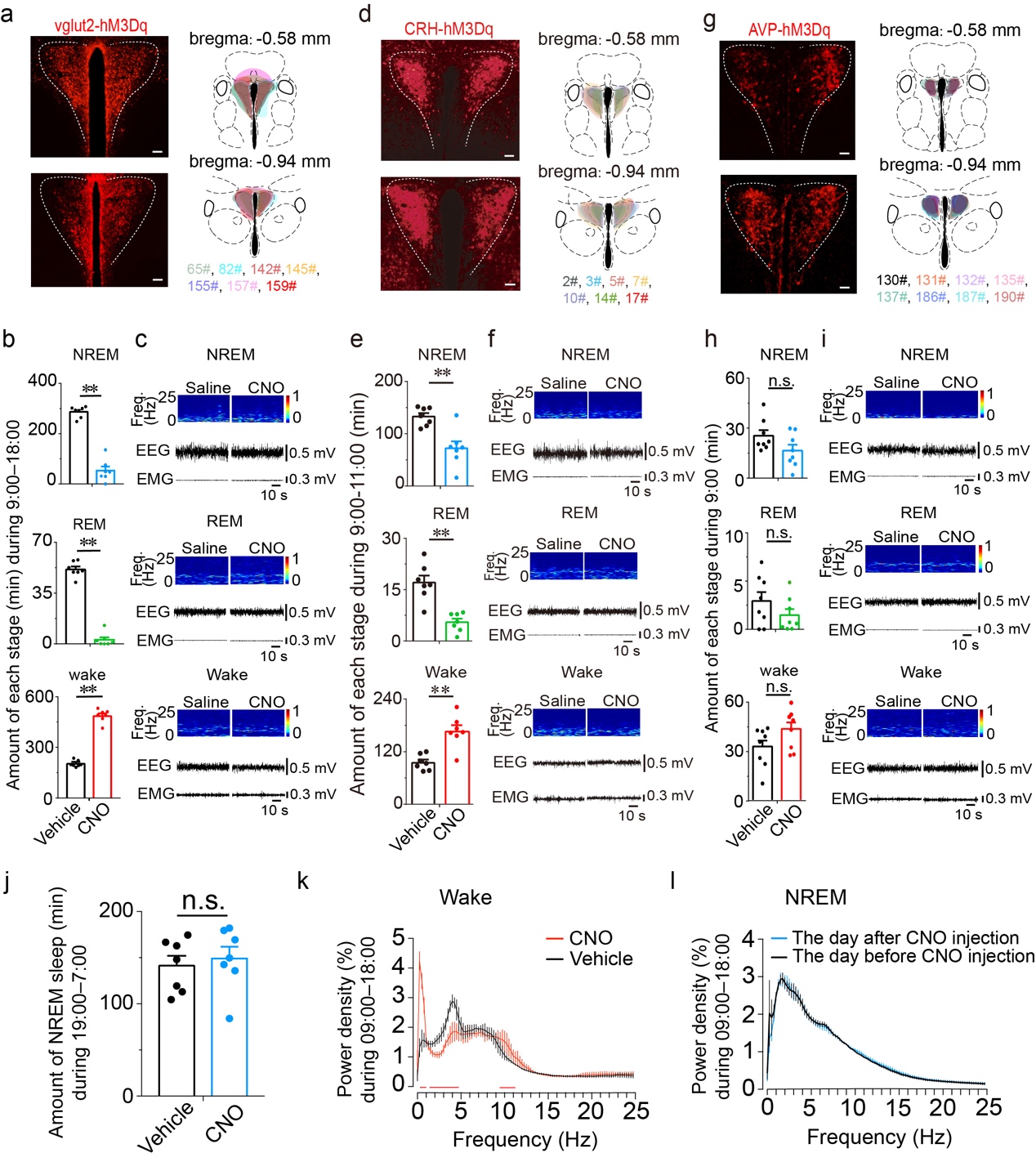
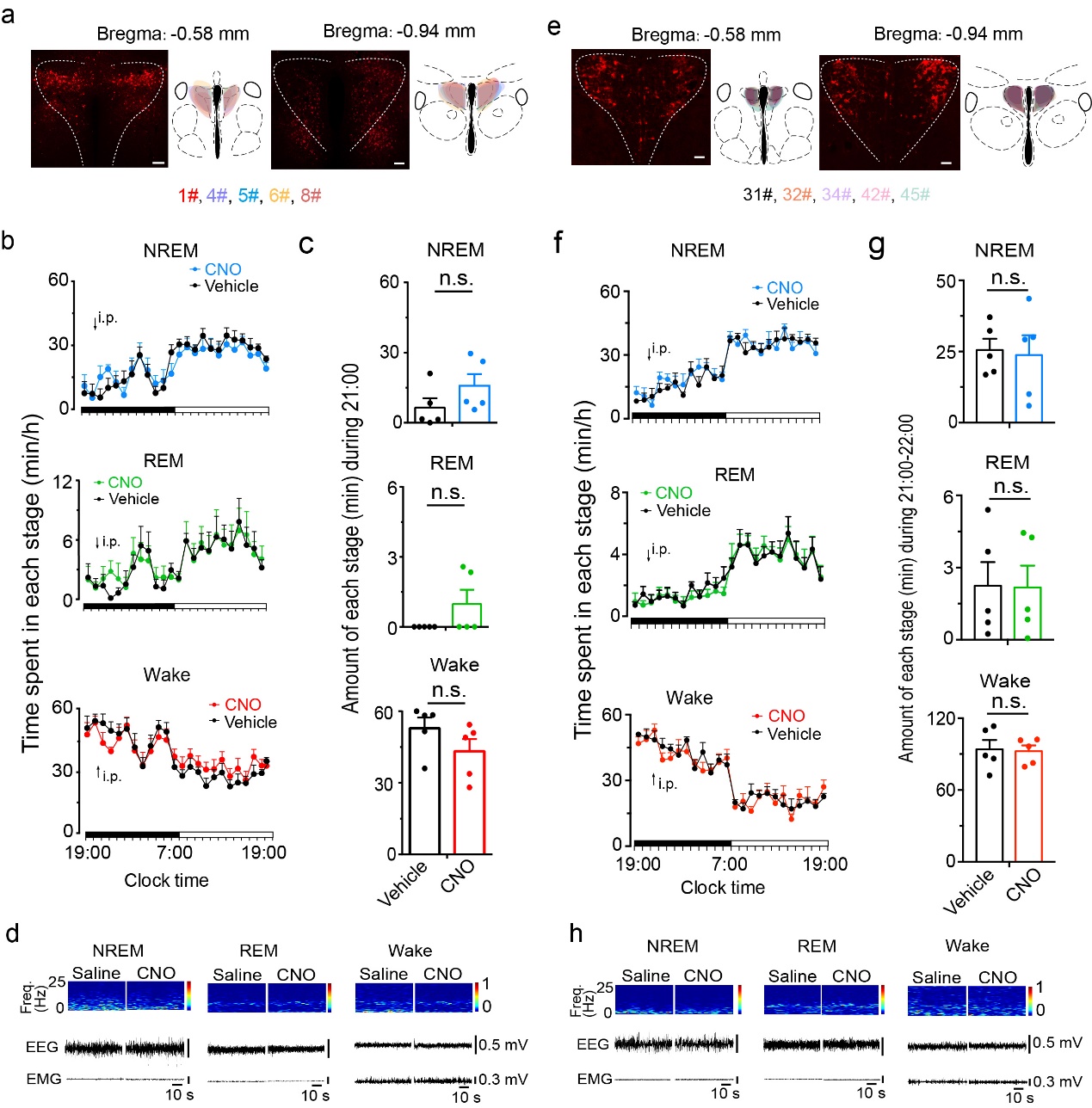
**Supplemental Information**

** Supplementary Fig 1.** **Chemogenetic activation of PVHvglut2,** **PVHCRH neurons rather than PVHAVP neurons during the light phase increases wakefulness (related to Fig 3). a, d** and **g** Location of hM3Dq expression in the PVHvglut2, PVHCRH and PVHAVP neurons. **b** Total time spent in each stage after vehicle or CNO injection to Vglut2-IRES-cre mice (**b**, n = 7, paired t test; *P* < 0.001 [wake], *P* < 0.001 [NREM], *P* < 0.001 [REM]), CRH-IRES-cre mice (n = 7, paired t test, *P* < 0.01 [wake], *P* < 0.01 [NREM], *P* < 0.01 [REM]), to AVP-IRES-cre mice (n = 8, paired t test; *P* = 0.09 [wake], 0.09 [NREM], 0.21 [REM]). Data represent the mean ± SEM (\**P* < 0.05, \*\**P* < 0.01, n.s. means no significant difference). **c, f** and **i** Representative EEG power spectra and EEG-EMG traces of wakefulness, NREM and REM sleep after injection in Vglut2-Cre mouse (**c**), CRH-Cre mouse (**f**) and AVP-Cre mouse (**i**). **j** Total time spent in NREM sleep during the dark period after vehicle or CNO injection (n = 7, *P* > 0.05, paired t test). **k** EEG power density of wakefulness during 9 h after vehicle or CNO injection (n = 5; *P* < 0.05, paired t test). **l** EEG power density of NREM sleep during the day (7:00–18:00) before/after the day of CNO injection (n = 5, *P* > 0.05, paired t test). Data represent the mean ± SEM (\**P* < 0.05, \*\**P* < 0.01, n.s. means no significant difference).



**Supplementary Fig 2. Chemogenetic activation of PVHvglut2 neurons during the dark phase increases wakefulness. a-c** Time course of wakefulness, NREM sleep, and REM sleep following injection of vehicle or CNO in mice expressing hM3Dq receptor in PVHvglut2 neurons (n = 4, repeated-measures ANOVA; F1, 6= 0.83 [wake], 0.51 [NREM], 0.91 [REM]; *P* = 0. 40 [wake], 0.50 [NREM], 0.38 [REM]). **d-f** Total time spent in each stage for 12 h after vehicle or CNO injection (n = 4, paired t test; *P* = 0.02 [wake], 0.01 [NREM], 0.26 [REM]). Data represent the mean ± SEM (\**P* < 0.05, \*\**P* < 0.01, n.s. means no significant difference).

****

**Supplementary Fig 3.** **Chemogenetic inhibition of PVHCRH or PVHAVP neurons during the dark phase has no effect on sleep and wakefulness. a, e** Location of hM4Di expression in the PVHCRH and PVHAVP neurons. **b, f** Time course of wakefulness, NREM sleep, and REM sleep following injection of vehicle or CNO in mice expressing hM3Dq receptor in PVHCRH neurons (**b**, n= 5, repeated-measures ANOVA, F1,8= 0.279 [wake], 0.861 [NREM], 0.36 [REM]; *P* = 0.52 [wake], 0.39 [NREM], 0.87 [REM]) and PVHAVP neurons (**f**, n = 5, repeated-measures ANOVA; F1,8= 0.279 [wake], 0.190 [NREM], 0.57 [REM]; *P* = 0.61 [wake], 0.68 [NREM], 0.87 [REM]). **c**, **g** Total time spent in each stage after vehicle or CNO injection to CRH-IRES-cre mice (n = 5, paired t test, *P* = 0.19 [wake], *P* = 0.36 [NREM], *P* = 0.14 [REM]), AVP-IRES-cre mice (n = 5, paired t test, *P* = 0.19 [wake], *P* = 0.36 [NREM], *P* = 0.14 [REM]). **d, h** Representative EEG power spectra and EEG-EMG traces of wakefulness, NREM and REM sleep after injection in CRH-Cre mouse (**d**) and AVP-Cre mouse (**h**). Data represent the mean ± SEM (\**P* < 0.05, \*\**P* < 0.01, n.s. means no significant difference).

**Supplementary Fig 4. Model of the PVH control of wakefulness.** Left: Increased levels of PVHvglut2 neurons projecting to the PB and the LSv, thereby activating PB and LSv neurons to control wakefulness. Top right: Decreased activity of PVHvglut2 neurons leads to sleep. Bottom right: The impairment of PVH neurons in neurological diseases may be associated with hypersomnolence.