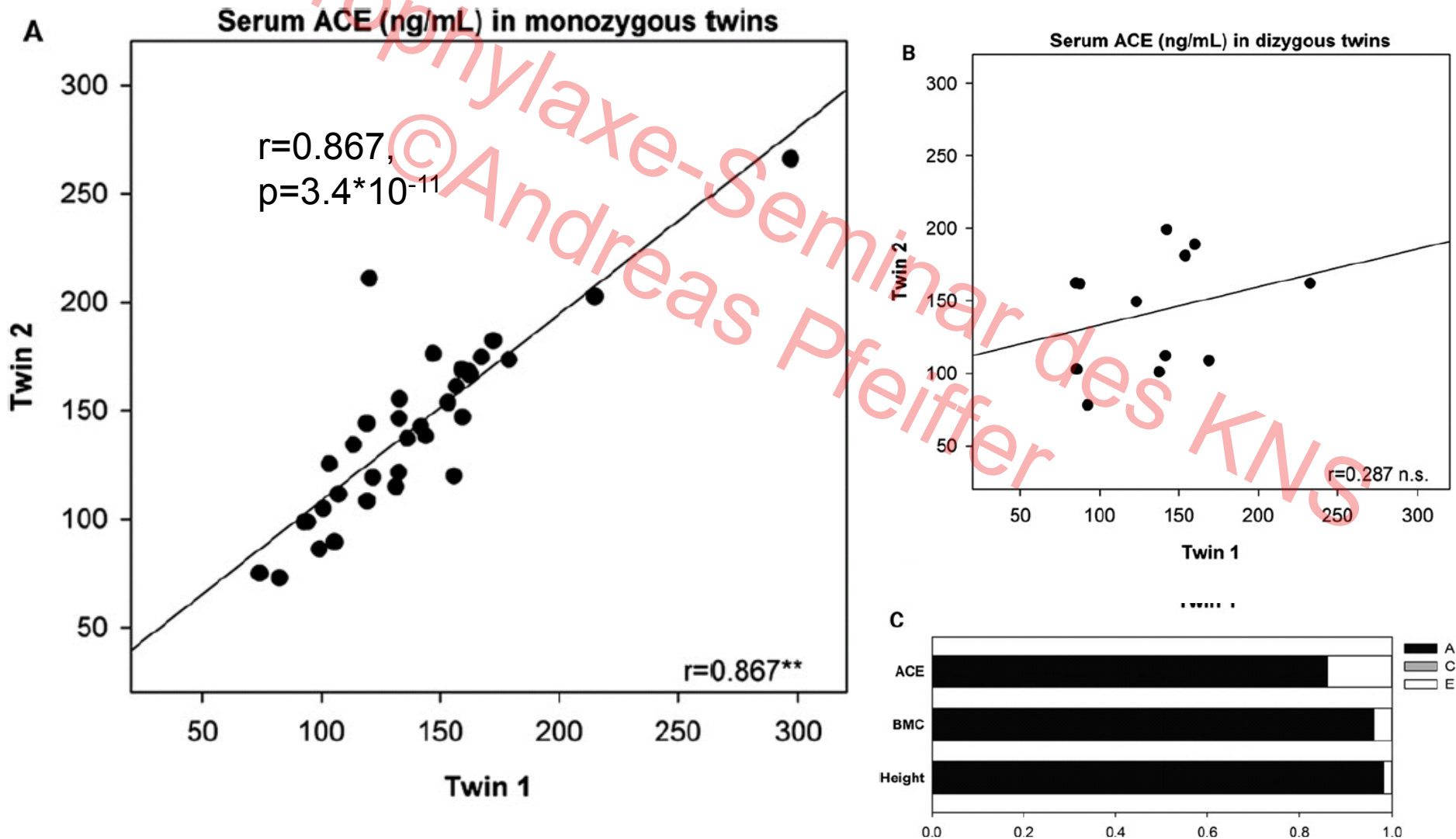


S.C. Larsson et al. / Atherosclerosis 221 (2012) 282– 286



Variable (median)	Total stroke		Age-adjusted RR	Multivariable RR <sup>a</sup>
	Cases	Person-years		
Long-chain omega-3 PUFAs, mg/d <sup>b</sup>				
131	379	70,855	1.00	1.00
222	319	72,278	0.93 (0.80–1.08)	0.93 (0.80–1.08)
289	285	72,639	0.87 (0.75–1.02)	0.87 (0.74–1.02)
370	317	72,317	0.91 (0.79–1.06)	0.89 (0.76–1.05)
559	380	70,924	0.91 (0.79–1.05)	0.84 (0.72–0.99)
<i>P</i> for trend			0.26	0.04
Omega-6 PUFAs, g/d <sup>c</sup>				
4.7	411	70,412	1.00	1.00
5.4	364	71,689	0.99 (0.86–1.14)	0.98 (0.85–1.13)
6.0	323	72,164	0.99 (0.85–1.14)	0.97 (0.84–1.13)
6.6	294	72,193	0.99 (0.85–1.15)	0.98 (0.83–1.14)
8.0	288	72,555	1.04 (0.89–1.21)	1.00 (0.86–1.17)
<i>P</i> for trend			0.63	0.98
Dietary cholesterol, mg/d				
100	310	71,000	1.00	1.00

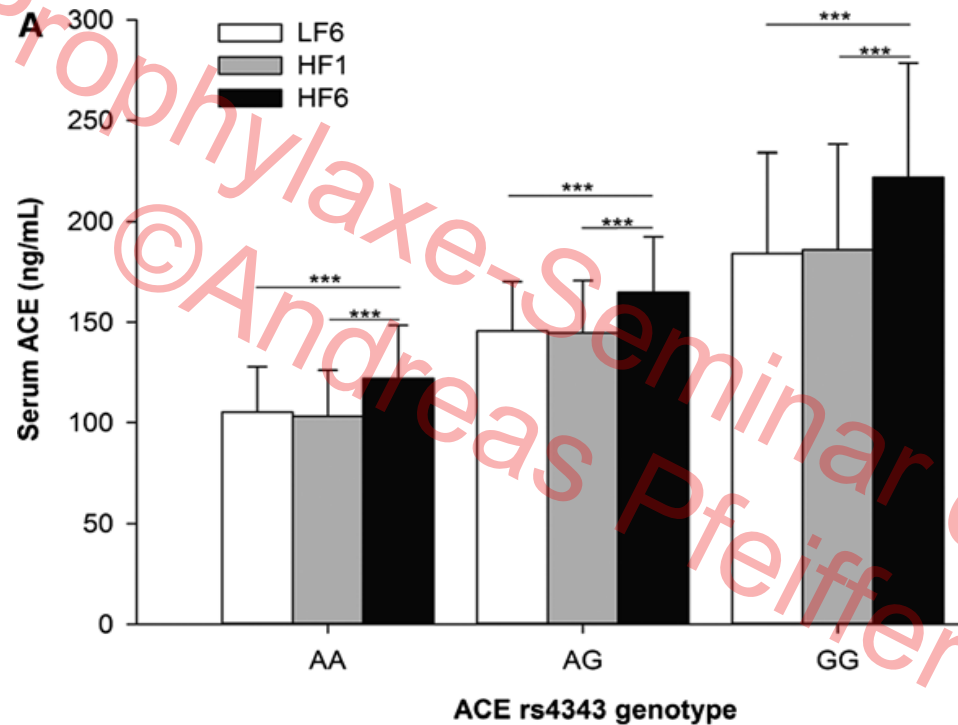
# Serum ACE Spiegel sind 86% erblich (NUGAT Studie)



# Träger des rs4343 GG-Genvariante (proxy für I/D) haben höhere Serum ACE Spiegel und höheren Blutdruck



Schüler et al., J Am Heart Ass 2017



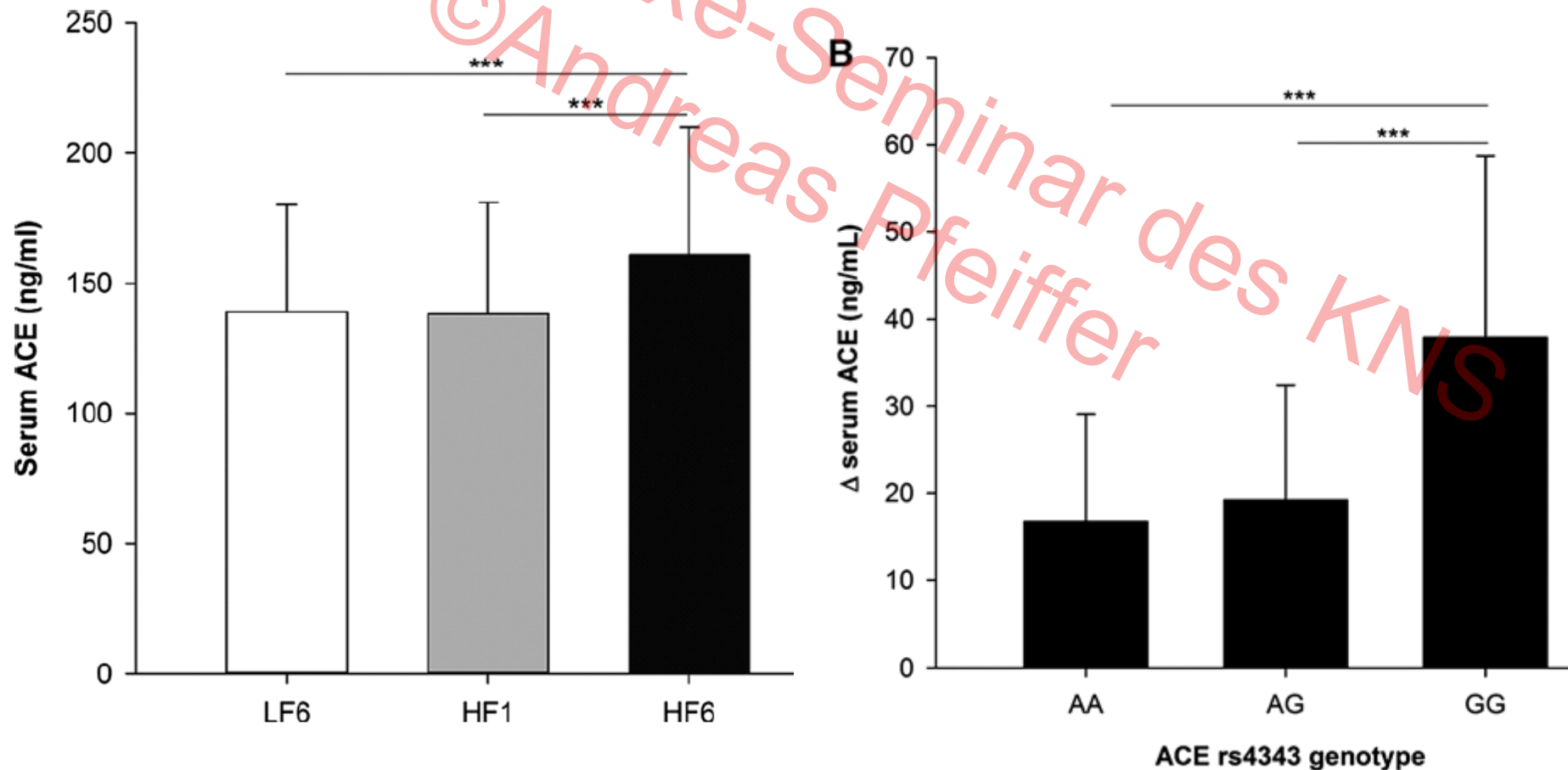
	Total	AA Genotype	AG Genotype	GG Genotype	P Value
n	92	31	44	17	0.842
Male/female	34/58	10/21	14/30	10/7	0.120
Age, y	31±14	30±14	31±11	34±20	0.764
BMI, kg/m <sup>2</sup>	22.8±2.7	22.8±2.2	22.9±2.7	22.9±3.6	0.990
SBP, mm Hg	118±13	116±12	116±14	125±8	0.044
DBP, mm Hg	74±9	73±7	74±9	80±10	0.035
PP, mm Hg	43±9	43±8	42±9	46±10	0.452

# Fetteiche Ernährung erhöht die Serum ACE-Spiegel generell aber signifikant stärker bei Trägern der GG-Variante des SNPs rs4343 (B)

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Schüler et al., J Am Heart Ass, 2017

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# Fetteiche Ernährung (>37 %E) ist nur bei Trägern der GG-Variante des SNPs rs4343 mit erhöhtem Blutdruck in der MESY-BEPO Studie verknüpft (Metabolisches Syndrom Berlin-Potsdam)



Schüler et al., J Am Heart Ass, 2017

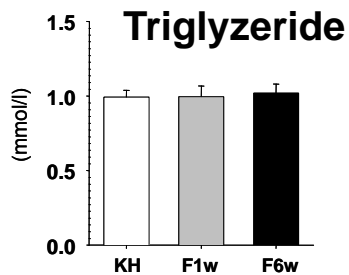
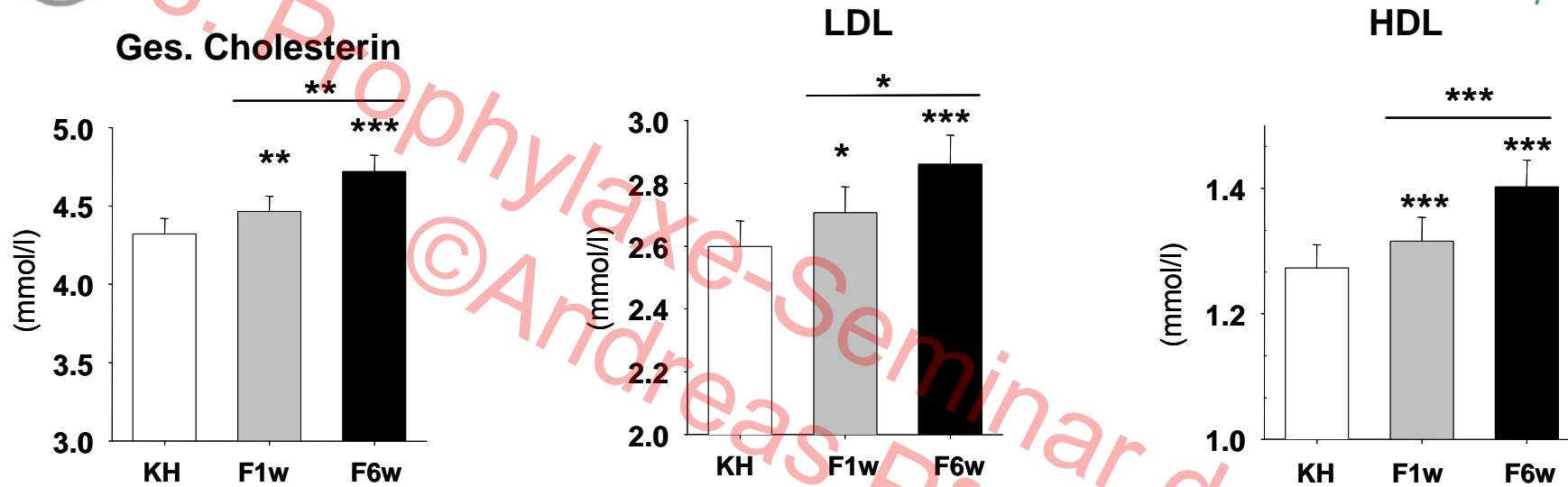


Fat Intake <37%				
	AA	AG	GG	P Value
n	39	131	68	0.070
SBP, mm Hg	127±17	123±17	124±19	0.385
DBP, mm Hg	77±11	78±10	78±10	0.885
PP, mm Hg	50±11	45±11	46±13	0.061

Fat Intake ≥37%				
	AA	AG	GG	P Value
n	27	66	34	0.632
SBP, mm Hg	126±17	120±15	131±21	0.011
DBP, mm Hg	77±10	75±8	79±10	0.132
PP, mm Hg	49±13	45±11	52±14	0.023



# Anstieg von ges. Cholesterin, LDL und HDL und Abfall von freien Fettsäuren



(\* P<0,05; \*\* P<0,01; \*\*\* P<0,001)

NUGAT Studie, **N**utrigenetic analysis in **T**wins  
 Kruse ...Pfeiffer, unpublished data

KH betont (55%) 5 Wochen	KH betont standardisiert (55%) 6 Tage	CID1 KH	Fett betont standardisiert (45%) 6 Tage	CID2 Fett	Fett betont (45%) 4 Wochen	Fett betont standardisiert (45%) 6 Tage	CID3 Fett	Protein betont (30%) 4 Wochen	Protein betont standardisiert (30%) 6 Tage	CID4 Protein
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# LDL- Cholesterin ist zu 72% und HDL-Cholesterin zu 92% genetisch determiniert

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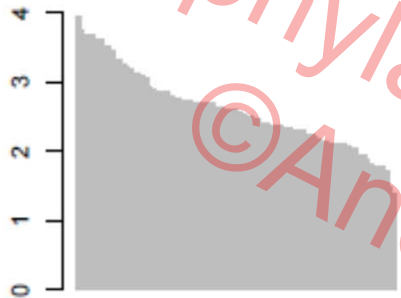
NUGAT Studie, **N**utrigenetic analysis in **T**wins

Kruse ...Pfeiffer, unpublished data

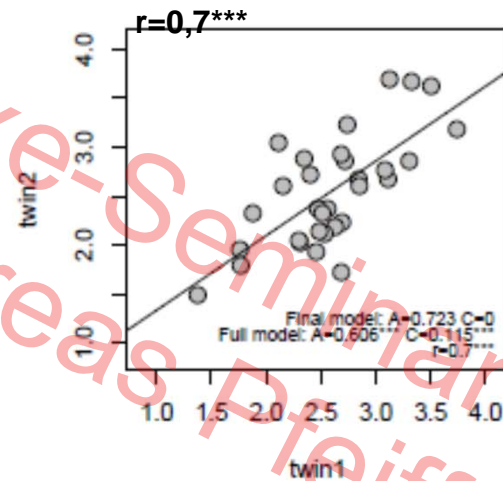


LDL-  
Cholesterin

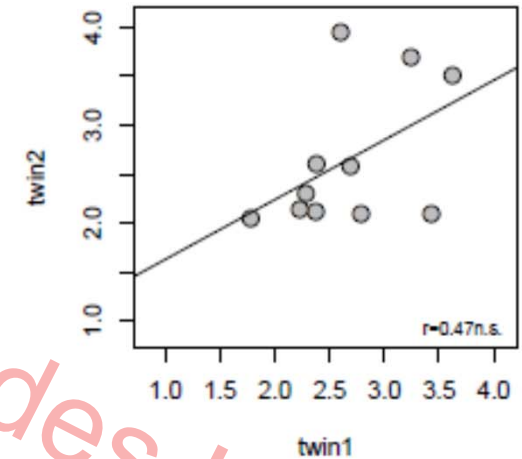
A: 0,72



Monozygot

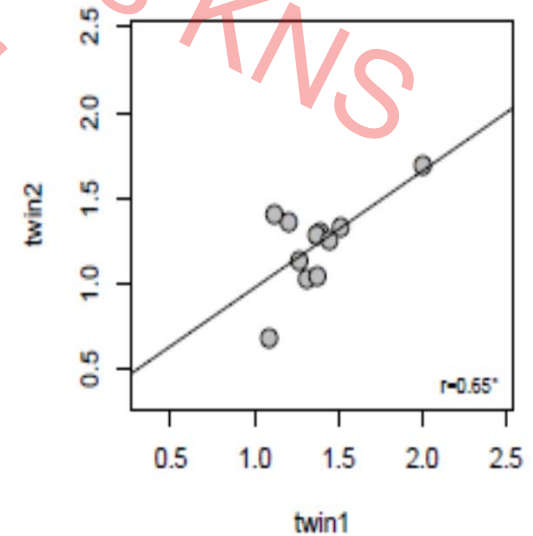
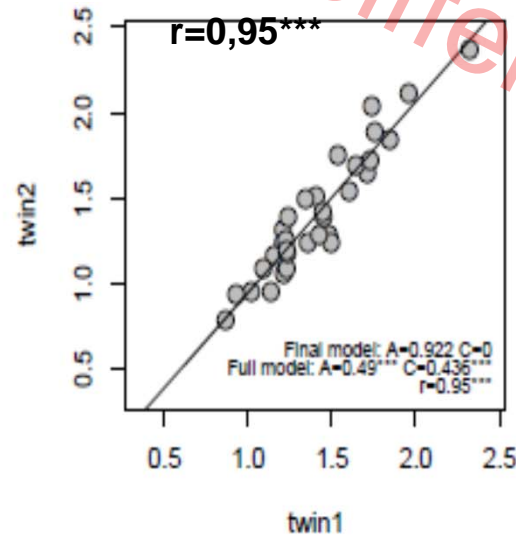
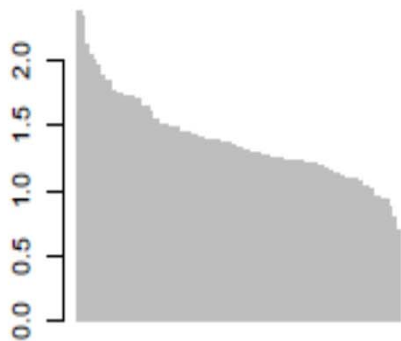


Dizygot



HDL-  
Cholesterin

A: 0,92



# Welche Nahrungskomponenten zeigen Einfluss

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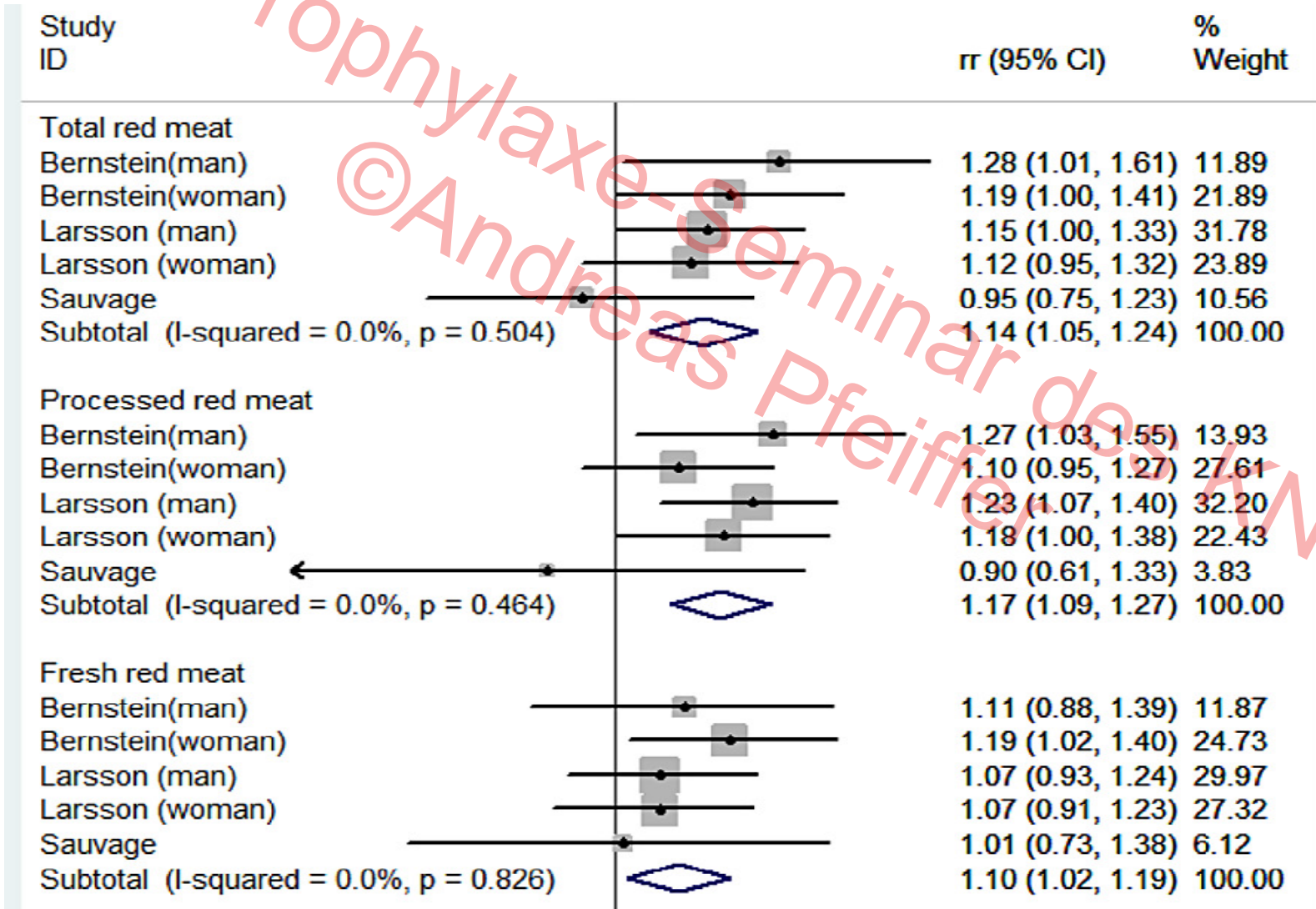
## Protein

- Rotes und prozessiertes Fleisch
- Tierisches Protein (Milch, Fleisch, Fisch)
- Protein insgesamt
- Pflanzenprotein

# Rotes Fleisch und prozessiertes Fleisch steigern das Schlaganfallrisiko in Metaanalysen



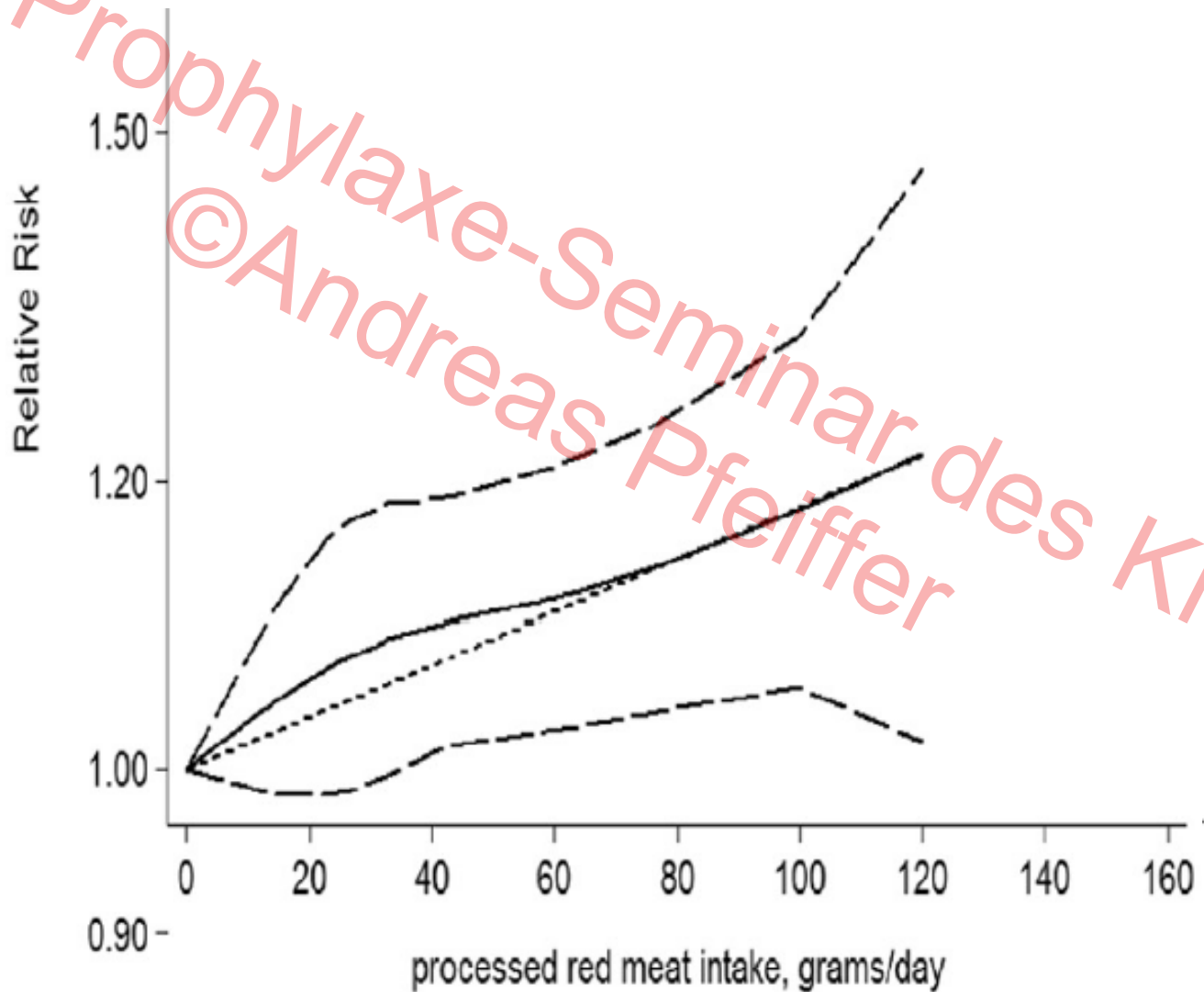
Zhang et al., <http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2016.01.040>



# Rotes Fleisch und prozessiertes Fleisch steigern das Schlaganfallrisiko in Metaanalysen: Dosis Wirkungsbeziehung



Zhang et al., <http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2016.01.040>

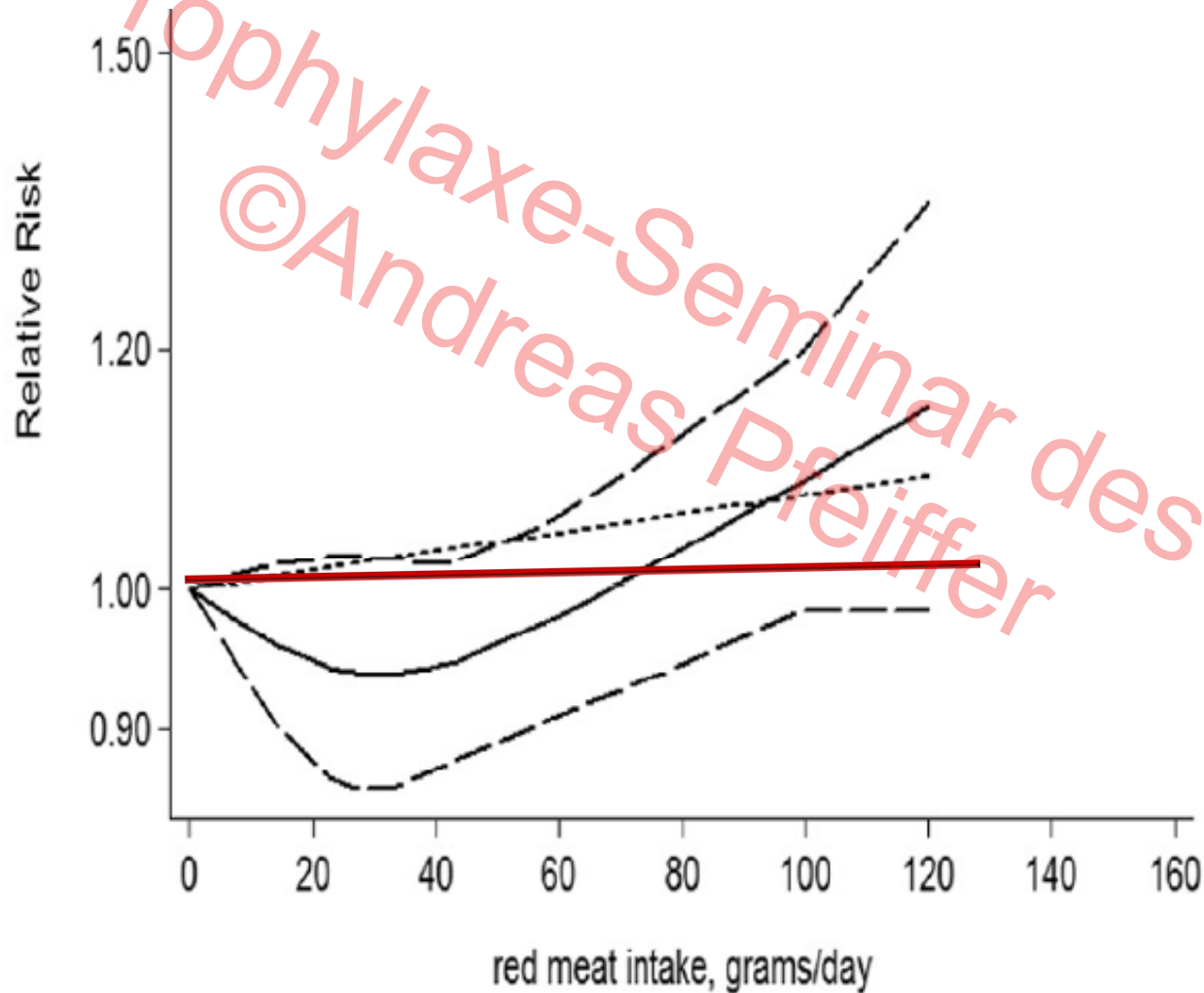


Prophylaxe-Seminar des KNS  
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# Frisches rotes Fleisch zeigt eine nicht-lineare Dosis Wirkungsbeziehung zum Schlaganfallrisiko in einer Metaanalyse



Zhang et al., <http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2016.01.040>



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# Höhere Proteinaufnahme reduziert Schlaganfall-Inzidenz (Schweden, n=39.227 Frauen) insgesamt und verstärkt bei Hypertonie



S.C. Larsson et al. / Atherosclerosis 224 (2012) 247e251



	Total stroke			
	No history of hypertension		History of hypertension	
	Cases	Multivariable RR <sup>a</sup>	Cases	Multivariable RR <sup>a</sup>
<i>Total protein, g/d</i>				
<61.8	245	1.00	141	1.00
61.8–67.2	205	0.92 (0.75, 1.12)	111	0.74 (0.57, 0.97)
67.3–72.1	225	1.01 (0.82, 1.25)	94	0.53 (0.39, 0.72)
72.2–78.6	203	0.87 (0.69, 1.10)	112	0.61 (0.45, 0.84)
≥78.7	219	0.86 (0.67, 1.10)	125	0.56 (0.40, 0.78)
<i>P for trend</i>		0.25		0.003
<i>P for interaction</i>		0.02		
<i>Animal protein, g/d</i>				
<38.3	243	1.00	139	1.00
38.3–44.2	195	0.84 (0.68, 1.03)	103	0.67 (0.51, 0.89)
44.3–49.7	207	0.88 (0.70, 1.11)	113	0.65 (0.48, 0.88)
49.8–57.9	226	0.93 (0.73, 1.20)	100	0.52 (0.37, 0.74)
≥58.0	226	0.80 (0.61, 1.05)	128	0.57 (0.40, 0.82)
<i>P for trend</i>		0.23		0.008
<i>P for interaction</i>		0.15		

# Höhere Proteinaufnahme reduziert Hirninfarkt-Inzidenz (Schweden, n=39.227) insgesamt und verstärkt bei Hypertonie



S.C. Larsson et al. / Atherosclerosis 224 (2012) 247e251



## Cerebral infarction

	No history of hypertension		History of hypertension	
	Cases	Multivariable RR <sup>a</sup>	Cases	Multivariable RR <sup>a</sup>
<i>Total protein, g/d</i>				
<61.8	186	1.00	117	1.00
61.8–67.2	154	0.90 (0.72, 1.14)	89	0.71 (0.53, 0.95)
67.3–72.1	170	1.00 (0.79, 1.28)	78	0.52 (0.37, 0.73)
72.2–78.6	155	0.87 (0.66, 1.13)	95	0.61 (0.43, 0.87)
≥78.7	163	0.83 (0.62, 1.10)	103	0.55 (0.38, 0.79)
<i>P for trend</i>		0.19		0.007
<i>P for interaction</i>		0.05		
<i>Animal protein, g/d</i>				
<38.3	189	1.00	113	1.00
38.3–44.2	144	0.78 (0.62, 1.00)	86	0.68 (0.50, 0.93)
44.3–49.7	158	0.84 (0.65, 1.10)	92	0.64 (0.46, 0.90)
49.8–57.9	170	0.88 (0.66, 1.18)	84	0.54 (0.37, 0.78)
≥58.0	167	0.72 (0.53, 0.99)	104	0.54 (0.36, 0.81)
<i>P for trend</i>		0.11		0.008
<i>P for interaction</i>		0.48		

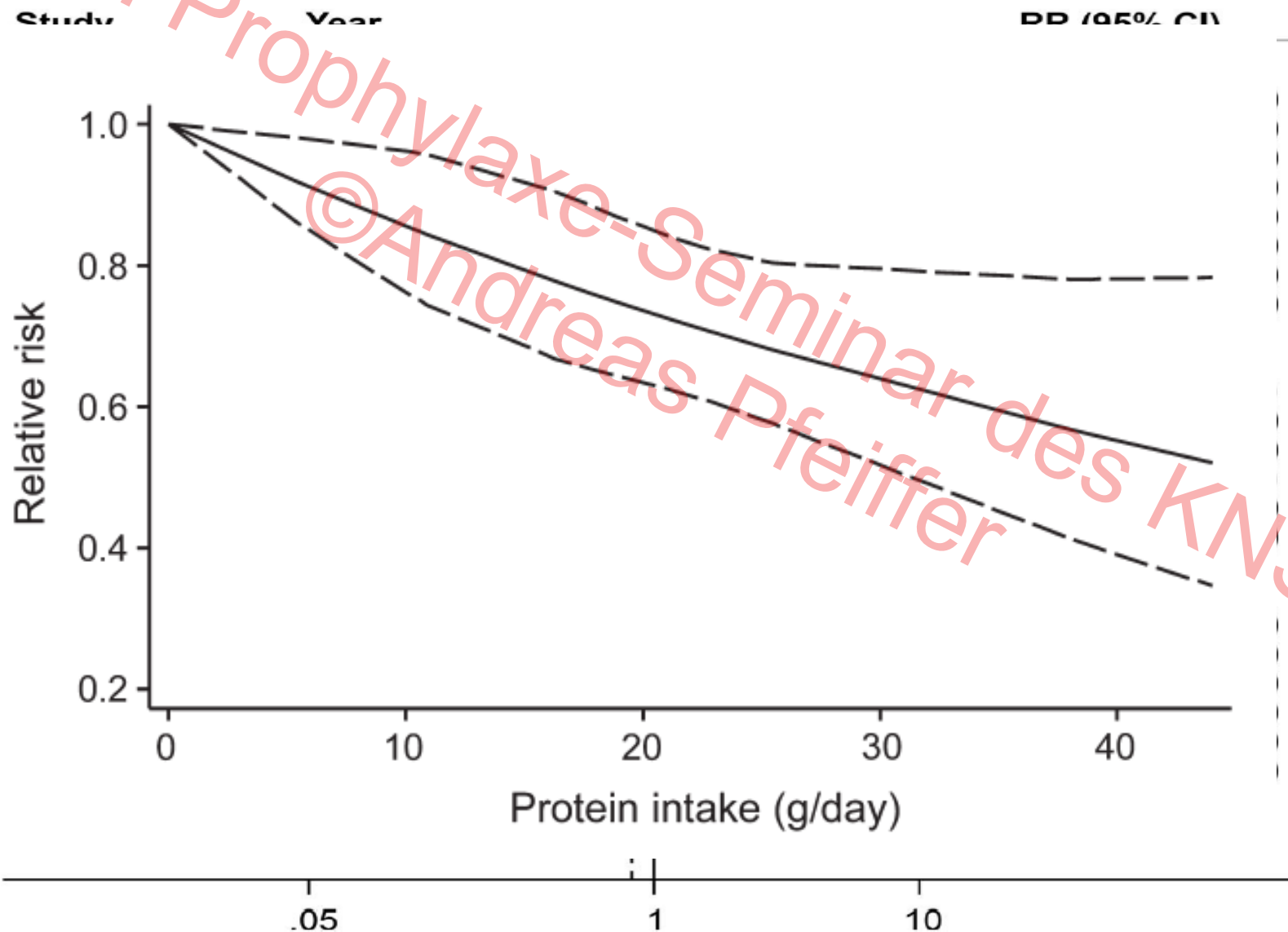


# Höhere Proteinaufnahme reduziert Schlaganfall-Inzidenz in Meta-analyse von 254,489 Teilnehmern

CHARITÉ  
Study

Zhang et al., Neurology 2014;83:19–25

D/E



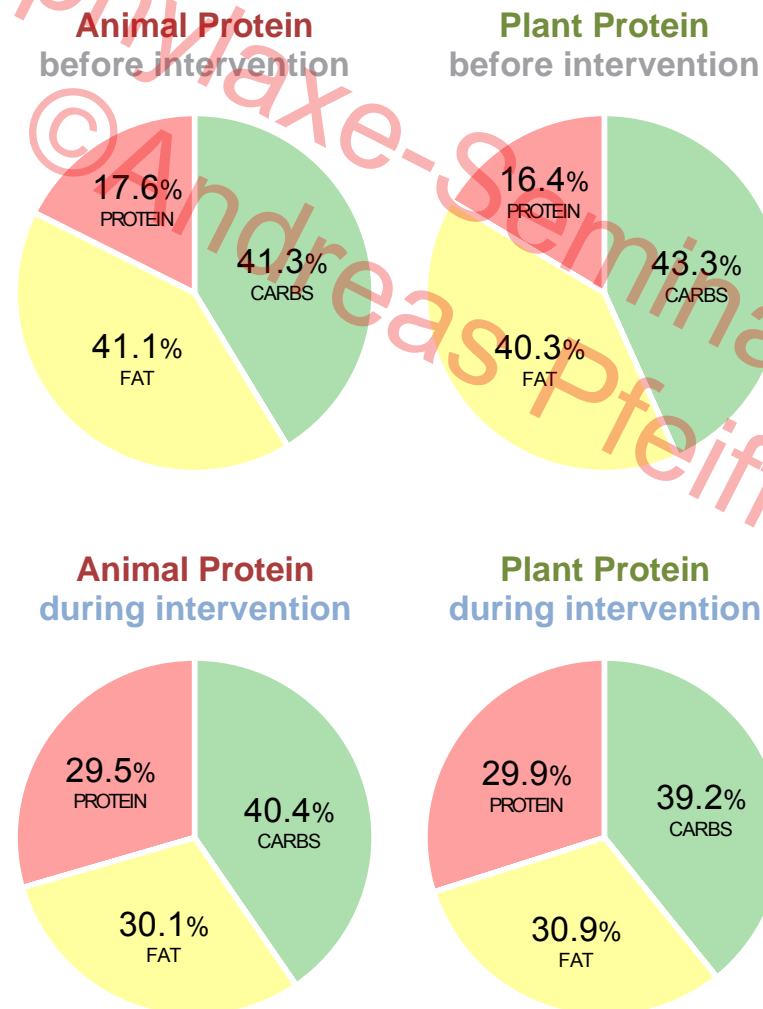
Prophylaxe-Seminar des KNS  
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## LeguAN-Studie

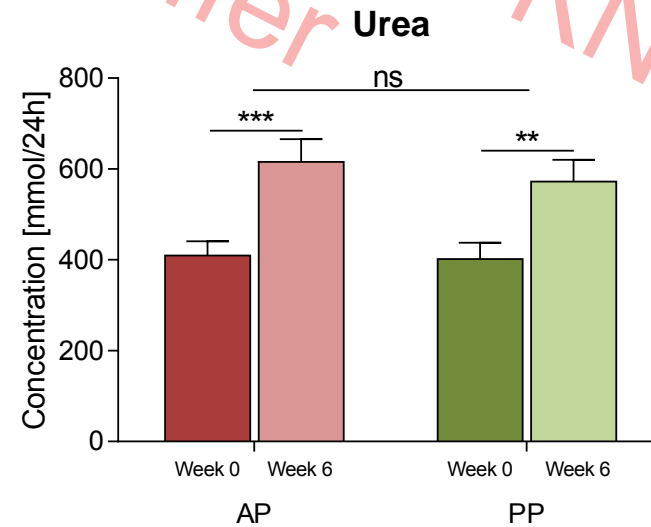
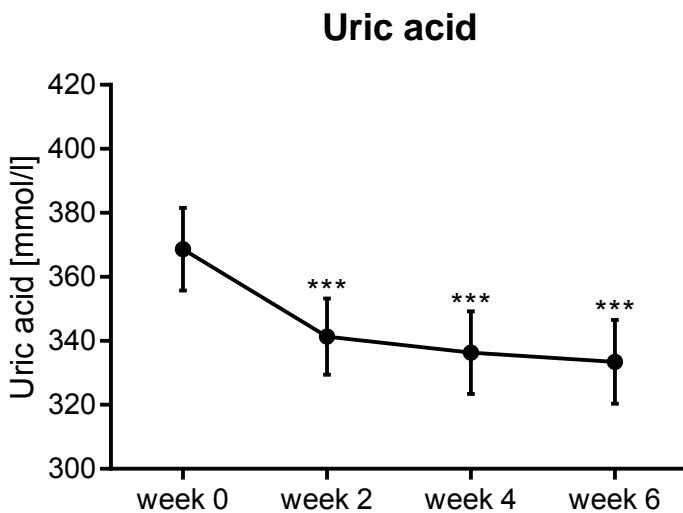
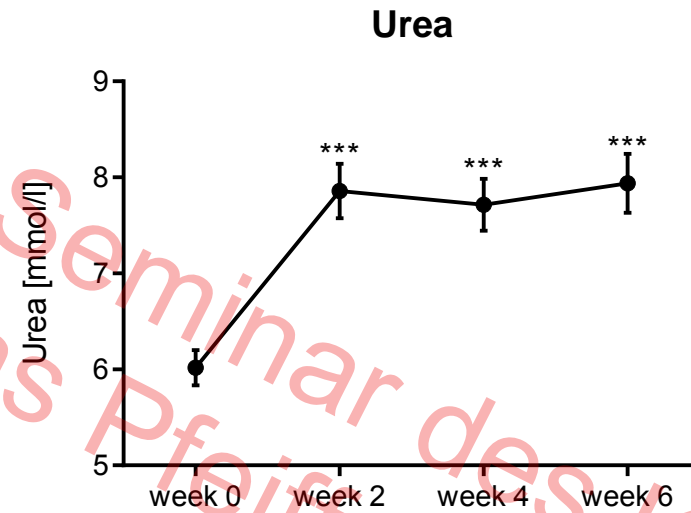
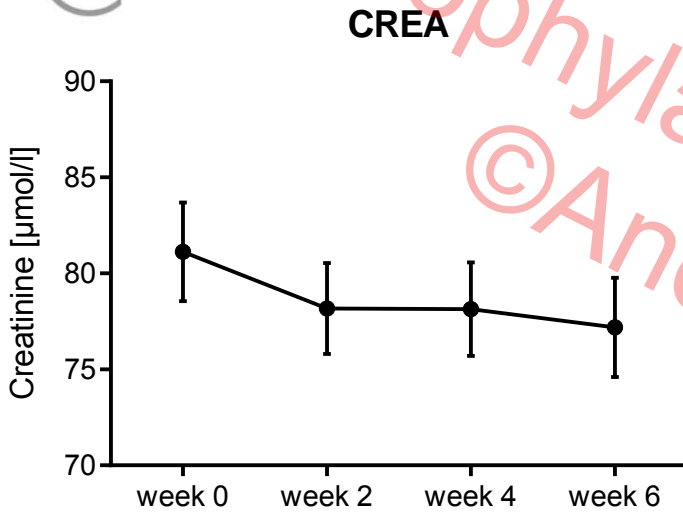
Vergleich einer proteinreichen, kohlenhydratreduzierten Ernährung mit einem hohen Anteil von Leguminosenprotein gegenüber tierischem Protein auf die Stoffwechseleinstellung bei Patienten mit Typ 2 Diabetes

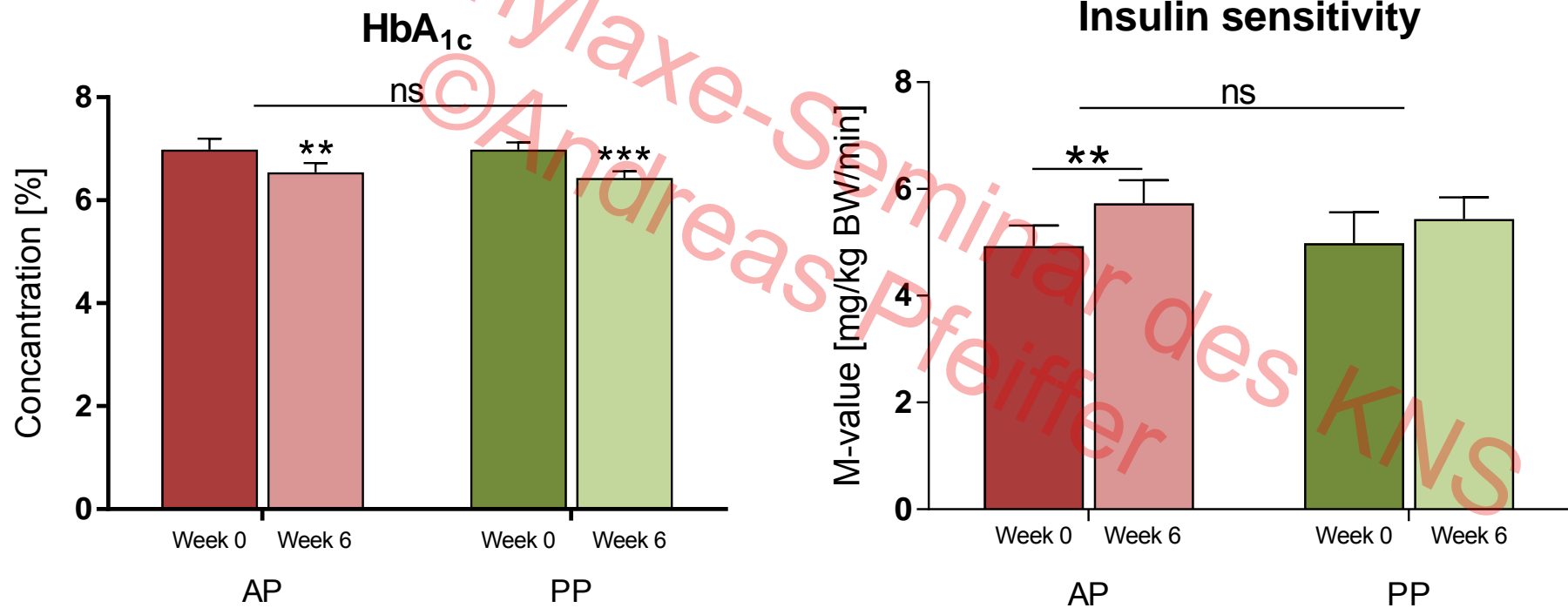
**M.Markova, S. Sucher, S.Hornemann, T.Frahnnow,  
M. Osterhoff, J.Machann, Chr.Herder, S.Rohn,  
S.Platz, A.F.H. Pfeiffer**

# LeguAN Studie: Austausch von 10% Fett vs 10% Protein tierischen oder pflanzlicher Herkunft (65J., T2DM, BMI 30)



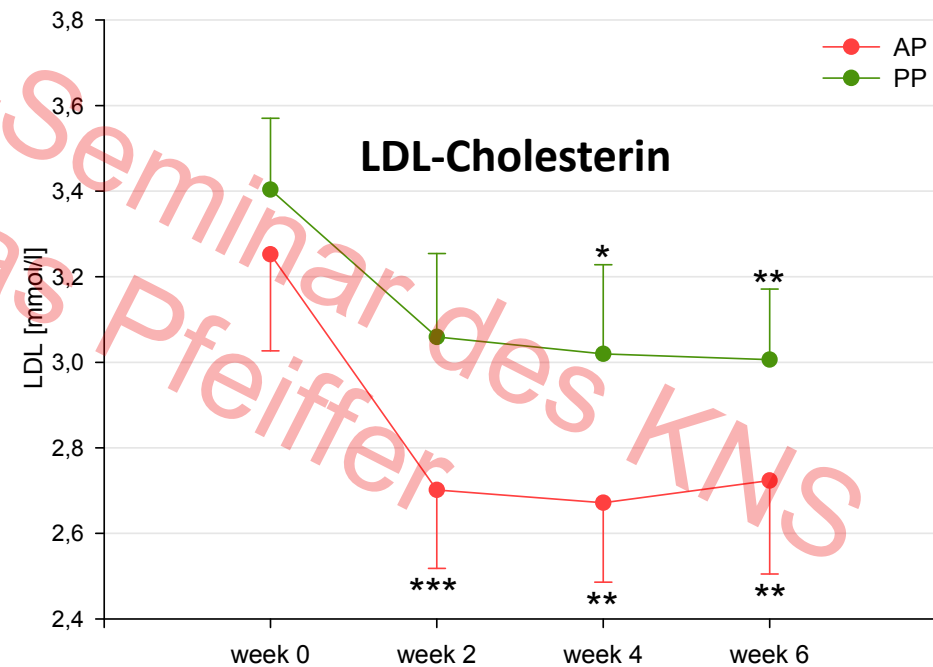
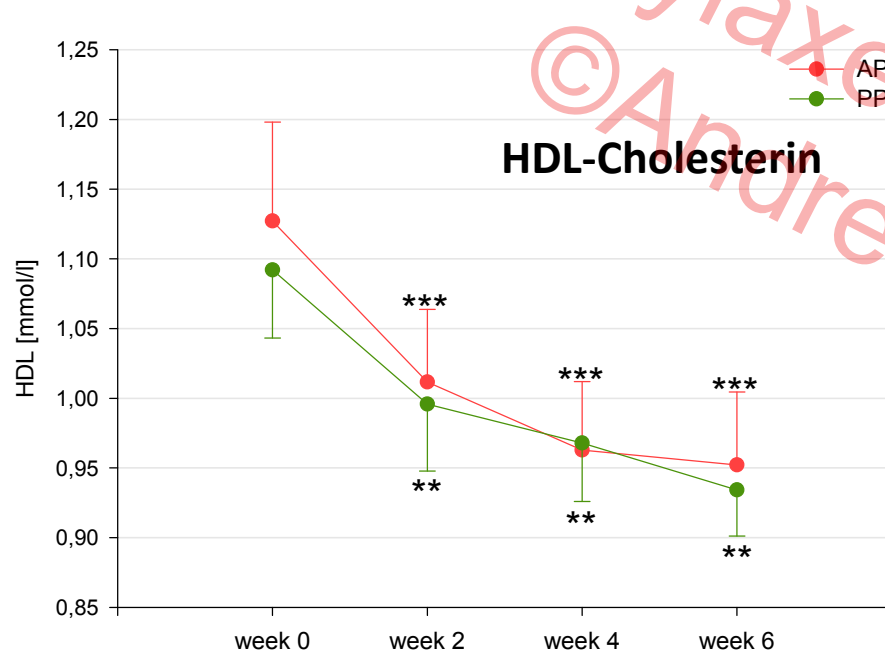
# Renale Funktion verbessert trotz Anstieg des Harnstoffs und Abfall der Harnsäure





Gannon & Nuttal, 2003, 2004, 2008, 2009; Weickert et. al., 2011

# HDL- und LDL Cholesterin



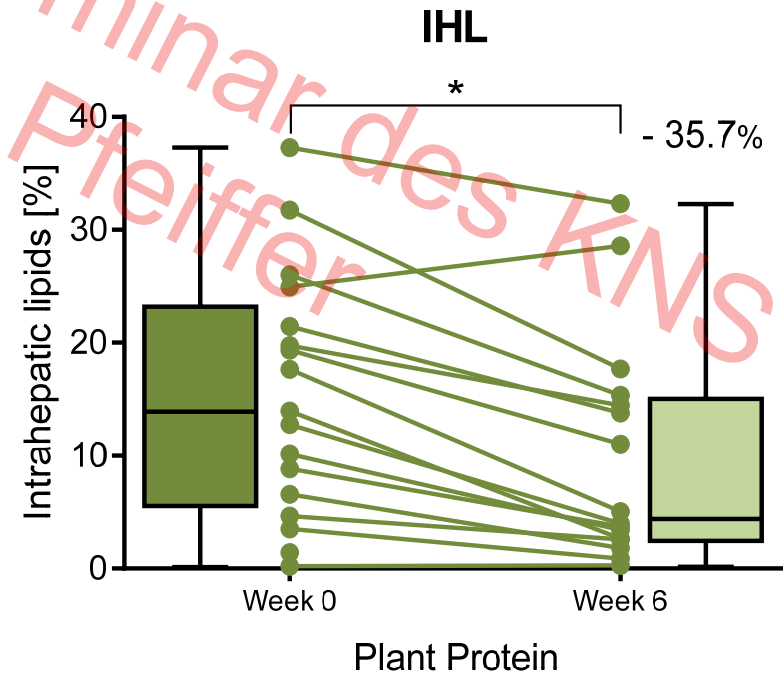
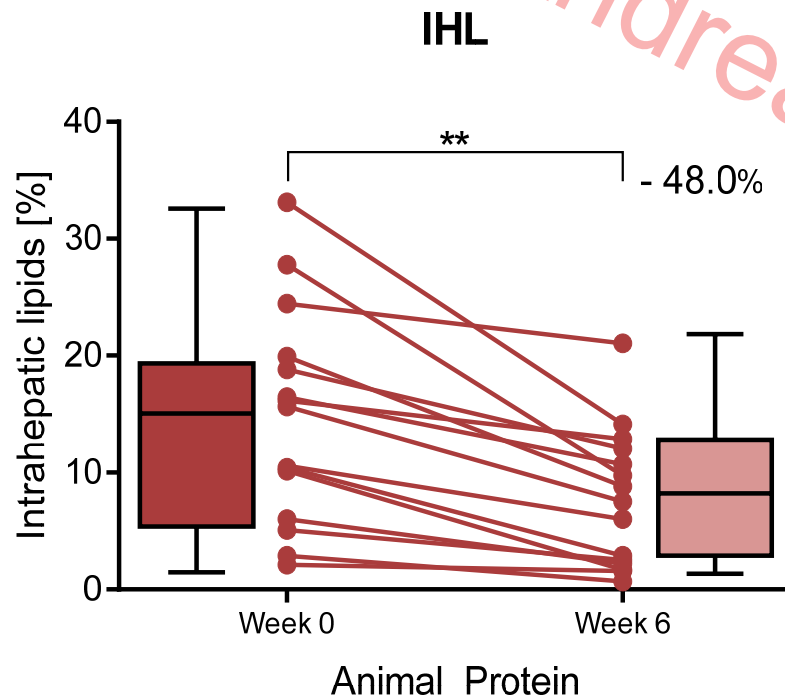
# Reduktion des Leberfettgehalts (MRI<sub>spect</sub>) in 6 Wochen um 36 – 48% ohne Kalorienrestriktion



Markova, Pivovarova et al., Gastroenterol. 2017



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Deutsches Zentrum  
für Diabetesforschung



$n_{AP} = 15, n_{PP} = 16$

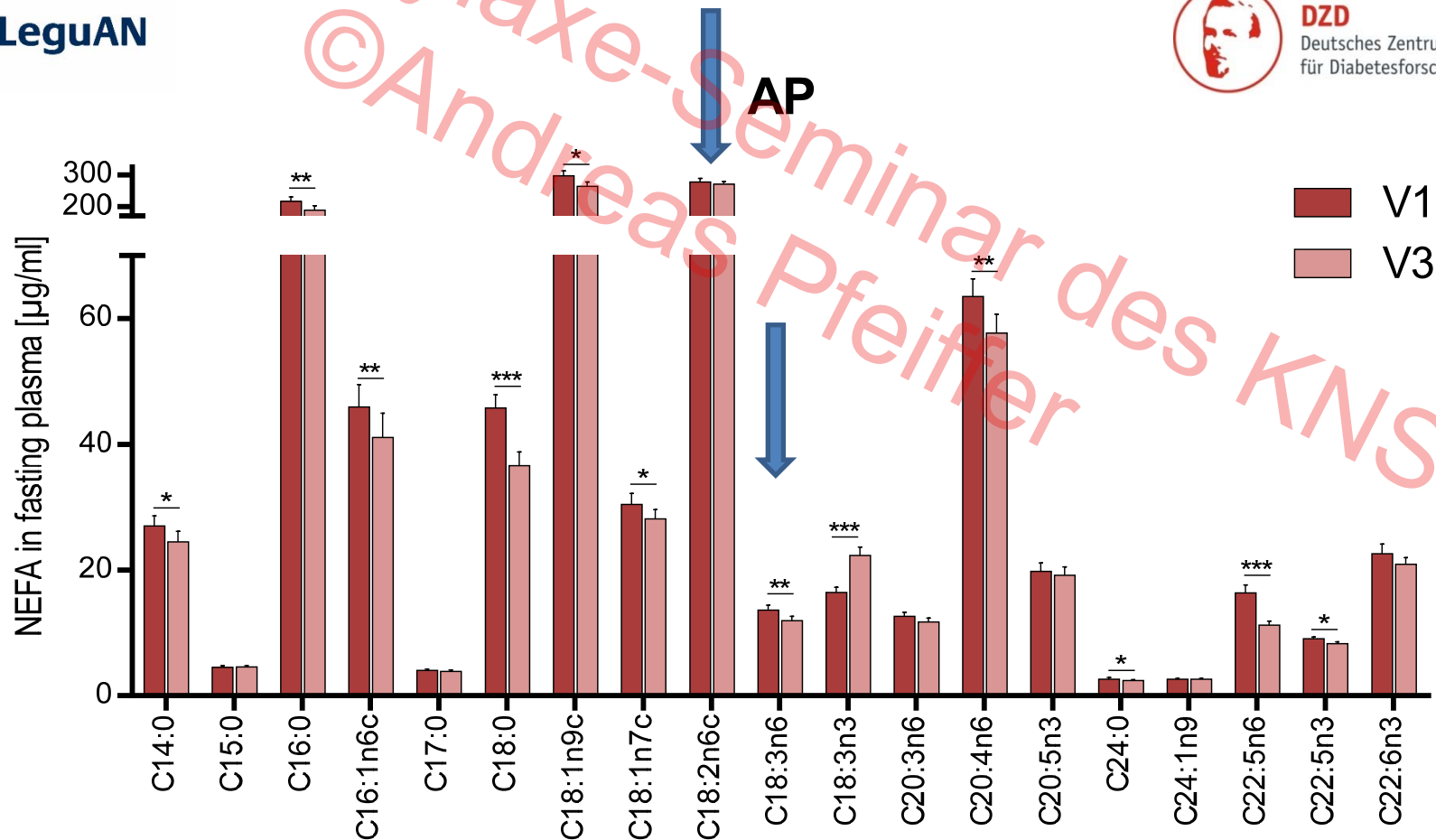
# Abfall aller gesättigten freien Fettsäuren im Plasma und der $\gamma$ -Linolensäure bei Konstanz der Linol ( $\omega 6$ )- und $\alpha$ -Linolensäure ( $\omega 3$ )



Markova, Pivovarova et al., Gastroenterol 2017



**DZD**  
Deutsches Zentrum  
für Diabetesforschung



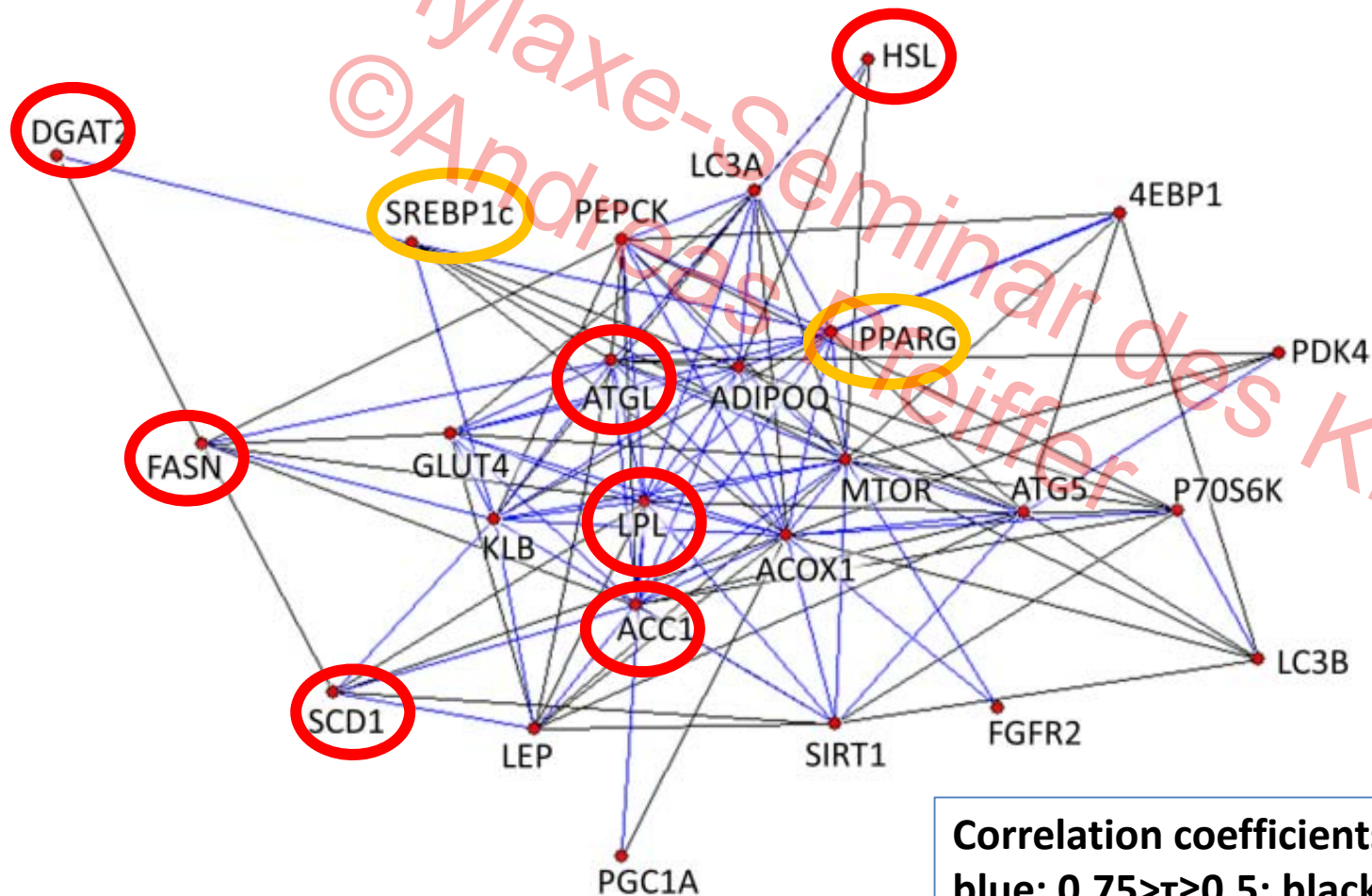
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Proprietary Seminar des KNS



# Protein-reiche Ernährung steuert eine hochkordinierte Umprogrammierung der Lipolyse- und Lipogenesewege im Fettgewebe

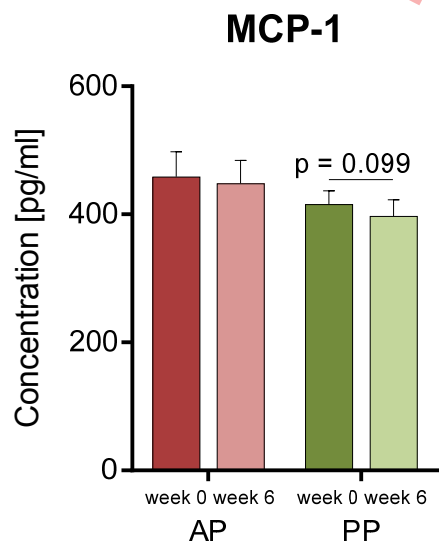
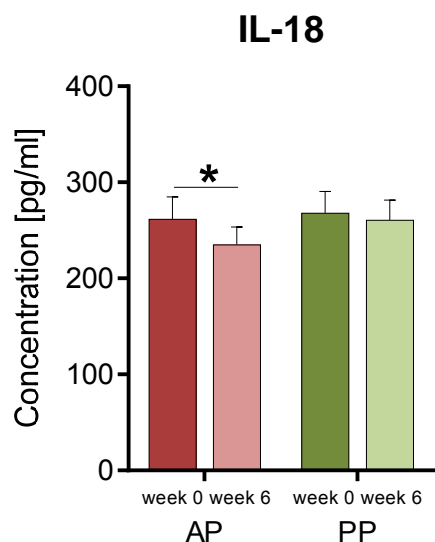
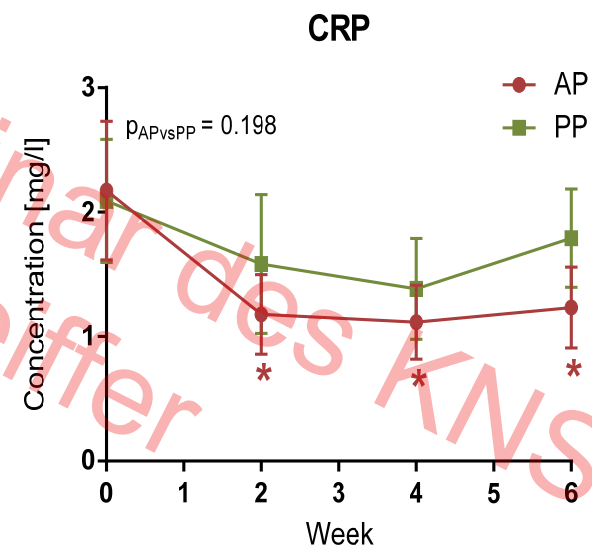
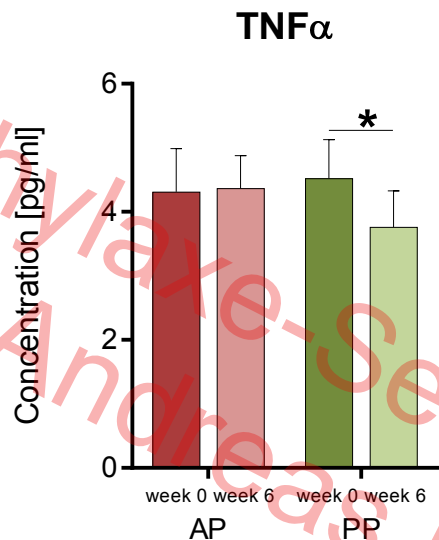
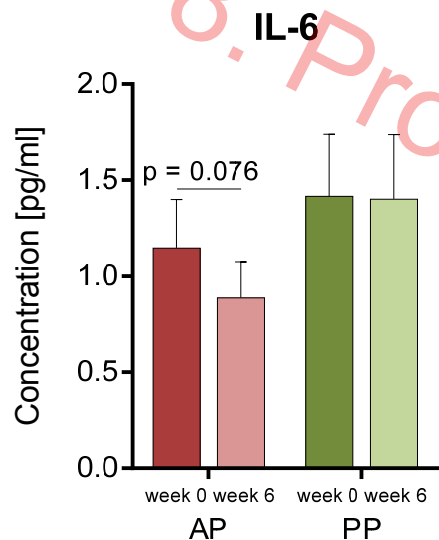


Markova, Pivovarova et al., Gastroenterol. 2017



Correlation coefficients:  
blue:  $0.75 > \tau \geq 0.5$ ; black:  $0.5 > \tau \geq 0.3$

# Reduktion von Inflammationsmarkern in Blut durch proteinreiche Ernährung



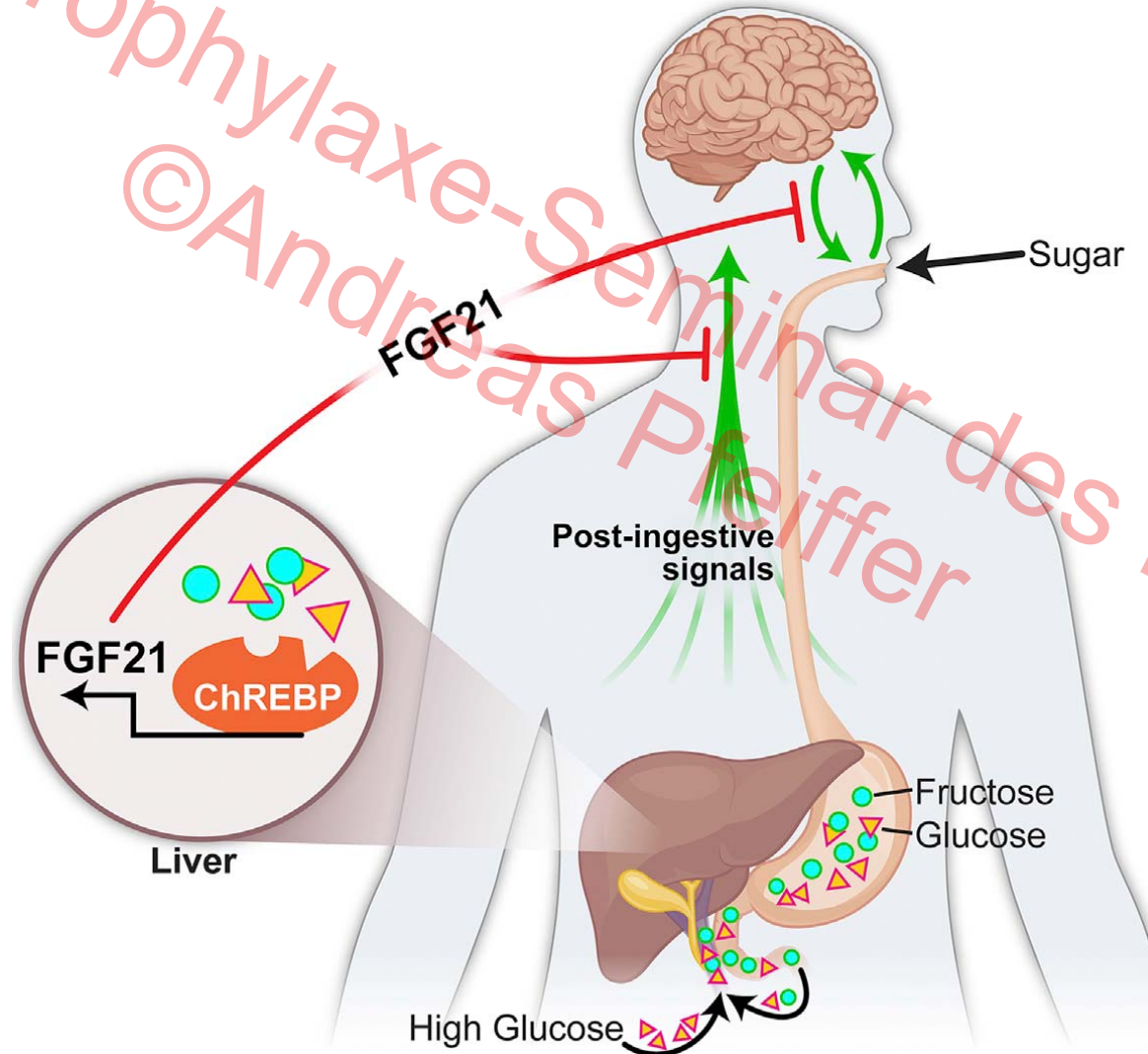
$n_{AP} = 10-18, n_{PP} = 10-19$

# Das Hepatokin FGF21 hemmt Süß-Geschmackspräferenz

CHARITÉ

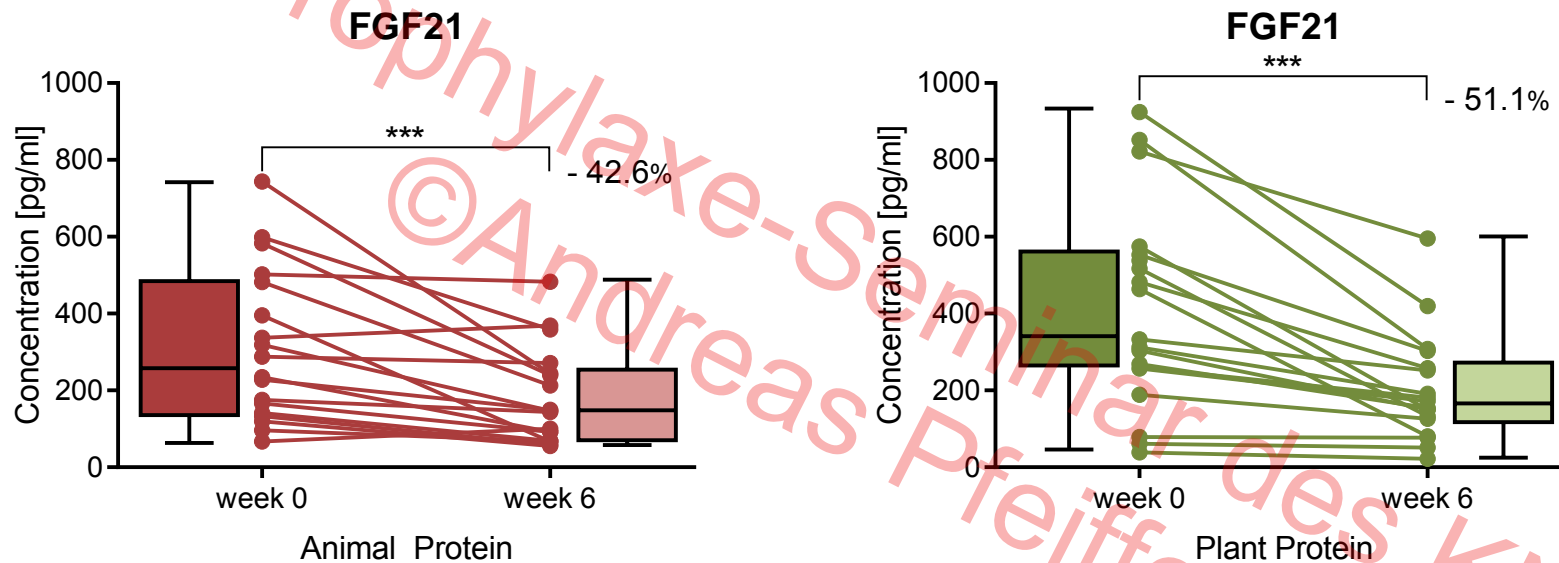
Holstein-Rathlou et al., 2016, Cell Metabolism 23, 1–9

D/E



8. Prophylaxe-Seminar des KNS  
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# Reduktion von Serum-FGF21 Spiegeln induziert nach 6 Wochen Hochproteindiäten

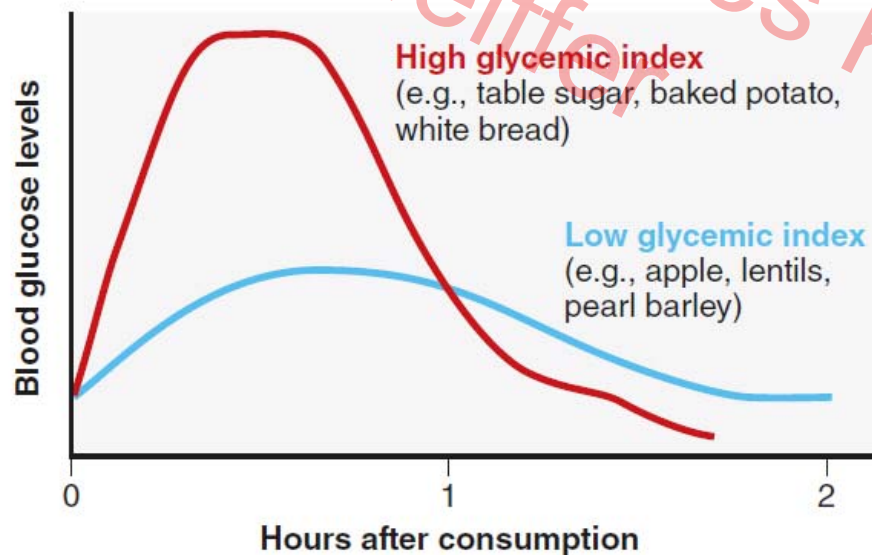
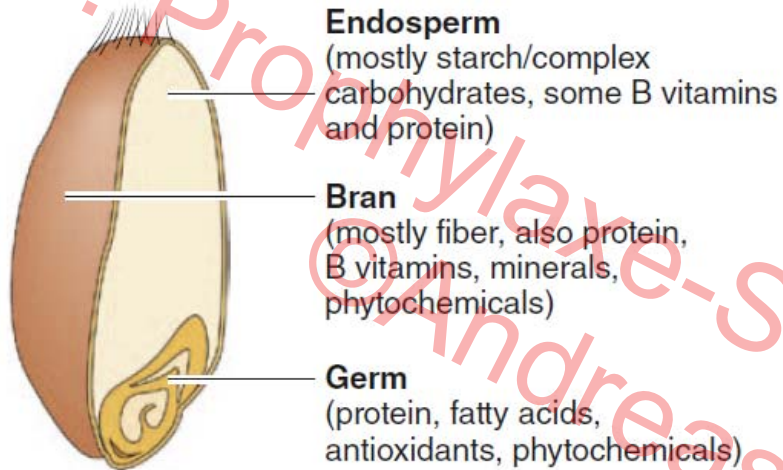


**Verminderter ER-Stress in Leber folglich der Reduktion des Leberfetts**

**FGF21 als Marker für metabolische Verbesserungen?**

$n_{AP} = 18, n_{PP} = 19$

# Ballaststoffe und Glykämischer Index



# Höhere Ballaststoffaufnahme reduziert Schlaganfall-Inzidenz

Swedish women and men (n = 69,677), 1998-2008



S.C. Larsson & Wolk, J Nutr 2014;144:1952-5



Quintile <sup>1</sup>	Total stroke				Cerebral infarction		
	Cases, <i>n</i>	Rates <sup>2</sup>	Model 1 <sup>3</sup>	Model 2 <sup>4</sup>	Cases, <i>n</i>	Model 1 <sup>3</sup>	Model 2 <sup>4</sup>
<b>Total fiber</b>							
Q1	760	5.34	1.00 (referent)	1.00 (referent)	560	1.00 (referent)	1.00 (referent)
Q2	746	5.20	0.92 (0.83, 1.02)	0.95 (0.86, 1.05)	540	0.90 (0.80, 1.02)	0.92 (0.82, 1.04)
Q3	752	5.21	0.89 (0.80, 0.99)	0.93 (0.84, 1.03)	542	0.87 (0.77, 0.97)	0.89 (0.79, 1.04)
Q4	722	5.00	0.87 (0.79, 0.96)	0.91 (0.82, 1.01)	557	0.90 (0.80, 1.02)	0.94 (0.83, 1.06)
Q5	700	4.83	0.86 (0.78, 0.96)	0.90 (0.81, 0.99)	523	0.87 (0.77, 0.98)	0.89 (0.79, 1.01)
<i>P</i> -trend			0.003	0.03		0.05	0.14
<b>Cereal fiber</b>							
Q1	713	4.99	1.00 (referent)	1.00 (referent)	500	1.00 (referent)	1.00 (referent)
Q2	696	4.84	0.91 (0.82, 1.01)	0.94 (0.84, 1.04)	517	0.96 (0.85, 1.09)	0.99 (0.87, 1.12)
Q3	731	5.06	0.92 (0.83, 1.03)	0.95 (0.85, 1.05)	552	0.99 (0.88, 1.12)	1.02 (0.90, 1.15)
Q4	781	5.42	0.94 (0.85, 1.04)	0.97 (0.87, 1.08)	600	1.02 (0.90, 1.15)	1.05 (0.93, 1.18)
Q5	759	5.27	0.93 (0.84, 1.03)	0.94 (0.84, 1.04)	553	0.96 (0.85, 1.08)	0.96 (0.85, 1.09)
<i>P</i> -trend			0.35	0.42		0.70	0.72

# Höhere Ballaststoffaufnahme reduziert Schlaganfall-Inzidenz

Swedish women and men (n = 69,677), 1998-2008



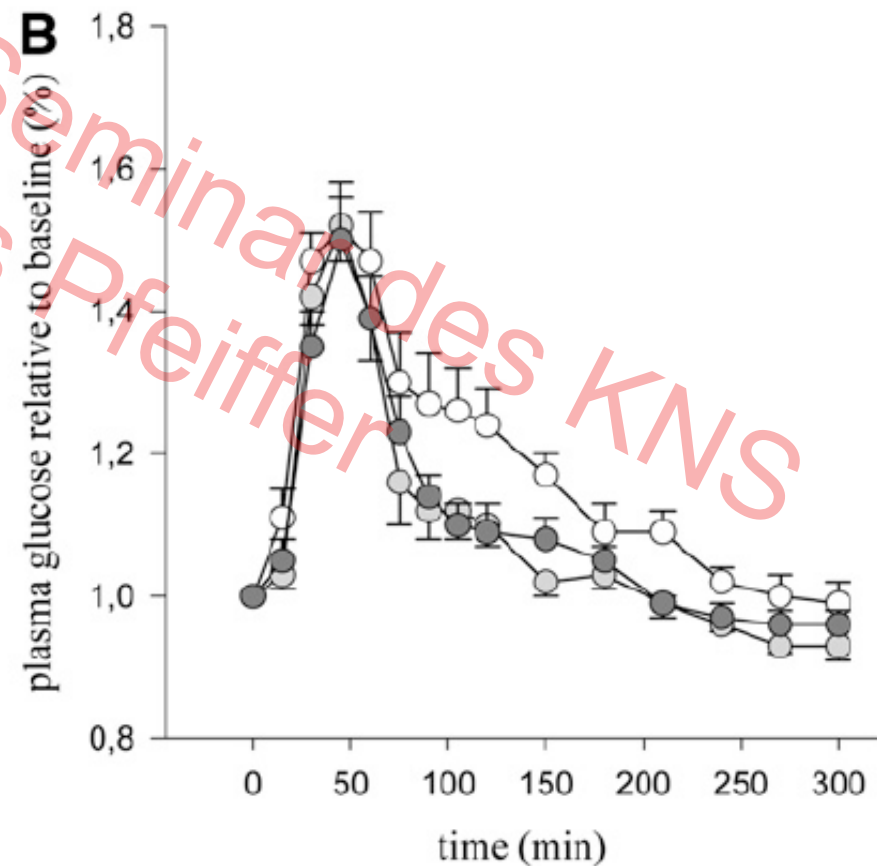
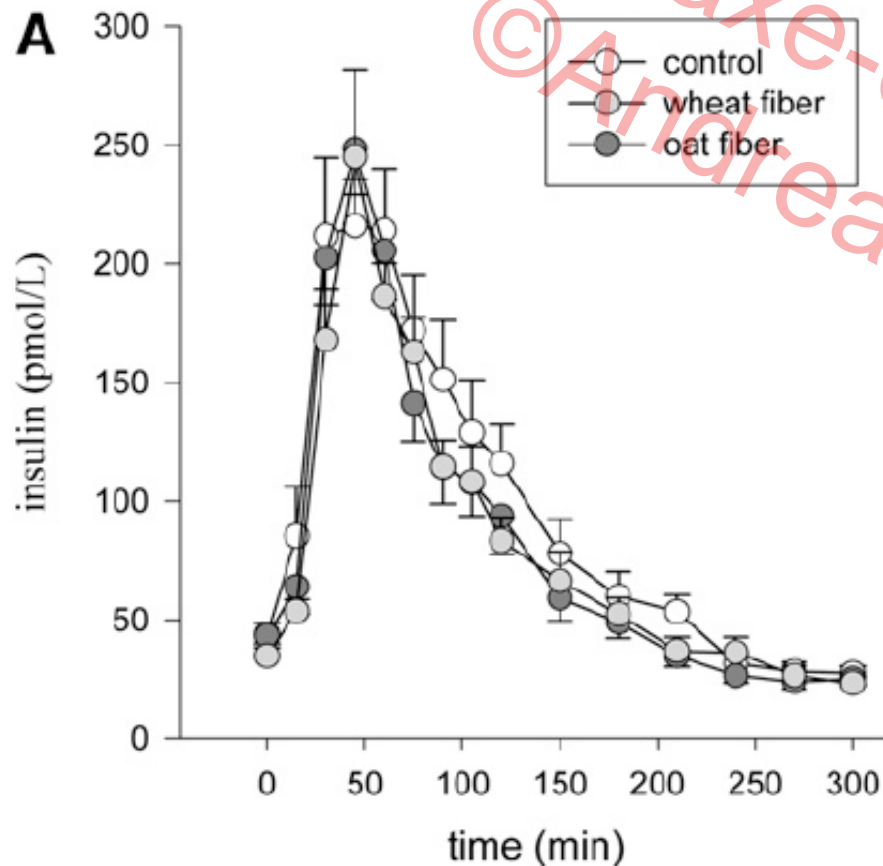
S.C. Larsson & Wolk, J Nutr 2014;144:1952-5



Quintile <sup>1</sup>	Total stroke				Cerebral infarction		
	Cases, <i>n</i>	Rates <sup>2</sup>	Model 1 <sup>3</sup>	Model 2 <sup>4</sup>	Cases, <i>n</i>	Model 1 <sup>3</sup>	Model 2 <sup>4</sup>
<b>Fruit fiber</b>							
Q1	771	5.42	1.00 (referent)	1.00 (referent)	550	1.00 (referent)	1.00 (referent)
Q2	740	5.12	0.94 (0.85, 1.04)	0.98 (0.89, 1.09)	557	0.99 (0.88, 1.11)	1.03 (0.91, 1.16)
Q3	725	5.03	0.87 (0.78, 0.96)	0.92 (0.83, 1.02)	526	0.88 (0.78, 0.99)	0.93 (0.82, 1.05)
Q4	710	4.92	0.80 (0.75, 0.91)	0.87 (0.78, 0.96)	530	0.84 (0.74, 0.94)	0.89 (0.79, 1.01)
Q5	734	5.10	0.80 (0.72, 0.88)	0.85 (0.77, 0.95)	559	0.85 (0.76, 0.96)	0.90 (0.80, 1.02)
<i>P</i> -trend			<0.0001	0.007		0.005	0.05
<b>Vegetable fiber</b>							
Q1	900	6.41	1.00 (referent)	1.00 (referent)	680	1.00 (referent)	1.00 (referent)
Q2	735	5.10	0.93 (0.85, 1.03)	0.96 (0.87, 1.06)	534	0.91 (0.81, 1.02)	0.93 (0.83, 1.04)
Q3	706	4.87	0.90 (0.81, 0.99)	0.94 (0.85, 1.04)	520	0.87 (0.78, 0.98)	0.91 (0.81, 1.02)
Q4	682	4.70	0.88 (0.80, 0.98)	0.93 (0.84, 1.04)	510	0.88 (0.78, 0.99)	0.93 (0.82, 1.05)
Q5	657	4.53	0.87 (0.78, 0.96)	0.90 (0.82, 1.00)	478	0.84 (0.74, 0.94)	0.87 (0.77, 0.98)
<i>P</i> -trend			0.02	0.12		0.01	0.06

# 50 g Kohlenhydrat-Test: Wirkung 30 g unlöslicher Weizen- oder Hafer Ballaststoffe auf Insulin- und Glucoseprofile am darauffolgenden Tag

23 y mean age, BMI 21 kg/m<sup>2</sup>, n = 14, NGT



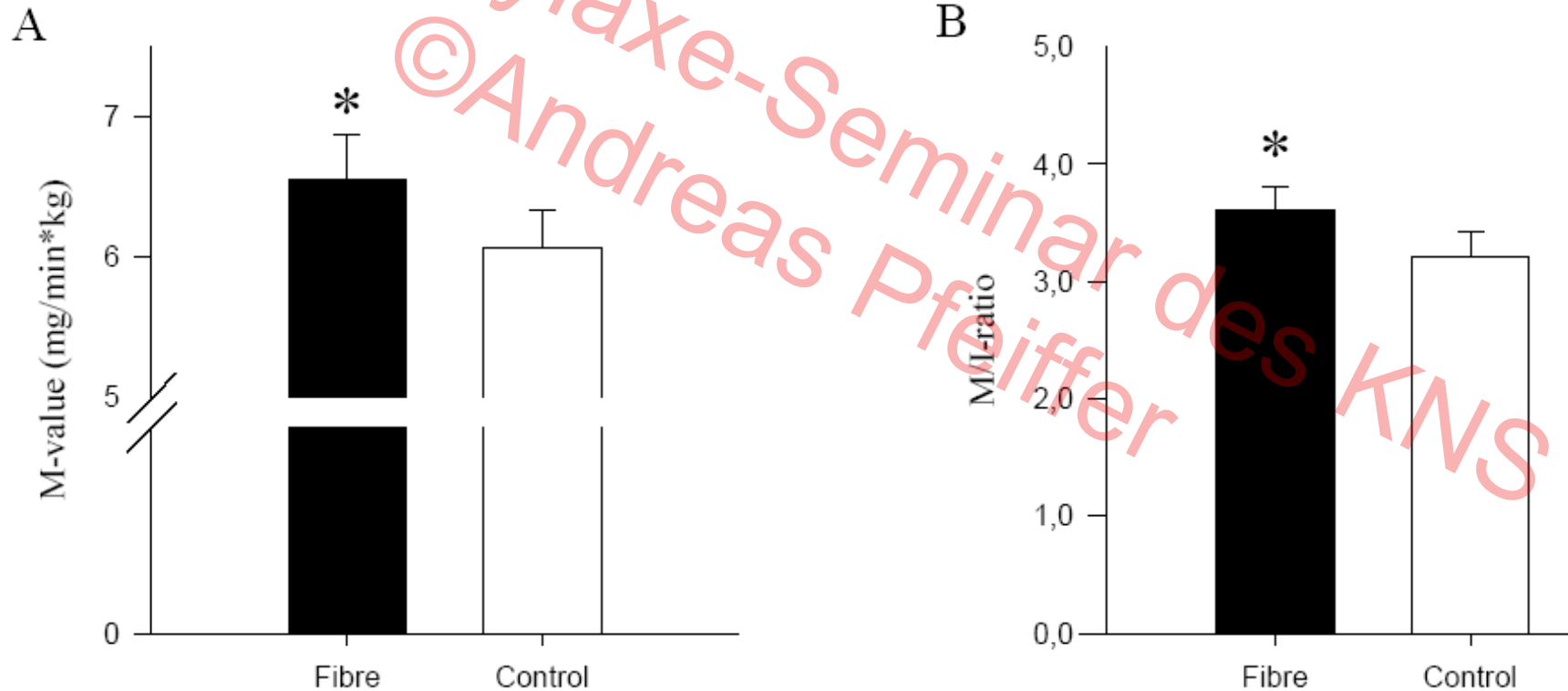


# Gesteigerte Insulinsensitivität bei adipösen Probanden nach 3 Tagen von 30g/Tag unlöslichen Haferfasern: euglycämische hyperinsulinämische Clamps

CHARITÉ CAMPUS BENJAMIN FRANKLIN

Weickert et al., Diabetes Care 2006

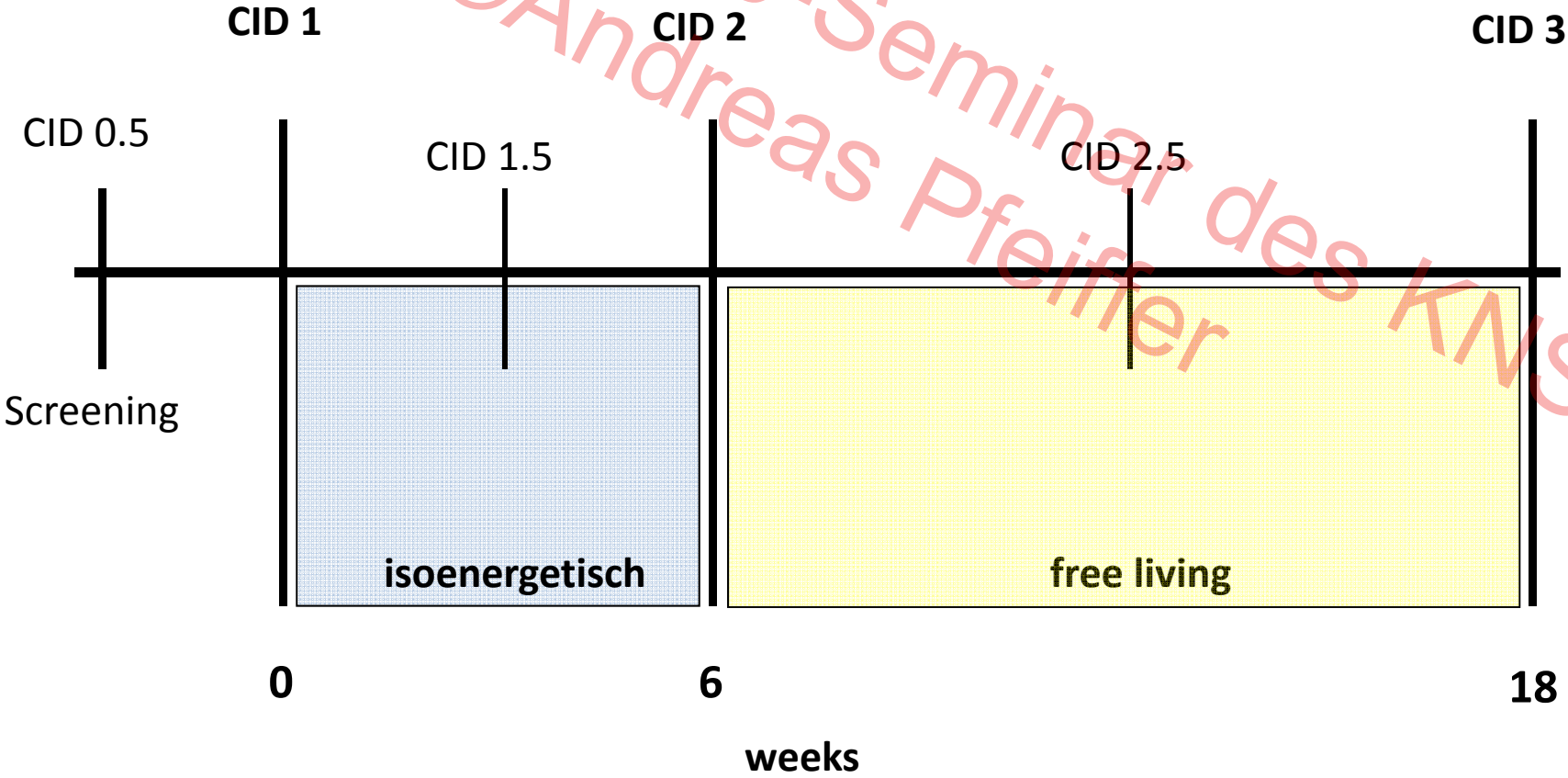
D/E



# Study design

- CIDs 1, 2, 3:** EHCs, EGP, MRI, H1 Spektroskopie, Anthropometrie, Bod Pod, Biopsien, RQ, Biomarker, Darmflora
- CIDs 0.5, 1.5:** OGTTs, Anthropometry, Biomarker

Weickert et al., Am J Clin Nutr 2011

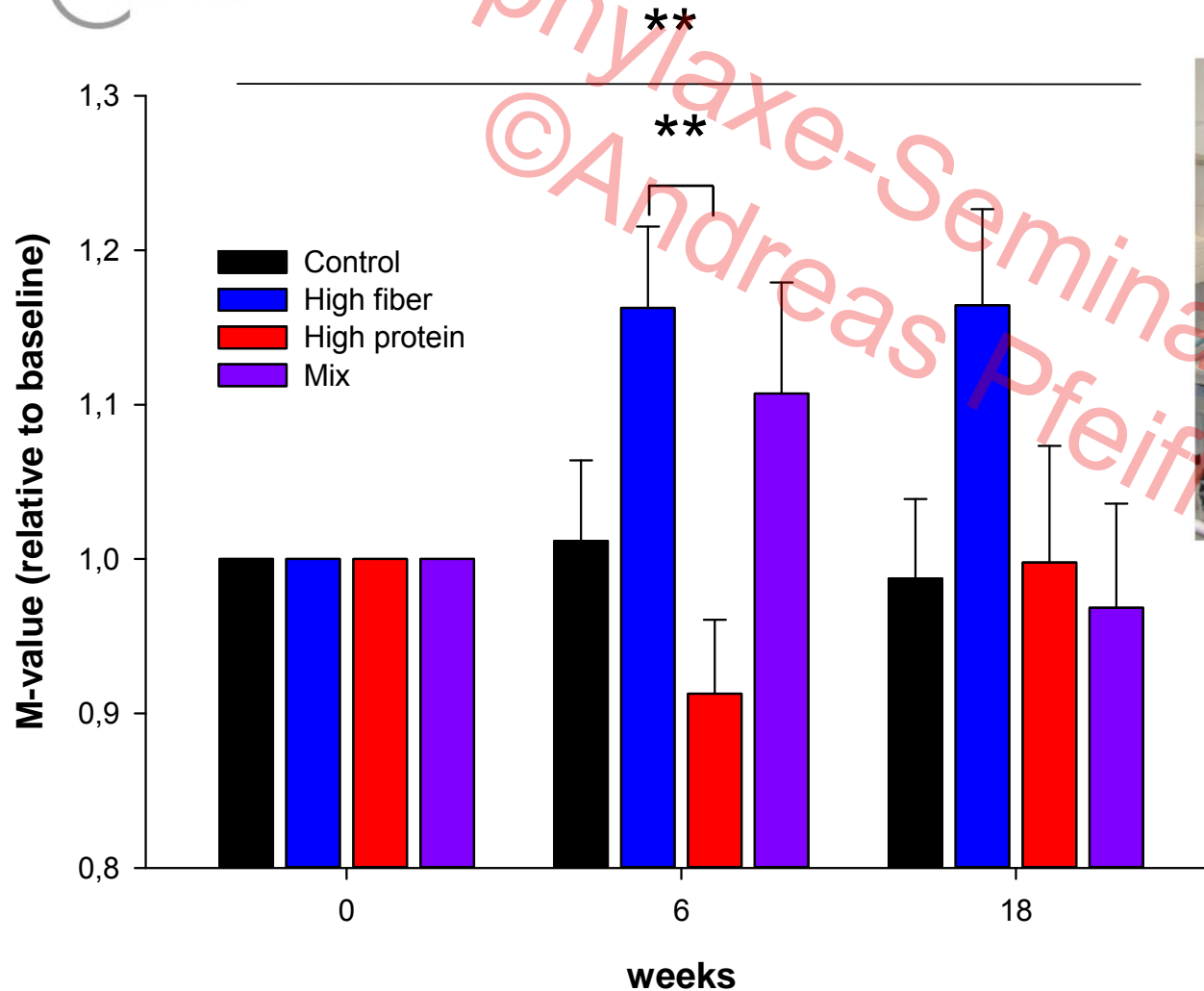


# Insulinsensitivität wird durch unlösliche Hafer-Ballaststoffe (blau) signifikant verbessert (ProFiMet)

CHARITÉ

Weickert et al., Am J Clin Nutr 2011

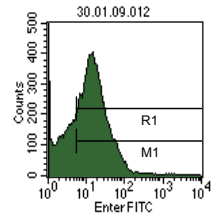
D/E



# Changes in gut microbiota

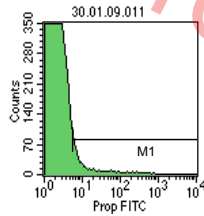
Weickert et al. Nutrition & Metabolism 2011, 8:90

n = 115,  
CID 1, 2, 3



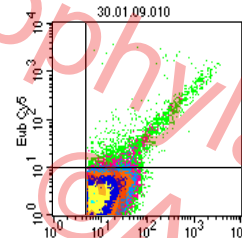
File: 30.01.09.012  
Sample ID: 007 CIC  
Tube: Enter FITC

Marker	Events	% Gate	Medi
All	100000	100.00	10.1
M1	67044	67.04	15.4



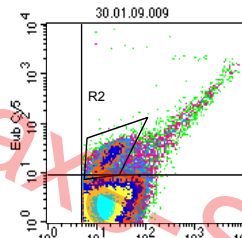
File: 30.01.09.011  
Sample ID: 007 CIC  
Tube: Prop FITC

Marker	Events	% Gate	Medi
All	100000	100.00	1.2
M1	3251	3.25	8.0



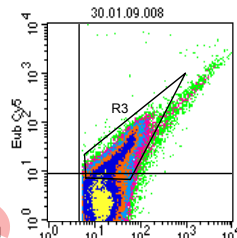
File: 30.01.09.010  
Tube: Bif FITC  
Gated Events: 38965  
Total Events: 100000

Region	Events	% Gate
R1	38965	100.00
R2	1890	4.85
R3	3695	9.48
R4	3441	8.83
R5	2958	7.59
R6	2979	7.65
R7	3952	10.14
R8	2883	7.40
R9	5550	14.24
R10	2327	5.97



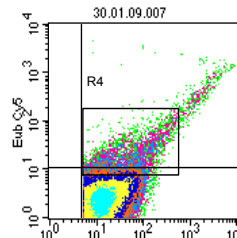
File: 30.01.09.009  
Tube: Ato FITC  
Gated Events: 69307  
Total Events: 100000

Region	Events	% Gate
R1	69307	100.00
R2	1890	4.85
R3	6334	9.14
R4	9043	13.05
R5	9539	13.76



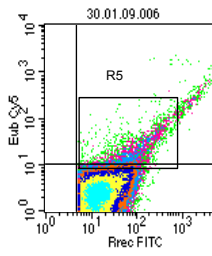
File: 30.01.09.008  
Tube: Clept FITC  
Gated Events: 71645  
Total Events: 100000

Region	Events	% Gate
R1	71645	100.00
R2	16303	22.76
R3	23052	32.18
R4	22974	32.07



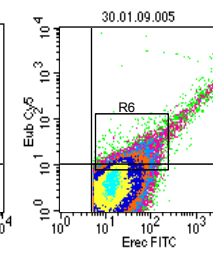
File: 30.01.09.007  
Sample ID: 007 CIC  
Tube: Lab FITC

Region	Events	% Gate
R1	65888	100.00
R2	2779	4.22
R3	6100	9.26
R4	6383	9.69
R5	5456	8.29



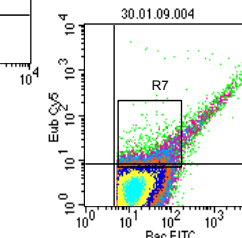
File: 30.01.09.006  
Sample ID: 007 CIC  
Tube: Rrec FITC

Region	Events	% Gate
R1	68806	100.00
R2	1342	1.95
R3	4694	6.82
R4	5048	7.34
R5	4191	6.09
R6	4200	6.10
R7	5739	8.34
R8	3795	5.52
R9	8250	11.99
R10	3034	4.41



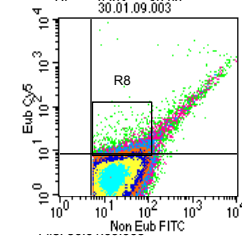
File: 30.01.09.005  
Tube: Erec FITC  
Gated Events: 69806  
Total Events: 100000

Region	Events	% Gate
R1	69806	100.00
R2	9176	13.15
R3	16312	23.37
R4	16084	23.04
R5	13972	20.02
R6	14491	20.76
R7	17776	25.46
R8	14033	20.10
R9	21900	31.37
R10	11708	16.77



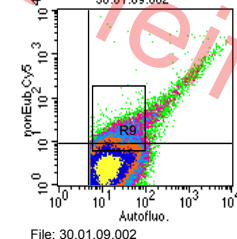
File: 30.01.09.004  
Tube: Bto FITC  
Gated Events: 73850  
Total Events: 100000

Region	Events	% Gate
R1	73850	100.00
R2	1954	2.86
R3	5208	7.63
R4	5653	8.28
R5	4750	6.96
R6	4688	6.87
R7	6267	9.18
R8	4281	6.27
R9	8682	12.72
R10	3474	5.09



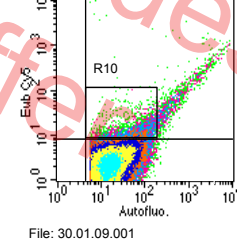
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Tube: background  
Gated Events: 73850  
Total Events: 100000

Region	Events	% Gate
R1	73850	100.00
R2	1669	2.26
R3	5687	7.70
R4	6134	8.31
R5	4996	6.77
R6	5087	6.89
R7	7057	9.56
R8	4661	6.31
R9	10296	13.94
R10	3589	4.86



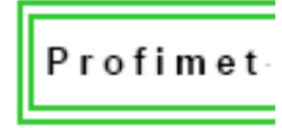
File: 30.01.09.002  
Tube: non Eub Cy5  
Gated Events: 69328  
Total Events: 100000

Region	Events	% Gate
R1	69328	100.00
R2	5127	7.40
R3	9473	13.66
R4	9693	13.98
R5	8535	12.31
R6	8579	12.37
R7	10395	14.99
R8	8065	11.63
R9	13005	18.76
R10	7006	10.11



File: 30.01.09.001  
Tube: Eub Cy5  
Gated Events: 71274  
Total Events: 100000

Region	Events	% Gate
R1	71274	100.00
R2	1198	1.68
R3	4228	5.93
R4	5096	7.15
R5	4307	6.04
R6	4165	5.84
R7	5516	7.74
R8	3574	5.01
R9	7719	10.83
R10	2985	4.19



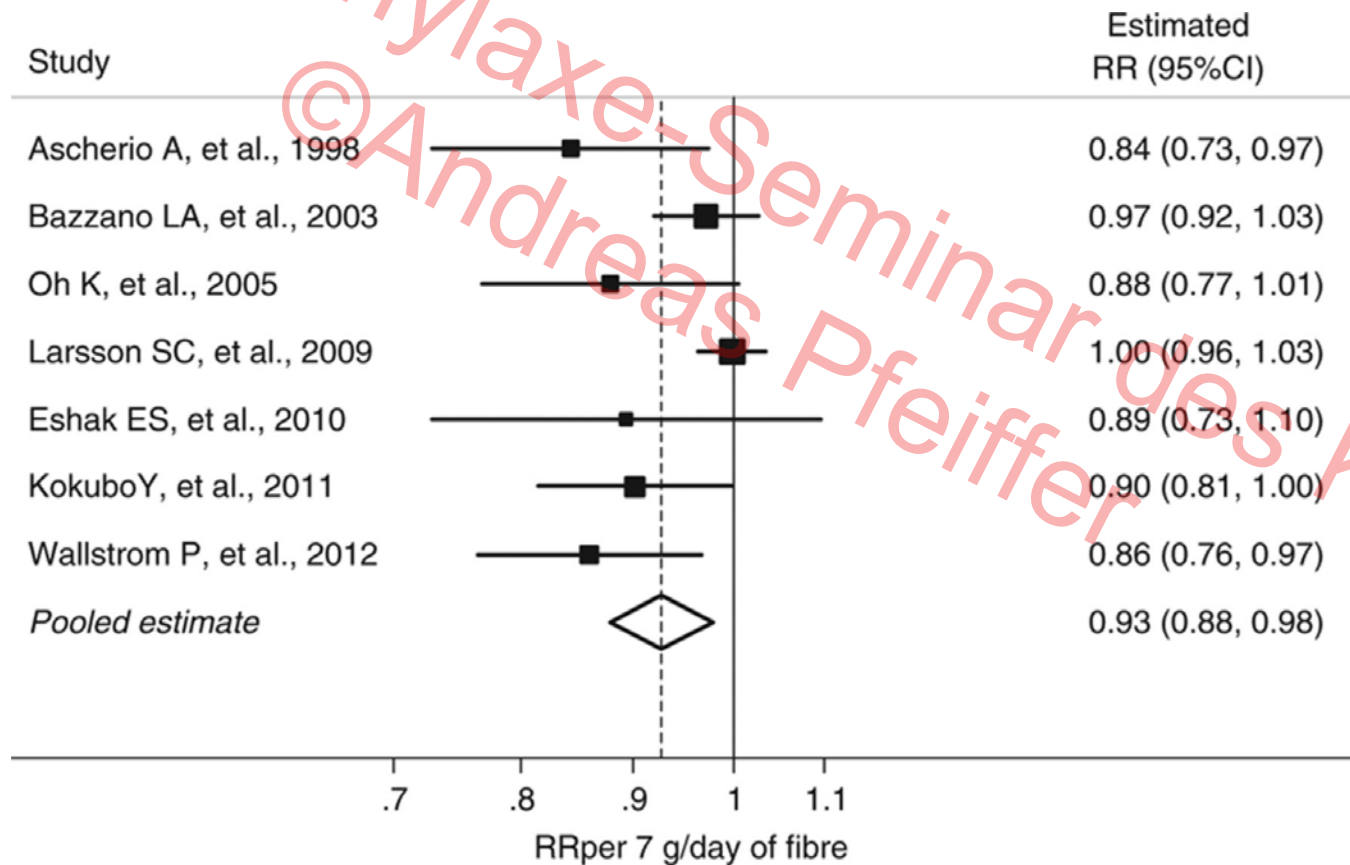
# Ballaststoffe reduzieren Schlaganfallrisiko in Meta-analyse



Threapleton et al. Stroke. 2013



8 cohort studies: Reduced risk for stroke each 7 g/day increase in total dietary fiber.

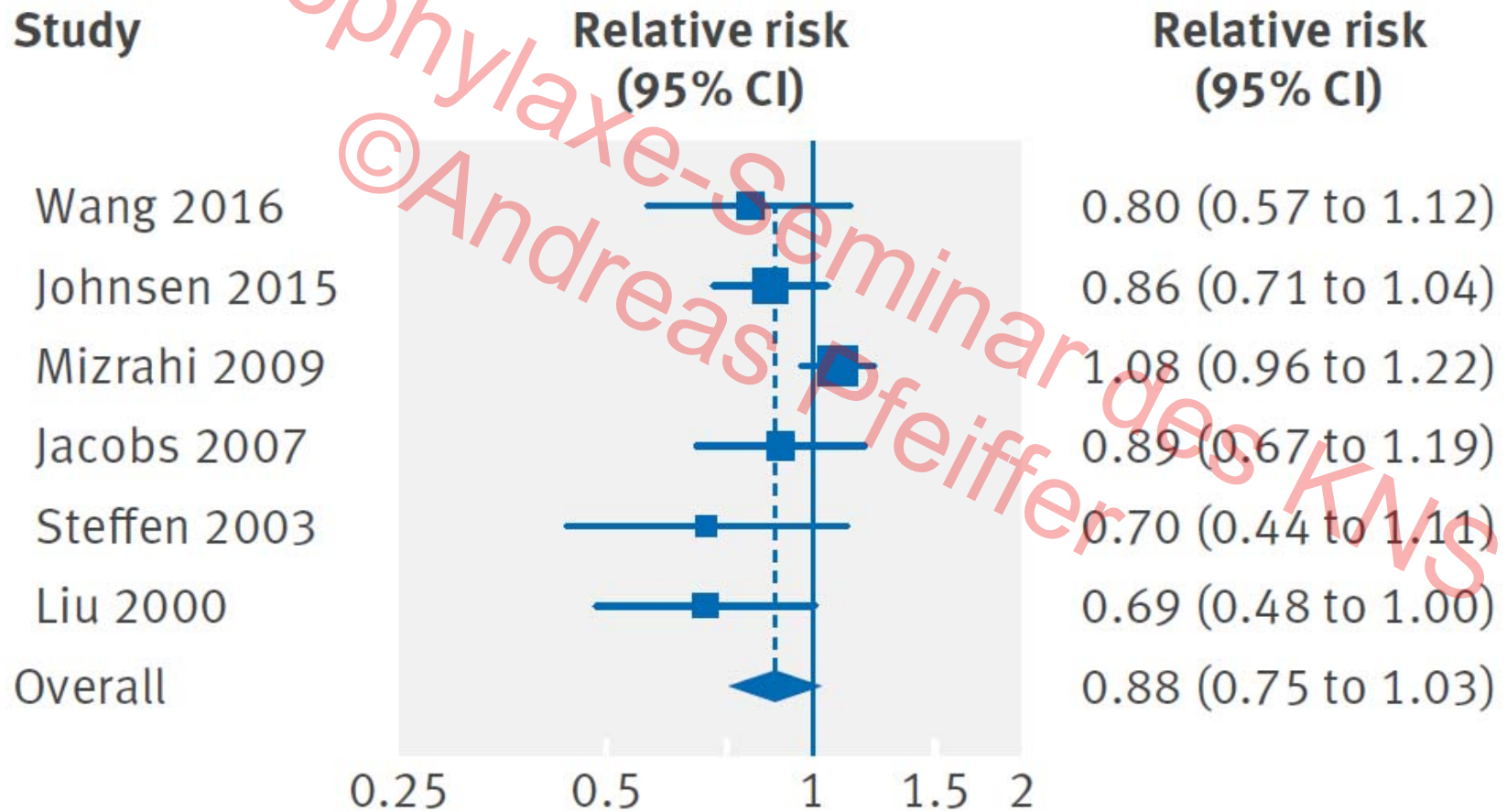


# Whole grain intake reduces incidence of stroke: Meta-analysis

CHARITÉ

Aune et al., BMJ 2016;353:i2716

D/E

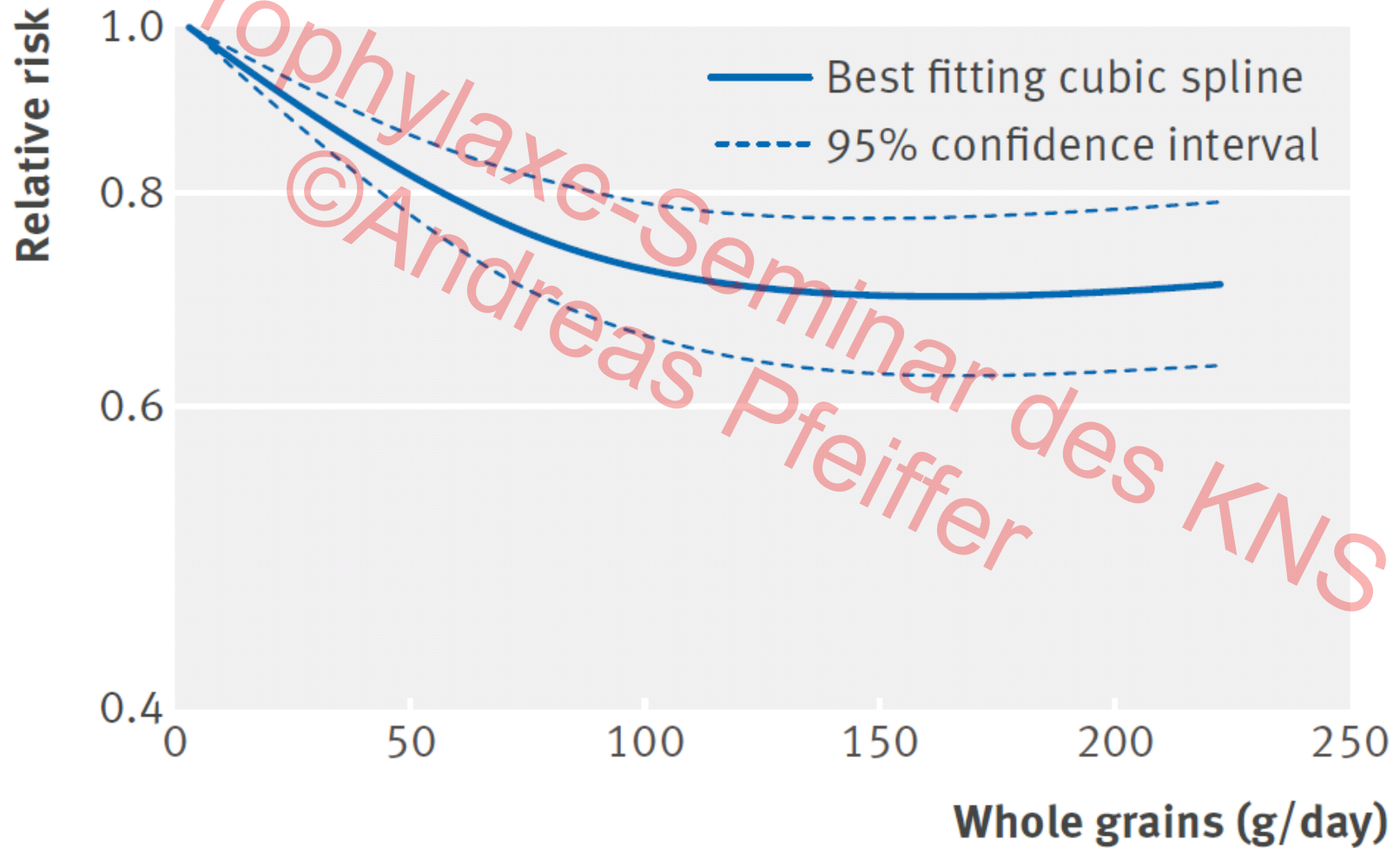


# Whole grain intake reduces incidence of stroke: Meta-analysis

CHARITÉ

Aune et al., BMJ 2016;353:i2716

D/E



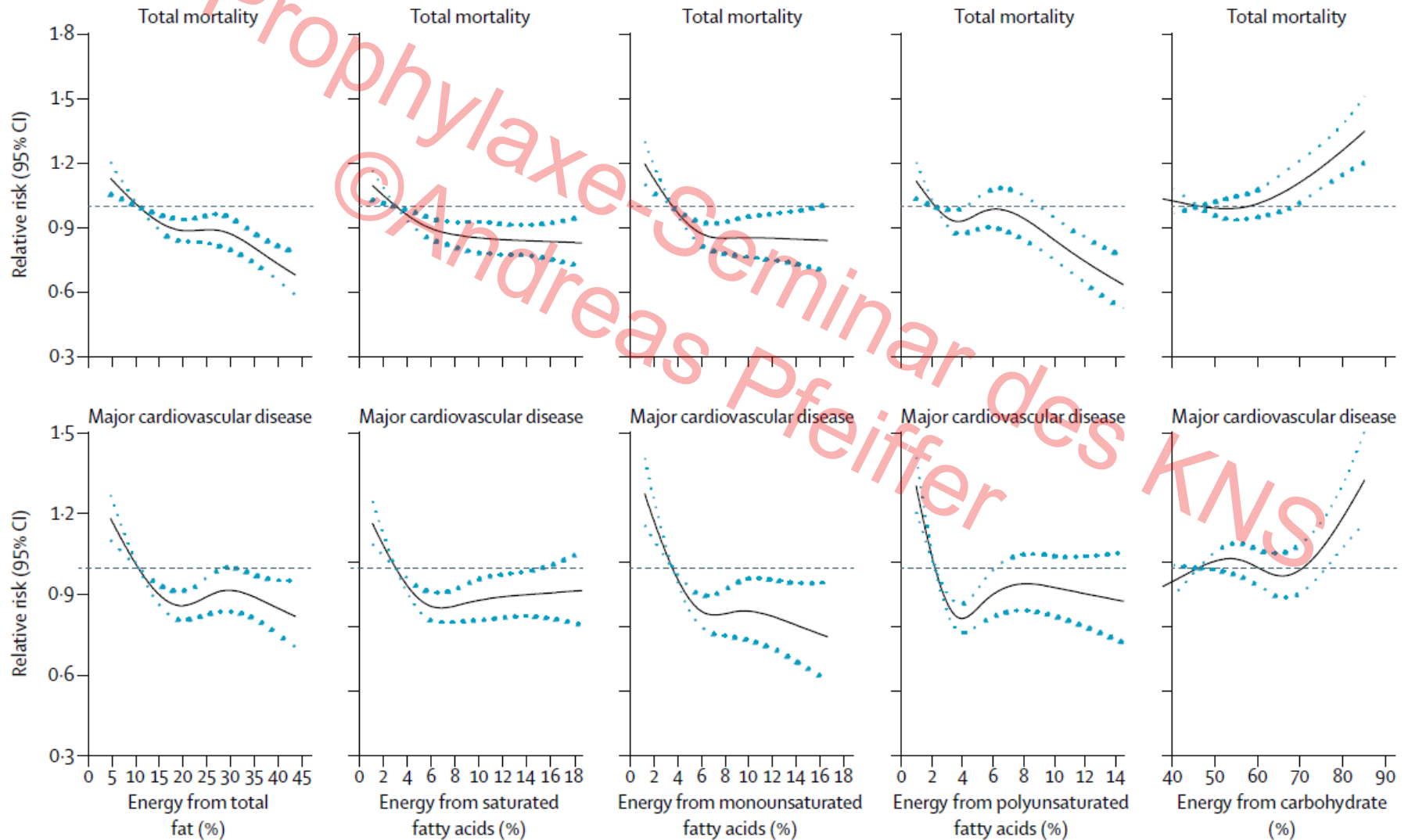
© Andreas Pfeiffer  
Prophylaxe-Seminar des KNS

# Fat intake, and cardiovascular disease and deaths in 18 countries (PURE-Study)

CHARITÉ

Deghan et al., Lancet 2017

D/E





# Fruit intake, and cardiovascular disease and deaths in 18 countries (PURE-Study)

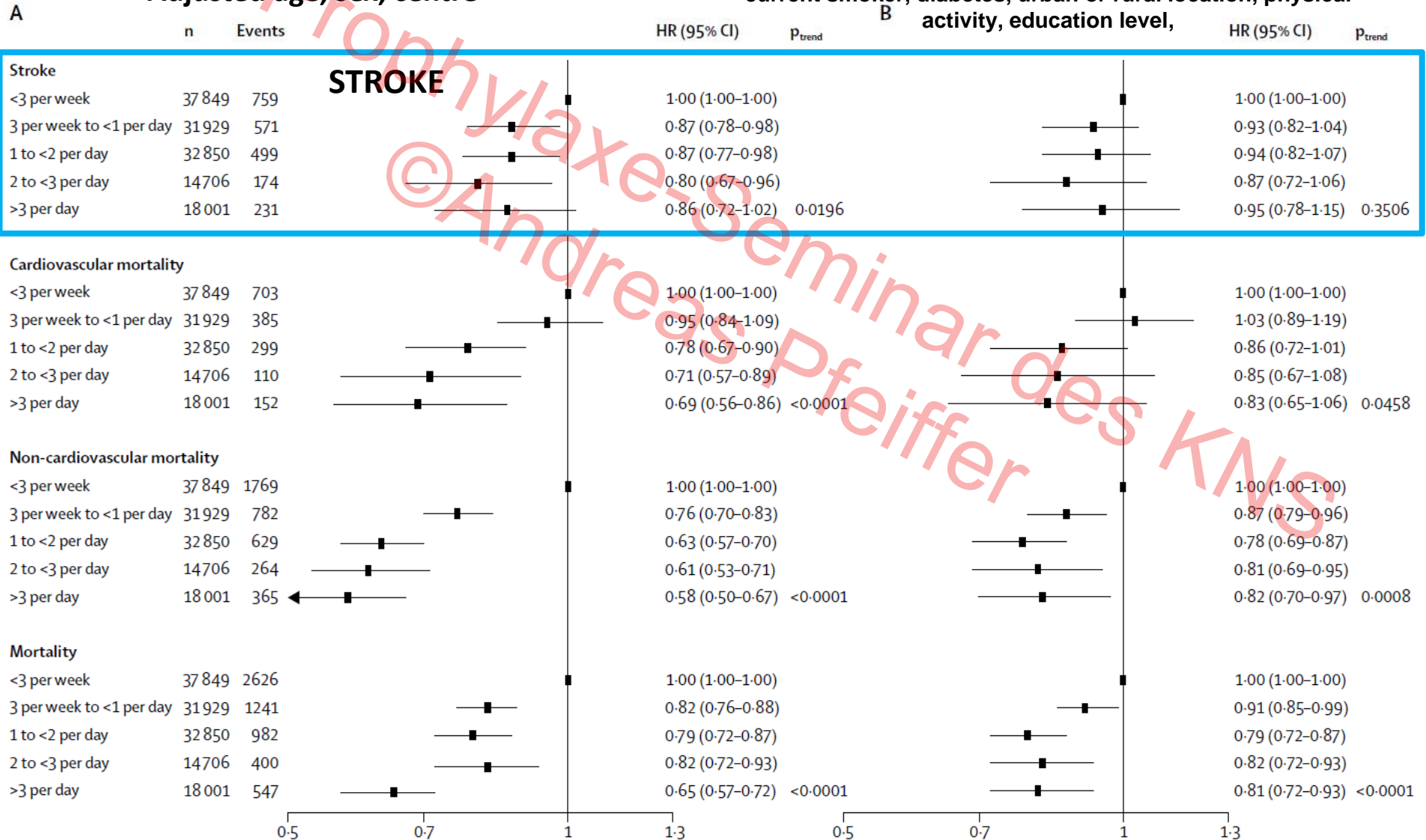


Miller et al., Lancet 2017; [http://dx.doi.org/10.1016/S0140-6736\(17\)32253-5](http://dx.doi.org/10.1016/S0140-6736(17)32253-5)



**Adjusted age, sex, centre**

**Adjusted for age, sex, centre (random effect), energy intake, current smoker, diabetes, urban or rural location, physical activity, education level,**



# Vegetable intake, and cardiovascular disease and deaths in 18 countries (PURE-Study)

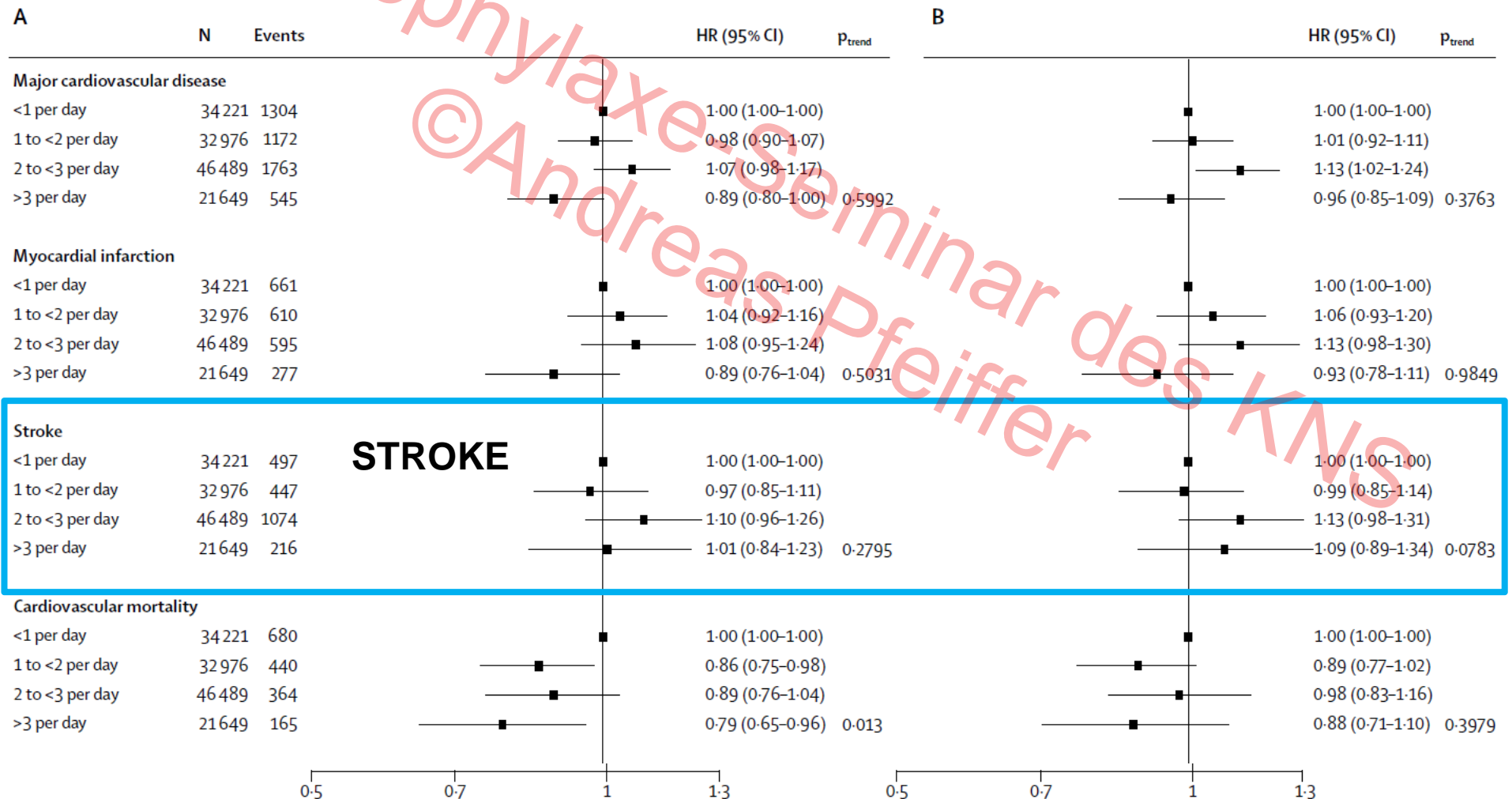


Miller et al., Lancet 2017; [http://dx.doi.org/10.1016/S0140-6736\(17\)32253-5](http://dx.doi.org/10.1016/S0140-6736(17)32253-5)



Adjusted age, sex, centre

Adjusted for age, sex, centre (random effect), energy intake, current smoker, diabetes, urban or rural location, physical activity, education level,



# Legume intake, and cardiovascular disease and deaths in 18 countries (PURE-Study)



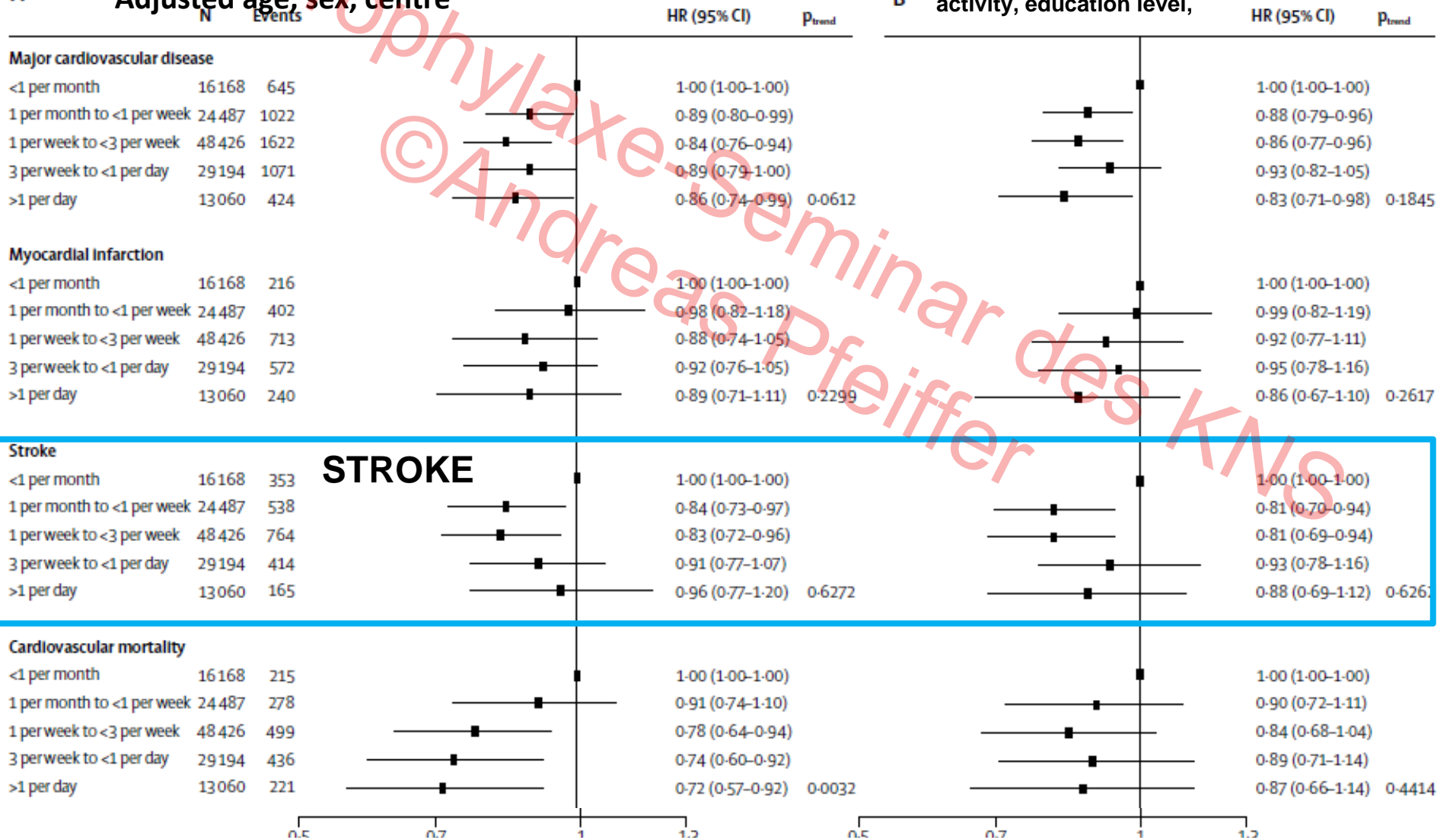
Miller et al., Lancet 2017; [http://dx.doi.org/10.1016/S0140-6736\(17\)32253-5](http://dx.doi.org/10.1016/S0140-6736(17)32253-5)



Adjusted for age, sex, centre (random effect), energy intake, current smoker, diabetes, urban or rural location, physical activity, education level,

**A** Adjusted age, sex, centre

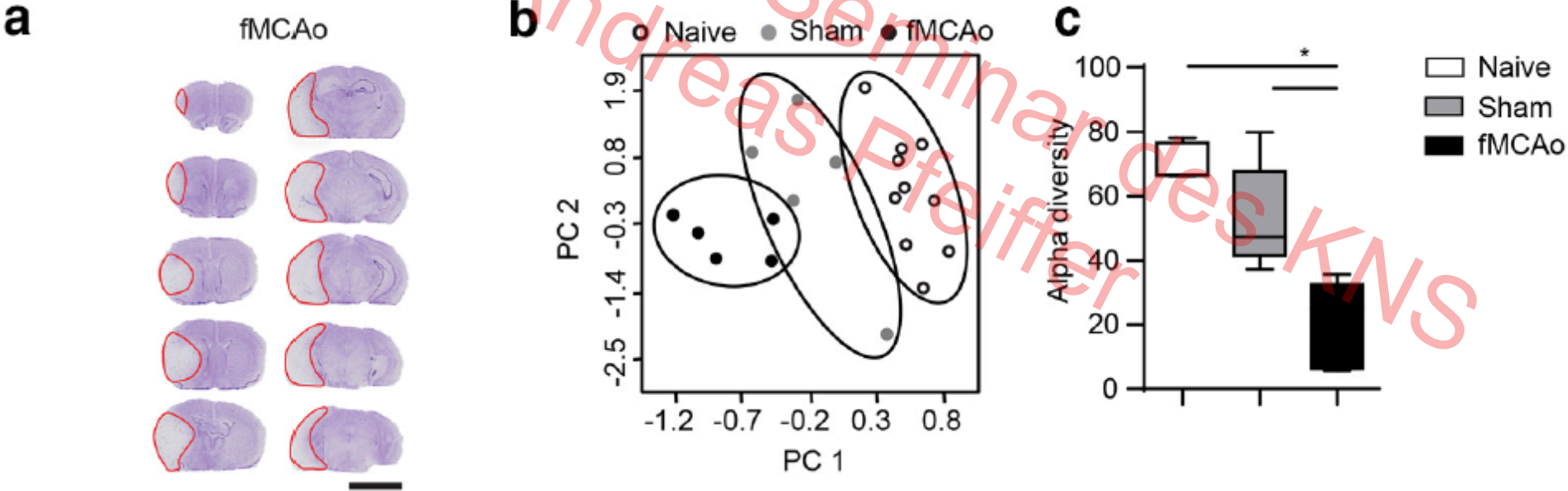
**B** activity, education level,



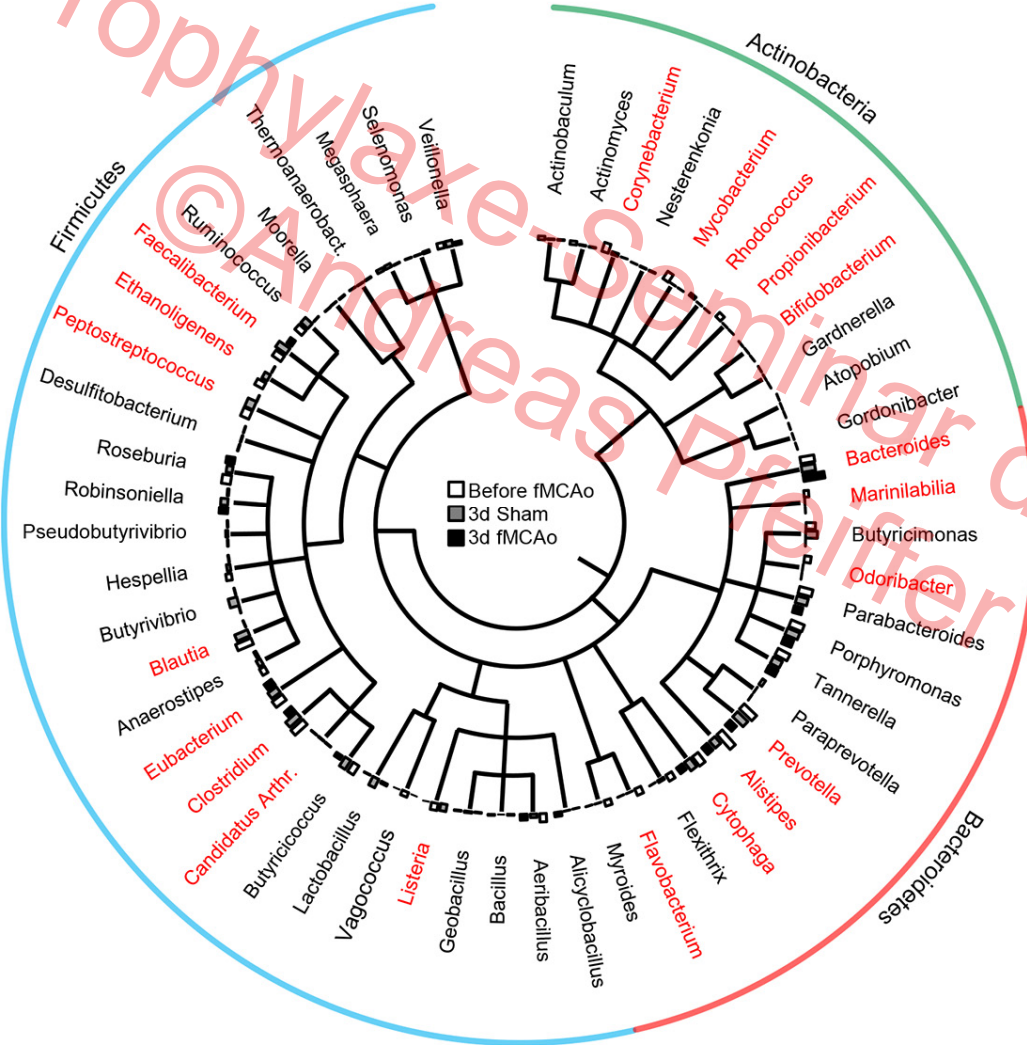
# Schlaganfälle reduzieren schnell die Diversität des Mikrobioms



Singh, Roth et al., J. Neurosci., July 13, 2016 • 36(28):7428 –7440

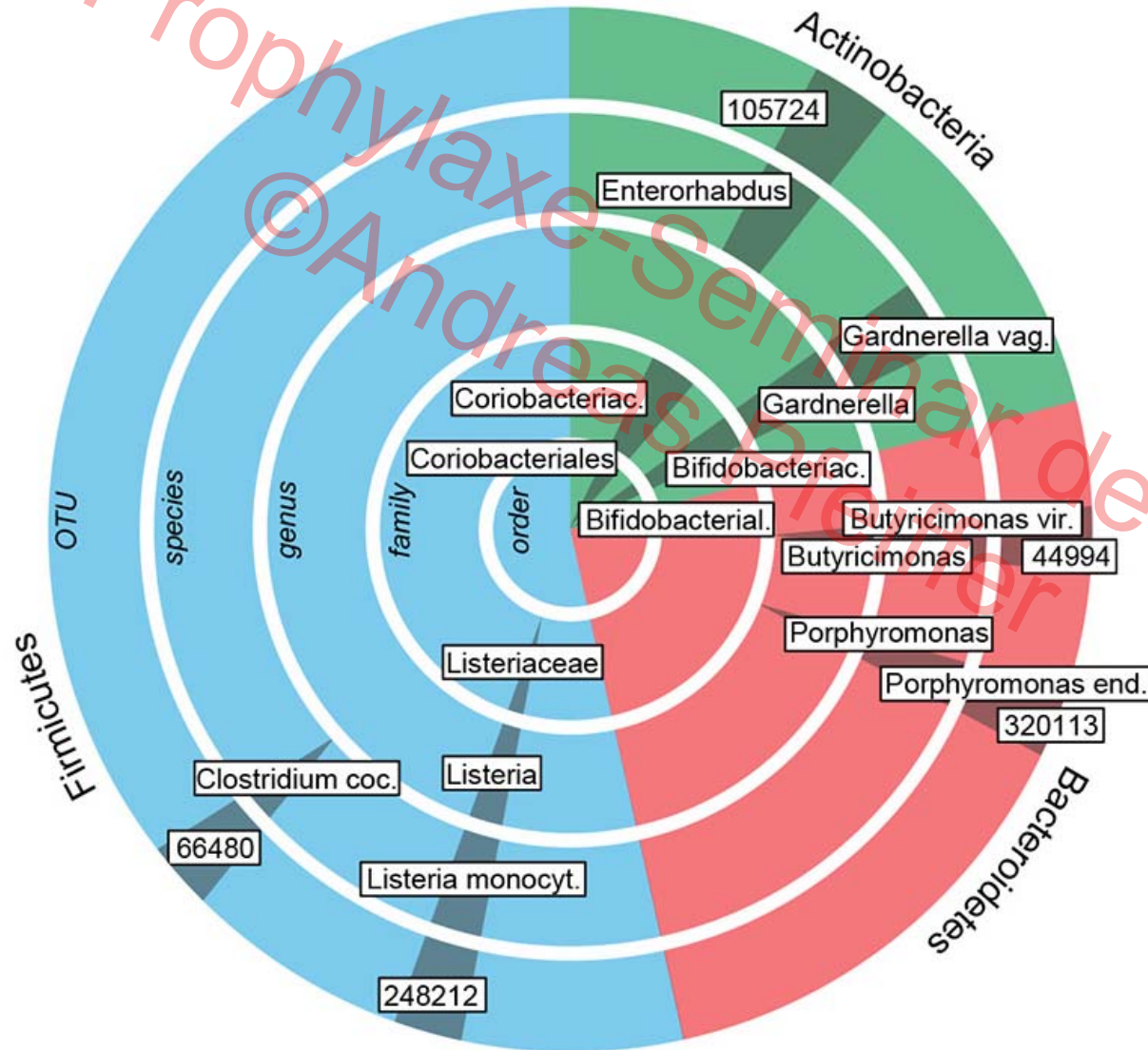


# Schlaganfälle reduzieren schnell die Diversität des Mikrobioms (rot=veränderte Phylae)

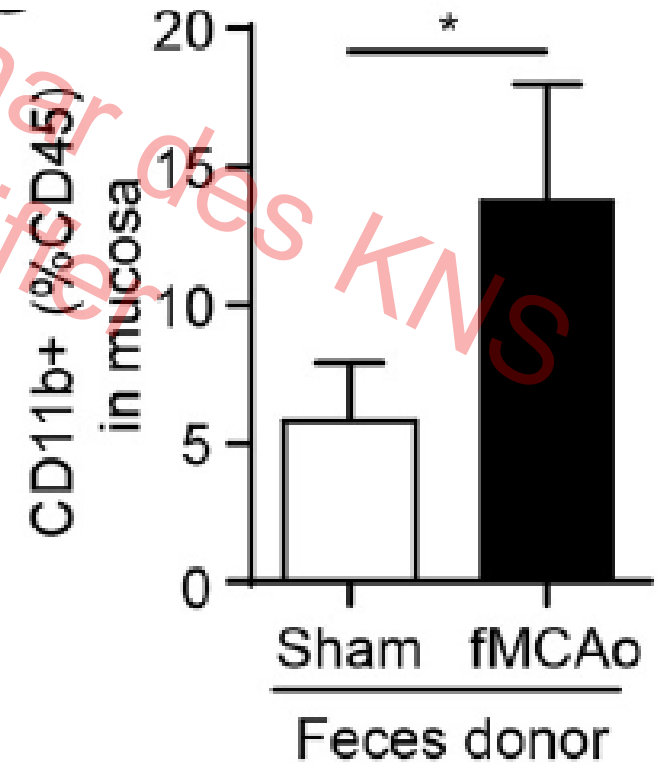
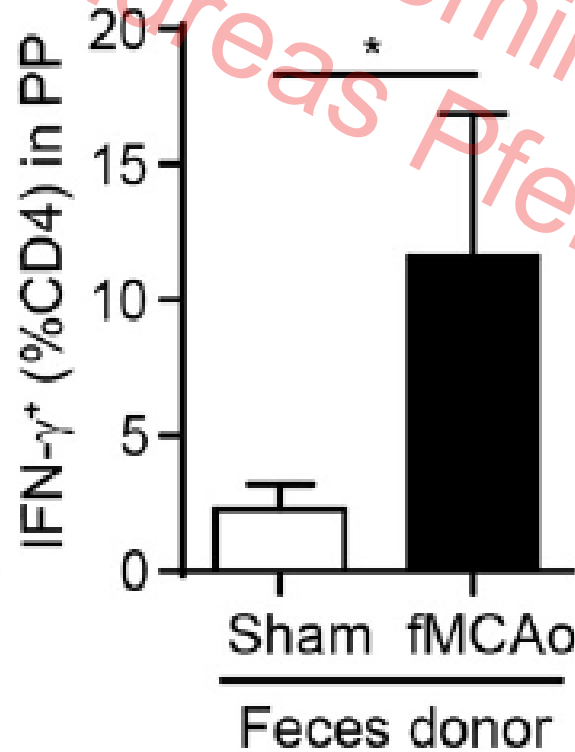
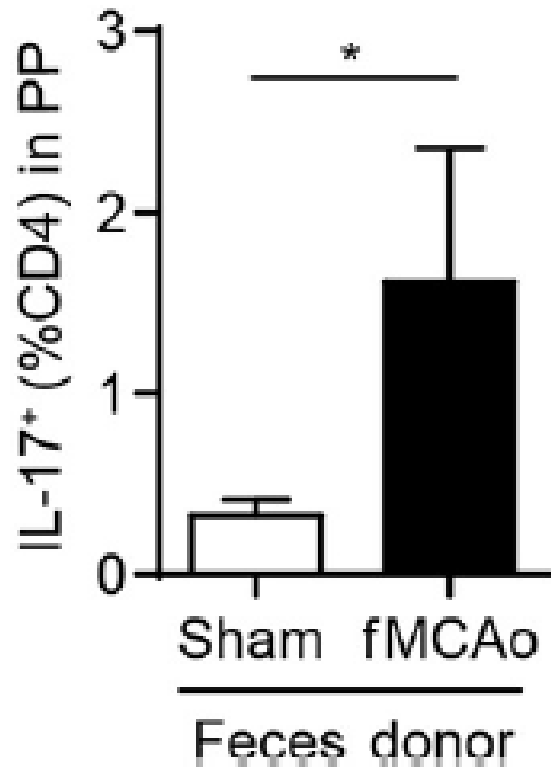
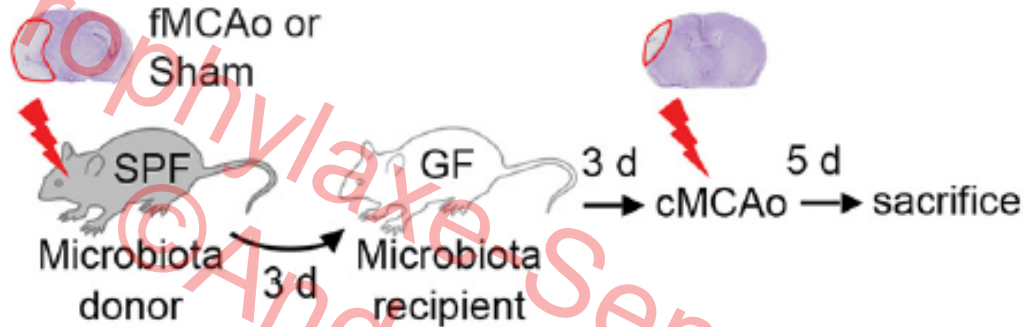


© Andreas Priller des KNS

# Dysbiosis and Stroke



# Zunahme von Immunzellen nach Schlaganfall und fäkaler Transplantation gesunder oder post-stroke Mikrobiota

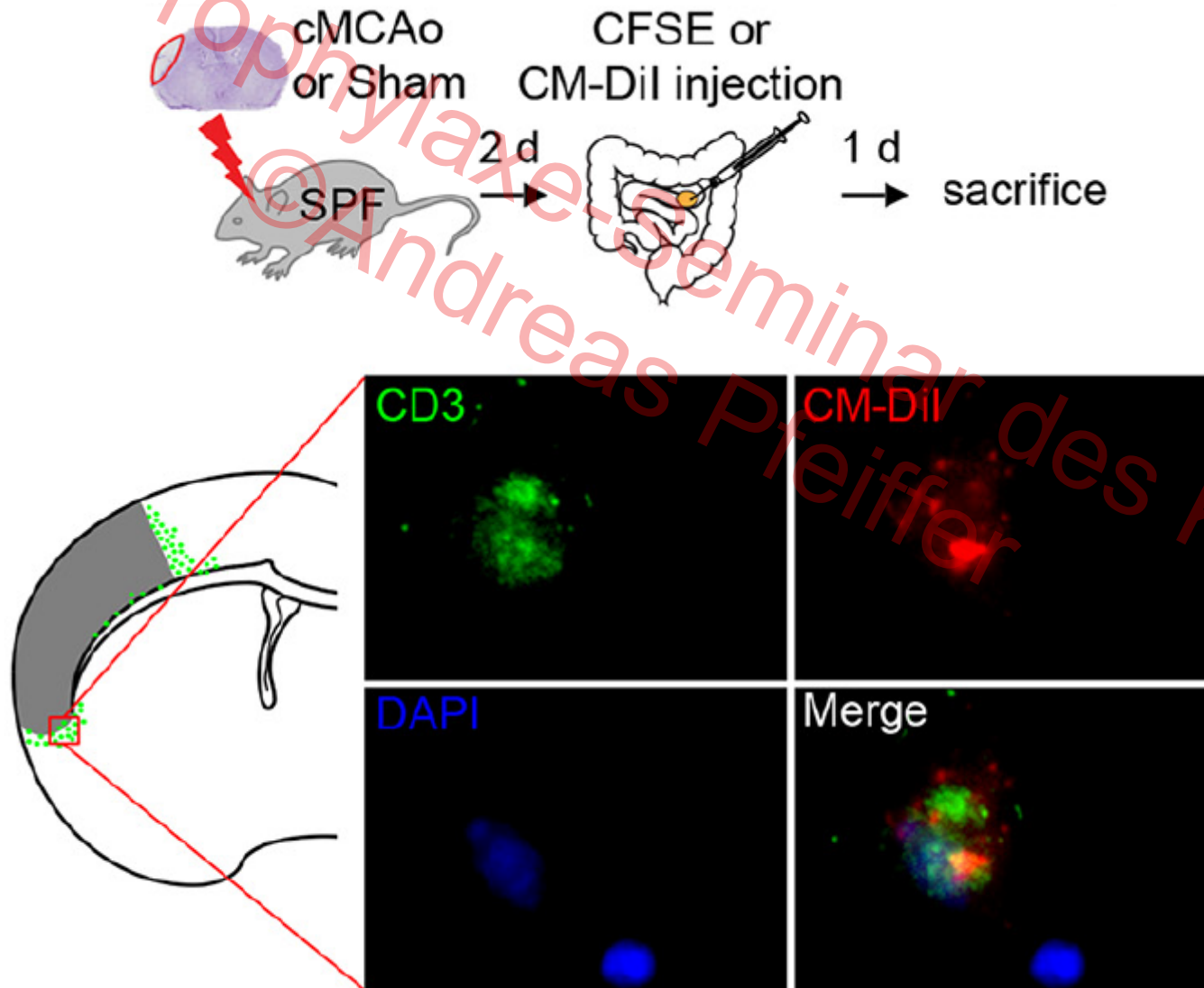


# Migration von markierten Immunzellen nach Schlaganfall aus dem Darm in die Meningen

CHARITÉ

Singh, Roth et al., J. Neurosci., July 13, 2016 · 36(28):7428–7440

D/E



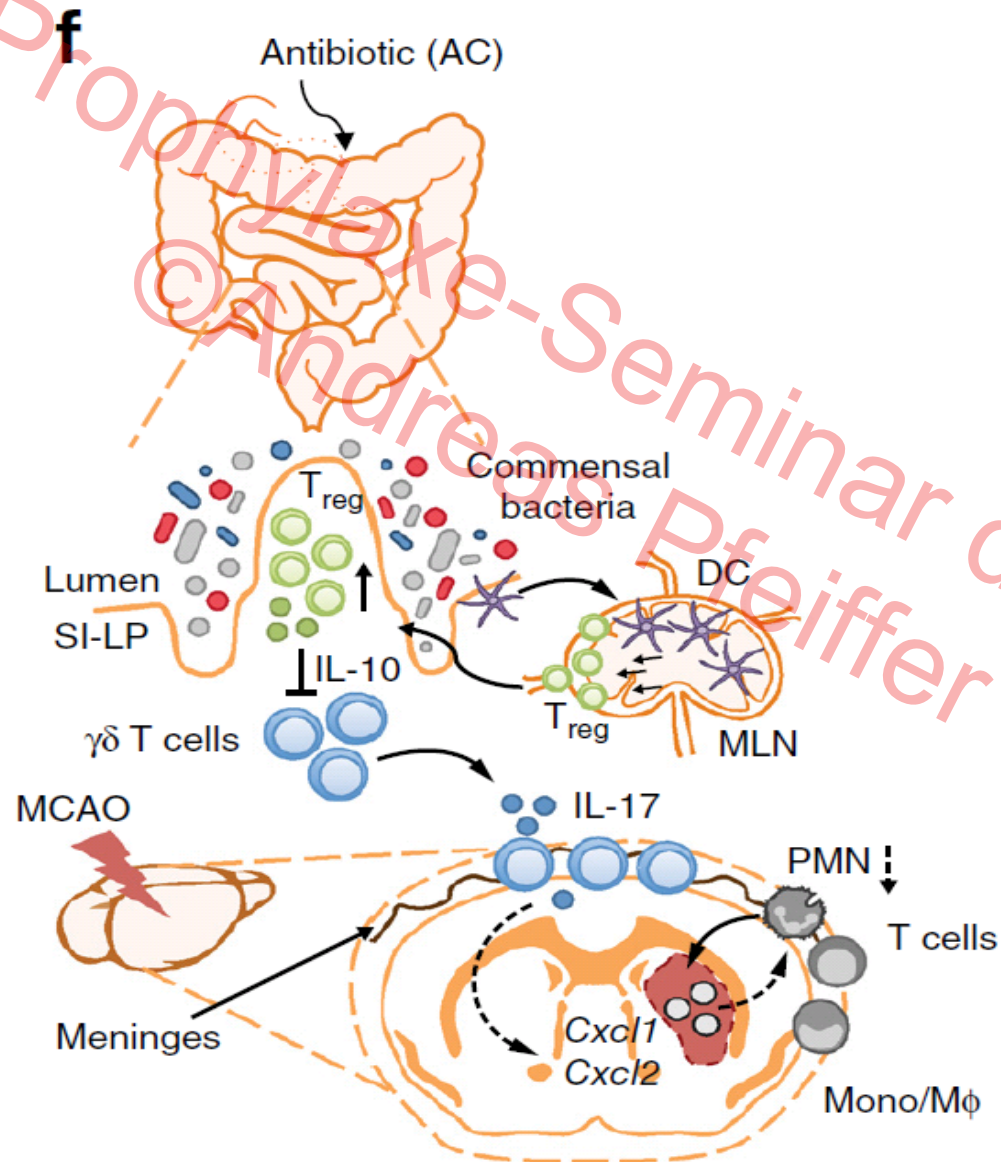


# Zusammensetzung des Mikrobioms beeinflusst die Infarktgröße durch Steuerung der Immunantwort im Darm

CHARITÉ

Benakis et al., Nat Med 2016

D/E



- **Ballaststoff- und proteinreiche Ernährung reduziert das Schlaganfallrisiko**
- **Protein reduziert das Risiko, mit Ausnahme von prozessiertem rotem Fleisch, u.a. durch Blutdrucksenkung und Stoffwechselverbesserung**
- **Fette haben offenbar keinen eindeutigen Effekt wenn man die blutdrucksteigernde, adipogene und andere Effekte (Gewicht) adjustiert**
- **Ballaststoffe haben protektive Effekte, wahrscheinlich durch Veränderung des Mikrobioms**
- **Mikrobiota werden durch Schlaganfälle modifiziert und vice versa und steuern die ZNS-Immunantwort**