Anaemia prevalence over time in Indonesia: estimates from the 1997, 2000, and 2008 Indonesia Family Life Surveys

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Running title: Anaemia over time in Indonesia

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ABSTRACT

Objective: To summarize anaemia prevalence data for children, women, and men using data from the second, third and fourth waves of the Indonesia Family Life Surveys (IFLS), which were conducted in 1997/8, 2000, and 2007/8, respectively. Methods: Anaemia prevalence was determined for children 0 to 5 years, 5 to 12 years, 12 to 15 years, non-pregnant women at least 15 years, pregnant women at least 15 years, and men at least 15 years, based on haemoglobin adjusted for altitude and smoking status. Results: Compared with 1997/8 estimates, anaemia prevalence estimates were lower in 2007/8 for all groups, with the greatest relative decline occurring in children 5 to 12 years (25.4%). Trend analysis found anaemia significantly declined over the survey years for all groups ($\chi^2 p=0.005$ for pregnant women, $\chi^2 p<0.001$ for all other groups). Discussion and Conclusions: IFLS anaemia estimates for different population groups decreased between 1997/8 and 2007/8 and were consistent with estimates from Southeast Asia, and with other studies conducted in Indonesia. While the prevalence of anaemia consistently decreased in all groups, anaemia remains a moderate public health problem for children 0 to 5 years, children 5 to 12 years, and non-pregnant and pregnant women.

Key words: anaemia, haemoglobin, Indonesia, IFLS, Southeast Asia

INTRODUCTION

Because anaemia is an important public health problem, it is often measured over time among children, adolescent, and adult populations.\textsuperscript{1,2} In adults, anaemia can cause weakness and fatigue, resulting in decreased productivity in the manual labour sector and decreased work capacity.\textsuperscript{3,4} In addition, there is evidence that anaemia-related cognitive defects are directly linked with lower future earnings.\textsuperscript{4,5} A recent systematic analysis of global anaemia estimated that, in East and Southeast Asia between 1995 and 2011, anaemia prevalence decreased from 29% to 25%, 29% to 21%, and 34% to 25%, in children less than 5 years, non-pregnant women, and pregnant women, respectively.\textsuperscript{2} Of all global regions, East and Southeast Asia tended to show strongest improvements in anaemia, thus it is important to monitor anaemia prevalence among Southeastern Asian countries to better understand the changing burden of anaemia over time.

While anaemia prevalence has been estimated previously for different Indonesian population groups, anaemia trends have not been published. For example, in the RISKESDAS (National
Basic Health Research Survey by the National Institute of Health Research and Development, Ministry of Health) conducted in 2013, the prevalence of anaemia was estimated in children 0 up to 15 years, pregnant women, non-pregnant women, and men. In the Indonesian South East Asian Nutrition Survey (SEANUTS) conducted in 2011, the prevalence of anaemia among children 6 months to 12 years was estimated.

The goal of this communication was to summarize anaemia trends for children, women, and men in Indonesia using longitudinal data.

MATERIALS AND METHODS
The Indonesia Family Life Survey (IFLS) is an on-going longitudinal survey conducted by the RAND Corporation that follows about 7,200 families in Indonesia. The survey is representative of about 83% of the Indonesian population and consists of over 30,000 individuals who live in 13 of the 27 Indonesian provinces at the start of the survey. The first wave of surveys, IFLS1, was conducted in 1993/4. The successive survey waves (IFLS2-4), were conducted in 1997/8, 2000, and 2007/8, respectively, and covered 94%, 95% and 94% of the original IFLS1 families, respectively. Data from the IFLS are publicly available upon registration with RAND. The three most recent waves measured haemoglobin, and were used to determine and compare anaemia prevalence in Indonesia for each of the corresponding survey years.

Anaemia prevalence was determined in the IFLS for children 0 to 5 years, 5 to 12 years, 12 to 15 years, non-pregnant women at least 15 years, pregnant women at least 15 years, and men at least 15 years, based on adjusted haemoglobin measurements. Each survey wave of the IFLS consistently measured haemoglobin using capillary blood and a HemoCue analyzer. The following haemoglobin cut-offs were used to define anaemia, in accordance with the WHO: 11.0 g/dL for children <5 years; 11.5 g/dL for children 5-<12 years; 12.0 g/dL for children 12-<15 years; 12.0 g/dL for non-pregnant women ≥15 years; 11.0 g/dL for pregnant women ≥15 years, and 13.0 g/dL for men ≥15 years.

Individuals’ haemoglobin levels were adjusted based on altitude (men, women, and children) and smoking status (men and women) as described by Sullivan et al. Individuals with adjusted haemoglobin concentrations lower than the cut-offs were defined as being anaemic. Smoking adjustments were made based on the number of cigarettes smoked per day, which was determined using the appropriate IFLS survey books, as previously performed. Altitude was
determined using Google Earth using the household location (sub district) that was recorded during data collection.\textsuperscript{14}

Sex and age were also determined using the appropriate survey books.\textsuperscript{14} Pregnancy status was determined by cross-checking respondent answers between survey books. The answers between books usually agreed, but if a discrepancy existed the values were set to missing, and were excluded from the analysis. If questions regarding pregnancy status were not answered, then women were assumed to be non-pregnant.

To ensure data quality, a few exclusions were made based on implausible information (e.g., pregnant males), or if responses were available to questions that should not have been asked (e.g., childhood smoking, childhood pregnancy). Three pregnant women under 15 years (2 from IFLS3, 1 from IFLS4), 5 pregnant males (all from IFLS3), and 4 smokers under 15 years (all from IFLS3) were excluded for these reasons. Additionally, 1 child under 5 years and 1 non-pregnant woman were excluded from IFLS3 because they had a haemoglobin concentration of 99.9 g/dL, which was implausible and may have resulted from incorrect data coding. No other exclusions were made.

No identifying information of human subjects was used, thus this study was exempt from Institutional Review Board review.

\textbf{RESULTS}
The proportion of anaemia in each of the groups along with the corresponding mean adjusted haemoglobin values are displayed in Table 1. Compared with 1997 estimates, anaemia prevalence estimates were lower in 2008 for all groups, with the greatest relative decline occurring in children 5-<12 years (25.4\%) (Table 1). In children 0 to 5 years, 12 to 15 years, and non-pregnant and pregnant women the highest prevalence of anaemia was observed in 2000. However, chi square trend analysis found anaemia prevalence declined significantly in all groups over the survey years ($p$=0.005 for pregnant women, $p$$<$0.0001 for all other groups).

\textbf{DISCUSSION}
From 1997 to 2008, the prevalence of anaemia consistently declined among Indonesian children, adolescents, women and men assessed in the Indonesia Family Life Surveys (IFLS). To our
knowledge, this is the first trend assessment of anaemia prevalence for different Indonesian population groups.

The IFLS data are consistent with other studies that have documented anaemia in Indonesia or Southeast Asia. For example, the decline in anaemia observed among non-pregnant women between 1997 and 2008 in the IFLS (9.4%) is consistent with the decline in non-pregnant women estimated between 1995 and 2011 in Southeast Asia (8%). The anaemia decline among pregnant women during those times is also consistent between the IFLS (7.8%) and estimates for Southeast Asia (9%). However, the anaemia decline among children less than 5 years during these time periods was much greater in the IFLS (14.6%) compared with estimates for Southeast Asia (4%).

Prior studies conducted in Indonesia also observed consistent results. For example, the SEANUTS study conducted in 2011 estimated anaemia in children 6 months to 12 years to be between 17.6% (urban) and 18.5% (rural), which is fairly consistent with the 2008 estimate for this same group according to the IFLS (20.6%). The RISKESDAS national health survey, which was conducted in 2013, produced similar estimates to comparable age groups for the 2007/8 IFLS: anaemia prevalence of non-pregnant women was estimated to be 22.7% (versus 26.6% from IFLS); anaemia prevalence of pregnant women was estimated to be 37.1% (versus 37.3% from IFLS); anaemia prevalence of men was estimated to be 16.6% (versus 15.4% from IFLS), and anaemia prevalence of children 0 to 5 years was estimated to be 28.1% (versus 31.1% from IFLS).

Despite important declines in the prevalence of anaemia in all population groups per the IFLS, anaemia remains a public health problem in Indonesia. Based on 2007/8 IFLS data, anaemia would be classified by WHO as a moderate public health problem for children 0–<5 years, children 5–<12 years, and for non-pregnant and pregnant women ≥15 years, as the prevalence ranged from 20.0–39.9%.

From this first ever trend analysis of anaemia in different population groups in Indonesia, we conclude that there has been a reduction in the prevalence of anaemia from 1997 to 2008 in all age and sex groups studied. Despite this progress, anaemia remains a moderate public health problem in children <12 years and in non-pregnant and pregnant women ≥15 years.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE
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REFERENCES


<table>
<thead>
<tr>
<th>Group</th>
<th>Year†</th>
<th>Sample size</th>
<th>Anaemia (%)</th>
<th>Mean adjusted Hb ± SD‡ (g/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children 0-&lt;5 y</td>
<td>1997/8</td>
<td>1,867</td>
<td>46.0</td>
<td>10.9 ± 1.4</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>2,346</td>
<td>54.6</td>
<td>10.7 ± 1.5</td>
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<tr>
<td></td>
<td>2007/8</td>
<td>2,963</td>
<td>31.4</td>
<td>11.4 ± 1.4</td>
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<tr>
<td>Children 5-&lt;12 y</td>
<td>1997</td>
<td>4,308</td>
<td>46.0</td>
<td>11.9 ± 1.4</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>4,887</td>
<td>36.4</td>
<td>11.8 ± 1.3</td>
</tr>
<tr>
<td></td>
<td>2008</td>
<td>5,570</td>
<td>20.6</td>
<td>12.3 ± 1.4</td>
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<tr>
<td>Children 12-&lt;15 y</td>
<td>1997</td>
<td>2,221</td>
<td>27.5</td>
<td>12.7 ± 1.4</td>
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<tr>
<td></td>
<td>2000</td>
<td>2,159</td>
<td>28.2</td>
<td>12.6 ± 1.3</td>
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<tr>
<td></td>
<td>2008</td>
<td>2,172</td>
<td>15.8</td>
<td>13.3 ± 1.4</td>
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<tr>
<td>Women ≥15 y (Non-pregnant)</td>
<td>1997</td>
<td>10,168</td>
<td>36.0</td>
<td>12.3 ± 1.6</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>12,935</td>
<td>38.8</td>
<td>12.2 ± 1.5</td>
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<td></td>
<td>2008</td>
<td>14,704</td>
<td>26.6</td>
<td>12.6 ± 1.6</td>
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<td>Women ≥15 y (Pregnant)</td>
<td>1997</td>
<td>277</td>
<td>45.1</td>
<td>12.0 ± 1.5</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>520</td>
<td>46.5</td>
<td>12.1 ± 1.5</td>
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<td></td>
<td>2008</td>
<td>563</td>
<td>37.3</td>
<td>12.4 ± 2.1</td>
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<td>Men ≥15 y</td>
<td>1997</td>
<td>8,592</td>
<td>29.0</td>
<td>13.8 ± 1.8</td>
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<td></td>
<td>2000</td>
<td>11,873</td>
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<td></td>
<td>2008</td>
<td>13,730</td>
<td>15.4</td>
<td>14.5 ± 1.9</td>
</tr>
</tbody>
</table>

†IFLS2 conducted in 1997/8, IFLS3 conducted in 2000, IFLS4 conducted in 2007/2008
‡Adjusted for altitude based on district using Google Earth and for smoking status based on number of cigarettes smoked per day as described¹; SD, standard deviation.