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The ‘Dangerous Cocktail’: an epidemiological survey on the attitude of a population of pregnant women towards some pregnancy risk factors

Vincenza La Fauci, Raffaele Squeri, Cristina Genovese, Valeria Alessi and Alessio Faciolì

ABSTRACT

Many investigations have shown the important role played by risk factors such as tobacco and alcohol and infectious agents (especially Rubella) in the development of congenital anomalies (CAs). Through the administration of a questionnaire, we evaluated the attitude of a population of pregnant women towards some risk factors in pregnancy (smoking and alcohol habit and risk of contracting one of TORCH agents). 14% of the women continued to smoke despite pregnancy; the majority of these were 34–35 years old, divorced, workers and with a high educational level. The 4.3% declared to be moderate drinkers; were mainly younger and married. Concerning the TORCH agents, it a high percentage were negative to the Rubella antibodies (62.8%). In order to improve the awareness of pregnant women on these risk factors, health education campaigns represent a public health cornerstone.

IMPACT STATEMENT

What is already known on this subject? Several investigations have shown an association between congenital anomalies (CAs) and various exogenous factors such as air pollutants, pesticides, metals, radiations and others present in the environmental matrices. Moreover, an important role is played by some risk factors linked to the lifestyles (i.e. tobacco and alcohol).

What do the results of this study add? Our study shows that the awareness of the women about the importance of these risk factors is still rather poor, especially concerning the avoidable risks associated with smoke and alcohol and the preventable risk associated with rubella infection.

What are the implications of these findings for clinical practice and/or further research? Our results highlight the importance of continuous health education both about the risk to smoke and drink during pregnancy and about the risk not to have had contract the rubella infection before the pregnancy. Particularly, about the latter issue, it appears necessary to increase the pre-conceptional diagnosis and, eventually, to vaccinate the women resulted negative in order to eliminate congenital rubella.

Introduction

Pregnancy represents a very delicate period of woman life, especially during the first trimester when the embryogenesis takes place. In this complicated period, many risk factors can act to perturb the delicate balance that leads to the foetal development and to cause congenital anomalies (CAs). CAs are a significant public health issue due to their consequences on the affected individuals and their families and because they are a cause of voluntary interruption of pregnancy (VIP). Particularly, some studies show that CAs are, in Italy, the cause of VIPs for a percentage ranging between 4 and 7.6% (Faciolì et al. 2018; Pertile et al. 2018; Puglia et al. 2018). About the onset of these anomalies, it is estimated that about 70% would be a consequence of complex interactions between genetic alterations and the expositions to exogenous factors (Weinhold 2009). Several epidemiological investigations showed an association between CAs and various toxic substances such as air pollutants, pesticides, metals, radiations and others present in the environmental matrices (food, water, air and soil) (Dolk and Vrijheid 2003; Shi et al. 2008; Miranda et al. 2009; Nieuwenhuijsen et al. 2009). Moreover, an important role it is played by risk factors linked to the lifestyles (i.e. tobacco and alcohol) and socioeconomic determinants (Slama and Cordier 2010). A separate mention must be made for the exposition to the TORCH agents, well-known cause of CAs (Arora et al. 2017).

The effects of active and passive smoking in the foetal develop have been known for a long time. Indeed, when a woman smokes during pregnancy, she exposes the foetus to the toxic effects of the several compounds contained in tobacco, among which vasoconstriction and hypoxia are the main ones (Rogers 2009). Several studies have investigated...
the sequelae associated with the exposure to smoke during the intrauterine life. Particularly, they showed that a woman smoking during pregnancy has higher probability to develop preterm delivery, pre- and post-natal growth defects, congenital malformations, stillbirth and increased risk of sudden infant death syndrome (Wisborg et al. 2001; Mitchell and Milrad 2006; Viefwerth et al. 2007; Leonardi-Bee et al. 2008; Shi et al. 2008). Moreover, it has been shown that nicotine and its metabolite cotinine are able to alter the functions of many neurotransmitter systems, among which the acetylcholine, serotonin and catecholamines transmission (Blood-Siegfried and Rende 2010). Finally, some studies showed that prenatal exposure to tobacco would be associated with attention and linguistic skills impairments, potentially secondary to compromised auditory processing (Milberger et al. 1998; Rodriguez and Bohlin 2005).

Similarly to smoking, it has been demonstrated that drinking alcohol during pregnancy can alter brain development and result in a complex syndrome known as foetal alcohol spectrum disorders (FASD), including several neurological defects (learning difficulties, executive dysfunction, impaired speech, motor problems and behavioural issues) (Astley et al. 2009; Lebel et al. 2011; House of Representatives Standing Committee on Social Policy and Legal Affairs 2012). Recent investigations showed that there is a link between moderate alcohol consumption and child neuropsychological outcomes (Flak et al. 2014) and between heavy prenatal alcohol exposure and coarse motor function (Lucas et al. 2014). Recently, another study suggests an association between drinking habit, especially in early period of pregnancy, and attention deficit hyperactivity disorder (ADHD) (Sayal et al. 2014). However, the evidence for neurological developmental damage derived from low and infrequent prenatal alcohol exposure remain unclear (Falgreen Eriksen et al. 2012; Kesmodel et al. 2012; Skogerbo et al. 2012; Humphriss et al. 2013; Skogerbo et al. 2013; Mather et al. 2015).

Finally, TORCH infections are well-recognised cause of CAs and classically include toxoplasmosis, Treponema pallidum, rubella, cytomegalovirus (CMV), herpesvirus (HSV1 and HSV2), hepatitis viruses (HBV, HCV and HEV) human immunodeficiency virus (HIV) and others. These infections are very impacting in developing countries where TORCHs are the major contributors to prenatal, perinatal and postnatal morbidity and mortality. The early recognition by prenatal screening of these pathogens is very important because for many of the prevention strategies are available (Neu et al. 2015). In particular, rubella is, generally, a mild and self-limiting infection but, when the virus is contracted during pregnancy, especially during the first 10 weeks, it can be vertically transmitted to the child. The result is a severe syndrome known as congenital rubella syndrome (CRS) characterised by miscarriage, stillbirth or physical malformations including deafness, blindness, cataracts, heart defects and mental retardation (Duszak 2009).

The aim of this article was to investigate about the attitude of a population of pregnant women towards some well-known risk factors in pregnancy that is smoking and alcohol habits and lifestyles exposing them to the risk of contracting one of TORCH agents (i.e. lack of rubella vaccination, consumption of raw/undercooked food).

**Material and methods**

**Data collection**

To collect the data, we administered a questionnaire to a sample of 200 pregnant women in the two principal hospitals of the Messina Sicilian city. The questionnaire contained questions about socio-demographic characteristics of the women (age, age of first pregnancy, marital status, education degree and profession), the type of gynaecological assistance, their lifestyles (smoking and drinking habits and consumption of raw/undercooked food) and the TORCH serological status. After we obtained an informed consent, the questionnaires were administered to the women during the birthing classes attended by them, for a period of two months (from May 1 to June 30 2018).

**Statistical analysis**

Statistical processing was performed using version 10 of StatSoft® software (StatSoft Power Solutions, Inc., Tulsa, United States). Descriptive statistics were used to find the percentages. Pearson’s correlation tests were performed to assess the relationship between socio-demographic characteristics and rubella serological status.

**Results**

The studied sample consisted of 200 pregnant women, 90.3% of them were of Italian nationality. Only the 9.7% were foreign women, most of which coming from East Europe and Sri Lanka. The mean age was 30.6 ± 5.45 years. Almost all the women (89.3%) were at her first pregnancy (mean age of first pregnancy 29.9 years). The socio-demographic characteristics of the women are shown in Table 1.

About the question on the type of gynaecological assistance, the 75.3% declared to be assisted by a private gynaecologist while only the 24.7% by a public structure.

**Table 1. Percentages of the studied women socio-demographic characteristics.**

<table>
<thead>
<tr>
<th>Marital status</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>2.2</td>
</tr>
<tr>
<td>Unmarried partner</td>
<td>15.1</td>
</tr>
<tr>
<td>Married</td>
<td>59.1</td>
</tr>
<tr>
<td>Divorced</td>
<td>23.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education degree</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary school</td>
<td>2.2</td>
</tr>
<tr>
<td>Secondary school</td>
<td>16.1</td>
</tr>
<tr>
<td>High school</td>
<td>26.9</td>
</tr>
<tr>
<td>University</td>
<td>48.4</td>
</tr>
<tr>
<td>Post-graduate</td>
<td>6.5</td>
</tr>
<tr>
<td>Profession</td>
<td></td>
</tr>
<tr>
<td>Students</td>
<td>15.1</td>
</tr>
<tr>
<td>Unemployed</td>
<td>40.8</td>
</tr>
<tr>
<td>Workers</td>
<td>44.1</td>
</tr>
</tbody>
</table>
Moreover, all the women stated that they had performed all the gynaecological and ultrasound checkes planned.

About the smoking habit, the 14% declared to smoke despite the pregnant status, the 61.3% were not smokers and the 24.7% were former smokers (80% of them stated they stopped smoking due to the pregnancy). Particularly, about the smokers’ socio-demographic characteristics, the 61.5% of them were 34–35 years old, the 53.8% were divorced, the 76.9% were graduated and the 69.2% were workers. Correlating the smoking habit with the socio-demographic characteristics of the studied women, we found a statistically significant difference for the marital status, with a higher number of smokers among the single women ($p < .05$). Moreover, we found a statistically significant difference also for the profession with a higher number of smokers in the worker women ($p < .05$).

About the drinking habit, the 4.3% declared to be moderate drinkers (occasional use of alcohol equal to 2–3 glasses a week) despite pregnancy, the 34.4% stated they do not drink alcohol during pregnancy and the 56% stated do not usually drink alcohol. A percentage of 5.3 did not give any question. Particularly, about the drinkers’ socio-demographic characteristics, the 50% of them were 24–25 years old and the 75% were married; there were no significant differences in the percentages of the other socio-demographic characteristics. About the type of alcoholic beverages consumed, most of them (86%) stated they usually drink bier during the weekend.

Concerning the raw/undercooked food, the 21% of women declared to have consumed this kind of food during pregnancy; of which, the 71.4% were married (no differences there were in the percentages of the other socio-demographic characteristics). Correlating this habit with the socio-demographic characteristics of the studied women, we found a statistically significant correlation for the educational level with a higher number of women consumers this kind of food in the group having a lower educational status ($p < .001$). Moreover, we found a statistically significant difference also for the gynaecological assistance with a higher number of consumers in the women followed by a public structure ($p < .01$).

Finally, about TORCH agents, only 7.5% of women stated that they underwent to the research of rubella antibodies before the conception and only the 26.9% declared to know that the TORCHs are infectious agents. The detailed responses about the serological status of each TORCH agent are shown in Figure 1.

The figure highlights very high percentages of serological negativity for all the TORCH infections but very alarming is the finding of the high negativity concerning the two vaccine preventable diseases, rubella and HBV infection. Particularly, correlating the rubella serological status with the socio-demographic characteristics of the studied women we found a statistical significant correlation with the age with the higher number of declaring negative women among the oldest ($p < .05$) and the educational level resulting the women with lower educational level more negative than those with a higher education ($p < .05$).

Finally, we found high percentages of not declaring women regarding the blood-borne infections HIV, HBV and HCV.

**Discussion**

The relationship between CAs and lifestyles as tobacco smoke and alcohol is well known for a long time. However, the real prevalence of smoking and drinking in pregnant woman is difficult to quantify (Cnattingius 1992; Mohsin and Bauman 2005). A recent meta-analysis showed that the global prevalence of smoking during pregnancy is estimated to be 1.7%. The three countries with the highest prevalence of smoking during pregnancy were Ireland (38.4%), Uruguay (29.7%) and Bulgaria (29.4%). The prevalence of smoking during pregnancy was 8.1% in the European Region, 5.9% in the Region of the Americas, 1.2% in the Southeast Asian Region, 1.2% in the Western Pacific Region, 0.9% in the Eastern Mediterranean Region, and 0.8% in the African Region (Lange et al. 2018). Studies from the USA show that prevalence of
smoking during pregnancy was 8.4%, with 20.6% of women who smoked especially in the first or second trimesters. Smoking during pregnancy was more prevalent for women aged 20–24 years (13.0%) and the highest rate was found for non-Hispanic American Indian or Alaska Native women (18.0%) (Curtin and Matthews 2016). Concerning drinking habits in pregnancy, a study revealed that about 10 and 15% of pregnant women consume alcohol in Canada and the United States, respectively, and that about 3% of women engage in binge drinking during pregnancy in both countries (Popova et al. 2017).

In our investigation, the studied sample consisted of almost all Italian women in an adult age, since the average age was 30.6 years. Moreover, most of them were at their first pregnancy (mean age of first pregnancy 29.9). The higher percentage of the women was married or unmarried partner and they had a high cultural level (high school/degree); almost half of them were workers. Concerning the risk factors, a quite high percentage of them (14%) declared that they continue to smoke despite the pregnancy while a lower percentage (4.3%) declared to be moderate consumers of alcohol. These data are perfectly in line with national Italian data concerning the smoking habit in pregnancy. Indeed, according to the ‘PASSI’ Italian surveillance the percentage of smoking women in pregnancy is 14%. Conversely, in our investigation, we found a percentage of drinker pregnant women (4.3%) much lower than the national one (15%) (Epicentro 2018a). The most part of smoker women was 34–35 years old, divorced, workers and with a high educational level. Moreover, in the statistical analysis, we found significant differences with the marital status (single women and, especially, divorced resulted more smokers than conjugated those) and profession (workers resulted more smokers than unemployed those). Conversely, concerning the drinker women, the highest percentages were among the younger and married women, with no significant differences about the percentages of the other considered socio-demographic characteristics. The remarkable differences in the found percentages of smoke and alcohol consumers suggest the latter is probably considered a more danger risk factor in pregnancy than the first. Moreover, we found that the age is an important determinant concerning these two pregnancy risk factors. Probably, the oldest women have more difficulties to stop smoking than the younger; maybe because they have been smoking for a long time and especially considering that the most of them live stressful situations like a divorce and a job career. Conversely, the younger are more likely to drink than the oldest, probably because they usually go out more frequently with friends in the weekends (habit that was, in our investigation, the major cause to drink alcohol). Finally, concerning the consumption of raw/undercooked food, a quite elevated percentage of women (21%) declared that they occasionally have eaten these kinds of food during pregnancy. This habit was statistically correlated with a lower educational level and with a public assistance compared to a private gynaecologist. Probably, we can suppose a major attention to this issue from the private compared to the public physicians. This finding can be potentially dangerous because could expose the women to the acquisition of pathogens able to damage the foetus such as *Toxoplasma gondii* or the hepatitis E virus, the latter present in our territory as demonstrated by a previous investigation (La Fauci et al. 2010, 2017).

Concerning the declared TORCH agents’ positivity, an important finding to highlight is the very high percentage (62.8%) of women declaring the negativity to rubella antibodies. The serological negativity was statistically correlated to the age of the women, resulting the oldest more frequently negative to the younger, and with a lower educational level. In general, we would expect that women with the socio-demographic characteristics of the studied women (a rather advanced age and a high educational level) are more careful about this pregnancy risk factor. Moreover, we can think that at this age, most of the pregnancies are desired and programmed and so it is very alarming that only a very low percentage of women declared to carry out a pre-conception analysis to know their anti-rubella serological status. In Italy, a national plan for the elimination of measles and congenital rubella (in Italian PNEMoRC) was approved in 2003 and updated in 2007 (Ministero della Salute 2003, 2011). In parallel to the PNEmORc, a surveillance system that provides for the mandatory notification of congenital rubella infection and rubella in pregnancy has been introduced in 2005. The combination of the PNEMoRC and the specific surveillance of all rubella cases aim to eliminate congenital rubella definitively. The achievement of this target can be possible thanks to the availability of a safety and effective vaccine. The main aims of vaccination programmes are to prevent rubella infection during pregnancy and to protect CRS, so previous studies have been carried out among pregnant women to investigate the seroprevalence of rubella virus infection (Lo Giudice et al. 2009; Calimeri et al. 2012; Fitter et al. 2013; Tahita et al. 2013; Lo Giudice et al. 2014; Olajide et al. 2015; Alvarado-Esquivel et al. 2016). However, our results clearly show that we are still far away in the achievement of this goal, despite the many years since the emanation of the plan and the activation of the surveillance. Rubella is a common disease all over the world. In Europe, according to the latest ECDC monthly report, between June 1 2017 and May 31 2018, 13 EU/EEA member states reported 620 cases of rubella. In the considered period, the highest number of cases was reported in Poland (481), Germany (63), Italy (30) and Austria (21) (European Center for Disease Control and Prevention 2018). In Italy, while for measles the notified cases have been constantly numerous since 2013 with a severe outbreak in 2017 that it is continuing in 2018 (Palamara et al. 2018; Epicentro 2018b), for rubella, since the beginning of 2013, there have been 225 cases of rubella (possible, probable and confirmed) (Epicentro 2018b).

**Conclusion**

Many risk factors such as smoke, alcohol and infectious agents can alter the delicate period of the pregnancy and lead to an altered foetal development. In order to improve the awareness of pregnant women on the importance of avoiding these risk factors and prevent CAs, health education...
campaigns at various levels surely represent the public health cornerstone. Particularly, these campaigns should stress the harmful effects of smoke and alcohol in pregnancy and focus the importance on the necessity to undergo a preconception analysis to identify susceptible rubella women and vaccinate them before conception. However, our study demonstrates that much has yet to be done to reach this goal. It would be important to intensify health educational campaigns targeted to workers in the obstetrics area to promote real prevention of pregnancy risk factors; they should recommend to women in childbearing age that they assist to undergo preconception rubella tests (Faccioli et al. 2019). Indeed, the healthcare workers often show poor interest to the prevention, especially concerning the importance of vaccination in general, as demonstrated by previous studies (La Fauci et al. 2016; Squeri, Genovese, et al. 2017; Squeri, Riso, et al. 2017; Genovese et al. 2018). Moreover, it would be also appropriate to involve the network of family doctors, the only ones who really come in contact with women throughout their lives.

**Disclosure statement**

No potential conflict of interest was reported by the authors.

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