Use of self-medication among adolescents: a systematic review and meta-analysis

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Background: We performed a systematic review and proportion meta-analysis in order to investigate the prevalence and the adverse effects of the self-medication among the teenagers. Methods: We selected observational studies published from January 1990 until January 2014 that examined the use of self-medication in the adolescents (aged from 13 to 18 years). Keywords used on PubMed, ISI Web of Knowledge and Scopus were ‘self-medication’, ‘adolescents’, ‘self prescription’, ‘over the counter preparations’ and ‘self administration’. Results: Finally, 15 articles met the inclusion criteria, for a total of 143,213 subjects involved. Overall, 50% of adolescents use to take drugs without consulting a physician. Further analyses stratified by number of drugs used demonstrated that in the studies reporting that adolescents use more than one type of drug the prevalence rises up to 63%. Only one study reported the possible adverse effects related to the inappropriate use of drugs, which were experienced by 31.1% of the females and 19.6% of the males. Conclusions: Self-medication use among adolescents is a widespread phenomenon. It would be advisable to give more attention on this public health concern and to promote initiatives, such as mass media campaigns and governmental actions, in order to make the citizens more aware to the risks related to the consumption of drugs without medical consultation. Further studies on adverse effects are urgently needed.

Data collection

Two researchers independently performed a systematic search in order to identify publications from PubMed, ISI Web of Knowledge and Scopus, using the following terms (keywords): ‘self-medication’, ‘adolescents’, ‘self prescription’, ‘over the counter preparations’ and ‘self administration’ from January 1990 until January 2014. All papers written in English, French, Portuguese, Spanish and Italian were considered.
Study selection

Firstly, the researchers analyzed individually the results retrieved to find potentially eligible studies. The publications were sorted by title and abstracts and only eligible studies were selected for full-text review. During this stage, all irrelevant studies (lack of pertinence, studies on animals, data already found in other publications), case reports and reviews were excluded (figure 1). The outcome measures of interest were the prevalence of self-medication, the type of drugs used and the prevalence of self-reported adverse effects.

Finally, only articles including the following criteria were selected and analyzed.

Study inclusion criteria

A study was included if:

1. it focused on the relationship between self-medication and the adolescents;
2. the sample was composed of individuals aged from 13 to 18 years. In some cases, the studies included a wider range of age: these studies were included only if data about adolescents’ consumption could be extracted;
3. it analyzed all type of drugs except for opioids and nicotine derivates;
4. the use of drugs was occasional AND/OR continuous;
5. the drug administration occurred without medical or other consultation;
6. drugs were recruited in order to treat a symptom; and
7. it was published in English, French, Portuguese, Spanish and Italian languages.

Data extraction and studies’ assessment

The researchers (S.P., M.S. and V.G.) reviewed each full text for eligibility and extracted the required data. For each study, information about characteristics of the survey, study design, sample size,
prevalence of self-medication, type of drugs (table 1) and prevalence of adverse effects (self-reported) were reported.

The methodological quality of the observational studies was assessed according to the STROBE Statements.

**Statistical analysis**

Proportion meta-analyses were performed by using the software Stats Direct 2.8, for Windows. The chi-squared test and the $I^2$ were used to evaluate heterogeneity of studies. In order to tackle potential sources of heterogeneity between studies, the random effects model was used in order to combine studies if heterogeneity was shown (chi-squared $P$-value $<0.10$ or $I^2 > 50\%$). As the heterogeneity was found among selected studies, the random effects model was used. Moreover, to give possible explanations to the heterogeneity, subgroups analyses were conducted.

Publication bias was assessed through the construction of a funnel plot for the primary endpoint, as well as by the Begg and Mazumdar adjusted rank correlation method.

### Results

#### Characteristics of the studies

Of the 3238 articles screened, 32 full texts were read and finally 15 articles met the inclusion criteria, for a total of 143 213 subjects involved. All articles analyzed were ‘descriptive population-based studies’ in which data were collected through a questionnaire. The majority of the studies was carried out in South America (Brazil), whereas only five studies were conducted in Europe (table 1).

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Sample (N)</th>
<th>Prevalence of self-medication (%)</th>
<th>Type of drugs most commonly used (%)</th>
<th>Age* (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opaleye et al. (2013)</td>
<td>Brazil</td>
<td>18 131</td>
<td>5</td>
<td>Tranquilizers or sedatives</td>
<td>14–18</td>
</tr>
<tr>
<td>Shehnaz et al. (2013)</td>
<td>Arabia</td>
<td>324</td>
<td>89.2</td>
<td>Antipyretics (70.2) Analgesics (68.5)</td>
<td>14–18</td>
</tr>
<tr>
<td>Padoveze et al. (2012)</td>
<td>Brazil</td>
<td>480</td>
<td>6</td>
<td>Topical treatment for acne N/A</td>
<td>Under 18</td>
</tr>
<tr>
<td>Morais et al. (2011)</td>
<td>Brazil</td>
<td>553</td>
<td>52.6</td>
<td>Cold and cough medicine (32.1) Vitamin supplement (21.6)</td>
<td>14–18</td>
</tr>
<tr>
<td>Du and Knopf (2009)</td>
<td>Germany</td>
<td>17 450</td>
<td>25.2</td>
<td>Dermalological products (14.2)</td>
<td>0–17</td>
</tr>
<tr>
<td>Kokkevi et al. (2008)</td>
<td>Greece</td>
<td>85 049</td>
<td>5.6</td>
<td>Tranquilizers or sedatives</td>
<td>Median age 16</td>
</tr>
<tr>
<td>Westerlund et al. (2008)</td>
<td>Sweden</td>
<td>245</td>
<td>88</td>
<td>Paracetamol (46.6) Ibuprofen (27.8)</td>
<td>Median age 17</td>
</tr>
<tr>
<td>Pereira et al. (2007)</td>
<td>Brazil</td>
<td>772</td>
<td>56.6</td>
<td>Analgesic/antipyretic (52.9) Non-hormonal anti-inflammatory (52.9) Action on the respiratory tract (15.4) Systematic antibiotics (8.6), Gastrointestinal tract drugs (9.6) Analgesic (81.3)</td>
<td>Under 18</td>
</tr>
<tr>
<td>James et al. (2006)</td>
<td>Bahrain Arabia</td>
<td>134</td>
<td>44.8</td>
<td>Pain relief (65) Respiratory conditions (54) Allergic condition (39) Dermalological condition (37) Nutritional supplements and vitamins (22) Gastrointestinal products (21) Antidandruff products (17) Painkillers/anti-inflammatory drugs/antigout drugs (32.5) Hormones and similar drugs (12.1) Drugs that act upon the autonomous nervous system (11.6)</td>
<td>18 ± 0.78 (mean and standard deviation)</td>
</tr>
<tr>
<td>Abahussain et. al. (2005)</td>
<td>Kuwait</td>
<td>1110</td>
<td>92</td>
<td>N/A</td>
<td>14–21</td>
</tr>
<tr>
<td>da Silva and Giugliani (2004)</td>
<td>Brazil</td>
<td>1281</td>
<td>12.3</td>
<td>Pain relief (65) Respiratory conditions (54) Allergic condition (39) Dermalological condition (37) Nutritional supplements and vitamins (22) Gastrointestinal products (21) Antidandruff products (17) Painkillers/anti-inflammatory drugs/antigout drugs (32.5) Hormones and similar drugs (12.1) Drugs that act upon the autonomous nervous system (11.6)</td>
<td>14–20</td>
</tr>
<tr>
<td>Pommier et al. (2002)</td>
<td>France</td>
<td>543</td>
<td>78</td>
<td>N/A</td>
<td>15–19</td>
</tr>
<tr>
<td>Sloand and Vessey (2001)</td>
<td>USA</td>
<td>77</td>
<td>36</td>
<td>Analgesics, antihistamines, decongestants</td>
<td>10–14</td>
</tr>
<tr>
<td>Stoelben et al. (2000)</td>
<td>Germany</td>
<td>56</td>
<td>51</td>
<td>Non-opioid analgesic antipyretics (35) Nasal throat cough and cold preparations (23) Sex hormones and urologicals (13)</td>
<td>15–17</td>
</tr>
<tr>
<td>Dengler and Roberts (1996)</td>
<td>UK</td>
<td>17 008</td>
<td>67</td>
<td>N/A</td>
<td>11–16</td>
</tr>
</tbody>
</table>

*aInformation as reported in the studies.*

<table>
<thead>
<tr>
<th>Study</th>
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<th>Sample (N)</th>
<th>Prevalence of self-medication (%)</th>
<th>Type of drugs most commonly used (%)</th>
<th>Age* (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td>143 213</td>
<td>67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Prevalence of self-medication and type of drugs used

The prevalence of self-assumption of drugs by adolescents ranged from a minimum of 5% to a maximum of 92%. Painkillers (27.8–70.2%), cough medicine (12.3–54%), dermatological products (14.2–37%), nutritional supplements (4.4–22%) and antibiotics (8.6–53.2%) were the most frequently drugs reported.

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*Table 1: Characteristics of the studies included in the analysis.*
The prevalence of self-medication among adolescents varied between 4% (95% CI: 3–5%) \(^2\) and 92% (95% CI: 90–93%). \(^2\) Overall, the pooled proportion of self-medication was 50% (95% CI: 31–68%). There was a high heterogeneity and the \(P\)-value of the whole population sampled was found to be <0.0001 (df = 14) and consequently the random effects model was performed. Figure 2 shows the forest plot.

Given that three studies\(^{19,20,26}\) included only data about the use of self-medication for only one type of drug (such as sedatives or topical treatment for acne), we decided also to stratify the analysis by the number of drugs used (one VS more than one). In this case, figure 3 shows the results of the meta-analysis (prevalence: 63%; 95% CI: 44–80%). This last finding was considered more consistent in comparison with the previous one and consequently all the subgroup analyses were made in line with this scenario.

Methodological quality assessment
The 15 observational studies, included in the systematic review, were evaluated according to the STROBE Statement.

As results, four studies\(^{1,19,22,25}\) presented more than 75% of the STROBE criteria whereas 11 studies\(^{4,14–18,20,21,23,24,26–28}\) fulfilled less than 75% of those criteria.

Publication bias
Examination of the funnel plot, shown in figure 4, did not provide evidence of publication bias.

Subgroup analyses
In order to address the heterogeneity of the studies, we therefore performed subgroup analyses by considering three factors: the sample size (cut-off value equal to 1000 subjects), the Country of the survey (OECD members, South America and Middle East) and the quality of the studies (\(\leq 15\) as STROBE score).

Regarding the results stratified by the sample size, we found that the smaller studies (with a sample <1000) had a global prevalence of self-medication accounting for 0.64 (95% CI: 0.50–0.76) whereas the studies with a sample larger or equal to 1000 subjects had a prevalence quite smaller (0.61; 95% CI: 0.28–0.89).

When we stratified by geographic area, the prevalence of self-medication reached the values of 0.60 (95% CI: 0.32–0.84), 0.53 (95% CI: 0.48–0.57) and 0.78 (95% CI: 0.54–0.95) for OECD countries, South America and Middle East, respectively.

In addition, we found that subjects enrolled in high-quality studies had a lower likelihood to use self-medication (OR = 0.32; 95% CI: 0.14–0.54) if compared with results of low-quality studies (0.56; 95% CI: 0.27–0.83).

Prevalence of adverse effects (self-reported)
Only one article, of the 15 that met the inclusion criteria, analyzed the issue of adverse effects. Westerlund et al.\(^{17}\) reported that adverse effects had been experienced by 31.1% of the females and 19.6% of the males using OTCs. In particular, the main issue was therapy failure reported in 46.5% of the girls and 38.1% of the boys.

Discussion
The purpose of our research was to investigate the phenomenon of self-medication among the adolescents, by systematically reviewing the existing literature, according with the PRISMA statements.\(^{29}\) Currently, in the literature, there are articles carried out in different countries on this topic, emphasizing how this issue is gaining attention in both Europe and USA mainly due to the possible impact on public health.

The results of this systematic review showed that the prevalence of self-medication use among adolescents is a widespread phenomenon. As result of the meta-analysis, we assessed that more than 60% of the adolescents use to take drugs without consulting physician and this worrying problem seems to be
extremely popular for treating the symptom of pain. Indeed, in the articles analyzed, the painkillers were the drugs most commonly reported by adolescents. In the articles analyzed, the percentage of adolescents that reported to use pain medication to treat symptoms related to pain amounted to 70.2%. These data can be related to the easy accessibility to drugs by adolescents through no standardized channels and highlight the potential health risks caused by the intake of these medicines just in this age group. Additionally, the antibiotics belong to a category of drugs very commonly used by teenagers, ranging from 8.6% to 53.2%. This result has an important impact on public health of this age group, particularly for the risk of development of antibiotic resistance. Considering the results of the stratified analyses, it seems that the sample size does not affect our results whereas the different geographic area could modify the prevalence of the self-medication habits among adolescents. In particular, the teenagers from Middle East use to consume drugs without any medical consultation more frequently than the ones from the other countries; this could be partly due to the pharmacist role that in these countries (such as Kuwait) is mainly seen as a drug salesman rather than a healthcare provider.

Moreover, as reported by da Silva and Giugliani, there are several determinants contributing to the widespread phenomenon of self-medication in countries such as Brazil: difficult access to healthcare services, inappropriate drug surveillance systems and
the growing habits of consuming drugs to control anxiety or other mental problems.31

In addition, we found that high-quality studies reported a lower prevalence of self-medication, perhaps this could be due in part to the presence of more defined and specific inclusion criteria to select subjects.

We also evaluated data on the adverse effects related to self-medication. Of the 15 articles that met the inclusion criteria, only one has reported the possible adverse effects related to the inappropriate use of drugs, emphasizing the lack of attention on the problems related to self-medication. The percentage reported by Westerlund et al.17 is quite high: 31.1% of the females and 19.6% of the males using OTCs. Of course, on this topic further studies have to be conducted.

Our study has several limitations that should be recognized. Firstly, we restricted our search to only papers written in English, French, Portuguese, Spanish and Italian language and we excluded case reports. Secondly, all type of drugs were included in the systematic review except for opioids and nicotine derivates because the prevalence of self-medication, related to this type of drugs, was very difficult to get. Thirdly, several studies explored the self-medication in both the adolescents and children. This methodological decision and the age strata may represent a several point of concern and the great variations among them may cause misinterpretation. Thus, to perform this systematic review and meta-analysis we only considered and extracted data related to the adolescents group.

Finally, the articles included in the systematic review are characterized by a high variability related to the methodological design, such as sample size and the age range of people enrolled and related to the types of drugs used and the symptoms treated by the adolescents. This variability is also expressed in the methodological quality assessment, in which only 4 of 11 studies achieved a high score according to the STROBE Statement.25

As the heterogeneity of the selected studies was acknowledged, we chose the random effects model to perform the meta-analysis, in order to address this issue. However, these two important limitations (the high variability of outcomes and the low quality of the studies) emphasize the strong need for new research on this topic with a standardized methodological approach to get data closer to reality and more extensive in terms of outcomes considered. This way will allow to obtain a complete view of the problem in order to prevent the health risk related to the misuse of drugs.

Based on our interesting findings, it would be advisable to give more attention on this public health concern and to promote initiatives, such as mass media campaigns and governmental actions, in order to make the citizens more aware to the risks related to the consumption of drugs without medical consultation.

Conflicts of interest: None declared.

Key points

- In 2008 in the USA, 42% of population declared to use drugs without prescription and 4% of them were potentially at risk of having a major drug–drug interaction.
- Overall, adolescents who use self-medication to assume more than one type of drug the prevalence is 63%.
- Further studies on adverse effects of self-medication are urgently needed.
- It would be advisable to give more attention on this public health concern and to promote initiatives, such as mass media campaigns and governmental actions, in order to make the citizens more aware to the risks related to the consumption of drugs without medical consultation.

References

Dietary protein and amino acids intake and its relationship with blood pressure in adolescents: the HELENA STUDY

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Objective: To analyze the association between dietary protein and amino acids intake and systolic (SBP) and diastolic (DBP) blood pressure in European adolescents. Methods: Participants were from the cross-sectional study performed in Europe, Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA study; n=1605; 12.5–17.5 years; 833 girls) selected by complex sampling. The associations between dietary protein and amino acids intake and SBP/DBP were examined by multilevel linear regression models (context variable by school); the analysis being stratified by sex. Cities, seasonality, age, socioeconomic level, parental education level, body mass index, waist circumference, Tanner stage and physical activity were used as covariates. Results: In boys, we found an inverse association between protein (animal and vegetable) intake and DBP, and a positive association between histidine and SBP. In girls, we observed a positive association among tryptophan, histidine with SBP and methionine with DBP. On the other hand, we observed an inverse association between tyrosine and both SBP and DBP levels in girls. Conclusions: The association between amino acids and BP levels is controversial and depends on the type of amino acids, and protein intake can help control the DBP in boys.

Introduction

Cardiovascular diseases (CVD) are the main sources of disease burden worldwide, thus being a major public health problem.1 Elevated blood pressure is considered the risk factor with the highest attributable fractions for CVD mortality being 40.6%.2 The prevalence of elevated blood pressure (BP) is already high during...