Group	**PreCry - Cry (*ΔC*)**	**Cry - Recovery (*ΔR*)**	**PreCry –Recovery (*ΔO*)**
Preterm	2,20442E-05	0,377462	0,000175
Full-Term	3,19572E-13	6,31E-11	0,014014

Table 1: Statistical significance (p-values) of the differences in oxygenation levels

approximately in the middle of the crying episode. A last reference value (*R*), related to the capability of the patient to recover the baseline oxygenation level, has been obtained by averaging the oxygenation level measured during 90s from the end of the cry episode.

Data have been analyzed in order to compare the oxygen saturation in basal condition (before the crying episode), in case of stress (during the episode), and the recovery capability of the newborn (90s after the episode). Comparison has been carried out, given the high differences in the absolute oxygenation levels, by comparing, on each episode, the variation of the oxygenation during and after the cry episode with the saturation before the episode:

$$\Delta C = C - B$$

$$\Delta O = R - B$$

We also evaluated the recovery of the oxygenation occurred during the recovery time:

$$\Delta R = R - C$$

The selected parameters have been evaluated separately on all episodes related to full term newborns and to preterm ones, and t-test has been applied to assess their statistical significance.

III. Results

The analysis has been carried out on a group of 20 preterm and/or low weight infants and 28 full term infants, having a pregnancy period ranging from 23 to 42 weeks and a weight at birth between 590g and 4250g, selected by physicians among patients at the Critical Care Unit of the Children Hospital A.Meyer, in Firenze, Italy and Nuovo Ospedale S.Giovanni di Dio, Scandicci, Firenze, Italy.

Full term newborns have been recorded a day after birth, while preterm newborns could be recorded only 20-30 days after birth, due to their long staying in the incubator.

Fig. 3 reports a sample extracted from the data set. In the upper part of the figure, the NIRS track is shown, while the bottom part of the figure shows the audio track acquired in the same period of time. The behavior shown in the figure is typical of full term newborns: during the cry episode, there is a clear decrease in the saturation level, which is promptly recovered when the crying episode is over.

We obtained about 150 cry episodes, which were analyzed by evaluating the difference between the values before, during, and after the cry episode using a paired t-test analysis. Results, summarized in Table 1, indicate there is a highly significant ($p<<0.01$) difference in the oxygenation level before and during the cry episode, both in the full term and in the preterm groups. A different behavior can be noticed comparing the values measured during the cry episode and the values after the recovery time: in the full term group, the t-test indicates the presence of a highly significant difference, while in the preterm group the increase is less pronounced, and is not statistically significant. The same result is confirmed by the comparison of the saturation measured before the cry episode and after the recovery time. This difference is highly significant in the preterm group, indicating that the oxygenation after recovery is noticeably lower than before the crying episode, while in the full term group the difference is only marginally significant ($0.01 < p < 0.05$), suggesting that oxygenation has been recovered, although not completely.

IV. Conclusion

The results of the experiments indicate that, both in the full term and in the preterm infants, a significant decrease of the oxygenation occurs during a cry episode. However, the two groups behave differently during the recovery time after the crying episode. Full term infants can recover almost completely the oxygenation level~~s~~ before cry in less the 90s, while preterm infants need a longer period of time to achieve a full recovery of the oxygenation level.

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Emotional voice

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