Hydrogen peroxide in exhaled air of healthy children: reference values


ABSTRACT: An increased content of hydrogen peroxide (H2O2), a marker of inflammation, has been described in the condensate of exhaled air from adults and children with inflammatory lung disorders, including asthma. However, the normal range of [H2O2] in the exhaled air condensate from healthy children has not been established. Therefore, the aim of this study was to determine the reference range of exhaled [H2O2] in healthy school-aged children.

Ninety-three healthy nonsmoking children (48 female and 45 male, mean age 10 yrs, range 8–13 yrs), with a negative history for allergy, eczema or respiratory disease and with a normal lung function, participated. Exhaled air condensate was examined fluorimetrically for the presence of H2O2. In addition, the reproducibility of [H2O2] within subjects and between days and the stability of [H2O2] during storage at -20°C were assessed.

The median [H2O2] in the exhaled air condensate of all children was 0.13 µM, with a 2.5–97.5% reference range of <0.01–0.48 µM. No significant difference existed between males and females. There was no correlation between exhaled [H2O2] and age or lung function. Repeated [H2O2] measurements on 2 consecutive days showed satisfactory within-subject reproducibility and [H2O2] in stored samples remained stable for at least 1 month at -20°C.

In conclusion, this study provides reference data for exhaled hydrogen peroxide in a large group of healthy children. The observed levels were lower than those reported previously for healthy adults and were independent of age, sex and lung function.

A noninvasive method to assess the presence and activity of airway inflammation would be valuable in the early diagnosis and monitoring of inflammatory airway diseases [1]. Exhaled air condensate can be collected with minimal risk and inconvenience and its content may reflect the composition of the lower airway fluids [2, 3]. Hydrogen per-oxide (H2O2) in the exhaled air condensate is a potential marker of airway inflammation [4–10]. The only two studies to suggest elevated levels of exhaled H2O2 in asthmatic children have used small numbers of healthy adults as controls [4, 10]. The aim of this study was, therefore, to establish reference values of [H2O2] in the exhaled air condensate of a large group of healthy school-aged children.

Patients and methods

One hundred and twenty-nine school children, pupils of a primary school, were interviewed with questionnaires on asthma, rhinitis and eczema, translated and validated from the core questionnaires of the International Study of Asthma and Allergy in Childhood (ISAAC). Of these children, 93 had negative questionnaires and were included in the study. Their mean age was 10 yrs (range 8–13 yrs) and 45 were male (table 1). All were term born, Caucasian lifelong nonsmokers, within the normal range for height, and used no medication. None of the subjects reported symptoms of acute respiratory infection within the previous month. Maximal expiratory flow-volume measurements were performed in all children (Vicatest P2A, Mijnhardt, The Netherlands); forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) were expressed as percentage predicted [11]. Condensate was collected while the children, wearing a noseclip, breathed quietly through a mouthpiece and a two-way nonrebreathing valve (Rudolph, The Netherlands). The median [H2O2] in the exhaled air condensate of all children was 0.13 µM, with a 2.5–97.5% reference range of <0.01–0.48 µM. No significant difference existed between males and females. There was no correlation between exhaled [H2O2] and age or lung function. Repeated [H2O2] measurements on 2 consecutive days showed satisfactory within-subject reproducibility and [H2O2] in stored samples remained stable for at least 1 month at -20°C.

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Table 1. – Characteristics of the study population

<table>
<thead>
<tr>
<th>Healthy children (n=93)*</th>
<th></th>
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<tbody>
<tr>
<td>Age yrs†</td>
<td>10 (8–13)</td>
</tr>
<tr>
<td>Sex male/female</td>
<td>45/48</td>
</tr>
<tr>
<td>FVC % pred‡</td>
<td>98±12</td>
</tr>
<tr>
<td>FEV1 % pred‡</td>
<td>100±12</td>
</tr>
</tbody>
</table>

*: all were lifelong nonsmokers, had no symptoms of asthma, eczema or rhinitis, used no medication, and had no symptoms of respiratory infection in the 4 weeks before the study. †: mean (range); ‡: mean±sd.
respectively, p=0.98). Individual data of all children are ween the \([H_2O2]\) immediately after collection (0.13±0.03 sate was satisfactory, with no significant difference bet-

Significance actions were determined immediately after collection, after

Fluorimetric assay based on the reaction of \(H_2O2\) with

To assess the stability of \([H_2O2]\) in the frozen condensate,

At least 1.5 mL of condensate was obtained by passing

Exhaled air that were substantially higher than those found in healthy

In this study the reference range of \(H_2O2\) in exhaled air

In conclusion, this study defined the reference range of

Discussions

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References


