

K23 The Evaluation of Direct and Indirect Biomarkers of Ethanol Consumption: A Likelihood Ratio (LR) Approach to Identify Chronic Alcohol Misusers for Forensic Purposes

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After attending this presentation, attendees will understand how to interpret and evaluate the values of direct biomarkers of ethanol consumption to be detected in hair and keratin matrix for forensic purposes.

This presentation will impact the forensic science community by informing attendees that the LR models proved to be capable of significantly discriminating non-chronic from chronic alcohol consumers.

The determination of direct ethanol metabolites, such as Ethyl Glucuronide (EtG) and Fatty Acid Ethyl Esters (FAEEs), to be quantified in keratin matrix samples is indicated as the gold-standard approach to efficiently identify chronic alcohol drinkers.^{1,2} Even if cut-off values have been established by the Society of Hair Testing (SoHT) to interpret EtG and FAEEs results, it has been documented that several confounding factors may alter the correlation between alcohol consumption and biomarkers' concentration in hair (e.g., cosmetic treatments).³ As a consequence, the adoption of the traditional univariate interpretative approaches seems not to be the best option, as it may lead forensic experts and physicians to infer misleading conclusions, thus triggering the possibility of employing alternative multivariate data interpretation approaches.

Due to the fact that the LR models overcome the drawbacks of the traditional univariate approaches, as no cut-off values are involved during the process of evidence evaluation, several LR models have been developed and tested.⁴ In the practice, LR values reveal the support to be delivered to the evaluated propositions and LR results can be expressed by means of verbal scales. An LR approach evaluates the Evidence (E) in case of two different, and mutually exclusive, hypotheses by examining the collected data. In the present case, the first hypothesis (H1) is that the individual under examination is a non-chronic alcohol consumer. Otherwise, the second hypothesis (H2) states that the examined subject is a chronic alcohol misuser. At the current stage, the collected data consists of direct (FAEEs, EtG) biomarkers of alcohol consumption from more than 150 scalp hair samples of different individuals, representing both chronic and non-chronic alcohol drinkers target categories. Different multivariate LR models have been evaluated and their ability to discriminate chronic alcohol misusers from non-chronic alcohol consumers were examined. The performance of each model was evaluated in terms of rates of correct classification (%) and empirical cross-entropy parameters. Since satisfactory reduction of information loss have been observed, together with correct classification rates close to 100%, LR validated models proved to be capable of discriminating non-chronic from chronic alcohol consumers. Similar results have been observed when employing further multivariate data analysis strategies such as Partial Least Squares Discriminant Analysis (PLSDA).⁵

Reference(s):

1. Pragst F., Yegles M. Determination of Fatty Acid Ethyl Esters (FAEE) and Ethyl Glucuronide (EtG) in Hair: A Promising Way for Retrospective Detection of Alcohol Abuse during Pregnancy. *Ther Drug Monit.* 2008;30(2):255-63.
2. Pirro V., Di Corcia D., Seganti F., Salomone A., Vincenti M. Determination of Ethyl Glucuronide Levels in Hair for the Assessment of Alcohol Abstinence. *Forensic Sci Int.* 2013;232(1-3):229-36.
3. Salomone A., Baumgartner M.R., Lombardo T., Alladio E., Di Corcia D., Vincenti M. Effects of Various Sample Pretreatment Procedures on Ethyl Glucuronide Quantification in Hair Samples: Comparison of Positivity Rates and Appraisal of Cut-off Values. *Forensic Sci Int.* 2016;267:60-65.
4. Alladio E., Martyna A., Salomone A., Pirro V., Vincenti M., Zadora G. Evaluation of Direct and Indirect Ethanol Biomarkers Using a Likelihood Ratio Approach to Identify Chronic Alcohol Abusers for Forensic Purposes. *Forensic Sci Int.* 2017;271:13-22.
5. Alladio E., Martyna A., Salomone A., Pirro V., Vincenti M., Zadora G. Direct and Indirect Alcohol Biomarkers Data Collected in Hair Samples — Multivariate Data Analysis and Likelihood Ratio Interpretation Perspectives. *Data Brief.* 2017;12:1-8.

Chronic Alcohol Drinkers, Hair Samples, Likelihood Ratio