Sunlight reduces COVID-19 risk: real-time meta analysis of 5 studies

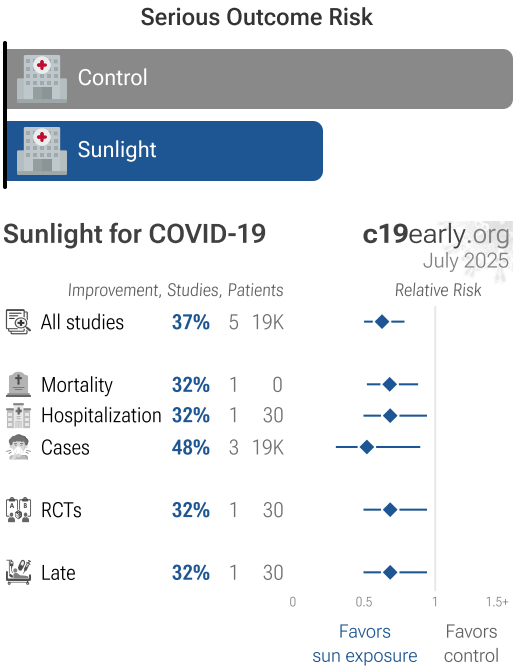
@CovidAnalysis, July 2025, Version 4
https://c19early.org/sunmeta.html

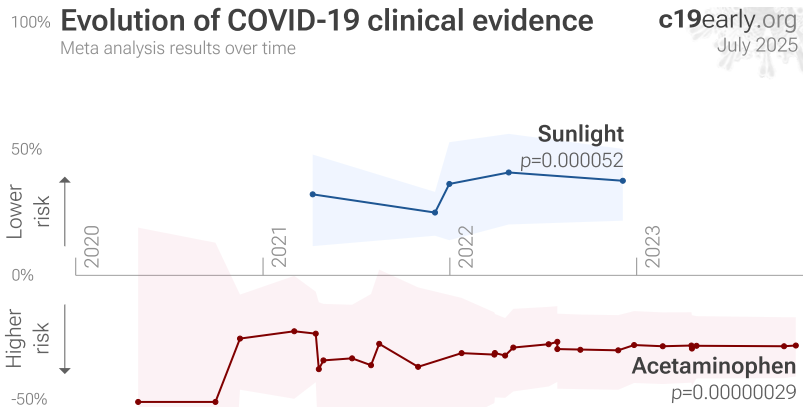
Abstract

Significantly lower risk is seen for mortality, hospitalization, recovery, and cases. 5 studies from 5 independent teams in 4 countries show significant benefit.

Meta analysis using the most serious outcome reported shows 37% [22-50%] lower risk. Results are similar for Randomized Controlled Trials.

No treatment is 100% effective. Protocols combine safe and effective options with individual risk/benefit analysis and monitoring. Sunlight currently has no early treatment studies. All data and sources to reproduce this analysis are in the appendix.



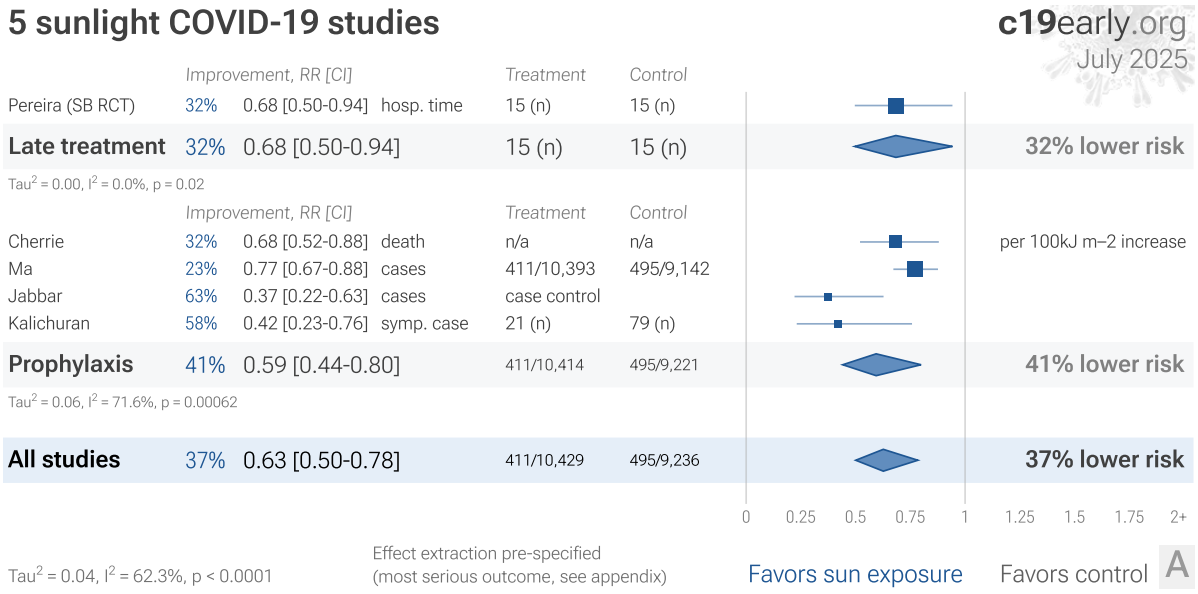


SUNLIGHT FOR COVID-19 — HIGHLIGHTS

Sunlight reduces risk with very high confidence for pooled analysis, high confidence for cases, and low confidence for mortality, hospitalization, and recovery.

35th treatment shown effective in December 2021, now with $p = 0.000052$ from 5 studies.

Real-time updates and corrections with a consistent protocol for 172 treatments. Outcome specific analysis and combined evidence from all studies including treatment delay, a primary confounding factor.



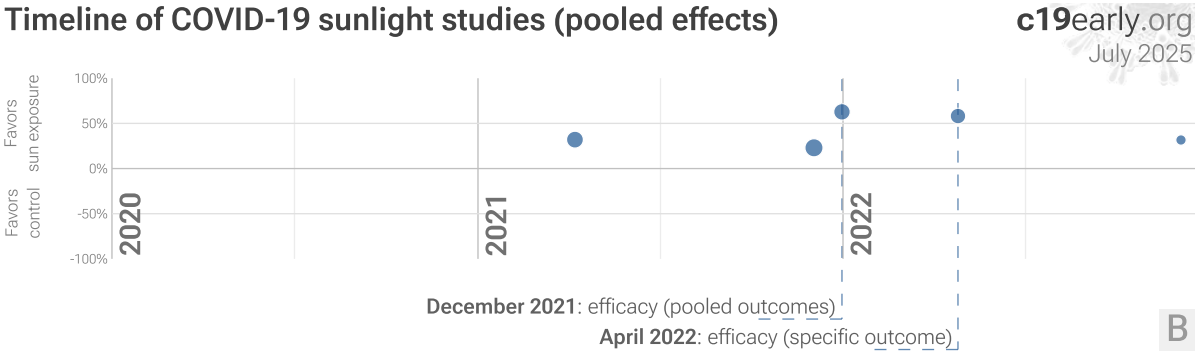


***Figure 1.* A. Random effects meta-analysis.** This plot shows pooled effects, see the specific outcome analyses for individual outcomes. Analysis validating pooled outcomes for COVID-19 can be found below. Effect extraction is pre-specified, using the most serious outcome reported. For details see the appendix. **B. Timeline of results in sunlight studies.** The marked dates indicate the time when efficacy was known with a statistically significant improvement of ≥10% from ≥3 studies for pooled outcomes and one or more specific outcome. Efficacy based on specific outcomes was delayed by 3.8 months, compared to using pooled outcomes.

Introduction

Sunlight

Sunlight increases nitric oxide and vitamin D, and helps regulate the circadian rhythm which is important for immune health and may increase melatonin production at night. Sunlight may also directly inactivate SARS-CoV-2 in the environment[3].

Other infections

Efficacy with sunlight has been shown for influenza[4-6].

Analysis

We analyze all significant studies reporting COVID-19 outcomes as a function of sunlight exposure. Search methods, inclusion criteria, effect extraction criteria (more serious outcomes have priority), all individual study data, PRISMA answers, and statistical methods are detailed in Appendix 1. We present random effects meta-analysis results for all studies, studies within each treatment stage, individual outcomes, and Randomized Controlled Trials (RCTs).

Preclinical Research

2 *In Vitro* studies support the efficacy of sunlight [7,8].

Preclinical research is an important part of the development of treatments, however results may be very different in clinical trials. Preclinical results are not used in this paper.

Figure 2. **The beneficial effect of sunlight on the immune system is periodically considered to be a new discovery [1], but has has long been known, for example Niels Ryberg Finsen received a Nobel Prize in 1903 for phototherapy [2].**

Results

Table 1 summarizes the results for all studies, for Randomized Controlled Trials, and for specific outcomes. Figure 3 plots individual results by treatment stage. Figure 4, 5, 6, 7, and 8 show forest plots for random effects meta-analysis of all studies with pooled effects, mortality results, hospitalization, recovery, and cases.

	Relative Risk	Studies	Patients
All studies	0.63 [0.50-0.78] ****	5	10K
RCTs	0.68 [0.50-0.94] *	1	30
Cases	0.52 [0.30-0.89] *	3	10K

Table 1. **Random effects meta-analysis for all studies, for Randomized Controlled Trials, and for specific outcomes.** Results show the relative risk with treatment and the 95% confidence interval. * $p<0.05$ *** $p<0.001$.

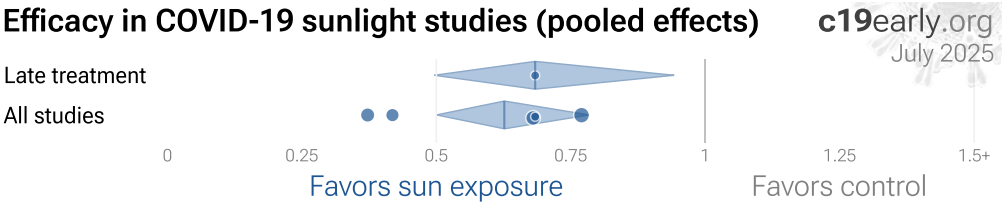


Figure 3. **Scatter plot showing the most serious outcome in all studies.** The diamond shows the results of random effects meta-analysis.

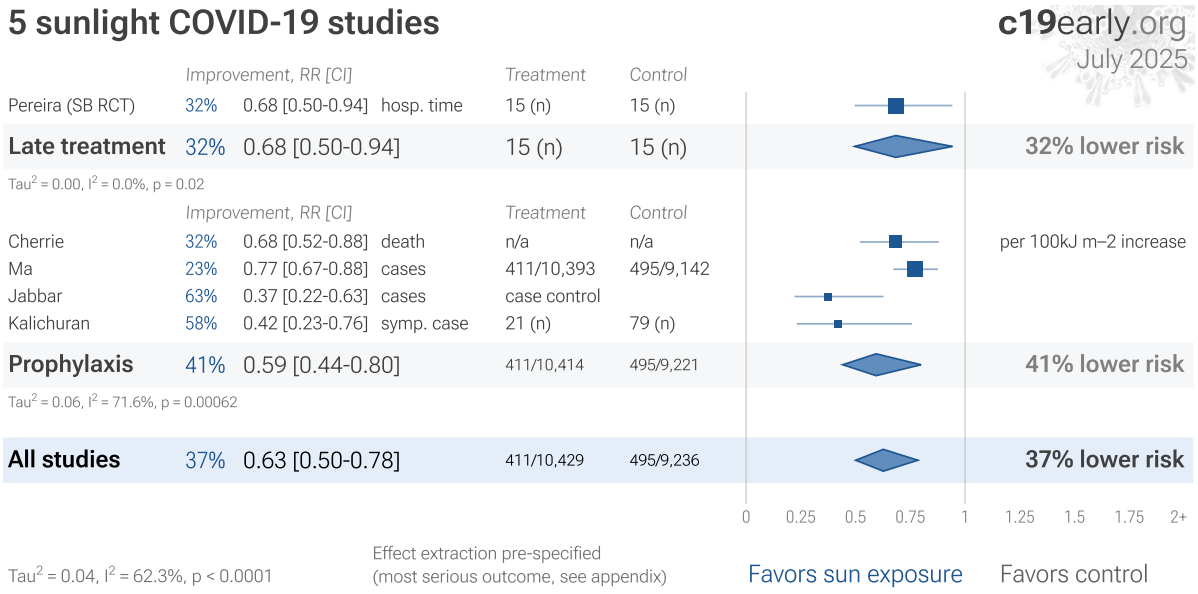


Figure 4. **Random effects meta-analysis for all studies.** This plot shows pooled effects, see the specific outcome analyses for individual outcomes. Analysis validating pooled outcomes for COVID-19 can be found below. Effect extraction is pre-specified, using the most serious outcome reported. For details see the appendix.

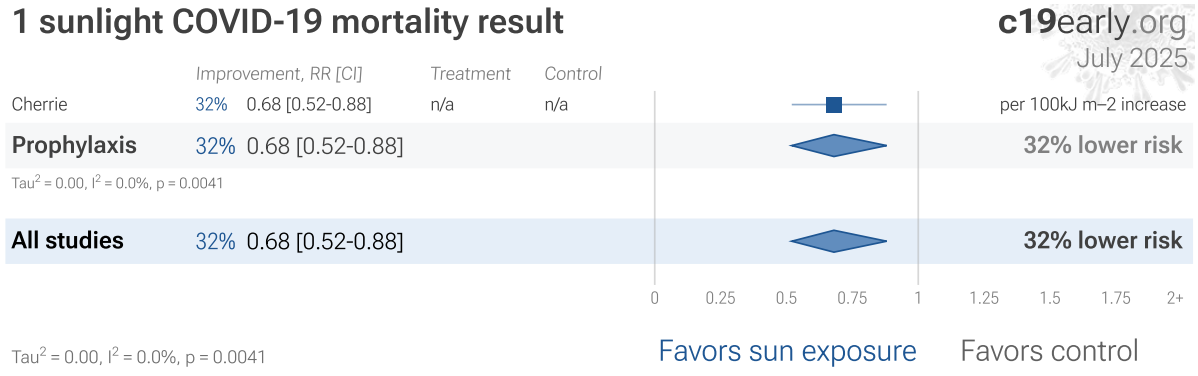


Figure 5. **Random effects meta-analysis for mortality results.**

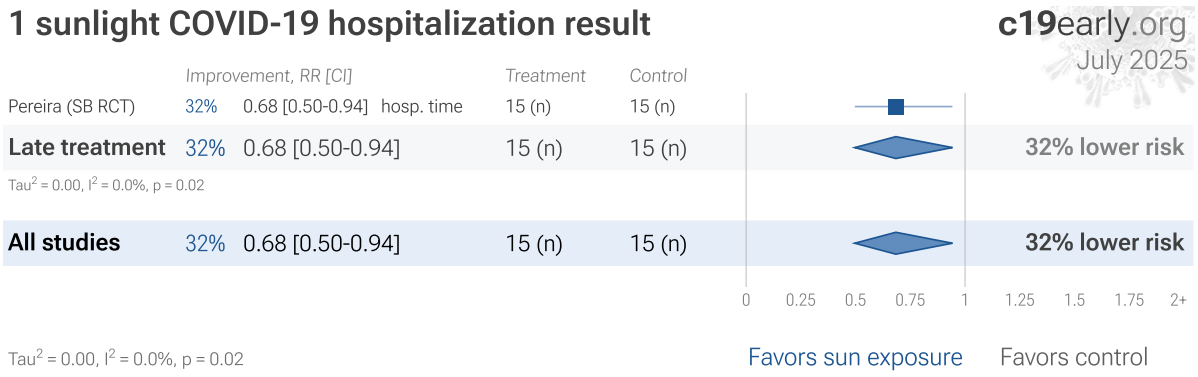


Figure 6. **Random effects meta-analysis for hospitalization.**

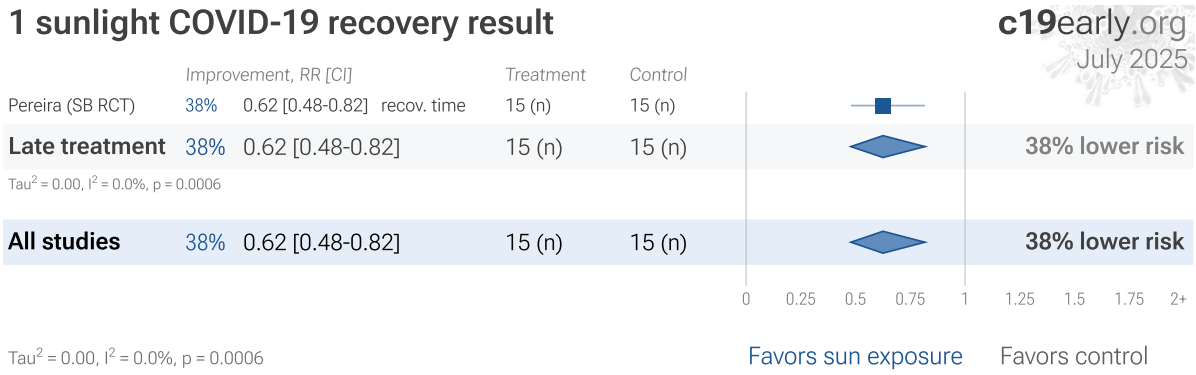


Figure 7. Random effects meta-analysis for recovery.

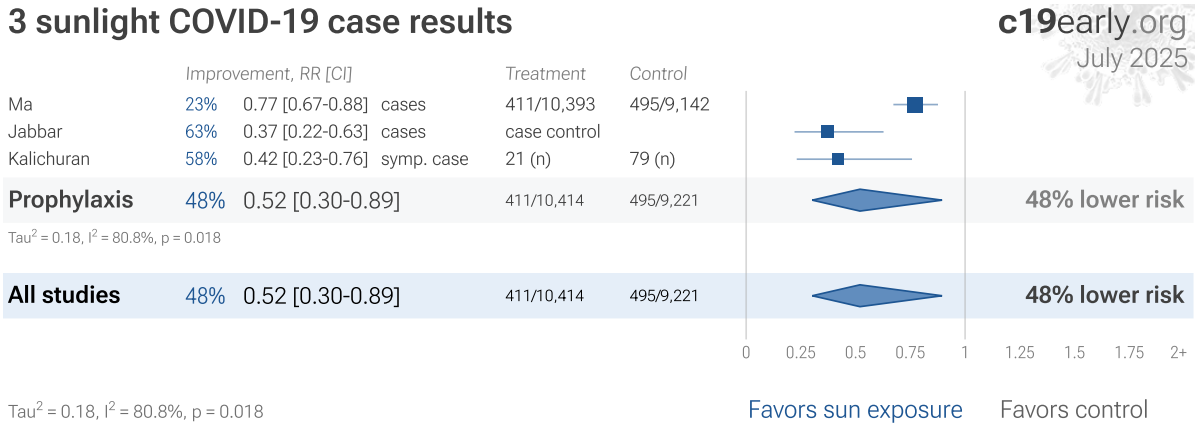


Figure 8. Random effects meta-analysis for cases.

Randomized Controlled Trials (RCTs)

Figure 9 shows a forest plot for random effects meta-analysis of all Randomized Controlled Trials. RCT results are included in Table 1. Currently there is only one RCT.

RCTs have many potential biases

RCTs help to make study groups more similar and can provide a higher level of evidence, however they are subject to many biases [9], and analysis of double-blind RCTs has identified extreme levels of bias [10]. For COVID-19, the overhead may delay treatment, dramatically compromising efficacy; they may encourage monotherapy for simplicity at the cost of efficacy which may rely on combined or synergistic effects; the participants that sign up may not reflect real world usage or the population that benefits most in terms of age, comorbidities, severity of illness, or other factors; standard of care may be compromised and unable to evolve quickly based on emerging research for new diseases; errors may be made in randomization and medication delivery; and investigators may have hidden agendas or vested interests influencing design, operation, analysis, reporting, and the potential for fraud. All of these biases have been observed with COVID-19 RCTs. There is no guarantee that a specific RCT provides a higher level of evidence.

Conflicts of interest for COVID-19 RCTs

RCTs are expensive and many RCTs are funded by pharmaceutical companies or interests closely aligned with pharmaceutical companies. For COVID-19, this creates an incentive to show efficacy for patented commercial products, and an incentive to show a lack of efficacy for inexpensive treatments. The bias is expected to be significant, for example *Als-Nielsen et al.* analyzed 370 RCTs from Cochrane reviews, showing that trials funded by for-profit organizations were 5 times more likely to recommend the experimental drug compared with those funded by nonprofit organizations. For COVID-19, some major philanthropic organizations are largely funded by investments with extreme conflicts of interest for and against specific COVID-19 interventions.

RCTs for novel acute diseases requiring rapid treatment

High quality RCTs for novel acute diseases are more challenging, with increased ethical issues due to the urgency of treatment, increased risk due to enrollment delays, and more difficult design with a rapidly evolving evidence base. For COVID-19, the most common site of initial infection is the upper respiratory tract. Immediate treatment is likely to be most successful and may prevent or slow progression to other parts of the body. For a non-prophylaxis RCT, it makes sense to provide treatment in advance and instruct patients to use it immediately on symptoms, just as some governments have done by providing medication kits in advance. Unfortunately, no RCTs have been done in this way. Every treatment RCT to date involves delayed treatment. Among the 172 treatments we have analyzed, 67% of RCTs involve very late treatment 5+ days after onset. No non-prophylaxis COVID-19 RCTs match the potential real-world use of early treatments. They may more accurately represent results for treatments that require visiting a medical facility, e.g., those requiring intravenous administration.

RCT bias for widely available treatments

RCTs have a bias against finding an effect for interventions that are widely available — patients that believe they need the intervention are more likely to decline participation and take the intervention. RCTs for sunlight are more likely to enroll low-risk participants that do not need treatment to recover, making the results less applicable to clinical practice. This bias is likely to be greater for widely known treatments, and may be greater when the risk of a serious outcome is overstated. This bias does not apply to the typical pharmaceutical trial of a new drug that is otherwise unavailable.

Observational studies have been shown to be reliable

Evidence shows that observational studies can also provide reliable results. *Concato et al.* found that well-designed observational studies do not systematically overestimate the magnitude of the effects of treatment compared to RCTs. *Anglemyer et al.* analyzed reviews comparing RCTs to observational studies and found little evidence for significant differences in effect estimates. We performed a similar analysis across the 172 treatments we cover, showing no significant difference in the results of RCTs compared to observational studies, RR 0.98 [0.92-1.05][15]. Similar results are found for all low-cost treatments, RR 1.00 [0.91-1.09]. High-cost treatments show a non-significant trend towards RCTs showing greater efficacy, RR 0.92 [0.84-1.02]. Details can be found in the supplementary data. *Lee et al.* showed that only 14% of the guidelines of the Infectious Diseases Society of America were based on RCTs. Evaluation of studies relies on an understanding of the study and potential biases. Limitations in an RCT can outweigh the benefits, for example excessive dosages, excessive treatment delays, or remote survey bias may have a greater effect on results. Ethical issues may also prevent running RCTs for known effective treatments. For more on issues with RCTs see[17,18].

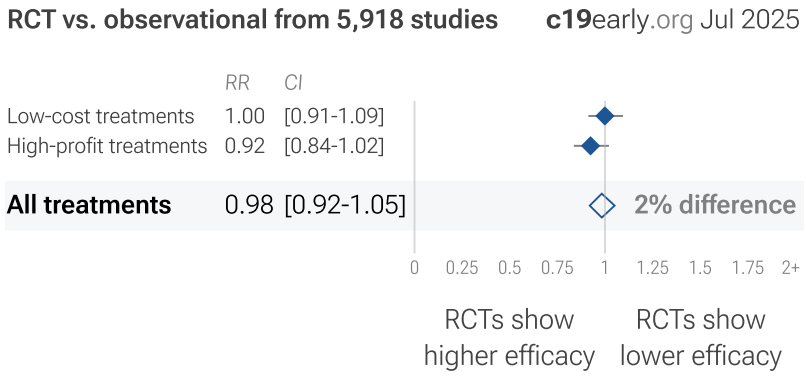


Figure 10. **For COVID-19, observational study results do not systematically differ from RCTs, RR 0.98 [0.92-1.05] across 172 treatments[12].**

Using all studies identifies efficacy 8+ months faster (9+ months for low-cost treatments)

Currently, 55 of the treatments we analyze show statistically significant efficacy or harm, defined as ≥10% decreased risk or >0% increased risk from ≥3 studies. Of these, 58% have been confirmed in RCTs, with a mean delay of 7.7 months (64% with 8.9 months delay for low-cost treatments). The remaining treatments either have no RCTs, or the point estimate is consistent.

Summary

We need to evaluate each trial on its own merits. RCTs for a given medication and disease may be more reliable, however they may also be less reliable. For off-patent medications, very high conflict of interest trials may be more likely to be RCTs, and more likely to be large trials that dominate meta analyses.

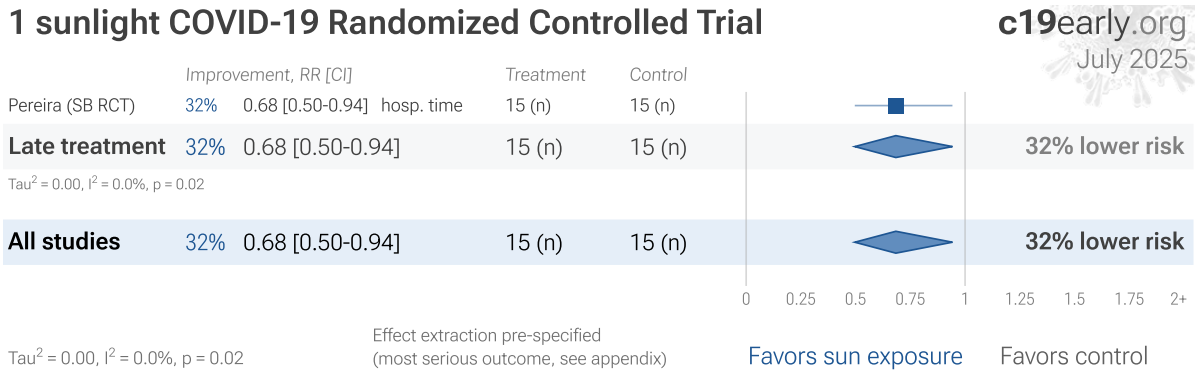


Figure 9. **Random effects meta-analysis for all Randomized Controlled Trials.** This plot shows pooled effects, see the specific outcome analyses for individual outcomes. Analysis validating pooled outcomes for COVID-19 can be found below. Effect extraction is pre-specified, using the most serious outcome reported. For details see the appendix.

Heterogeneity

Heterogeneity in COVID-19 studies arises from many factors including:

Patient demographics

Details of the patient population including age and comorbidities may critically affect how well a treatment works. For example, many COVID-19 studies with relatively young low-comorbidity patients show all patients recovering quickly with or without treatment. In such cases, there is little room for an effective treatment to improve results, for example as in *López-Medina et al.*

SARS-CoV-2 variants

Efficacy may depend critically on the distribution of SARS-CoV-2 variants encountered by patients. Risk varies significantly across variants [20], for example the Gamma variant shows significantly different characteristics [21-24]. Different mechanisms of action may be more or less effective depending on variants, for example the degree to which TMPRSS2 contributes to viral entry can differ across variants [25,26].

Other treatments

The use of other treatments may significantly affect outcomes, including supplements, other medications, or other interventions such as prone positioning. Treatments may be synergistic [27-43], therefore efficacy may depend strongly on combined treatments.

Effect measured

Across all studies there is a strong association between different outcomes, for example improved recovery is strongly associated with lower mortality. However, efficacy may differ depending on the effect measured, for example a treatment may be more effective against secondary complications and have minimal effect on viral clearance.

Meta analysis

The distribution of studies will alter the outcome of a meta analysis. Consider a simplified example where everything is equal except for the treatment delay, and effectiveness decreases to zero or below with increasing delay. If there are many studies using very late treatment, the outcome may be negative, even though early treatment is very effective. All meta analyses combine heterogeneous studies, varying in population, variants, and potentially all factors above, and therefore may obscure efficacy by including studies where treatment is less effective. Generally, we expect the estimated effect size from meta analysis to be less than that for the optimal case. Looking at all studies is valuable for providing an overview of all research, important to avoid cherry-picking, and informative when a positive result is

found despite combining less-optimal situations. However, the resulting estimate does not apply to specific cases such as early treatment in high-risk populations. While we present results for all studies, we also present treatment time and individual outcome analyses, which may be more informative for specific use cases.

Pooled Effects

Pooled effects are no longer required to show efficacy as of April 2022

This section validates the use of pooled effects for COVID-19, which enables earlier detection of efficacy, however pooled effects are no longer required for sunlight as of April 2022. Efficacy is now known based on specific outcomes. Efficacy based on specific outcomes was delayed by 3.8 months compared to using pooled outcomes.

Combining studies is required

For COVID-19, delay in clinical results translates into additional death and morbidity, as well as additional economic and societal damage. Combining the results of studies reporting different outcomes is required. There may be no mortality in a trial with low-risk patients, however a reduction in severity or improved viral clearance may translate into lower mortality in a high-risk population. Different studies may report lower severity, improved recovery, and lower mortality, and the significance may be very high when combining the results. *"The studies reported different outcomes"* is not a good reason for disregarding results. Pooling the results of studies reporting different outcomes allows us to use more of the available information. Logically we should, and do, use additional information when evaluating treatments—for example dose-response and treatment delay-response relationships provide additional evidence of efficacy that is considered when reviewing the evidence for a treatment.

Specific outcome and pooled analyses

We present both specific outcome and pooled analyses. In order to combine the results of studies reporting different outcomes we use the most serious outcome reported in each study, based on the thesis that improvement in the most serious outcome provides comparable measures of efficacy for a treatment. A critical advantage of this approach is simplicity and transparency. There are many other ways to combine evidence for different outcomes, along with additional evidence such as dose-response relationships, however these increase complexity.

Ethical and practical issues limit high-risk trials

Trials with high-risk patients may be restricted due to ethics for treatments that are known or expected to be effective, and they increase difficulty for recruiting. Using less severe outcomes as a proxy for more serious outcomes allows faster and safer collection of evidence.

Validating pooled outcome analysis for COVID-19

For many COVID-19 treatments, a reduction in mortality logically follows from a reduction in hospitalization, which follows from a reduction in symptomatic cases, which follows from a reduction in PCR positivity. We can directly test this for COVID-19.

Analysis of the the association between different outcomes across studies from all 172 treatments we cover confirms the validity of pooled outcome analysis for COVID-19. Figure 11 shows that lower hospitalization is very strongly associated with lower mortality ($p < 0.000000000001$). Similarly, Figure 12 shows that improved recovery is very strongly associated with lower mortality ($p < 0.000000000001$). Considering the extremes, *Singh et al.* show an association between viral clearance and hospitalization or death, with $p = 0.003$ after excluding one large outlier from a mutagenic treatment, and based on 44 RCTs including 52,384 patients. Figure 13 shows that improved viral clearance is strongly associated with fewer serious outcomes. The association is very similar to *Singh et al.*, with higher confidence due to the larger number of studies. As with *Singh et al.*, the confidence increases when excluding the outlier treatment, from $p = 0.000000082$ to $p = 0.0000000033$.

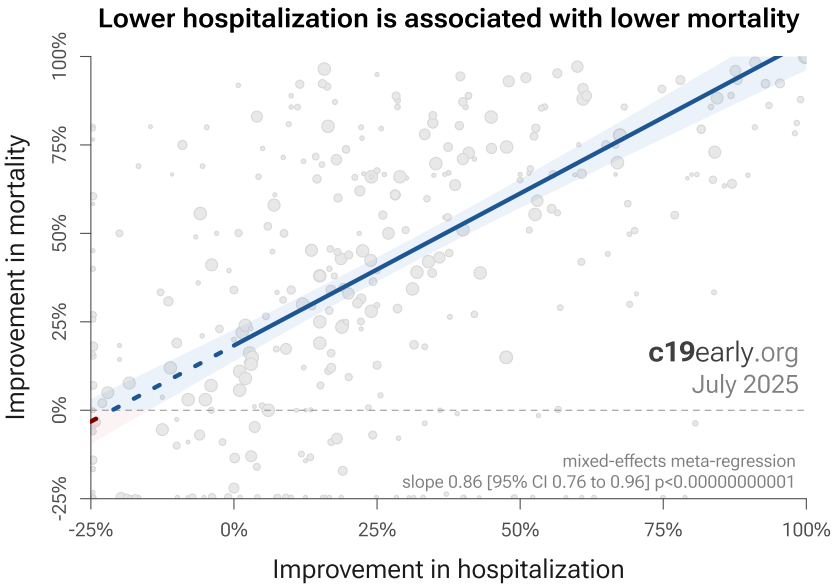


Figure 11. Lower hospitalization is associated with lower mortality, supporting pooled outcome analysis.

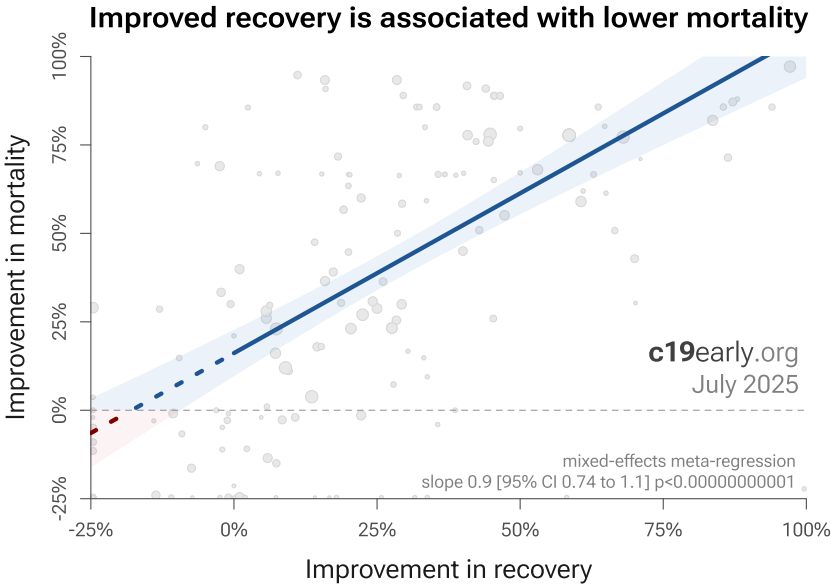


Figure 12. Improved recovery is associated with lower mortality, supporting pooled outcome analysis.

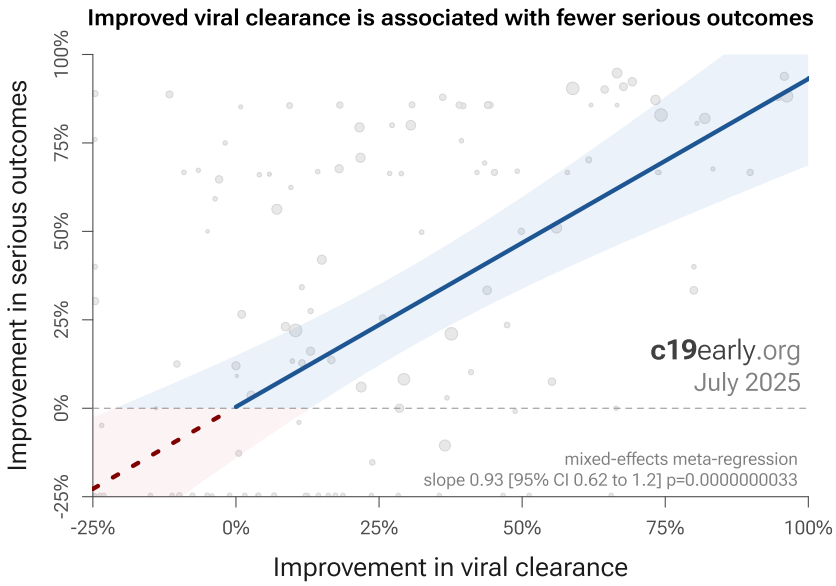


Figure 11. **Improved viral clearance is associated with fewer serious outcomes, supporting pooled outcome analysis.**

Pooled outcomes identify efficacy 5 months faster (7 months for RCTs)

Currently, 55 of the treatments we analyze show statistically significant efficacy or harm, defined as ≥10% decreased risk or >0% increased risk from ≥3 studies. 88% of these have been confirmed with one or more specific outcomes, with a mean delay of 4.9 months. When restricting to RCTs only, 57% of treatments showing statistically significant efficacy/harm with pooled effects have been confirmed with one or more specific outcomes, with a mean delay of 7.3 months. Figure 14 shows when treatments were found effective during the pandemic. Pooled outcomes often resulted in earlier detection of efficacy.

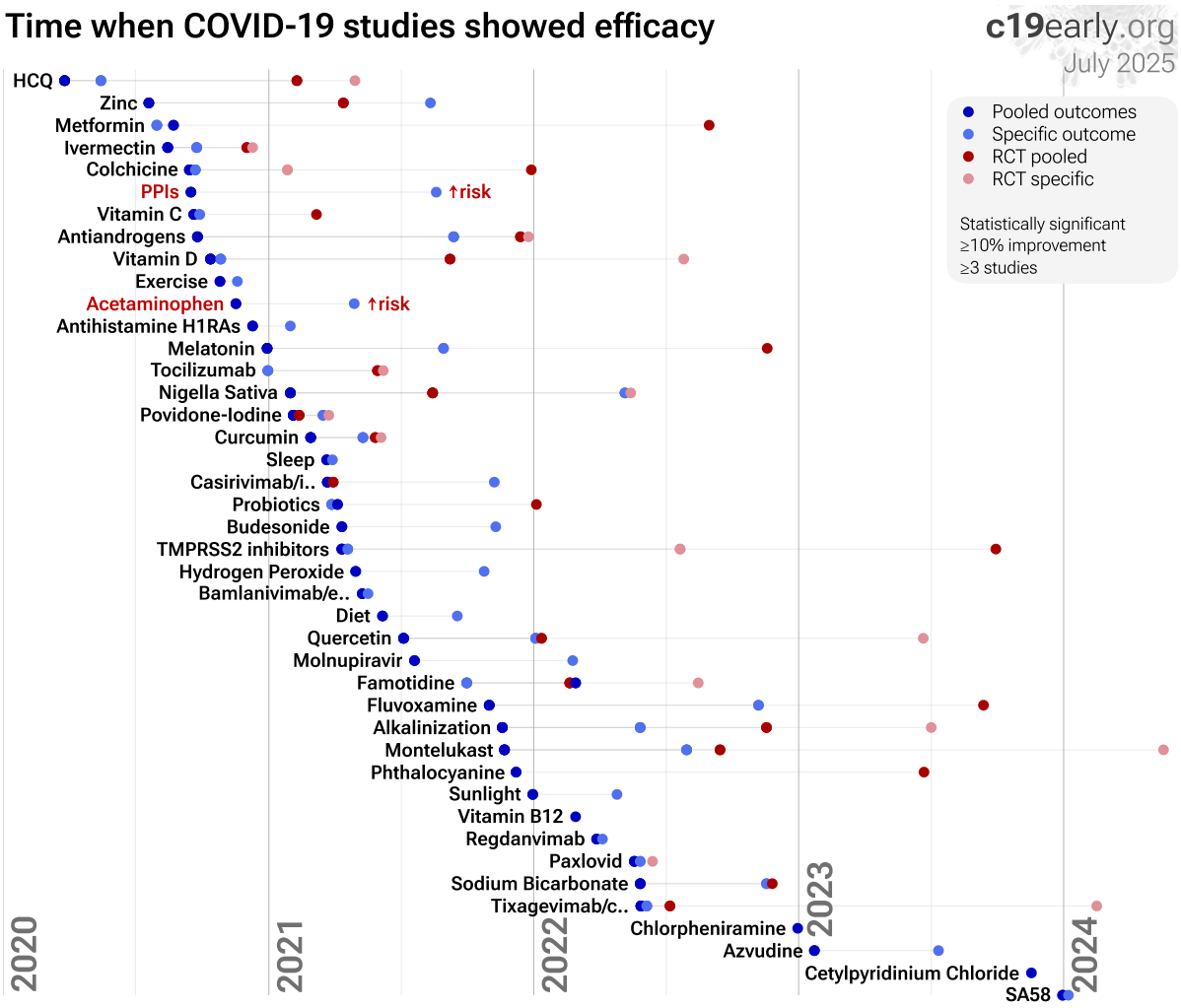


Figure 14. **The time when studies showed that treatments were effective, defined as statistically significant improvement of ≥10% from ≥3 studies.** Pooled results typically show efficacy earlier than specific outcome results. Results from all studies often shows efficacy much earlier than when restricting to RCTs. Results reflect conditions as used in trials to date, these depend on the population treated, treatment delay, and treatment regimen.

Limitations

Pooled analysis could hide efficacy, for example a treatment that is beneficial for late stage patients but has no effect on viral clearance may show no efficacy if most studies only examine viral clearance. In practice, it is rare for a non-antiviral treatment to report viral clearance and to not report clinical outcomes; and in practice other sources of heterogeneity such as difference in treatment delay is more likely to hide efficacy.

Summary

Analysis validates the use of pooled effects and shows significantly faster detection of efficacy on average. However, as with all meta analyses, it is important to review the different studies included. We also present individual outcome analyses, which may be more informative for specific use cases.

Discussion

Results for other infections

Efficacy with sunlight has also been shown for influenza [4-6].

Reviews

Multiple reviews cover sunlight for COVID-19, presenting additional background on mechanisms and related results, including [45-49].

Perspective

Results compared with other treatments

SARS-CoV-2 infection and replication involves a complex interplay of 100+ host and viral proteins and other factors [50-57], providing many therapeutic targets. Over 9,000 compounds have been predicted to reduce COVID-19 risk [58], either by directly minimizing infection or replication, by supporting immune system function, or by minimizing secondary complications. Sunlight increases nitric oxide and vitamin D, and helps regulate the circadian rhythm which is important for immune health and may increase melatonin production at night. Sunlight may also directly inactivate SARS-CoV-2 in the environment [3]. Figure 15 shows an overview of the results for sunlight in the context of multiple COVID-19 treatments, and Figure 16 shows a plot of efficacy vs. cost for COVID-19 treatments.

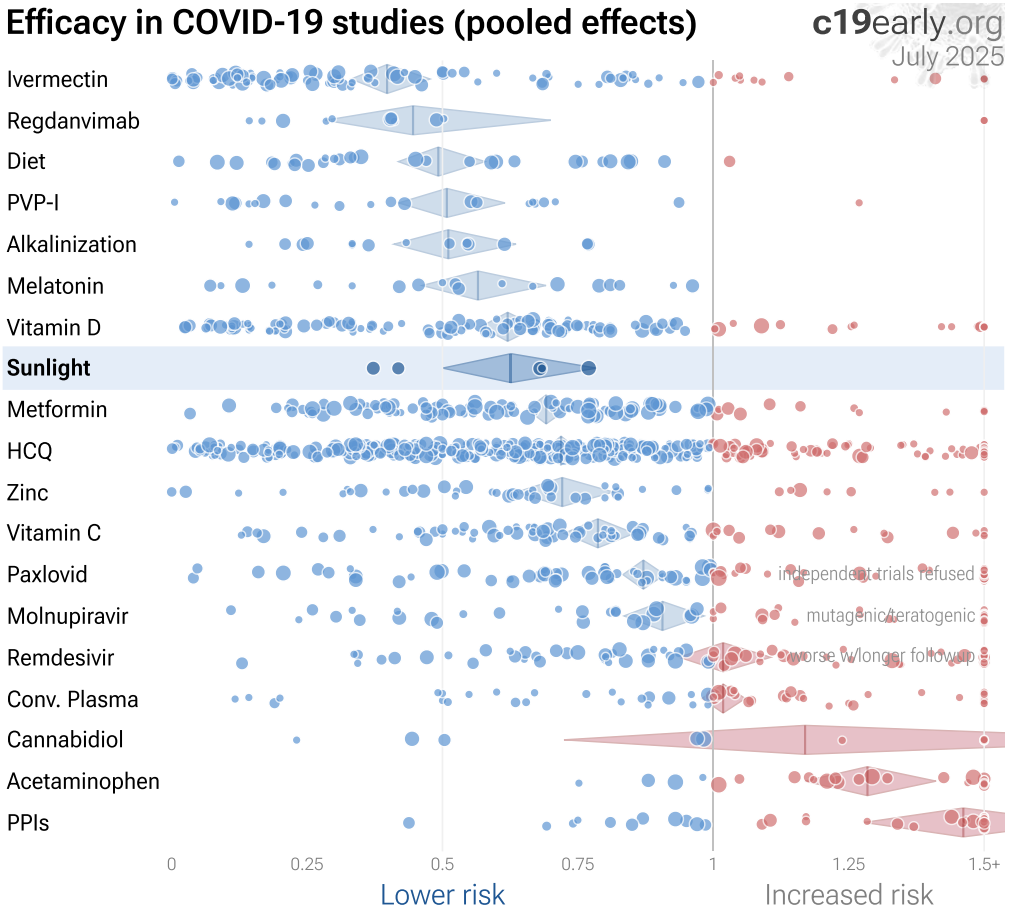


Figure 15. **Scatter plot showing results within the context of multiple COVID-19 treatments.** Diamonds shows the results of random effects meta-analysis. 0.6% of 9,000+ proposed treatments show efficacy [59].

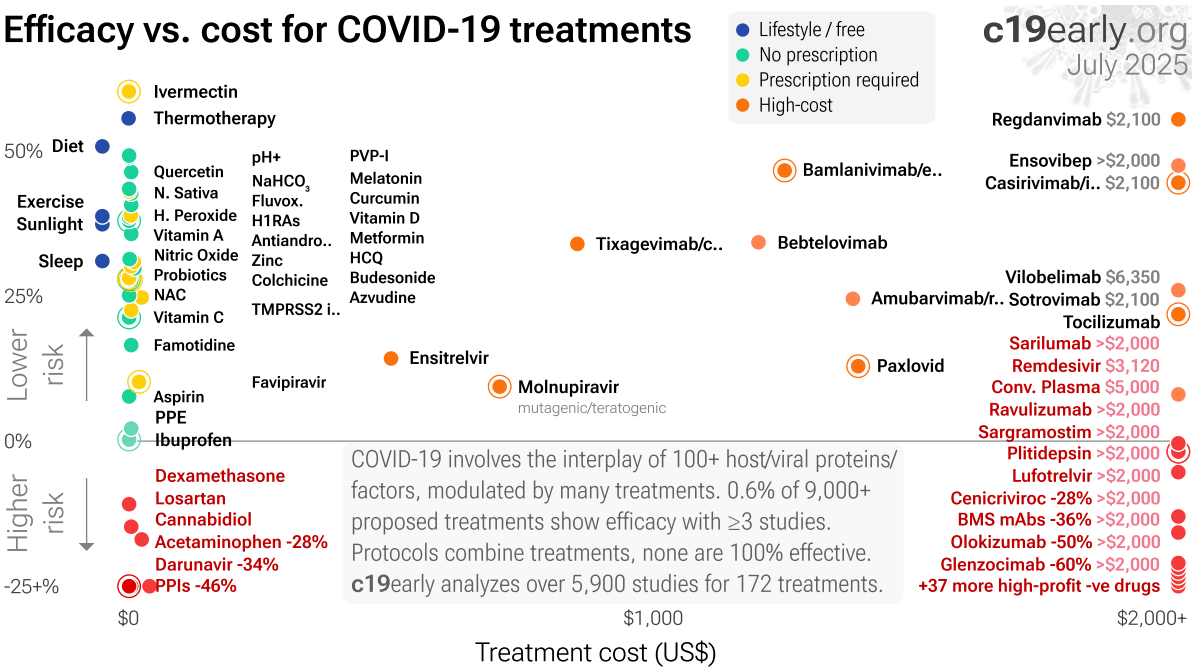


Figure 16. Efficacy vs. cost for COVID-19 treatments.

Conclusion

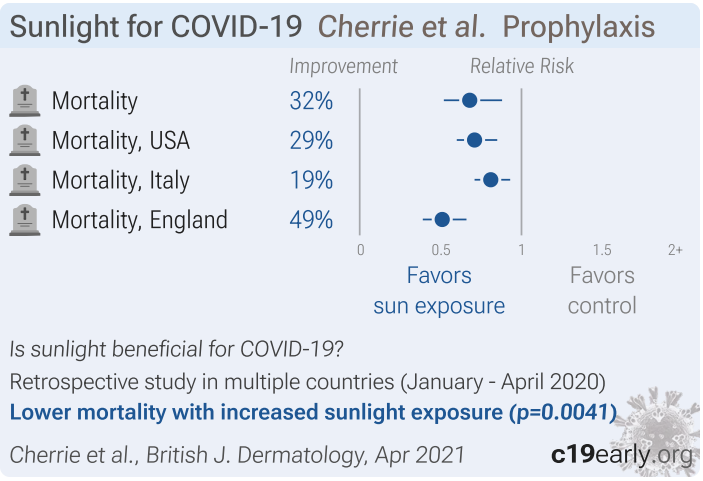
Sunlight increases nitric oxide and vitamin D, and helps regulate the circadian rhythm which is important for immune health and may increase melatonin production at night. Sunlight may also directly inactivate SARS-CoV-2 in the environment[3].

Increased sun exposure reduces risk for COVID-19. Significantly lower risk is seen for mortality, hospitalization, recovery, and cases. 5 studies from 5 independent teams in 4 countries show significant benefit. Meta analysis using the most serious outcome reported shows 37% [22-50%] lower risk. Results are similar for Randomized Controlled Trials.

Efficacy with sunlight has also been shown for influenza[4-6].

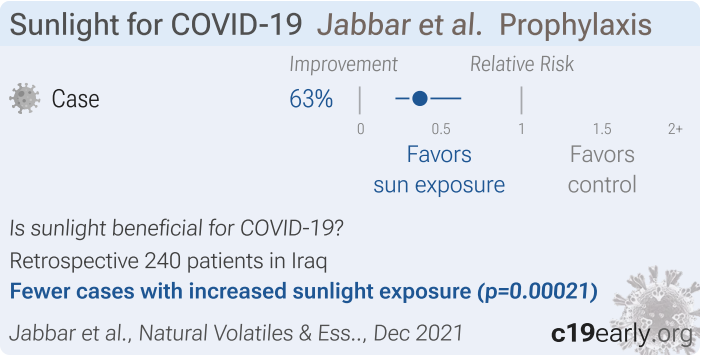
Study Notes

Cherrie



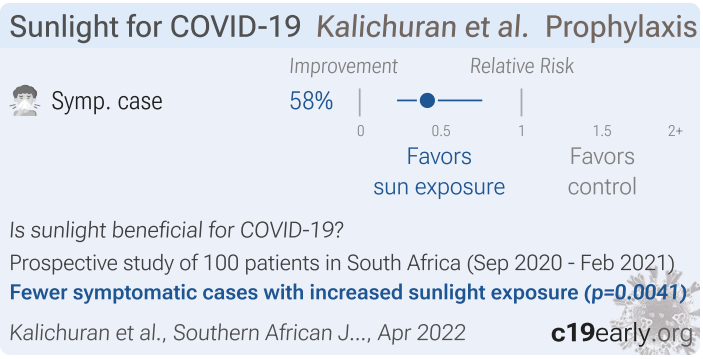
Analysis of UVA exposure and COVID-19 mortality in the USA, England, and Italy, showing increased UVA exposure associated with lower mortality.

Jabbar



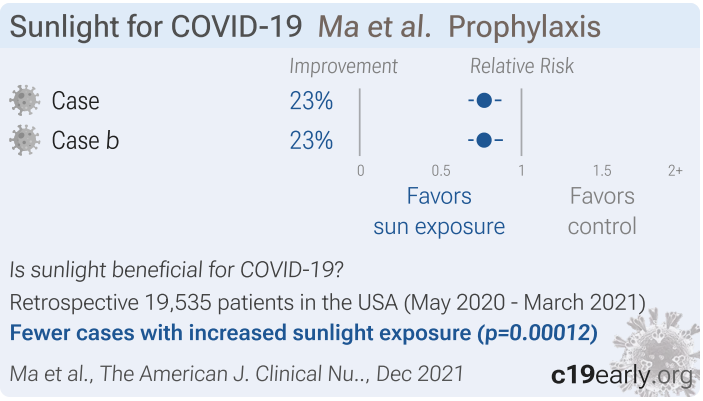
Analysis of 120 COVID-19 and 120 control patients in Iraq, showing lower risk of cases with regular sunlight exposure (3 times/week).

Kalichuran



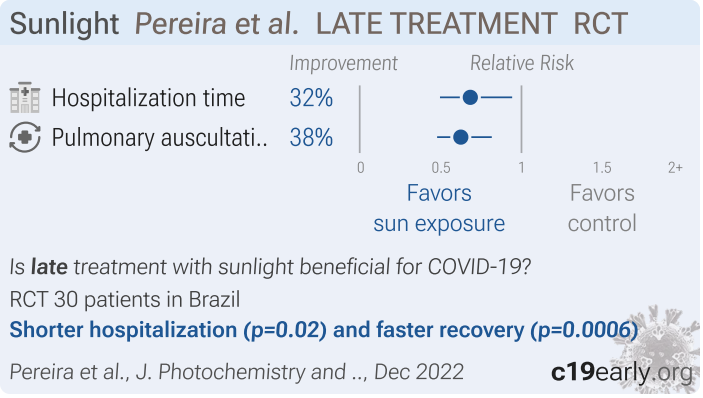
Prospective study of 100 COVID-19 patients in South Africa, 50 with COVID-19 pneumonia and 50 asymptomatic, showing higher risk of symptomatic COVID-19 with lower exposure to sunlight, and with vitamin D deficiency. Sunlight exposure may be correlated with physical activity and may have additional benefits independent of vitamin D [60].

Ma



Analysis of 39,915 patients with 1,768 COVID+ cases based on surveys in the Nurses' Health Study II, showing higher UVA/UVB exposure associated with lower risk of COVID-19 cases.

Pereira



RCT 30 hospitalized COVID-19 patients investigating the effectiveness of photobiomodulation (PBM) using a vest with near-infrared LEDs (simulating part of the sunlight spectrum). The treatment group showed shorter hospitalization, significant improvement in cardiopulmonary function, and improvements in leukocyte, neutrophil, and lymphocyte counts post-treatment. The treatment group had higher pneumonia severity at baseline.

For more discussion see[61].

Appendix 1. Methods and Data

We perform ongoing searches of PubMed, medRxiv, Europe PMC, ClinicalTrials.gov, The Cochrane Library, Google Scholar, Research Square, ScienceDirect, Oxford University Press, the reference lists of other studies and meta-analyses, and submissions to the site c19early.org. Search terms are sunlight and COVID-19 or SARS-CoV-2. Automated searches are performed twice daily, with all matches reviewed for inclusion. All studies regarding the use of sunlight for COVID-19 that report a comparison with a control group are included in the main analysis. Studies with major unexplained data issues, for example major outcome data that is impossible to be correct with no response from the authors, are excluded. This is a living analysis and is updated regularly.

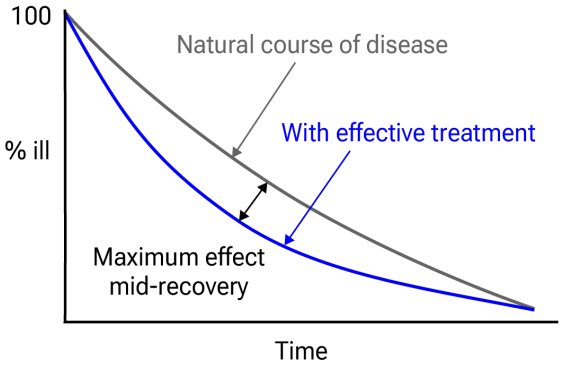


Figure 17. **Mid-recovery results can more accurately reflect efficacy when almost all patients recover.** *Mateja et al.* **confirm that intermediate viral load results more accurately reflect hospitalization/death.**

We extracted effect sizes and associated data from all studies. If studies report multiple kinds of effects then the most serious outcome is used in pooled analysis, while other outcomes are included in the outcome specific analyses. For example, if effects for mortality and cases are reported then they are both used in specific outcome analyses, while mortality is used for pooled analysis. If symptomatic results are reported at multiple times, we use the latest time, for example if mortality results are provided at 14 days and 28 days, the results at 28 days have preference. Mortality alone is preferred over combined outcomes. Outcomes with zero events in both arms are not used, the next most serious outcome with one or more events is used. For example, in low-risk populations with no mortality, a reduction in mortality with treatment is not possible, however a reduction in hospitalization, for example, is still valuable. Clinical outcomes are considered more important than viral outcomes. When basically all patients recover in both treatment and control groups, preference for viral clearance and recovery is given to results mid-recovery where available. After most or all patients have recovered there is little or no room for an effective treatment to do better, however faster recovery is valuable. An IPD meta-analysis confirms that intermediate viral load reduction is more closely associated with hospitalization/death than later viral load reduction[62]. If only individual symptom data is available, the most serious symptom has priority, for example difficulty breathing or low SpO_2 is more important than cough. When results provide an odds ratio, we compute the relative risk when possible, or convert to a relative risk according to *Zhang et*

al. Reported confidence intervals and *p*-values are used when available, and adjusted values are used when provided. If multiple types of adjustments are reported propensity score matching and multivariable regression has preference over propensity score matching or weighting, which has preference over multivariable regression. Adjusted results have preference over unadjusted results for a more serious outcome when the adjustments significantly alter results. When needed, conversion between reported *p*-values and confidence intervals followed *Altman, Altman (B)*, and Fisher's exact test was used to calculate *p*-values for event data. If continuity correction for zero values is required, we use the reciprocal of the opposite arm with the sum of the correction factors equal to 1 [66]. Results are expressed with RR < 1.0 favoring treatment, and using the risk of a negative outcome when applicable (for example, the risk of death rather than the risk of survival). If studies only report relative continuous values such as relative times, the ratio of the time for the treatment group versus the time for the control group is used. Calculations are done in Python (3.13.5) with scipy (1.16.0), pythonmeta (1.26), numpy (2.3.1), statsmodels (0.14.4), and plotly (6.2.0).

Forest plots are computed using PythonMeta [67] with the DerSimonian and Laird random effects model (the fixed effect assumption is not plausible in this case) and inverse variance weighting. Results are presented with 95% confidence intervals. Heterogeneity among studies was assessed using the I^2 statistic. Mixed-effects meta-regression results are computed with R (4.4.0) using the metafor (4.6-0) and rms (6.8-0) packages, and using the most serious sufficiently powered outcome. For all statistical tests, a *p*-value less than 0.05 was considered statistically significant. Grobid 0.8.2 is used to parse PDF documents.

We have classified studies as early treatment if most patients are not already at a severe stage at the time of treatment (for example based on oxygen status or lung involvement), and treatment started within 5 days of the onset of symptoms. If studies contain a mix of early treatment and late treatment patients, we consider the treatment time of patients contributing most to the events (for example, consider a study where most patients are treated early but late treatment patients are included, and all mortality events were observed with late treatment patients). We note that a shorter time may be preferable. Antivirals are typically only considered effective when used within a shorter timeframe, for example 0-36 or 0-48 hours for oseltamivir, with longer delays not being effective [68,69].

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A summary of study results is below. Please submit updates and corrections at https://c19early.org/sunmeta.html.

Late treatment

Effect extraction follows pre-specified rules as detailed above and gives priority to more serious outcomes. For pooled analyses, the first (most serious) outcome is used, which may differ from the effect a paper focuses on. Other outcomes are used in outcome specific analyses.

Pereira, 12/5/2022, Single Blind Randomized Controlled Trial, placebo-controlled, Brazil, peer-reviewed, 5 authors.	hospitalization time, 31.6% lower, relative time 0.68, $p = 0.02$, higher sunlight exposure 15, lower sunlight exposure 15.
	pulmonary auscultation improvement time, 37.5% lower, relative time 0.62, $p < 0.001$, higher sunlight exposure 15, lower sunlight exposure 15.

Prophylaxis

Effect extraction follows pre-specified rules as detailed above and gives priority to more serious outcomes. For pooled analyses, the first (most serious) outcome is used, which may differ from the effect a paper focuses on. Other outcomes are used in outcome specific analyses.

Cherrie, 4/8/2021, retrospective, multiple countries, peer-reviewed, 7 authors, study period 22 January, 2020 - 30 April, 2020, per 100kJ m–2 increase.	risk of death, 32.0% lower, RR 0.68, $p = 0.004$, USA, England, Italy combined.
	risk of death, 29.0% lower, RR 0.71, $p < 0.001$, USA.

	risk of death, 19.0% lower, RR 0.81, p = 0.002, Italy.
	risk of death, 49.0% lower, RR 0.51, p < 0.001, England.
Jabbar, 12/31/2021, retrospective, Iraq, peer-reviewed, 4 authors.	risk of case, 62.8% lower, OR 0.37, p < 0.001, higher sunlight exposure 43 of 120 (35.8%) cases, 72 of 120 (60.0%) controls, NNT 4.1, case control OR.
Kalichuran, 4/26/2022, prospective, South Africa, peer-reviewed, survey, 4 authors, study period September 2020 - February 2021.	risk of symptomatic case, 58.2% lower, RR 0.42, p = 0.004, higher sunlight exposure 21, lower sunlight exposure 79, inverted to make RR<1 favor higher sunlight exposure, higher sunlight exposure vs. lower sunlight exposure.
Ma, 12/3/2021, retrospective, USA, peer-reviewed, 16 authors, study period May 2020 - March 2021.	risk of case, 23.0% lower, RR 0.77, p < 0.001, higher sunlight exposure 411 of 10,393 (4.0%), lower sunlight exposure 495 of 9,142 (5.4%), NNT 68, adjusted per study, odds ratio converted to relative risk, UVB, highest quartile vs. lowest quartile, model 3, table 3, multivariable.
	risk of case, 23.1% lower, RR 0.77, p < 0.001, higher sunlight exposure 325 of 9,325 (3.5%), lower sunlight exposure 436 of 9,079 (4.8%), NNT 76, adjusted per study, odds ratio converted to relative risk, UVA, highest quartile vs. lowest quartile, model 3, table 3, multivariable.

Supplementary Data

Supplementary Data

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