

Labor Progression Phenotypes Identified by Unsupervised Machine Learning

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OBJECTIVE

To determine whether physiologic labor comprises distinct labor-progression phenotypes rather than a single population trajectory by applying unsupervised machine learning to cervical dilation data.



METHODS

- Retrospective cohort study
- Labor trajectories (4–10 cm) clustered using unsupervised k-means based solely on cervical dilation progression, without incorporating clinical outcomes
- Compared with contemporary Zhang nulliparous reference curve (P0)



STUDY POPULATION

Nulliparous women with singleton, term, vertex pregnancies and spontaneous labor from two tertiary hospitals (2015–2024).

12,998
women

FIGURE. MEDIAN CERVICAL DILATION TRAJECTORIES

Median cervical dilation (cm) from 4 cm to each subsequent dilation over time (hours)

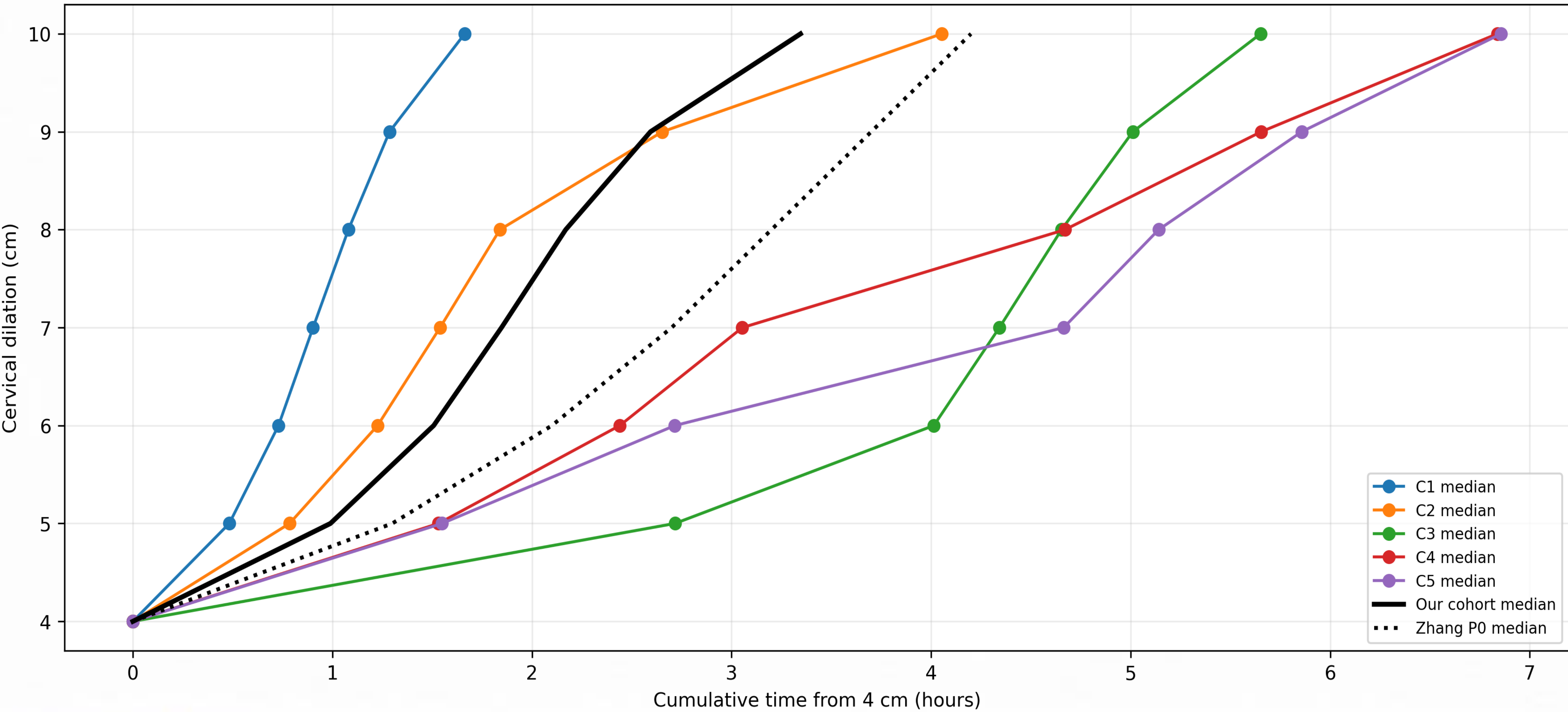


FIGURE LEGEND: Cumulative median cervical dilation (cm) from 4 cm to each subsequent dilation over time (hours). Colored lines show the five clusters identified by unsupervised k-means clustering based solely on dilation trajectories. The solid black line is the overall cohort median and the dashed black line is the contemporary Zhang nulliparous reference (P0). Numbers in legend indicate median total duration from 4–10 cm and the proportion of women in each cluster.



C1 FAST

Consistently fast progression throughout labor



C2 EARLY SLOWING, LATER ACCELERATION

Slower in early latent phase, faster in active phase



C3 TRANSITION DELAY

Delayed progress at 4–5 and 5–6 cm, catching up later



C4 MID-ACTIVE PHASE SLOWING

Slower during the mid-active phase (6–8 cm)



C5 LATE PROLONGED PROGRESSION

Prolonged in the last part of active phase (8–10 cm)

TAKE-HOME MESSAGE:

Physiologic labor appears to be inherently heterogeneous, with multiple distinct and reproducible progression patterns that may all represent normal labor.



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