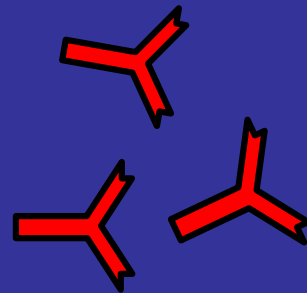


# Immunoadsorption bei ME/CFS und Post COVID – ME/CFS

INTERNATIONAL ME/CFS CONFERENCE 08/05/2026

Elisa Stein

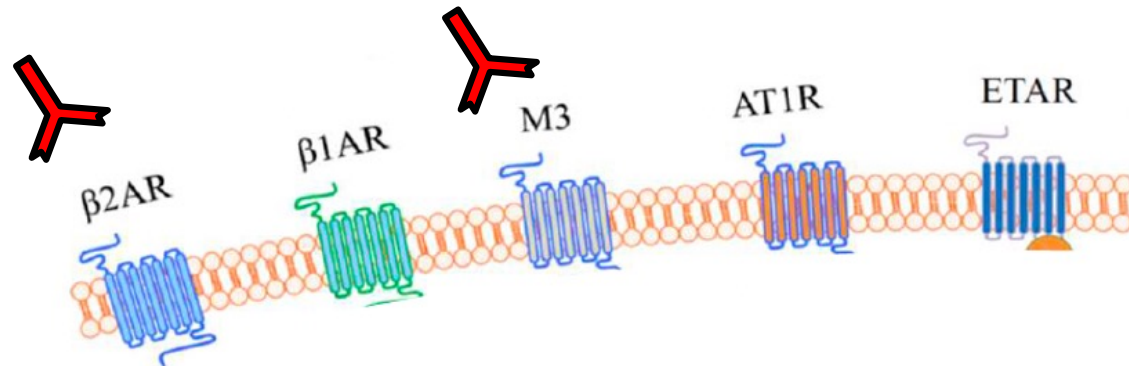
Institut für  
Medizinische  
Immunologie  
Charité



# Immunadsorption bei ME/CFS / Post Covid Syndrom

- **Rolle von Autoantikörpern**
- **Studien zur IA am Institut für Immunologie, Charite**
- **Übersicht Immunadsorptionsstudien**

# GPCR Autoantikörper



- **Natürliche Autoantikörper - wir alle haben sie**
- **Korrelationen mit klinischen Parametern bei ME/CFS, PCS und vielen weiteren Erkrankungen (1-7)**
- **$\beta$ 2 Adrenalin Rezeptor AK agonistisch, verminderte Funktion bei ME/CFS (7,8)**

1. Löbel, et al. Autoantibodies to  $\beta$  adrenergic and m acetylcholine receptors in ME/CFS. Brain Behaviour Immunity 2016
2. Fujii H, Sato W, Kimura Y, et al. Altered structural brain networks related to adrenergic/muscarinic receptor autoantibodies in chronic fatigue syndrome. J Neuroimaging. 2020
3. Kimura Y et al. Free water corrected diffusion and adrenergic/muscarinic antibodies in ME/CFS, J Neuroimaging 2023
4. Freitag H et al. Autoantibodies to Vasoregulative G-Protein-Coupled Receptors Correlate with Symptom Severity, Autonomic Dysfunction and Disability in Myalgic Encephalomyelitis/Chronic Fatigue Syndrome. J Clin Med. 2021
5. Sotzny F et al. Autoantibodies targeting GPCRs and RAS-related molecules are dysregulated in PCS and correlate with symptom severity, Frontie Immunology, 2022
6. Seibert FS *et al.*, "Severity of neurological Long-COVID symptoms correlates with increased level of autoantibodies targeting vasoregulatory an autonomic nervous system receptors," *Autoimmunity Reviews*, 2023
7. Szewczykowski et al. Long Covid: Association of functioanl autoantibodies against GPCR with impaired retinal microcirculation, Int J Mol Sci 22
8. Hartwig J,et al. IgG stimulated  $\beta$ 2 adrenergic receptor activation is attenuated in patients with ME/CFS. Brain Behav Immun Health. 2020

# First evidence for efficacy of immunoadsorption in pre-pandemic postinfectious ME/CFS



RESEARCH ARTICLE

## Immunoadsorption to remove $\beta_2$ adrenergic receptor antibodies in Chronic Fatigue Syndrome CFS/ME

Carmen Scheibenbogen<sup>1,2\*</sup>, Madlen Loebel<sup>1</sup>, Helma Freitag<sup>1</sup>, Anne Krueger<sup>3</sup>, Sandra Bauer<sup>1</sup>, Michaela Antelmann<sup>1</sup>, Wolfram Doehner<sup>4</sup>, Nadja Scherbakov<sup>4</sup>, Harald Heidecke<sup>5</sup>, Petra Reinke<sup>2,3</sup>, Hans-Dieter Volk<sup>1,2</sup>, Patricia Grabowski<sup>1</sup>

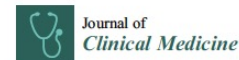
**1** Institute for Medical Immunology, Charité—Universitätsmedizin Berlin, Berlin, Germany, **2** Berlin-Brandenburg Center for Regenerative Therapies (BCRT), Berlin, Germany, **3** Department of Nephrology, Charité—Universitätsmedizin Berlin, Berlin, Germany, **4** Center for Stroke Research Berlin, Charité—Universitätsmedizin Berlin, Berlin, Germany, **5** CellTrend GmbH, Luckenwalde, Germany

\* [Carmen.Scheibenbogen@charite.de](mailto:Carmen.Scheibenbogen@charite.de)

### Abstract

### Introduction

Infection-triggered disease onset, chronic immune activation and autonomic dysregulation in Chronic Fatigue Syndrome/Myalgic Encephalomyelitis (CFS/ME) point to an autoimmune disease directed against neurotransmitter receptors. We had observed elevated autoanti-



Article

## Myalgic Encephalomyelitis/Chronic Fatigue Syndrome: Efficacy of Repeat Immunoadsorption

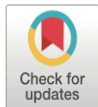
Markus Tölle<sup>1</sup>, Helma Freitag<sup>2</sup>, Michaela Antelmann<sup>2</sup>, Jelka Hartwig<sup>2</sup>, Mirjam Schuchardt<sup>1</sup>, Markus van der Giet<sup>1</sup>, Kai-Uwe Eckardt<sup>1</sup>, Patricia Grabowski<sup>2,†</sup> and Carmen Scheibenbogen<sup>2,3,\*,†</sup>

- 1** Department of Nephrology and Medical Intensive Care, Charité—Universitätsmedizin Berlin, Corporate Member of Freie Universität Berlin, Humboldt Universität zu Berlin, and Berlin Institute of Health, 12203 Berlin, Germany; Markus.Toelle@charite.de (M.T.); Mirjam.Schuchardt@charite.de (M.S.); Markus.vanderGiet@charite.de (M.v.d.G.); Kai-Uwe.Eckardt@charite.de (K.-U.E.)  
**2** Institute of Medical Immunology, Charité—Universitätsmedizin Berlin, Corporate Member of Freie Universität Berlin, Humboldt Universität zu Berlin, and Berlin Institute of Health, 13353 Berlin, Germany; Helma.Freitag@charite.de (H.F.); Michaela.Antelmann@charite.de (M.A.); Jelka.Hartwig@charite.de (J.H.); Patricia.Grabowski@charite.de (P.G.)  
**3** Berlin-Brandenburg Center for Regenerative Therapies (BCRT), 13353 Berlin, Germany  
\* Correspondence: [Carmen.Scheibenbogen@charite.de](mailto:Carmen.Scheibenbogen@charite.de)  
† Shared senior.

Received: 13 July 2020; Accepted: 28 July 2020; Published: 30 July 2020



**Abstract:** (1) Myalgic Encephalomyelitis/Chronic Fatigue Syndrome (ME/CFS) is a complex neuroimmunological disease. There is evidence for an autoimmune mechanism for ME/CFS with an infection-triggered onset and dysfunction of  $\beta_2$ -adrenoreceptor antibodies ( $\beta_2$ AR-AB). In a first proof-of-concept study, we could show that IA was effective to reduce  $\beta_2$ AR-AB and led to improvement of various symptoms. (2) Five of the ME/CFS patients who had clinical improvement following treatment with a five-day IA were retreated in the current study about two years later with a modified IA protocol. The severity of symptoms was assessed by disease specific scores during a follow-up period of 12 months. The antibodies were determined by ELISA. (3) The modified IA treatment protocol resulted in a remarkable similar clinical response. The treatment was well tolerated and 80–90% decline of total IgG and  $\beta_2$ AR-AB was achieved. Four patients showed a rapid improvement in several clinical symptoms during IA therapy, lasting for six to 12 months. One patient had no improvement. (4) We could provide further evidence that IA has clinical efficacy in patients with ME/CFS. Data from our pilot trial warrant further controlled studies in ME/CFS.



OPEN ACCESS

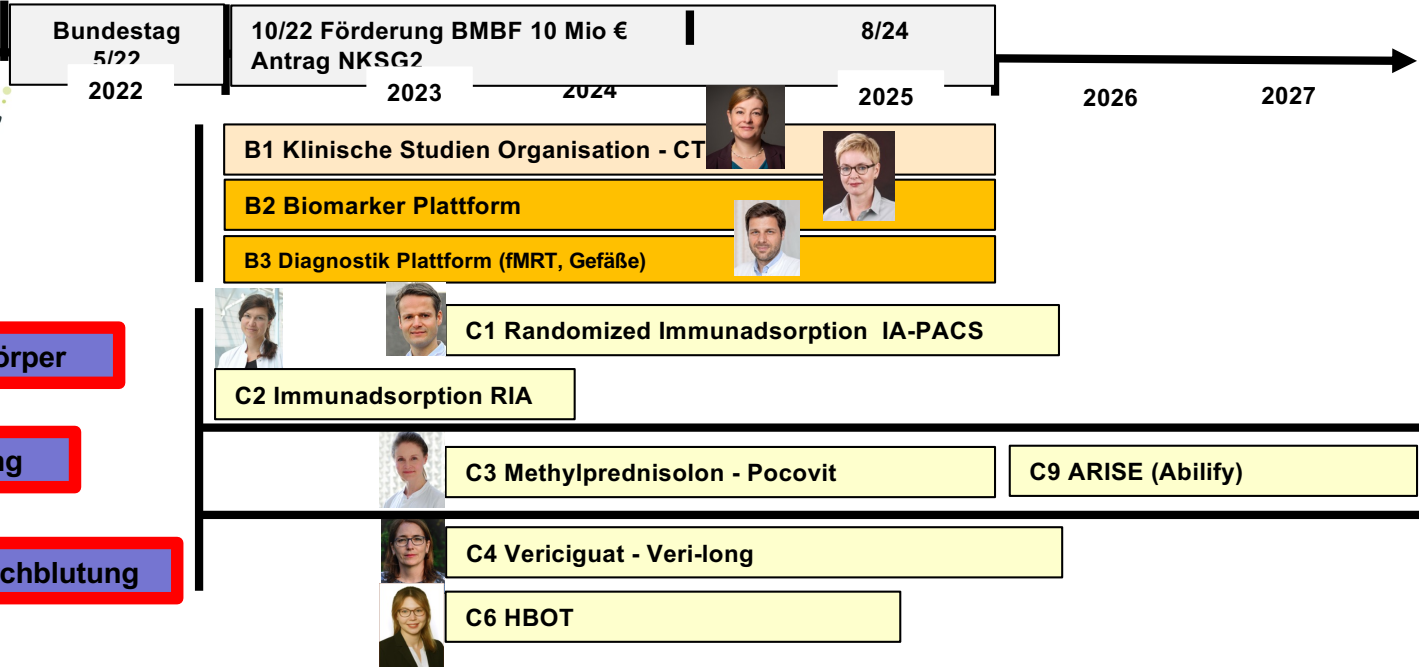
**Citation:** Scheibenbogen C, Loebel M, Freitag H, Krueger A, Bauer S, Antelmann M, et al. (2018) Immunoadsorption to remove  $\beta_2$  adrenergic receptor antibodies in Chronic Fatigue Syndrome CFS/ME. *PLoS ONE* 13(3): e0193672. <https://doi.org/10.1371/journal.pone.0193672>

**Nationale klinische Studien Gruppe (NKSG)  
für ME/CFS und Post Covid Syndrom  
Forschung und Therapiestudien „Hand in Hand“**



**LONG COVID**

DEUTSCHLAND



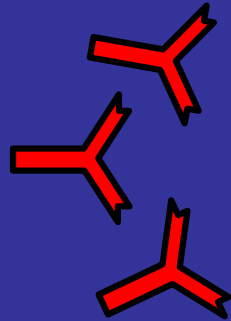
**Autoantikörper**

**Entzündung**

**Minderdurchblutung**



Bundesministerium  
für Bildung  
und Forschung



## Anwendungsbeobachtungsstudie zur Immunadsorption bei Patienten mit ME/CFS

5x Immunoadsorption mit TheraSorb®5 über 10 Tage

**20 Patienten**

**EK:**

- ME/CFS nach COVID
- Erhöhte  $\beta_2$  adrenerge Rez Antikörper
- Bell 30 - 60

# Efficacy of repeated immunoadsorption in patients with post-COVID myalgic encephalomyelitis/chronic fatigue syndrome and elevated $\beta$ 2-adrenergic receptor autoantibodies: a prospective cohort study



The Lancet Regional Health - Europe  
2025;49: 101161

Elisa Stein,<sup>a</sup> Comelia Heindrich,<sup>a</sup> Kirsten Wittke,<sup>a</sup> Claudia Kedor,<sup>a</sup> Rebekka Rust,<sup>a,c</sup> Helma Freitag,<sup>a</sup> Franziska Sotzny,<sup>a</sup> Anne Krüger,<sup>b</sup> Markus Tölle,<sup>b</sup> Patricia Grabowski,<sup>a</sup> Carmen Schäbenbogen,<sup>a</sup> and Laura Kim<sup>a,\*</sup>



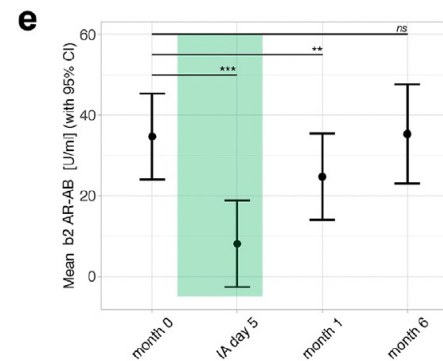
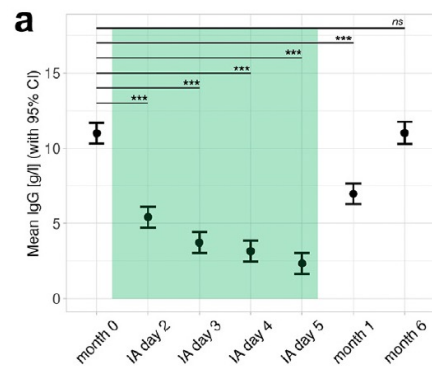
<sup>a</sup>Institute of Medical Immunology, Charité - Universitätsmedizin Berlin, Corporate Member of Freie Universität Berlin and Humboldt-Universität zu Berlin, Augustenburger Platz 1, Berlin, 13353, Germany

<sup>b</sup>Department of Nephrology, Charité - Universitätsmedizin Berlin, Corporate Member of Freie Universität Berlin and Humboldt-Universität zu Berlin, Augustenburger Platz 1, Berlin, 13353, Germany

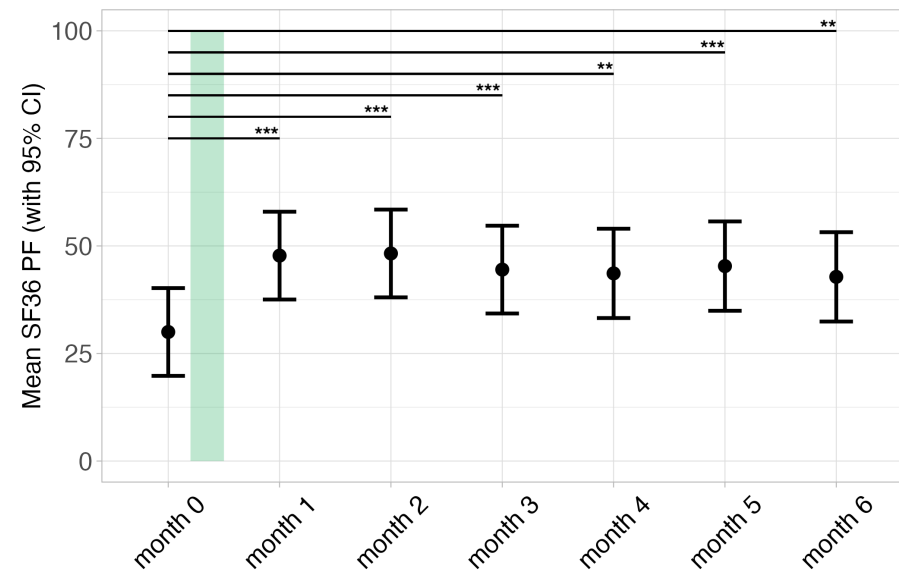
<sup>c</sup>Experimental and Clinical Research Center and Neuro Science Clinical Research Center, Charité - Universitätsmedizin Berlin, Corporate Member of Freie Universität Berlin, Humboldt Universität zu Berlin, Berlin Institute of Health, Charitéplatz 1, Berlin, 10117, Germany



## IgG and antibody depletion

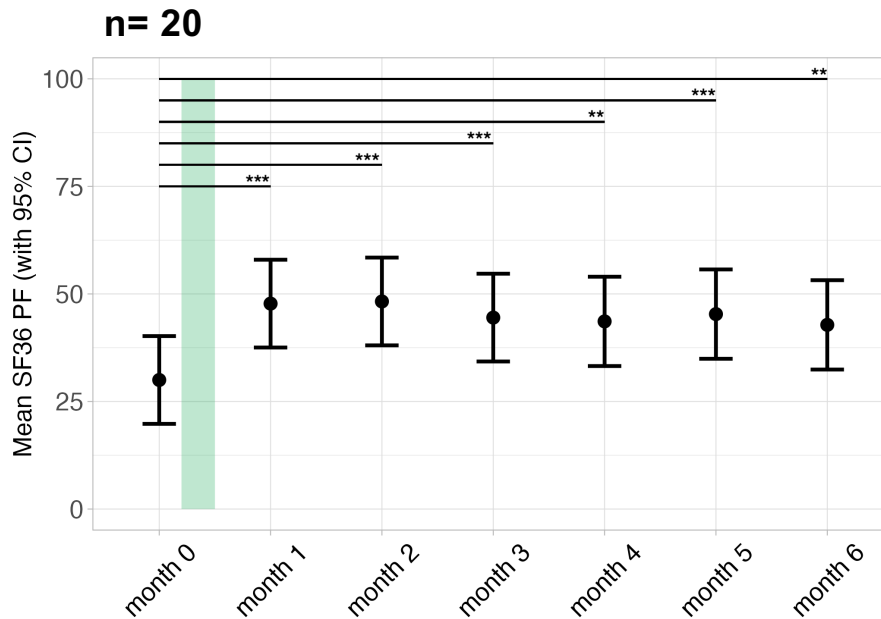


## SF-36 physical function, n=20

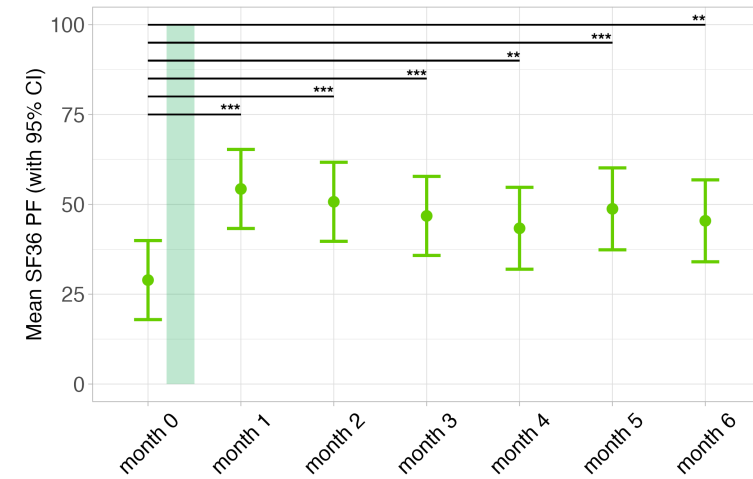


# Anwendungsbeobachtungsstudie zur Immunadsorption bei Patienten mit Post Covid ME/CFS

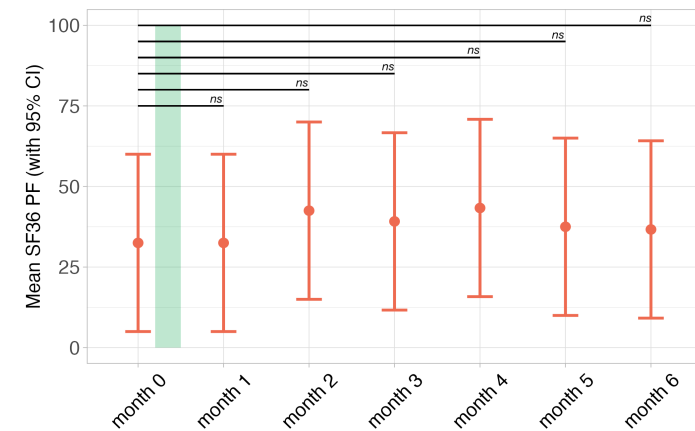
## SF-36 physical function = alltägliche Aktivität



## SF-36PF ≥10 n=14



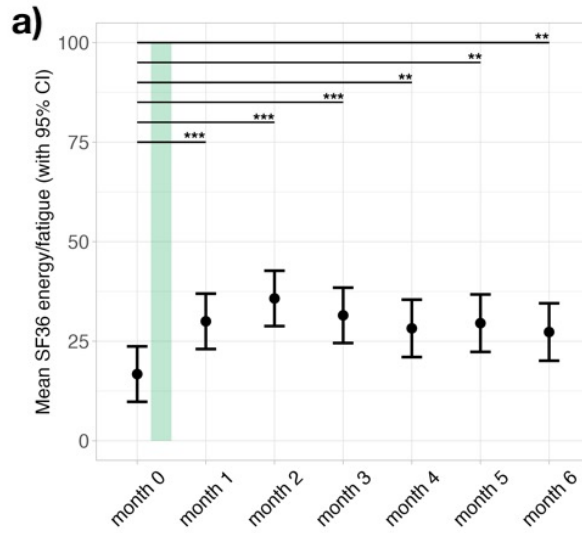
## SF-36PF <10 n= 6



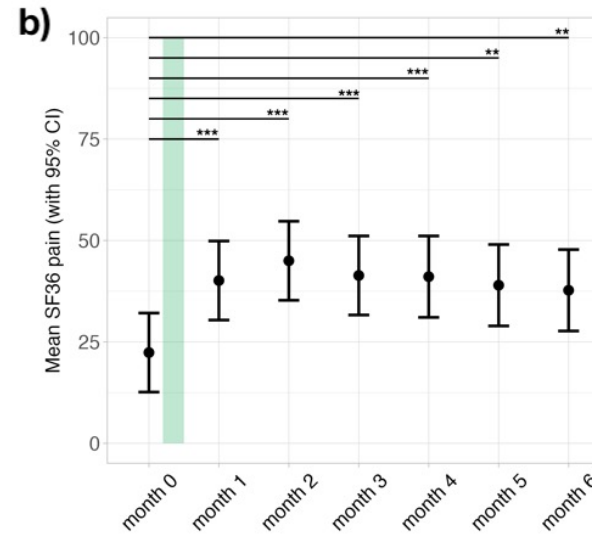
Stein E et al., Lancet RHE 2025

# Anwendungsbeobachtungsstudie zur Immunadsorption bei Patienten mit Post Covid ME/CFS

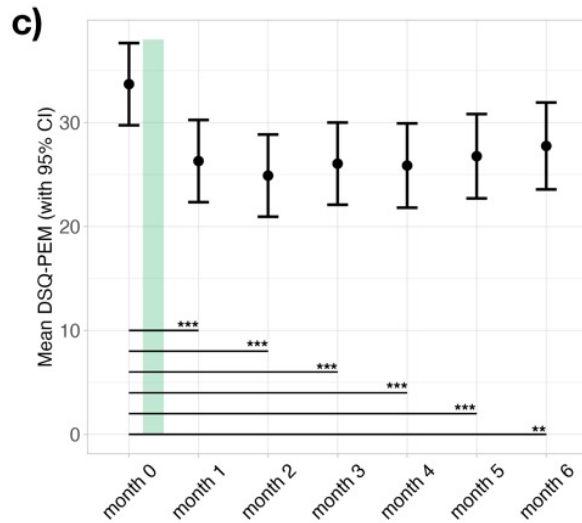
**SF36  
fatigue**



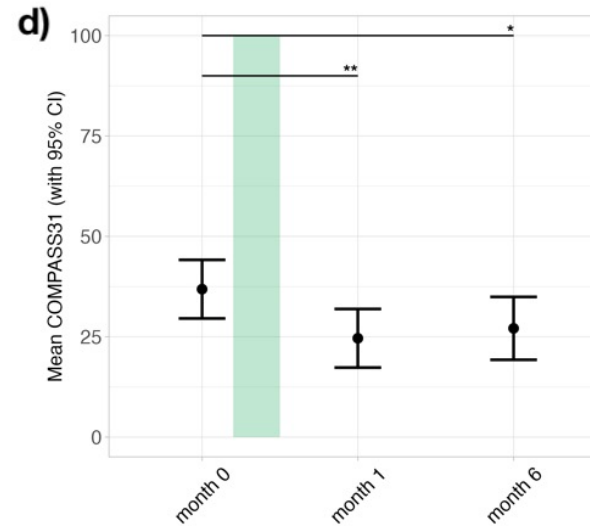
**SF36  
Schmerz**



**PEM**



**Autonome  
Dysfunktion**



Stein E et al., Lancet RHE 2025

# B2 Biomarker Plattform

70% gebessert

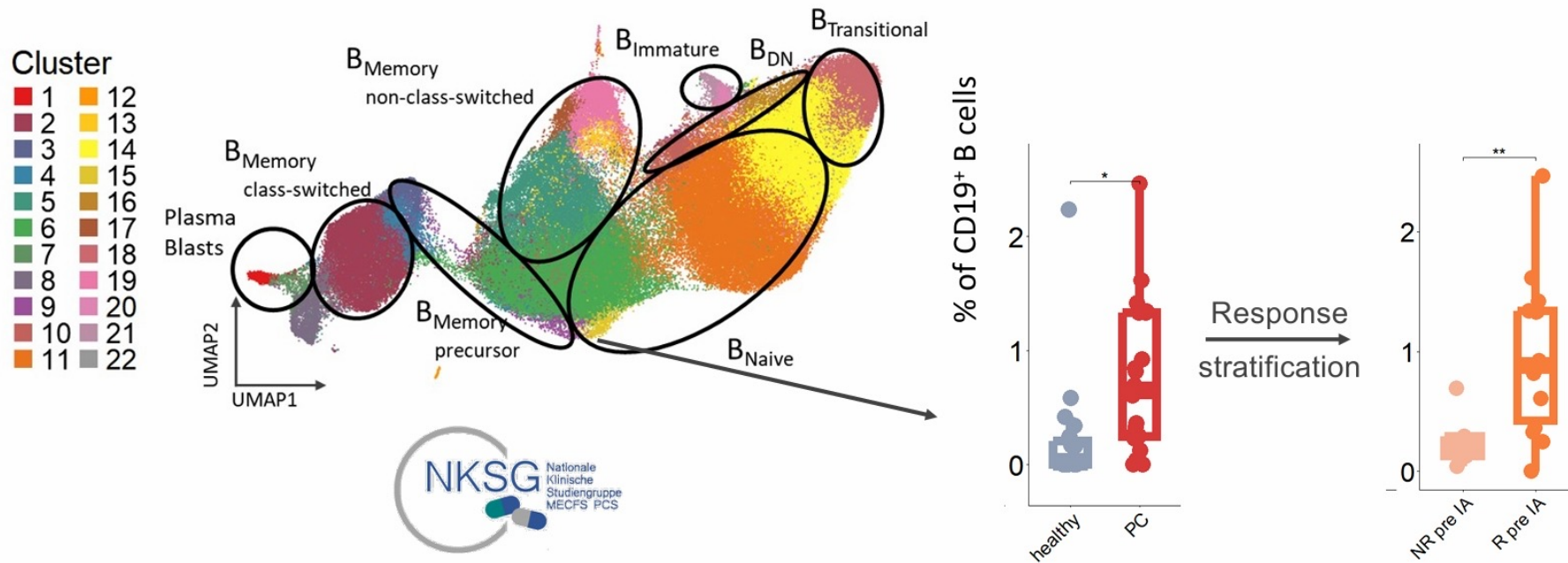
30% nicht gebessert



Unterschiedliche Immunprofile



ME/CFS patients display signs of B cell activation indicative of response to immunoadsorption



CURE – ME Characterizing Autoimmune REsponses and Defining Targets in ME/CFS Prof. Dr. Birgit Sawitzki  
Center of Immunomics, Translational Immunology BIH @ Charité University Medicine

# Immunadsorption in piMECFS (post Covid and non PC)

15 Patienten mit MECFS in 09-12.2025

EK:

- postinfektiöses MECFS
- diagnostiziert im Fatigue Centrum, Charite
- Alter 18-65
- Bell mind. 30
- erhöhte AAK ( $\beta$ 2-adr-R-AAK)

Design:

- 5 Zyklen IA im Diamedicum Potsdam mit TheraSorb Adsorber von Milteniy

Primärer Endpunkt:

- Anstieg des SF36, physical function um 10 Punkte an **Woche 8 nach IA**

Ergebnis:

- 7 responder, 6 non-responder

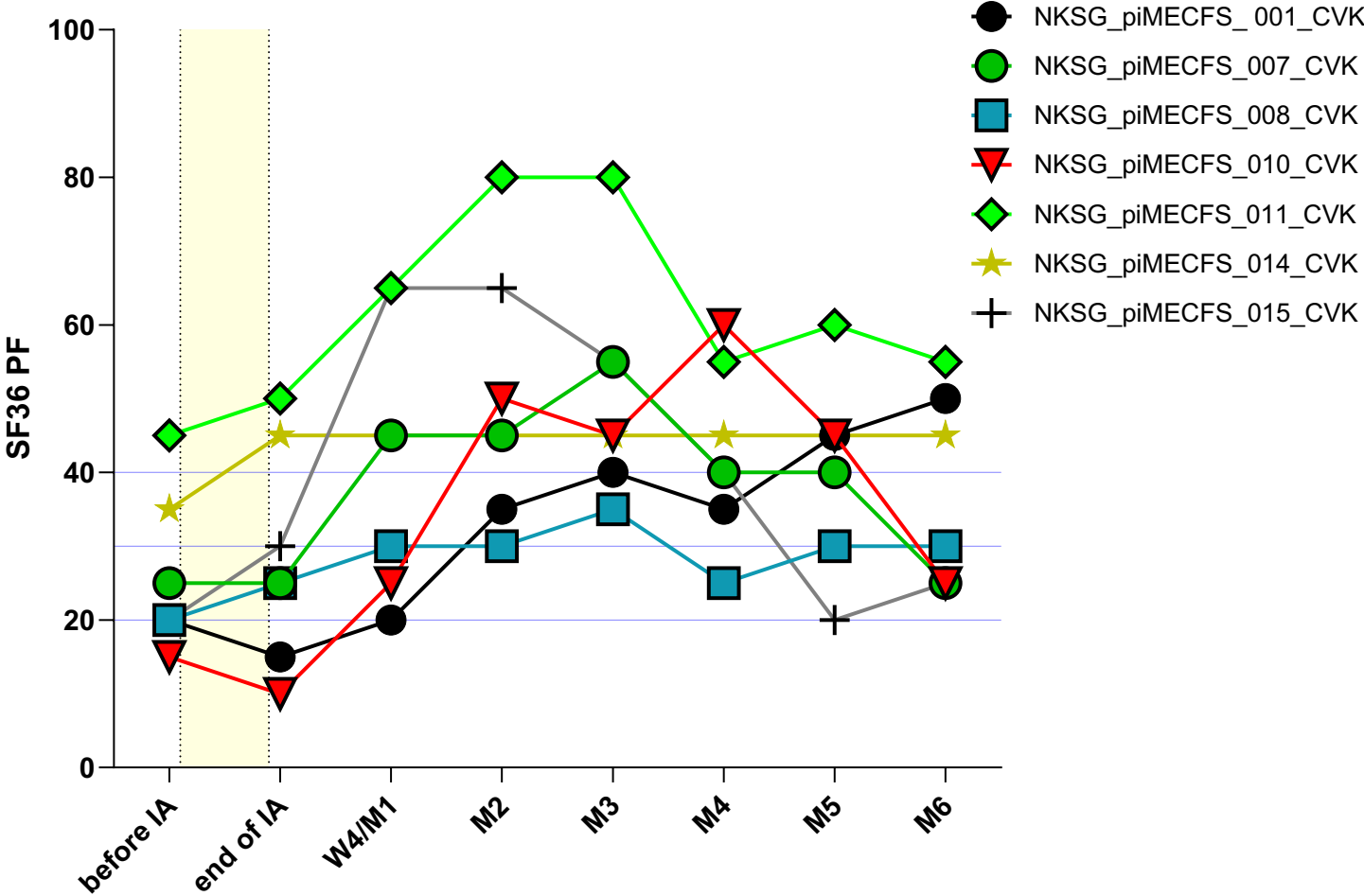
Verlaufsdaten und weitere Analyse stehen aus.



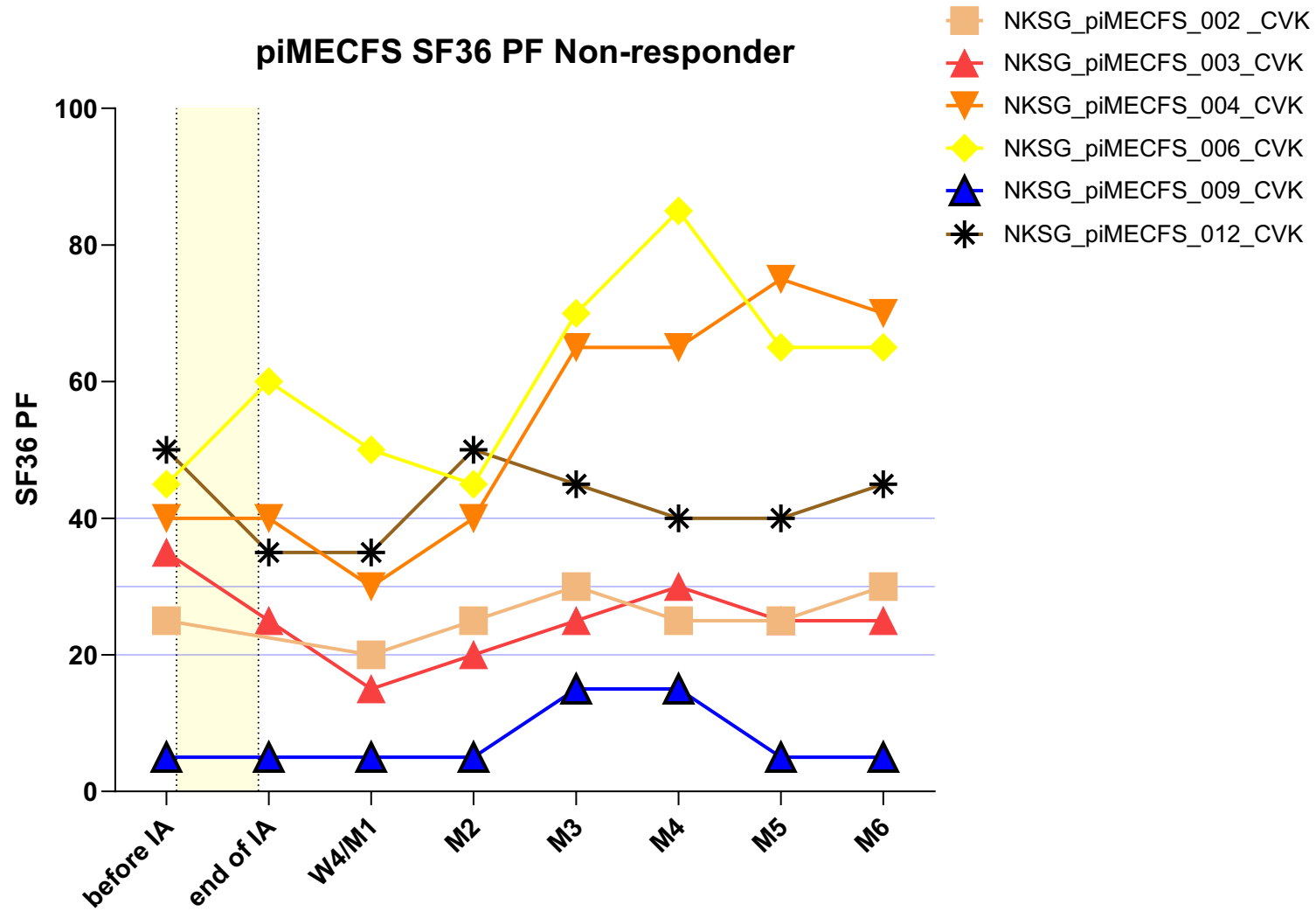
Miltenyi Biotec



### piMECFS SF36 PF Responder



### piMECFS SF36 PF Non-responder



## **Aktuell : IMPACT Immunadsorption in piMECFS seit 03/2026**

### **EK:**

- **postinfektiöses MECFS**
- **diagnostiziert im Fatigue Centrum, Charite**
- **Alter 18-65**
- **Bell: mind. 30**
- **erhöhte AAK ( $\beta$ 2-adr-R-AAK)**

### **Design:**

- **5 Zyklen IA im Diamedicum Potsdam mit TheraSorb Filter von Milteniy**

### **Primärer Endpunkt:**

- **Anstieg des SF36, physical function um 10 Punkte an Woche 8 nach IA**

## **Folgestudie: PIONEER B-Zell Depletion in piMECFS**



## RCT zur Immunadsorption bei Patienten mit PCS

● RECRUITING

NCT05954325

Immunoadsorption vs. Sham Treatment in **Post COVID-19** Patients With Chronic Fatigue **Syndrome**

Conditions

Post-Acute COVID-19 Syndrome Fatigue

Locations

Hannover, Lower Saxony, Germany

● RECRUITING

NCT05841498

Immunoadsorption Study Mainz in Adults With **Post-COVID Syndrome**

Conditions

Post COVID-19 Condition Post-COVID-19 Syndrome Post-COVID Syndrome

Locations

Mainz, Rheinland-Pfalz, Germany

● RECRUITING

NCT05710770

Immunoadsorption in Patients With Chronic Fatigue **Syndrome** Including Patients With **Post-COVID-19 CFS**

Conditions

Post-COVID ME/CFS ME/CFS

Locations

Berlin, Germany

Patient inclusion criteria	outcome	n	IA
PC ME/CFS CCC Bell 20 - 50	CFQ week 12	60	5 days IA vs sham IA  TheraSorb
PCS WHO	CFQ week 2	40	5 days IA vs sham IA  Immunsorba TR-350 Tryptophan
pi ME/CFS CCC Bell 20 – 50	CFQ week 12	66	5 days IA vs sham IA  TheraSorb

# Zusammenfassung

- **Daten aus Studien ohne Kontrollarm zeigen, dass die Immunadsorption bei Patienten mit Post COVID und piME/CFS zu einer Besserung führen kann**
- **Begleitende Biomarkerstudien zeigen unterschiedliche Immun-Phänotypen, die mit dem Ansprechen auf die IA korrelieren**
- **Weitere Analysen und Verlaufsdaten werden aktuell noch ausgewertet**
- **Diese Ergebnisse bilden die Grundlage für Therapiestudien B- und Plasma-Zell-Depletion**
- **Die Veröffentlichung der Ergebnisse mehrerer RTCs steht aktuell noch aus**

*Vielen Dank an alle PatientInnen und.....*



# Team, Zusammenarbeit und Förderung

## Med. Immunologie Charité

Katharina Stößlein  
Laura Kim  
Nadège Lepetre  
Linus Fock  
Rebekka Rust  
Claudia Kedor  
Katrin Metz  
Kirsten Wittke  
Franziska Sotzny  
Helma Freitag  
Cornelia Heindrich  
Sandra Bauer  
Carmen Scheibenbogen

Martina Seifert

Neurologie Charité  
Judith Bellmann-Strobl  
Friedemann Paul



BIH  
Birgit Sawitzki  
Lucas Arendholz  
Katrin Vogt  
Manuela Fiedler  
Christine Appelt

WEIDENHAMMER  
ZÖBELE **STIFTUNG**

Diamedikum  
Potsdam  
Anja Ramlow  
Simone Horn  
Wolfgang Ramlow  
Jens Ringel

**ME CFS**  
Research Foundation



[https://cfc.charite.de/klinische\\_studien/nksg/](https://cfc.charite.de/klinische_studien/nksg/)

The screenshot shows the website interface for the Charité Fatigue Centrum. The main header includes the Charité logo and navigation options. The central content area features the NKSG logo and a search bar. A sidebar on the left lists various research areas like 'Für Patienten', 'Für Ärzte', 'Klinische Studien', 'NKSG', 'Clinical Trial Office', 'Biomarker Plattform', 'Diagnostik Plattform', 'Studie IA-PACS-CFS', 'Studie RIA', 'Studie PoCoVIT', 'Studie VERI-LONG', 'Studie HBOT', and 'Weitere Forschung'. The main content area provides information about the NKSG as an interdisciplinary network of doctors and scientists, and includes a photograph of a white lab coat with the Charité logo.



**Miltenyi Biotec**

**LONG COVID  
DEUTSCHLAND**

