Quantum effects in cold-atom breathers\footnote{This research was supported by NSF and BSF} VLADIMIR YUROVSKY, Tel Aviv Univ., MAXIM OLSHANII, UMass Boston, BORIS MELAMED, Tel Aviv Univ. — The one-dimensional (1D) Gross-Pitaevskii equation (GPE) has exact oscillatory solutions — breathers — predicted by the inverse scattering transform. In the mean-field approximation, they are formed from bright solitons by four-fold quench of the attractive interaction strength. Here, we address quantum counterparts of the breather states, applying the same quench to the Lieb-Liniger-McGuire model (the quantum version of the 1D GPE). Using exact Bethe-ansatz solutions for up to $N = 20$ atoms, we find that the quench leads to formation of all multi-soliton (multi-string) states, possible for $N = 20$, while two-soliton pairs dominate. The calculated fidelity exhibits a damped oscillatory dynamics. One of the decay mechanisms — dephasing due to non-equidistant energy spectrum of the two-soliton states — is expected to be suppressed at large $N$. In addition, the dephasing due to the solitons’ kinetic energy spread leads to decay of the fidelity oscillation amplitude by half in the course of $\sim 2.5$ classical soliton periods for $4 \leq N \leq 20$. The results suggest a possibility of observation of macroscopic quantum effects.