Longcovid

Therapie

- Colas et al., Physical Activity in Long COVID: A Comparative Study of Exercise Rehabilitation Benefits in Patients with Long COVID, Coronary Artery Disease and Fibromyalgia (03.08.23 – bei Betroffenen ohne PEM hilft körperliche Aktivität; Unterscheidung wichtig!)
- Liu et al., The effect of nirmatrelvir-ritonavir on the long-term risk of neuropsychiatric sequelae following COVID-19 (Juli 2023 – deutliche Reduktion von kognitiven Beeinträchtigungen durch Paxlovid)
- Gloeckl et al., Rehabilitative interventions in patients with persistent post COVID-19 symptoms—a review of recent advances and future perspectives (16.06.23)
- Finnigan et al, Efficacy and tolerability of an endogenous metabolic modulator (AXA1125) in fatigue-predominant long COVID: a single-centre, double-blind, randomised controlled phase 2a pilot study (14.04.23 – Fatigue-Symptome deutlich verbessert)
- Rachel Fairbank, Long COVID exercise trials proposed by NIH raise alarm (31.03.23)
- Mikulska et al., Triple Combination Therapy With 2 Antivirals and Monoclonal Antibodies for Persistent or Relapsed Severe Acute Respiratory Syndrome Coronavirus 2 Infection in Immunocompromised Patients (28.03.23)
- Xie et al., Association of Treatment With Nirmatrelvir and the Risk of Post–COVID-19 Condition (23.03.23 – **Risikoreduktion von LongCOVID bei Patienten mit wenigstens einem Risikofaktor für schweren Akutverlauf**)
- Tran et al., Efficacy of first dose of covid-19 vaccine versus no vaccination on symptoms of patients with long covid: target trial emulation based on ComPaRe e-cohort (28.02.23)
- Shionogi says its drug Xocova may reduce risks of long COVID symptoms (22.02.23 – relatives Risiko um 45% reduziert, 1/3 für neurologische Symptome, **antivirales Medikament Ensitrelvir Fumaric Acid**)
- Thompson et al., Long-term high-dose immunoglobulin successfully treats Long COVID patients with pulmonary, neurologic, and cardiologic symptoms (02.02.23)
- Bramante et al., Outpatient treatment of Covid-19 with metformin, ivermectin, and fluvoxamine and the development of Long Covid over 10-month follow-up. (24.12.22, preprint – **“There was a 42% relative decrease in the incidence of Long Covid in the metformin group”**)
- Trisha Greenhalgh, Long covid—an update for primary care (22.09.22)
- WHO: Clinical management of COVID-19: Living guideline (15 September 2022 – WHO warnt vor aktivierender Reha bei LongCOVID, wenn PEM/PESE vorliegt)
- Long-COVID treatments: why the world is still waiting (09.08.22 – derzeit mehr als 25 randomisierte Versuche am Laufen in verschiedenen Stadien)
- Imai et al., Epipharyngeal Abrasive Therapy (EAT) Has Potential as a Novel Method for Long COVID Treatment (27.04.22)

- Wright et al., The Relationship between Physical Activity and Long COVID: A Cross-Sectional Study (22.04.22 – **in 75% der Bewegungstherapien verschlechterte sich LongCOVID, nur bei 0,8% zeigte sich eine Verbesserung**)
- Ayoubkhani et al, Trajectory of long covid symptoms after covid-19 vaccination: community based cohort study (12.04.22)
- Glynne et al., Long COVID following mild SARS-CoV-2 infection: characteristic T cell alterations and response to antihistamines (05.10.21 – **H1/H2-Blocker erfolgreich in einem Subset an LongCOVID-Betroffenen**)

Meta-Analysen, Übersichten

- Jiang et al., A Systematic Review of Persistent Clinical Features After SARS-CoV-2 in the Pediatric Population (21.07.23 – 16% LongCOVID bei Kindern, Mädchen stärker betroffen)
- D'Souza et al., Incidence of Diabetes in Children and Adolescents During the COVID-19 PandemicA Systematic Review and Meta-Analysis (30.06.23)
- Lin et al., COVID-related dysphonia and persistent long-COVID voice sequelae: A systematic review and meta-analysis (22.06.23 – **ein Viertel der Covid-Patienten, v.a. Frauen, leiden unter Stimmbeeinträchtigungen während der Infektion, bei 70% der Betroffenen bleiben diese länger bestehen – für Sänger relevant!**)
- Kole et al., Acute and Post-Acute COVID-19 Cardiovascular Complications: A Comprehensive Review (20.05.23)
- Woodrow et al., Systematic review of the prevalence of Long Covid (03.05.23 – 120 Studien berücksichtigt, 3-12 Monate Follow-Up; "[…] **the burden of chronic illness is likely to be substantial even using the most conservative estimates.**")
- Perumal et al., Long COVID: a review and proposed visualization of the complexity of long COVID (20.04.23)
- Turner et al., Long COVID: pathophysiological factors and abnormalities of coagulation (19.04.23 – **LongCOVID als Folge von Mikrozirkulationsstörungen**)
- Zheng et al., Prevalence and risk factor for long COVID in children and adolescents: A meta-analysis and systematic review (07.03.23 – **40 Studien, n = 12424 Betroffene unter 18, Prävalenz für jegliche LongCOVID-Symptome lag bei 23,3%**)
- Byambasuren et al., Effect of covid-19 vaccination on long covid: systematic review (28.02.23 – **gewisser schützender Effekt vorhanden**)
- Guo et al., Long-term cardiac symptoms following COVID-19: a systematic review and meta-analysis (17.01.23, preprint – **Herzrhythmusstörungen und Schmerzen in der Brust am häufigsten**)
- Velichkovsky et al., Attention and memory after COVID-19 as measured by neuropsychological tests: Systematic review and meta-analysis (12.01.23)
- Nader et al., A Systematic Review of Trials Currently Investigating Therapeutic Modalities for Post-Acute COVID-19 Syndrome and Registered on World Health Organization International Clinical Trials Platform (12.01.23 – **388 Medikamentenversuche**)
- Massoud et al., Risk of thromboembolic events in non-hospitalized COVID-19 patients: A systematic review (15.02.23 – "Our meta-analyses support the **increase in risk of DVT and PE, and likely increase of MI**, in non-hospitalized COVID-19 patients. The risk of stroke appears significant **in the first week following infection** but drops to insignificance two weeks later.")
- Lai et al., Biomarkers in long COVID-19: A systematic review (20.01.23)

- Davis et al., LongCOVID: major findings, mechanisms and recommendations (13.01.23 – **wichtige Zusammenfassung des aktuellen Kenntnisstands: 65 Mio Betroffene weltweit, Fokus 36-50. Lebensjahr, produktivste Phase des Erwerbslebens, Herzerkrankungen nehmen bereits mit Erstinfektion zu, selbst bei 3fach Geimpften steigt LongCOVID-Risiko nach Reinfektion an**)
- Zuin et al., Risk of incident heart failure after COVID-19 recovery: a systematic review and meta-analysis (27.12.22 – **90% Risiko über 9 Monate hinweg nach überstandener Infektion, steigendes Risiko mit Alter und Bluthochdruck**)
- Zuin et al., Increased risk of acute myocardial infarction after COVID-19 recovery: A systematic review and meta-analysis (16.12.22 – 93% höher als in Normalbevölkerung)
- Marra et al., The effectiveness of coronavirus disease 2019 (COVID-19) vaccine in the prevention of post–COVID-19 conditions: A systematic literature review and meta-analysis (06.12.22 – **Impfung bietet 29% Schutz gegen LongCOVID**)
- Ssentongo et al., Association of COVID-19 with diabetes: a systematic review and meta-analysis (23.11.22 – COVID-19 was associated with a 66% higher risk of incident diabetes, **Glukosedysregulierung nach Infektion überwachen!**)
- O'Mahoney et al., The prevalence and long-term health effects of Long Covid among hospitalised and non-hospitalised populations: A systematic review and meta-analysis (01.12.22 – **45% mit anhaltenden Symptomen unabhängig Schwere der Erkrankung**)
- Astin et al., Long COVID: mechanisms, risk factors and recovery (22.11.22)
- Zhang et al., Risk for newly diagnosed diabetes after COVID-19: a systematic review and meta-analysis (15.11.22 – **über alle Altersgruppen hinweg erhöhtes Diabetes-Risiko, am höchsten 3 Monate nach Infektion**, bereits bekannt bei Influenza und anderen Viruserkrankungen vermutet)
- Notarte et al., Impact of COVID-19 vaccination on the risk of developing long-COVID and on existing long-COVID symptoms: A systematic review (26.08.22 – **n = 11 Studien, 7 zeigten Verbesserung von Long COVID nach Impfung, 4 keine Änderung oder Verschlechterung**)
- Houben et al., The Impact of COVID-19 Infection on Cognitive Function and the Implication for Rehabilitation: A Systematic Review and Meta-Analysis (24.06.22 – 27 Studien, n = 90317)
- Lopez-Leon et al., Long-COVID in children and adolescents: a systematic review and meta-analyses (23.06.22)
- Patients diagnosed with Post-COVID conditions: An analysis of private healthcare claims using the official ICD-10 diagnostic code – A FAIR White Paper (18.05.22 – **n = 78000! 76% der LongCOVID-Patienten waren nicht im Krankenhaus, Altersgruppe 36-50 Jahre mit höchstem Risiko, 60% weiblich, 40% männlich; 31% ohne Vorerkrankungen**)
- Chen et al., Global Prevalence of Post-Coronavirus Disease 2019 (COVID-19) Condition or Long COVID: A Meta-Analysis and Systematic Review (16.04.22)
- Ceban et al., Fatigue and Cognitive Impairment in Post-COVID-19 Syndrome: A Systematic Review and Meta-Analysis (29.12.21)
- Nasserie et al., Assessment of the Frequency and Variety of persistent symptoms among patients with covid-19 – A systematic review (26.05.21)
- Lopez-Leon et al., More than 50 Long-term effects of COVID-19: a systematic review and meta-analysis (30.01.21)
- Malas et al., Thromboembolism risk of COVID-19 is high and associated with a higher risk of mortality: A systematic review and meta-analysis (11.11.20)

Long COVID bei Kindern und Jugendlichen

siehe Menüpunkt Kinder

Wissenschaftliche Kommentare (keine Studien)

- Thaweethai et al., Development of a Definition of Postacute Sequelae of SARS-CoV-2 Infection (25.05.23 – **10% Betroffene, moderater Schutz durch Impfung, erhöhtes Risiko bei Reinfektionen, 1/3 der Betroffenen mit Besserung nach 9** Monaten)
- Yang et al., Association of SARS-CoV-2 infection and persistence with long COVID (10.05.23)
- David Putrino: Long COVID: Incidence, Impacts, And Implications (29.03.23)
- Eric Topol, Some light on Long COVID (12.08.22)
- Gideon M-K: How many people get long covid? (04.08.22)
- Walker et al., Parosmia – a common consequence of covid-19 (27.04.22 – im Schnitt erst 3 Monate nach der Infektion)
- Brodin et al., Studying severe long COVID to understand post-infectious disorders beyond COVID-19 (05.04.22)
- Seitz and Ong, Endothelial dysfunction in COVID-19: A potential predictor of long-COVID? (23.11.21)
- Ainsley Hawthorn: Like polio, the long-term impact of COVID will be measured in disability (26.09.21)
- Nisreen A. Alwan: The road to addressing Long COVID (30.07.21)
- Nisreen A. Alwan: The teachings of Long COVID (12.07.21)
- Michael Marshall: The four most urgent questions about long COVID (09.06.21)
- Dr. Francis Collins: How COVID-19 can lead to diabetes (08.06.21)
- Osuchowski et al., The COVID-19 puzzle: deciphering pathophysiology and phenotypes of a new disease entity (06.05.21)
- Vivien Marx, Scientists set out to connect the dots on long COVID (28.04.21)
- Etheridge and Asaki, COVID-19 Infection and Corrected QT Interval Prolongation—Collateral Damage From Our Newest Enemy (23.04.21)
- Nalbandian et al: Post-acute COVID-19 syndrome (22.03.21)
- Nisreen Alwan: We must pay more attention to covid-19 morbidity in the second year of the pandemic (03.02.21)
- Callard and Perego, How and why patients made Long Covid (**01/21**)
- Altmann and Boyton, Confronting the pathophysiology of long covid (09.12.20)
- Gareth Lacobucci: Long covid: Damage to multiple organs presents in young, low risk patients (17.11.20)
- Perego et al.: Why we need to keep using the patient made term „Long Covid“ (01.10.20)
- Rita Rubin, As their numbers grow, COVID-19 „long-haulers“ stump experts (23.09.20)
- Eric Topol: Covid19 can affect the heart (23.09.20)
- The lasting misery of coronavirus long-haulers (14.09.)
- Yelin et al., Long-term consequences of COVID-19: research needs (01.09.20)
- Nisreen A. Alwan: A negative COVID-19 test does not mean recovery (11.08.20)
- Greenhalgh et al., Management of post-acute covid-19 in primary care (11.08.20)
- From ‘brain fog’ to heart damage, COVID-19’s lingering problems alarm scientists (31.07.20)
- Helen Salisbury: When will we be well again? (23.06.20)

Sonstige Forschungsergebnisse

- Zhang et al., SARS-COV-2 spike protein promotes RPE cell senescence via the ROS/P53/P21 pathway (04.02.23 – **Covid beschleunigt Makuladegeneration des Auges (AMD),** häufigste Ursache für **Erblindung** im höheren Alter, kann mit LongCOVID schon im Kindesalter beginnen)
- Jammoul et al., Investigating the possible mechanisms of autonomic dysfunction post-COVID-19 (24.12.22)
- Gorman and Syed, Connecting the Dots in Emerging Mast Cell Research: Do Factors Affecting Mast Cell Activation Provide a Missing Link between Adverse COVID-19 Outcomes and the Social Determinants of Health? (28.05.22)
- Chudzik et al., Chronic fatigue associated with post-COVID syndrome versus transient fatigue caused by high intensity exercise: are they comparable in terms of vascular effects? (05.02.22, preprint)
- Mehandru and Merad, Pathological sequelae of long-haul COVID (01.02.22 – 3 zentrale Ursachen von LongCOVID: Viruspersistenz, anhaltende Entzündungsprozesse, Autoimmunreaktionen)
- Van Campen et al., Orthostatic Symptoms and Reductions in Cerebral Blood Flow in Long-Haul COVID-19 Patients: Similarities with Myalgic Encephalomyelitis/Chronic Fatigue Syndrome (24.12.21)
- Sukocheva et al., Analysis of post COVID-19 condition and its overlap with myalgic encephalomyelitis/chronic fatigue syndrome (26.11.21)
- Blomberg et al., Long COVID affects home-isolated young patients (23.02.21)

Organschäden und Autoimmunität

Multisystemerkrankung:

- Parotto et al., Post-acute sequelae of COVID-19: understanding and addressing the burden of multisystem manifestations (17.07.23)
- Petersen et al., Multi-organ assessment in mainly non-hospitalized individuals after SARS-CoV-2 infection: The Hamburg City Health Study COVID programme (14.03.22 – häufiger Thrombose, reduziertes Lungenvolumen)
- Dennis et al., Multi-organ impairment in low-risk individuals with long COVID (16.10.20)

Herz

"COVID survivors should be monitored for at least a year after recovering from the acute illness to diagnose cardiovascular complications of the infection, which form part of LongCOVID" – The European Society of Cardiology (19.01.23)

- Zhang et al., Ectopic expression of SARS-CoV-2 S and ORF-9B proteins alters metabolic profiles and impairs contractile function in cardiomyocytes (22.02.23 – **Covid19 beeinträchtigt die Herzmuskelzellen und macht das Herz weniger leistungsfähig**)
- Puzyrenko et al., Collagen-Specific HSP47^{+} Myofibroblasts and CD163^{+} Macrophages Identify Profibrotic Phenotypes in Deceased Hearts With SARS-CoV-2 Infections (15.02.23 – **Herzfibrose führt zu Herzinsuffizienz und unerwarteten Herztod auch bei jungen Menschen, Lebenserwartung 5-10 Jahre**)
- Raisi-Estabragh et al., Cardiovascular disease and mortality sequelae of COVID-19 in the UK Biobank (24.10.22 – **milde Infektionen führen zu 2,7x höheren Risiko von Blutgerinnseln und 10,2x höheren Sterblichkeit als Kontrollgruppe**)
- Puntmann et al., Long-term cardiac pathology in individuals with mild initial COVID-19 illness (05.09.22 – **höhere Herzfrequenzen, höhere Bildgebungswerte oder Kontrastmittelakkumulation**)
- Roca-Fernández et al., Cardiac impairment in Long Covid 1-year post-SARS-CoV-2 infection (04.04.22, n > 500, 20% von Herzproblemen betroffen, die bis ein Jahr anhielten, MRI-Diagnostik, nicht erkennbar mit Blutbild (Troponin), 4/5 der Kohorte mit mildem Verlauf)
- Jennifer Abbasi, The COVID Heart—One Year After SARS-CoV-2 Infection, Patients Have an Array of Increased Cardiovascular Risks (02.03.22)
- Xie et al., Long-term cardiovascular outcomes of COVID-19 (07.02.22)
- Tereshchenko et al., Risk of Cardiovascular Events after Covid-19: a double-cohort study (29.12.21 – n = 1355, erhöhtes Risiko nach symptomatischen/asymptomatischen Verläufen)
- Al-Aly et al., One-year Risks and Burdens of Incident Cardiovascular Disease in COVID-19: Cardiovascular Manifestations of Long COVID (05.10.21, n = 151 195)
- Singh et al., Persistent Exertional Intolerance after COVID-19: Insights from Invasive Cardiopulmonary Exercise Testing (10.08.21)
- Marfella et al., SARS-COV-2 colonizes coronary thrombus and impairs heart microcirculation bed in asymptomatic SARS-CoV-2 positive subjects with acute myocardial infarction (24.06.21 – **asymptomatische Patienten!**)
- Rubin et al., Cardiac Corrected QT Interval Changes Among Patients Treated for COVID-19 Infection During the Early Phase of the Pandemic (23.04.21)
- McVaney et al., The relationship of large city out-of-hospital cardiac arrests and the prevalence of COVID-19 (07.04.21)
- Sultanian et al., Cardiac arrest in COVID-19: characteristics and outcomes of in- and out-of-hospital cardiac arrest. A report from the Swedish Registry for Cardiopulmonary Resuscitation (05.02.21)
- Prezant et al., System impacts of the COVID-19 pandemic on New York City's emergency medical services (09.11.20)
- Puntmann et al., Anhaltende Herzmuskelentzündung und Herzprobleme bei genesenen Patienten mit überwiegend milden Verläufen (27.07.20) – Zusammenfassung auf Deutsch (BR)
- Lai et al., Characteristics Associated With Out-of-Hospital Cardiac Arrests and Resuscitations During the Novel Coronavirus Disease 2019 Pandemic in New York City (19.06.20)
- Zheng et al., COVID-19 and the cardiovascular system (**05.03.20**)

Lunge

- Kramer et al., Pulmonary Fibrosis and COVID-19 (20.07.23)
- Bellini et al., Long COVID in Young Patients: Impact on Lung Volume Evaluated Using Multidetector CT (30.06.23 – **10% kleinere Lunge bei jungen Post-Covid-Patienten**)
- Van Willigen et al., One-Fourth of COVID-19 Patients Have an Impaired Pulmonary Function after 12 Months of Illness Onset (24.02.23) – (Zusammenfassung)

- Gagiannis et al., Clinical, imaging, serological, and histopathological features of pulmonary post-acute sequelae after mild COVID-19 (PASC) (30.11.22, preprint – T-Zellen-Bronchiolitis und Narbenbildung)
- Rendeiro et al., Persistent alveolar type 2 dysfunction and lung structural derangement in post-acute COVID-19 (29.11.22, preprint)

Magen-Darm

- Ma et al., Risks of digestive diseases in long COVID: Evidence from a large-scale cohort study (25.04.23, preprint)
- Almeida et al., Gut microbiota from patients with mild COVID-19 cause alterations in mice that resemble post-COVID syndrome (22.06.22 – **Darmflora bei LongCOVID-Patienten verursacht Verlust an kognitiven Funktionen und beeinträchtigt die Lunge**)
- Zollner et al., Post-acute COVID-19 is characterized by gut viral antigen persistence in inflammatory bowel diseases (28.04.22)
- Meringer and Mehandru et al., Gastrointestinal post-acute COVID-19 syndrome (05.04.22)
- Gaebler et al, Evolution of Antibody Immunity to SARS-CoV-2 (05.11.20) – „Analysis of GI biopsies from asymptomatic individuals 3 months after COVID19….revealed persistence of SARSCoV2 in the small bowel in 7 out of 14 volunteers“ – **evtl. relevant für LongCovid!** ==> bestätigt durch Studie an der Uni-Klinik Innsbruck (01.05.22)

Niere und Blase

- Ebner et al., The COVID-19 pandemic — what have urologists learned? (13.04.22)

Schilddrüse

- Yanachkova et al., Thyroid dysfunction as a long-term post-COVID-19 complication in mild-to-moderate COVID-19 (31.01.23)
- The Coronavirus May Mess With Thyroid Levels, Too (10.08.20)

Bauchspeicheldrüse

- Taylor et al., Diabetes following SARS-CoV-2 infection: Incidence, persistence, and implications of COVID-19 vaccination. A cohort study of fifteen million people (09.08.23, preprint – Diabetes häufiger nach schweren Verläufen, Impfung reduziert Risiko erheblich)
- Naveed et al., Association of COVID-19 Infection With Incident Diabetes (18.04.23)
- Xu et al., Risks and burdens of incident dyslipidaemia in long COVID: a cohort study (06.01.23 – “Our findings suggest increased risks and 1-year burdens of **incident dyslipidaemia** and incident lipid-lowering medications use in the post-acute phase of COVID-19 infection.”)
- Barreto et al., Metabolic disorders and post-acute hospitalization in black/mixed-race patients with long COVID in Brazil: A cross-sectional analysis (31.10.22 – **LongCOVID kann Diabetes auslösen, unabhängig von der Schwere vom Anfangsverlauf**)
- Xie et al., Risks and burdens of incident diabetes in long COVID: a cohort study (21.03.22)
- Reiterer et al., Hyperglycemia in acute COVID-19 is characterized by insulin resistance and adipose tissue infectivity by SARS-CoV-2 (15.09.21)
- Montefusco et al., Acute and long-term disruption of glycometabolic control after SARS-CoV-2 infection (25.05.21)
- Müller et al, SARS-CoV-2 infects and replicates in cells of the human endocrine and exocrine pancreas (->Insulinstörung, Diabetes) – (03.02.21)

Fortpflanzung

- Kandemir et al., Evaluation of long-COVID symptoms in women infected with SARS-CoV-2 during pregnancy (30.06.23 – **n = 99, 74% mit mindestens einem LongCOVID-Symptom, Hospitalisierung erhöht LongCOVID-Risiko**)
- Li et al., Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections by intranasal or testicular inoculation induces testicular damage preventable by vaccination in golden Syrian hamsters (18.02.22 – SARS-CoV2 kann Mumps-ähnliche Schäden an den Hoden machen und Unfruchtbarkeit hervorrufen)
- Duel et al., Persistence, prevalence, and polymorphism of sequelae after COVID-19 in young adults (13.02.22 – **signifikant niedrigere Testosteronwerte bei zuvor gesunden jungen Männern**)
- Kresch et al., COVID-19 Endothelial Dysfunction Can Cause Erectile Dysfunction: Histopathological, Immunohistochemical, and Ultrastructural Study of the Human Penis (07.05.21)
- Sansone et al., „Mask up to keep it up": Preliminary evidence of the association between erectile dysfunction and COVID-19 (30.03.21)
- Ma et al., Pathological and molecular examinations of postmortem testis biopsies reveal SARS-CoV-2 infection in the testis and **spermatogenesis damage** in COVID-19 patients (14.12.20)

Gehirn (kognitiv, Demenz, etc.)

- Besteher et al., Cortical thickness alterations and systemic inflammation define long-COVID patients with cognitive impairment (23.07.23, preprint)
- Pandharipande et al., Mitigating neurological, cognitive, and psychiatric sequelae of COVID-19-related critical illness (17.07.23)
- Louise Cummings, Long COVID: The impact on language and cognition (22.06.23)
- Gesundheitsreport der Techniker Krankenkasse (Deutschland), Konzentrationsprobleme von 21 auf 53% bei Studenten gestiegen (Juni 2023)
- Martinez-Marmol et al., SARS-CoV-2 infection and viral fusogens cause neuronal and glial fusion that compromises neuronal activity (07.06.23)
- Sen et al., Cerebral blood flow in patients recovered from mild COVID-19 (02.06.23)
- Ali Nouraeinejad, The functional and structural changes in the hippocampus of COVID-19 patients (25.05.23)
- Covid19 erhöht das Gürtelrose-Risiko (Herpes Zoster), Herpes Zooster-Impfung verhindert viele Alzheimerfälle (25.05.23, preprint; Conclusio: unbedingt weiter gegen Covid impfen UND gegen Gürtelrose)
- Herrera et al., Cognitive impairment in young adults with post COVID-19 syndrome (19.04.23, n = 214, bei 85% Einschränkungen, stärkere Einschränkungen bei jüngeren Patienten)
- Ajčević et al., Cerebral hypoperfusion in post-COVID-19 cognitively impaired subjects revealed by arterial spin labeling MRI (10.04.23 – **deutlich reduzierter Blutfluss ins Gehirn bei LongCOVID**)
- Kase et al., The original strain of SARS-CoV-2, the Delta variant, and the Omicron variant infect microglia efficiently, in contrast to their inability to infect neurons: Analysis using 2D and 3D cultures (14.03.23)
- Bhowmik et al., Persistent olfactory learning deficits during and post-COVID-19 infection (05.03.23 – **rund 80% der Patienten mit kognitiven Beeinträchtigungen 4-18 Monate nach der Genesung**)
- Fontes-Dantas et al., SARS-CoV-2 Spike protein induces TLR4-mediated long-term cognitive dysfunction recapitulating post-COVID-19 syndrome in mice (16.02.23 – **Gedächtnisverlust**)

- Zhou et al., Causal Effects of COVID-19 on Structural Changes in Specific Brain Regions: A Mendelian Randomization Study (16.02.23)
- Greene et al., Blood-brain barrier disruption in Long COVID-associated cognitive impairment (23.01.23)
- Antar et al., Long COVID brain fog and muscle pain are associated with longer time to clearance of SARS-CoV-2 RNA from the upper respiratory tract during acute infection (19.01.23, preprint – könnte Paxlovid helfen?)
- Stein et al., SARS-CoV-2 infection and persistence in the human body and brain at autopsy (14.12.22)
- Monje and Iwasaki, The Neurobiology of Long COVID (06.10.22 – **Covid kann das Gehirn auf 6 verschiedene Arten schädigen**)
- Crunfli et al., Morphological, cellular, and molecular basis of brain infection in COVID-19 patients (11.08.22)
- Dan Hurley: Persistent Anosmia due to COVI-19 linked to cognitive impairment (06.08.22)
- Tana et al., Long COVID headache (01.08.22)
- Stephanie Pappas, COVID Virus May Tunnel through Nanotubes from Nose to Brain (20.07.22)
- Lee et al., Neurovascular injury with complement activation and inflammation in COVID-19 (05.07.22 – LongCOVID ähnelt Alzheimer bei Gehirnbeteiligung)
- Charnley et al., Neurotoxic amyloidogenic peptides in the proteome of SARS-COV2: potential implications for neurological symptoms in COVID-19 (13.06.22 – LongCOVIDs neurologische Symptome ähneln Alzheimer)
- Douaud et al., SARS-CoV-2 is associated with changes in brain structure in UK Biobank (07.03.22)
- Bauer et al., The neuroinvasiveness, neurotropism, and neurovirulence of SARS-CoV-2 (02.03.22 – Gehirn wird direkt und indirekt attackiert)
- Reiken et al., Alzheimer's-like signaling in brains of COVID-19 patients (03.02.22)
- Shen et al., SARS-CoV-2 invades cognitive centers of the brain and induces Alzheimer's-like neuropathology (31.01.22, n = 5)
- Zhao et al., Rapid vigilance and episodic memory decrements in COVID-19 survivors (19.01.22 – auch nach milden Verläufen **ohne** klassische LongCOVID-Symptome nach 6-9 Monaten noch verringerte Konzentration und Gedächtnisstörungen)
- Fernandez-Castaneda et al., Mild respiratory SARS-CoV-2 infection can cause multi-lineage cellular dysregulation and myelin loss in the brain (10.01.22, preprint -> **12.06.22 peer-reviewed**)
- Chertow et al., SARS-CoV-2 infection and persistence throughout the human body and brain (**20.12.21**)
- Islam et al., Neurotoxic Amyloidogenic Peptides Identified in the Proteome of SARS-COV2: Potential Implications for Neurological Symptoms in COVID-19 (24.11.21, preprint Amyloid ist an Demenz beteiligt)
- Becker et al., Assessment of Cognitive Function in Patients after COVID-19 infection (22.10.21 – 7 Monate nach Infektion 15% Processing deficits, 12% Memory deficits, nach Hospitalisierung 2-3x so häufig)
- Wenzel et al., The SARS-CoV-2 main protease M^{pro} causes microvascular brain pathology by cleaving NEMO in brain endothelial cells (21.10.21 – Hypothese bestätigt, dass Covid19 kleine Blutgefäße im Gehirn zerstört, erhöhtes Demenzrisiko denkbar)
- Douaud et al., Brain imaging before and after COVID-19 in UK Biobank (18.08.21 – „**Auch nach milden Covid Verläufen, ohne Krankenhaus, hatten die Covid Patienten graue Substanz im Gehirn verloren. Auch Hirnbereiche die für Gedächtnis wichtig sind und Riechzentrum betroffen. Wie kommt das? Man vermutet, dass Virus und Entzündung über Nase ins Gehirn dringen. Das würde auch erklären, weshalb harmlose Durchbruchsinfektion nach Impfung Long COVID und solche Veränderungen im Gehirn machen kann.“** (Karl Lauterbach)

- Graham et al. Persistent neurologic symptoms and cognitive dysfunction in non-hospitalized COVID-19 „long haulers“ (23.03.21)
- Philippens et al., SARS-CoV2 causes brain inflammation and induces Lewy body formation in macaques (23.02.21 – Form von Alzheimer)
- De Melo et al., COVID-19-associated olfactory dysfunction reveals SARS-CoV-2 neuroinvasion and persistence in the olfactory system (Preprint, 19.11.20)
- Yiping et al., Cerebral Micro-Structural Changes in COVID-19 Patients – An MRI-based 3-month Follow-up Study (03.08.20)

Nervensystem und Muskeln

- Abrams et al., Persistent post–COVID-19 neuromuscular symptoms (19.07.23)
- Woo et al., Vagus nerve inflammation contributes to dysautonomia in COVID-19 (20.06.23 – preprint)
- Kovanen and Vuorio, SARS-CoV-2 reinfection: Adding insult to dysfunctional endothelium in patients with atherosclerotic cardiovascular disease (07.06.23)
- Sadiq et al., Myasthenia Gravis Associated With COVID-19 Infection (25.05.23)
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- Sun et al., Urine proteomic characterization of active and recovered COVID-19 patients (13.03.23, preprint – **Gerinnungsstörungen und Veränderungen im Zentralnervensystem bei genesenen Patienten**)
- Aschman et al., Post-COVID syndrome is associated with capillary alterations, macrophage infiltration and distinct transcriptomic signatures in skeletal muscles (16.02.23, preprint)
- Spatola et al., Neurologic sequalae of COVID-19 are determined by immunologic imprinting from previous Coronaviruses (10.11.22, preprint)
- Cao et al., Accelerated biological aging in COVID-19 patients (19.04.22)
- Odozor et al., Post-acute sensory neurological sequelae in patients with SARS-CoV-2 infection: the COVID-PN observational cohort study (24.03.22 – periphere Nervenschäden 3 Monate nach Infektion als in der Kontrollgruppe)
- Advani et al., Transverse myelitis after SARS-CoV-2 infection: Report of two cases with COVID-19 (18.12.21)
- Rory et al., Small fiber neuropathy associated with SARS-CoV-2 infection (12.11.21)
- Mongelli et al., Evidence for Biological Age Acceleration and Telomere Shortening in Covid-19 survivors (7.6.21)
- Song et al., Divergent and self-reactive immune responses in the CNS of COVID-19 patients with neurological symptoms (27.04.21)
- Heidbreder et al., Video-polysomnographic findings after acute COVID-19: REM sleep without atonia as sign of CNS pathology? (Feb 21, Anzeichen für Parkinson, n = 11)
- Ramani et al., Musculoskeletal involvement of COVID-19: review of imaging
- (18.02.21)
- Nath and Smith, Neurological issues during COVID-19: An Overview (**25.11.20**) ~ **10-35% LongCovid**
- Wildwing and Holt: The Neurological Symptoms of ‘Long’ COVID-19: A Comparison with other Neurological Conditions and Implications for Healthcare Services (18.09.20)
- Ellul et al., Neurological associations of COVID-19 (02.07.20)

Gefäße

- Kuchler et al., Persistent endothelial dysfunction in post-COVID-19 syndrome and its associations with symptom severity and chronic inflammation (28.07.23)
- Kalaw et al., Retinal tissue and microvasculature loss in COVID-19 infection (29.03.23)

- Nunes et al., Cardiovascular and haematological pathology in myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS): A role for viruses (20.03.23)
- Podrug et al., Long-Term Adverse Effects of Mild COVID-19 Disease on Arterial Stiffness, and Systemic and Central Hemodynamics: A Pre-Post Study (08.03.23)
- Knight et al., Association of COVID-19 With Major Arterial and Venous Thrombotic Diseases: A Population-Wide Cohort Study of 48 Million Adults in England and Wales (19.09.22 – **Herzattacke, Schlaganfall, Thrombosen, Lungenembolie, Hochrisiko sinkt rasch ab nach der Infektion, bleibt aber für 26-49 Wochen erhöht, v.a. für venöse Komplikationen – generell höhere Risiken nach schwerem Verlauf**)
- Ahamed and Laurence, Long COVID endotheliopathy: hypothesized mechanisms and potential therapeutic approaches (01.08.22)
- Wagner and Heger, Thromboinflammation: From Atherosclerosis to COVID-19 (08.07.22)
- Burn et al., Venous or arterial thrombosis and deaths among COVID-19 cases: a European network cohort study (13.05.22)
- Prasannan et al., Impaired exercise capacity in post-COVID syndrome: the role of VWF-ADAMTS13 axis (11.05.22 – Hinweise auf endotheliale Dysfunktion, prothrombotischer Zustand bei LongCOVID, auch in Verbindung mit eingeschränkter Belastbarkeit)
- Pretoruius et al., Prevalence of symptoms, comorbidities, fibrin amyloid microclots and platelet pathology in individuals with Long COVID/ Post-Acute Sequelae of COVID-19 (PASC) (09.05., preprint)
- Katsoularis et al., Risks of deep vein thrombosis, pulmonary embolism, and bleeding after covid-19: nationwide self-controlled cases series and matched cohort study (06.04.22)
- Wang et al., Long COVID: The Nature of Thrombotic Sequelae Determines the Necessity of Early Anticoagulation (05.04.22)
- Fogarty et al, Persistent Endotheliopathy in the Pathogenesis of Long COVID Syndrome (10.08.21)

Autoimmunerkrankungen und Reaktivierung von Viren

- Zhu et al., Dynamics of inflammatory responses after SARS-CoV-2 infection by vaccination status in the USA: a prospective cohort study (07.08.23- Impfung verringert Entzündungsmarker)
- Woodruff et al., Chronic inflammation, neutrophil activity, and autoreactivity splits long COVID (14.07.23 – verschiedene Subtypen bei LongCOVID, unspezifische Marker, ANA beim entzündlichen Subtyp erhöht und persistierend (wie auch bei MECFS), erhöhte Autoreaktivität, aktivierte Gerinnung)
- Sharma et al., High risk of autoimmune diseases after COVID-19 (12.04.23)
- Tesch et al., Incident autoimmune diseases in association with a SARS-CoV-2 infection: A matched cohort study (26.01.23, preprint – **erhöhtes Risiko für Rheuma, Diabetes, Hashimoto, Gefäßerkrankungen**)
- Chang et al., Risk of autoimmune diseases in patients with COVID-19: A retrospective cohort study (10.01.23, Risiko für rheumatoide Erkrankungen signifikant erhöht: Arthritis, Psoriasis, Vaskulitis, Mb. Bechterew)
- Swewczyk-Dabrowska et al., Correlation between COVID-19 severity and previous exposure of patients to *Borrelia* spp. (24.09.22 – **ein vorheriger Zeckenstich und Borreliose können auf erhöhtes Risiko für einen schweren Verlauf hinweisen: auf Borrelien-Antikörper screenen lassen, Einschränkung: nicht nach Alter stratifiziert – je älter, desto wahrscheinlicher Kontakt mit Borrelien und statistisch gesehen schwererer Verlauf**)
- Peluso et al., Impact of Pre-Existing Chronic Viral Infection and Reactivation on the Development of Long COVID (22.07.22, preprint)
- Charvet et al., SARS-CoV-2 induces human endogenous retrovirus type W envelope protein expression in blood lymphocytes and in tissues of COVID-19 patients (21.01.22)

- Liu et al., Paradoxical sex-specific patterns of autoantibody response to SARS-CoV-2 infection (30.12.21 – von 177 HCW hatten alle selbst-attackierende Antikörper 6 Monate nach der Infektion, unabhängig von der Schwere)
- Kitsou et al., Upregulation of Human Endogenous Retroviruses in Bronchoalveolar Lavage Fluid of COVID-19 Patients (06.10.21)
- Long-COVID-Symptome als Folge einer EBV-Reaktivierung? (12.08.21)
- Gold et al., Investigation of Long COVID Prevalence and Its Relationship to Epstein-Barr Virus Reactivation (17.06.21)
- Wang et al., Diverse Functional Autoantibodies in Patients with COVID-19 (10.12.20) und erläuternder Thread von Prof. Akiko Iwasaki dazu

Immunschwäche

Es sind zumindest **vier Formen von Immunschwäche** infolge einer Covid19-Infektion denkbar:

- LongCOVID und MECFS (chronifizierte Erkrankung)
- LongCOID nach Reinfektionen mit der gleichen oder neuen SARS-CoV2-Varianten ("natürliche" Abnahme der Immunität)
- LongCOVID nach Durchbruchsinfektionen trotz (mehrfacher) Impfung
- (temporäre) Vulnerabilität gegenüber bakteriellen und viralen Infekten sowie Pilzen generell

Hinsichtlich einer lang anhaltenden Immunschwäche vergleichbar mit Masern oder AIDS gibt es folgende Stellungnahmen aus der Fachwelt:

- Andrew Ewing (World Health Network): COVID-19 and Immune Dysregulation, a Summary and Resource (05.03.23)
- Frederik Jötten: Löst Corona eine Immunschwäche aus? (17.02.23)
- Tim Requarth: What Is COVID Actually Doing to Our Immune Systems? The research sounds scary. It's not bunk—but it's important to understand its purpose. (31.01.23)

Reinfektionen

- Hendrix et al., Influence of Prior SARS-CoV-2 Infection on COVID-19 Severity: Evidence from the National COVID Cohort Collaborative (06.08.23, preprint – n > 2 Mio., leicht erhöhtes Risiko für schweren Verlauf bei der 2. Infektion: "We observed a mild protective effect of prior infection during the early and mid-stages of the pandemic that waned after the rise of the Omicron variants, ultimately resulting in loss of protection or a tendency toward more severe second infections.")
- Cassandra Willyard: Are repeat COVID infections dangerous? What the science says (26.04.23)
- Bosworth et al., Risk of new-onset Long Covid following reinfection with SARS-CoV-2: community-based cohort study (17.04.23, preprint – relative Abnahme des Risikos)
- Fatality rate of people infected with Covid-19 twice higher than those infected once (18.01.23, IFR 0,11 gegenüber 0,06)
- Hadley et al., SARS-CoV-2 Reinfection is Preceded by Unique Biomarkers and Related to Initial Infection Timing and Severity: an N3C RECOVER EHR-Based Cohort Study (05.01.23, preprint – **Zunahme von LongCOVID-Risiko mit Reinfektion**)

- Marra et al., Risk factors for long COVID among healthcare workers, Brazil, 2020&2022 (05.01.23, preprint – Reinfektionen erhöhten LongCOVID-Risiko, 4. Impfung verringert Risiko)
- Bowe et al., Acute and postacute sequelae associated with SARS-CoV-2 reinfection (10.11.22 – **zwei Infektionen mit höherem Risiko zu sterben (2fach), Hospitalisierung (3fach), Herzproblemen (3fach), Blutgerinnsel (3fach)** als eine Infektion, Limitation: nur 10% Frauen, 88% über 39 Jahre)
- Neuseeland warnt vor Reinfektionen (28.10.22)
- Reinfektionen verschlechtern LongCOVID bei 80% der Betroffenen und kann bei 60% zum erneuten Auftreten von LongCOVID-Symptomen bei Genesenen führen .(n = 600, 08.09.22 – Linkfix)
- The interplay of omicron, reinfections and long COVID (27.08.22)
- Al-Aly et al, Outcomes of SARS-CoV2 Reinfection (17.06.22, preprint –Erläuterung zu Limitation und Stärke von Blake Murdoch)
- Shen et al., ACE2-independent infection of T lymphocytes by SARS-CoV-2 (11.03.22 – Immunsystem kann durch Infektion geschwächt werden, T-Zellen infiziert, Zelltod. Evidenz gegen "Infektion trainiert Immunsystem"-Konzept)

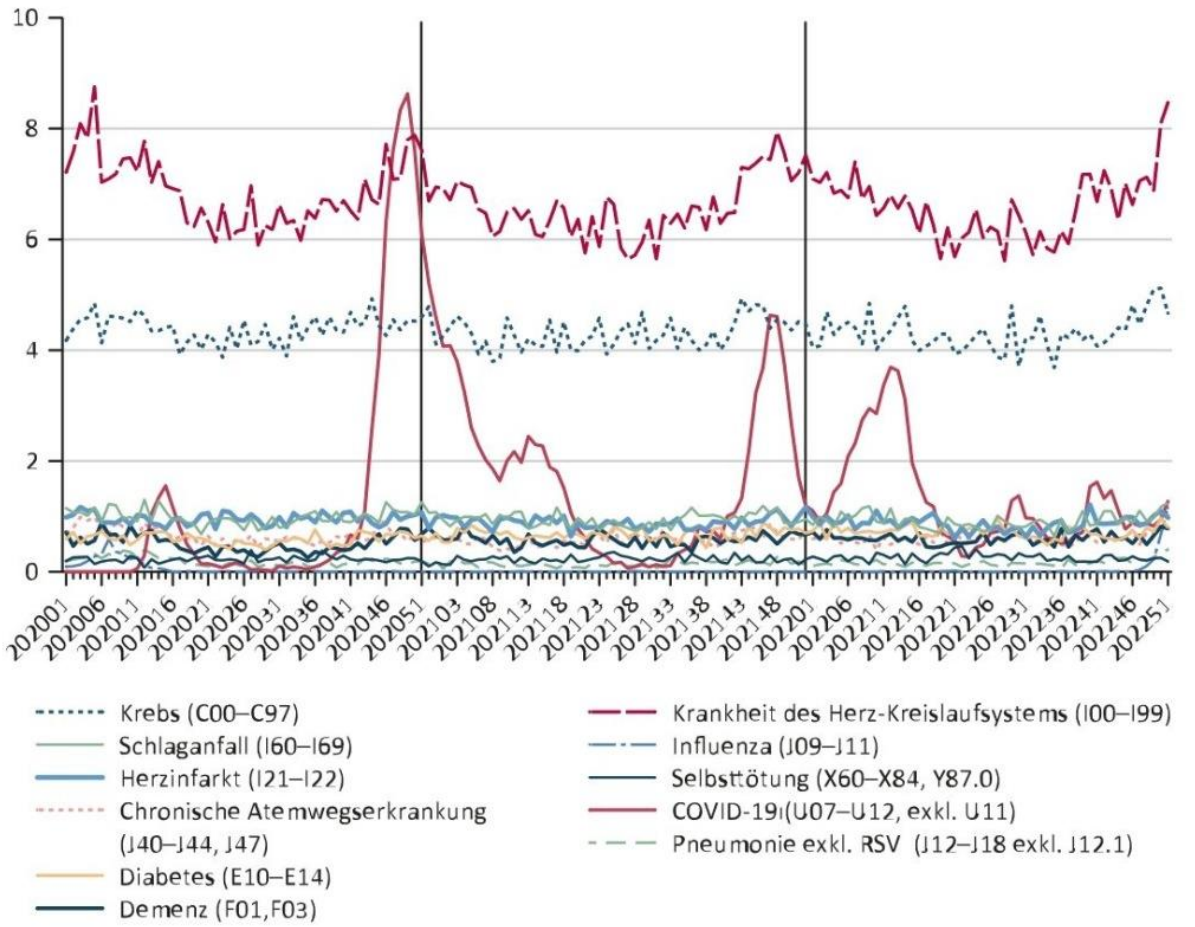
Durchbruchsinfektionen nach Impfung

- Brannock et al., Long COVID risk and pre-COVID vaccination in an EHR-based cohort study from the RECOVER program (22.05.23 – **verringertes LongCOVID-Risiko durch Impfung, auch bei OMICRON**)
- Tran et al., Efficacy of first dose of covid-19 vaccine versus no vaccination on symptoms of **patients** with long covid: target trial emulation based on ComPaRe e-cohort (28.02.23)
- Richard et al., Persistent COVID-19 Symptoms at 6 Months After Onset and the Role of Vaccination Before or After SARS-CoV-2 Infection (18.01.23, n = 1832, **Impfung verringert LongCOVID-Symptome um 40%, Caveat: vor OMICRON**)
- Nehme et al., Prevalence of post-COVID Condition 12 Weeks after Omicron Infection Compared to Negative Controls and Association with Vaccination Status (15.12.22 – nach BA.1/BA.2 weniger LongCOVID in Geimpften gegenüber Ungeimpften)
- Perlis et al., Prevalence and Correlates of Long COVID Symptoms Among US Adults (27.10.22, n = 16000, 15% LongCOVID, **Geimpfte im Vergleich Ungeimpfte 28% geringeres Risiko für LongCOVID**, OMICRON etwas seltener LongCOVID, Studienzeitraum bis 6.7.22)
- Ayoubkhani et al., Risk of Long Covid in people infected with SARS-CoV-2 after two doses of a COVID-19 vaccine: community-based, matched cohort study (12.09.22 – longcovid risk scheint mit Anfangsschwere der Symptome zuzunehmen, 10% longcovid bei geimpften, verglichen zu 15% bei Ungeimpften.)
- Ayoubkhani and Bosworth, Self-reported long COVID after infection with the Omicron variant in the UK: 18 July 2022 (18.07.22 – **4% der 3fach Geimpften nach 3-4 Monaten noch eingeschränkt, kaum Unterschiede zwischen DELTA, BA.1 und BA.2**)
- Azzolini et al., Association Between BNT162b2 Vaccination and Long COVID After Infections Not Requiring Hospitalization in Health Care Workers (01.07.22 2-3 Dosen reduzieren LongCOVID-Risiko um 75-85%)
- Antonelli et al., Risk of long COVID associated with delta versus omicron variants of SARS-CoV-2 (18.06.22 – **weniger LongCOVID bei Omicron im Vergleich zu DELTA, Limitation: überwiegend BA.1**)
- Emecen et al., The presence of symptoms within 6 months after COVID-19: a single-center longitudinal study (17.06.22 – n = 5610, **Impfung reduziert Risiko um 50%, keine klare Aussage über Absolutzahlen möglich**)
- Al-Aly et al., Long COVID after breakthrough SARS-CoV-2 infection (25.05.22, n = 33940, **2fache Impfung bietet nur ca. 15% Schutz vor LongCOVID**)

- Ayoubkhani et al., Trajectory of long covid symptoms after covid-19 vaccination: community based cohort study (18.05.22, n = 28356)
- Morioka et al., Post COVID-19 condition of the Omicron variant of SARS-CoV-2 (16.05.22, preprint, small group – LongCOVID bei OMICRON seltener, Limitation: 01/12/21-09/02/22, überwiegend BA.1)
- Ayoubkhani and Bosworth, Self-reported long COVID after infection with the Omicron variant in the UK (06.05.22 – **ähnlich hohes LongCOVID-Risiko bei 3fach Geimpften zwischen DELTA und BA.1 (rund 8%), bei BA.2 noch höher (8-11%)**
- Ayoubkhani et al., Risk of Long Covid in people infected with SARS-CoV-2 after two doses of a COVID-19 vaccine: community-based, matched cohort study (24.02.22, zweifache Impfung halbiert LongCOVID-Risiko)
- Ayoubkhani et al., Self-reported long COVID after two doses of a coronavirus (COVID-19) vaccine in the UK: 26 January 2022 (26.01.22 – Risiko an LongCOVID zu erkranken von 14,6 auf 9,5% gesunken nach zweifacher Impfung – vor OMICRON)
- Kuodi et al., Association between vaccination status and reported incidence of post-acute COVID-19 symptoms in Israel: a cross-sectional study of patients infected between March 2020 and November 2021 (17.01.22, preprint, Update mit Referenzgruppe – 54% weniger Kopfschmerzen, 64% weniger Fatigue, 68% weniger Muskelschmerzen als bei Ungeimpften)
- The effectiveness of vaccination against long COVID – A rapid evidence briefing (12.01.22)
- Jördis Frommhold: Nur sporadische Patienten mit LongCOVID unter 3000 Patienten (04.01.22 – meistens direkt nach der 2. Impfung)
- Antonelli et al., Risk factors and disease profile of post-vaccination SARS-CoV-2 infection in UK users of the COVID Symptom Study app: a prospective, community-based, nested, case-control study (01/022 – ca. halbiertes Risiko vor OMICRON)
- Do vaccines protect against long COVID? What the data say (23.11.21)
- Simon et al., Reduced Incidence of Long-COVID Symptoms Related to Administration of COVID-19 Vaccines Both Before COVID-19 Diagnosis and Up to 12 Weeks After (18.11.21 – vor DELTA)
- Al-Aly, Long COVID after Breakthrough COVID-19: the post-acute sequelae of breakthrough COVID-19 (15.11.21, preprint – **n = 16000, controls 3,5 Mio, auch nach milden Verläufen**)
- Taquet et al., Six-month sequelae of post-vaccination SARS-CoV-2 infection: a retrospective cohort study of 10,024 breakthrough infections (26.10.21, preprint – **Impfung reduziert im Fall eines Impfdurchbruchs Risiko von LongCOVID NICHT!**)
- Senjam et al., Assessment of Post COVID-19 Health Problems and its Determinants in North India: A descriptive cross section study (07.10.21 – 2fache Impfung reduziert um 45%)

Erhöhtes Krebsrisiko mit/nach Covid19?

Grafik 2: Altersstandardisierte Sterberaten nach ausgewählten Todesursachen(gruppen) und Kalenderwochen 2020, 2021 und 2022



Q: STATISTIK AUSTRIA, Todesursachenstatistik. – Stand 21.02.2023, vorläufige Daten ohne Kalenderwoche 52 im Berichtsjahr 2022. – ICD-Textierung vereinfacht.

- Jahankhani et al., Possible cancer-causing capacity of COVID-19: Is SARS-CoV-2 an oncogenic agent? (02.06.23)
- Gómez-Carballa et al., Is SARS-CoV-2 an oncogenic virus (09.08.22)
- Ahmadi et al., Cancer related-genes enriched in peripheral blood mononuclear cells (PBMCs) of COVID-19 patients. a bioinformatics study (02.08.22)
- Nguyen et al., SARS-CoV-2 M Protein Facilitates Malignant Transformation of Breast Cancer Cells (07.06.22)

Schwächung des Immunsystems gegenüber anderen Infekten

Bekannte Viren, die speziell CD4+ T-Zellen infizieren: HIV, CMV (Zytomegalievirus, Herpesviren), EBV, Masern, HTLV-1 (Onkovirus, humanes T-lymphotropes Virus)

Theorie:

- Brunetti et al., SARS-CoV-2 uses CD4 to infect T helper lymphocytes (31.03.23)
- Vazquez-Alejo et al., Persistent Exhausted T-Cell Immunity after Severe COVID-19: 6-Month Evaluation in a Prospective Observational Study (18.05.23)

- Visvabharathy et al., Autoantibody production is enhanced after mild SARS-CoV-2 infection despite vaccination in individuals with and without long COVID (12.04.23, preprint – **bei SLE und entzündlichen Muskelerkrankungen bis zu 8 Monate erhöhte Produktion von Autoantikörpern, einhergehend mit neurologischen und kognitiven Beeinträchtigungen und größerer Symptomschwere, nachfolgende Impfung verringert die Autoantikörper nicht**)
- Sun et al., Immune damage mechanisms of COVID-19 and novel strategies in prevention and control of epidemic (07.03.23)
- Yin et al., Long COVID manifests with T cell dysregulation, inflammation, and an uncoordinated adaptive immune response to SARS-CoV-2 (10.02.23, preprint)
- Pedroso et al., COVID-19 INDUCES SENESCENCE AND EXHAUSTION OF T CELLS IN PATIENTS WITH MILD/MODERATE AND SEVERE DISEASE DURING A SEVEN-DAY INTERVAL (18.01.23, preprint – " **SARS-CoV2 infection can accelerate immunosenescence in both CD4 and CD8 T cell compartments in a short period of time**.")
- Maher et al., Transcriptional reprogramming from innate immune functions to a pro-thrombotic signature by monocytes in COVID-19 (26.12.22 – **unspezifische Immunabwehr (Innate immune system) auch nach mild-moderatem Verlauf beeinträchtigt, kann schwerere Verläufe bei Folgeerkrankungen nach Covid mit Viren und Bakterien (z.b. Streptokokken) erklären**)
- 36+ Papers über covid bedingte Immunschwäche (CAID, Thread)
- Khoo et al., Tracking the clonal dynamics of SARS-CoV-2-specific T cells in children and adults with mild/asymptomatic COVID-19 **(21.12.22 – "These data suggest that rapid clearance of SARS-CoV-2 in children may compromise their cellular immunity and ability to resist reinfection**." – Limitation: sehr kleine Stichprobe (n = 5/7)
- Miura et al., Asymptomatic SARS-COV-2 infection in children's tonsils (11.11.22 – **Covid zerstört die dendritischen Zellen und Lymphozyten in den Mandeln, wo Strep A bei Kindern attackiert**)
- Kee et al., SARS-CoV-2 disrupts host epigenetic regulation via histone mimicry (05.10.22 – **SARS-CoV2 verwirrt das Immunsystem, indem es chemische Marker (Proteine) imitiert, die der Körper verwendet, um Gene zu aktivieren**, auch bei HIV bekannt)
- Govender et al., T cell perturbations persist for at least 6 months following hospitalization for COVID-19 (08.08.22 – **nach schweren Verläufen für mindestens 6 Monate geschwächtes Immunsystem**)
- Shen et al., ACE2-independent infection of T lymphocytes by SARS-CoV-2 (11.03.22 – **Studie bestätigt, dass unser Immunsystem (T-Zellen infiziert, Apoptose begünstigt) durch eine Infektion mit SARS-CoV-2 selbst geschwächt werden kann. Wissenschaftliche Evidenz gegen „die Infektion trainiert unser Immunsystem" Konzept**)
- Chang et al., Depletion and Dysfunction of Dendritic Cells: Understanding SARS-CoV-2 Infection (21.02.22)
- Jing et al., SARS-CoV-2 infection causes immunodeficiency in recovered patients by downregulating CD19 expression in B cells via enhancing B-cell metabolism (22.09.21)
- Perez-Gomez et al., Dendritic cell deficiencies persist seven months after SARS-CoV-2 infection (21.07.21)
- André et al., T cell apoptosis characterizes severe Covid-19 disease (22.01.22)
- Ryan et al., Long-term perturbation of the peripheral immune system months after SARS-CoV-2 infection (14.01.22 – vorübergehende Immunschwäche v.a. 3-4 Monate nach Infektion, anhaltende Effekte bis 6 Monate)
- Phetsouphanh et al., Immunological dysfunction persists for 8 months following initial mild-to-moderate SARS-CoV-2 infection (13.01.22)
- Winheim et al., Impaired function and delayed regeneration of dendritic cells in COVID-19 (6.10.21 – **Covid kann die dendritischen Zellen schwächen!**)
- Files et al., Sustained cellular immune dysregulation in individuals recovering from SARS-CoV-2 infection (29.10.20)

- Davanzo et al., SARS-CoV-2 Uses CD4 to Infect T Helper Lymphocytes (28.09.20)
- Sciaccitano and Giovagnoli, AIDS and COVID-19 are two diseases separated by a common lymphocytopenia (July 2020)
- Diao et al., Reduction and Functional Exhaustion of T Cells in Patients with Coronavirus Disease 2019 **(COVID-19, 20.02.20**)

Real-Life-Data:

- Nielsen et al., Group A *Streptococcus* Meningitis in Adults, Denmark (09.09.23 – 21fache Zunahme zwischen 10/2022 und 04/2023)
- Wang et al., Disrupted seasonality and association of COVID-19 with medically attended respiratory syncytial virus infections among young children in the US: January 2010-January 2023 (16.05.23, preprint – **Covid19 hat zur starken RS-Welle 2021/2022 beigetragen)**
- Emily Henderson: New insights into deadly fungal invasion in people with compromised immune systems (12.01.23 – **"We discovered that influenza and Cov19 destroy a previously unknown natural immunity that we need to resist invasive fungal infections," says Nicole Sarden, a PhD candidate at the University of Calgary."**)
- Terry Pender: Immune systems seriously weakened by COVID (20.12.22)
- "We discovered that influenza and COVID-19 destroy a previously unknown natural immunity that we need to resist invasive fungal infections" (12.22)
- In Südengland Ausbruch von Streptokokken A bei Kindern, bereits 6 Todesfälle – Co-Infektion mit Covid (02.12.22), und Dänemark: überdurchschnittlich viele Infekteionen (21.01.23)
- Morton et al., Defective antifungal immunity in patients with COVID-19 (30.11.22)
- Alemu et al., Tuberculosis in individuals who recovered from COVID-19: A systematic review of case reports (28.11.22 – **Tuberkulose-Fälle nehmen seit Covid zu**)
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- Najeeb et al, The Menace of *Candida auris* Epidemic Amidst the COVID-19 Pandemic: A Systematic Review (29.08.22 – increase of bacterial, fungal and viral superinfection)
- Al-Aly et al., High-dimensional characterization of post-acute sequelae of COVID-19 (22.04.21 – **Covid19 vervierfacht das Risiko von weiteren Viruserkrankungen**)