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CO-CONSTRUCTING AND EVALUATING AN ENDOCRINE DISRUPTOR EDUCATION PROGRAM FOR TEENAGERS IN SCHOOLS: THE COPE-ADOS PROGRAM

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Abstract

Some Endocrine Disruptors (EDs) are suspected to cause deleterious effects on the reproductive system, developmental abnormalities and hormone-dependent cancers (breast, uterus, prostate, testis). The public's perceptions of these chemicals are poorly understood. The period of adolescence is a critical time when exposure to ED could have long-term health consequences. As part of the third axis of France's second national strategy on endocrine disruptors (SNPE 2) 2019-2022, the COPE ADOS project aims to offer an education and information program on endocrine disruptors for teenagers in schools. The COPE ADOS project is divided into 4 steps: 1) documenting the knowledge, representations and skills of high school students on the subject of endocrine disruptors; 2) co-constructing with teachers an educational device aimed at students and their educational supervisors; 3) building a specific tool to evaluate the program; 4) implementing the program and carrying out its evaluation. The communication will describe the implementation of the project and the results associated to its different steps: **1-** A qualitative study (23 focus groups – N=275) has been carried out among high school students in order to collect knowledge and social representations. The sample includes general and professional high schools, including hairdressing and automobile, whose professions are more exposed to ED. **2-** Based on the results of this qualitative survey, the consortium of researchers - (public health, education sciences) and teachers jointly developed 6 educational objectives. The objectives were then declined into 14 educational tools made available to teachers on a digital platform. **3-** The project has been supported by academic authorities, and 10 schools are currently involved in the program trial. The first intervention phase will involve 218 high school students; 493 high school students have been included in the control group. **4-** An evaluation questionnaire was drawn up in line with the objectives. The questionnaire measures high-school students' skills and knowledge relating to endocrine disruptors, using a 60-point score. Data were collected for all high school students (intervention and control) in September 2023 (T0) and after 4 months of intervention in January 2024 (T1). These questionnaires are currently being entered into the EPIDATA software for statistical analysis. At the same time, a process evaluation will be carried out by interviewing teachers. This will provide data on the program's acceptability and the use of the tools offered on the digital platform.

Keywords: *Health education, endocrine disruptors, co-creation, evaluation.*

1. Introduction

Endocrine-disrupting chemicals are "*natural or human-made chemicals that may mimic, block, or interfere with the body's hormones, which are part of the endocrine system*."[1]

Characterizing the risk associated with endocrine disruptors in humans is difficult, however, the report on the state of scientific knowledge concerning these chemical substances (Gore et al., 2015) highlights their impact on the reproductive health of women and men, including an overall deterioration in reproductive health in men since the 1990s (reduced sperm quality, increased incidence of testicular cancer, etc.). EPs are also suspected of increasing the incidence of hormone-dependent cancers (breast and prostate cancer) as well as other pathologies (obesity, diabetes, thyroid and metabolic disorders), having an effect on immune function and increasing neurobehavioral disorders (Fini & Demeneix 2019) (dyslexia, mental retardation, autism, attention deficit disorder).

[1] National Institute of Environmental Health Sciences: *https://www.niehs.nih.gov/health/topics/agents/endocrine*

Because endocrine disruptors come from many different sources, people are exposed to them in many ways, including in the air we breathe, the food we eat and the water we drink. EDCs can also enter the body through the skin. The characteristics of occupational exposure (dose, frequency and duration) entail greatly increased risks for certain professionals in contact with drugs, solvents, pesticides, the metallurgical, pharmaceutical, cosmetics and plastics industries, as well as in the agricultural sector. Endocrine disruptors act on the hormonal system. As the quantity of hormones required for the functioning of the endocrine system is extremely small, disruption of this system can result from very low concentrations of substance. What's more, PEs call into question the principles of classical toxicology: substances that do not individually cause measurable endocrine disruption nevertheless have a significant effect when mixed together, the so-called cocktail effect (Delfosse et al., 2015).

In France, the public authorities are paying particular attention to EDCs. The second French national strategy SNPE 2: 2019-2022 has been published, with the aim of better protecting the population and reducing environmental contamination by EDCs. This national strategy focuses on three key areas: "improving knowledge; preventing environmental contamination and protecting the population; educating and informing".

Early childhood and pregnancy, recognized as vulnerable periods, have given rise to numerous interventions aimed at treating and preventing exposure during these critical periods. Adolescence, marked by pubertal sexual activation, is emerging as a crucial period, underlining the need to examine and reduce the impact of endocrine-disrupting substances during this stage of development.

Public policy initiatives aimed at moderating individual or family behavior do not affect the entire population in the same way. For example, eating organic food is more common among the higher socio-economic classes. Preventing the population's exposure to endocrine disruptors must therefore be achieved more generally through health education programs to provide all individuals with the necessary skills to make their own health choices.

Several initiatives have been developed to reduce exposure to endocrine disruptors in pregnant women (Rouillon et al., 2017). Overall, there are very few initiatives aimed at teenagers.

2. Objectives

Our research team specializing in cancer prevention (Chaire HYGEE, Institut PRESAGE) decided to develop a program aimed at teenagers in schools. The COPE ADOS project brings together a consortium of 3 research teams, including an academic team specialized in educational sciences to co-construct with teachers a program that could be feasible and acceptable, and that has real pedagogical qualities. The challenge was also to define a research design to measure the program's implementation in the classroom and its impact on pupils' knowledge, representations and know-how in terms of preventing exposure to endocrine disruptors.

3. Design

The COPE ADOS project is divided into 4 steps: 1) documenting the knowledge, representations and skills of high school students on the subject of endocrine disruptors; 2) co-constructing with teachers an educational device aimed at students and their educational supervisors; 3) building a specific tool to evaluate the program; 4) implementing the program and carrying out its evaluation.

4. Qualitative study

4.1. Data collection and methodology

In order to collect knowledge and social representations among teenagers, a qualitative study has been carried out among high school students. The sample includes general and professional high schools, including hairdressing and automobile, whose professions are more exposed to EDCs. The schools were contacted by telephone or e-mail. We wanted to have a great diversity of profiles, in general and vocational school sections, and especially in professions impacted by EDCs. The choice to call upon students in the second and final year of high school was made in order to investigate the potential evolution of their knowledge between the beginning and the end of their studies. in fact, elements of EDC education could already be present in school curriculum. After several tests, we decided to structure the focus groups following a framework of questions in two parts, before and after viewing a small video a short video presenting PEs, their harmful effects on health and preventive attitudes.

6 high schools participated in the study and 23 focus groups were conducted by 2 researchers together, involving 275 students. The focus groups were recorded and transcribed for analysis.

Two researchers independently coded the same randomly selected transcripts and discussed the codes for reliability and validity in their application to the data. (Kidd & Parshall, 2000). Qualitative coding was conducted in NVivo 13, and one-third of the focus group interviews were double coded by an independent researcher.

4.2. Main results of the qualitative study

As for the notion of "endocrine disruptors", the term was mostly unknown. For them, "endocrine disruptors" are assimilated to the various pathogenic agents studied in their biology courses: viruses, bacteria, etc. They are considered bad for health, invisible and transmissible. These elements are close to the representations of COVID and we can think that there may be an assimilation given the period of the survey.

The link between EDC with the hormonal system is rarely made by itself. However, most high school students know about hormones, are able to name several of them and explain their use in the body. None of the majors endocrine disrupting molecules are identified. But students indicate some associations with health controversies.

About the perception of risks and consequences on health; we can see that the professional situations are better documented than everyday situation. Plastics, which are a very common source of endocrine disruptors in everyday life- were rarely identified. Several professions are qualified as higher risks: specific to endocrine disruptors like farmers using pesticides, or beauty care professionals handling cosmetics. We noted the influence of career paths in the knowledge of the sources of EDC.

After the video, the consequences of EDC are well described at the individual level and at the environmental level. We also noted a confusion with other types of risks for health such as exposure to screens or exposure to pathogenic agents. Exposure to endocrine disruptors also associated with risky behaviors among the adolescents: drugs, tobacco, alcohol and unprotected sexual relations are mentioned.

The web is the main source of information cited by students. The social and academic level of the students determines the web search strategies. There is also a strong exposure to information on social networks. Prevention behaviors are more influenced by the family environment.

In term of prevention strategies, adolescent said us that avoiding these molecules seems complicated, but it seems possible to limit them and to protect oneself from them. Several preventive behaviors regarding endocrine disruptors are known by high school students: for example, they are washing clothes before wearing them, they are airing and cleaning their homes regularly. But these attitudes are not connected with EDCs prevention.

Nevertheless, regarding their actual behaviors, vigilance regarding the composition of food and cosmetic products in particular, and the attention paid to labels or to plastic are weak. However, considering their actual behavior, many things can be improved. The priority is due to the vigilance on the composition of food and cosmetic products, the misuses of plastics.

5. Co-create an educational device

Based on the results of this qualitative survey, the consortium of researchers - (public health, education sciences) and teachers jointly developed 6 educational objectives.

The performance (educational) objectives were determined in partnership with the co-construction team following the analysis of focus groups. The identification and selection of theoretical methods that are believed to influence changes for the determinants associated with each educational objective. This broad goal was subsequently dissected into six distinct performance objectives, as identified by the co-creation team and termed as educational objectives by the researchers engaged in the COPEADOS project. These performance objectives include:

1. Increase knowledge levels about EDs.
2. Increase the sense of control over environmental risks.
3. Be able to assess risks related to EDs in everyday life and/or professional situations.
4. Be able to implement appropriate prevention strategies.
5. Know how to identify reliable sources of information on EDs.
6. Reduce anxiety related to EDs and their exposure.

To progress with the program logic model, steps 3 and 4 required a series of 3 meetings with the co-creation team to reach consensus on the model. The co-creation team established a framework for the program, defining three sessions, each with a specific objective. Session 1 was devoted to assessing students' knowledge and perceptions. The co-creation team emphasized the need for tools that would enable

a comprehensive assessment of students' specific needs, in order to tailor the program accordingly. Session 2 aimed to foster the acquisition of EDC knowledge and exposure prevention skills, while session 3 was designed to consolidate contributions.

It was also stressed that each session should be limited to a duration of 50 minutes to align with the typical pace of high school activities. The program should be adaptable for use in both whole classes and small groups. Furthermore, all tools should be easily downloadable from a shared platform accessible to facilitators, complete with technical guidelines that would enable facilitators to use them independently without requiring assistance from researchers. The tools should be delivered by members of the high school, and people in the high school should be self-sufficient in delivering the program without the need for additional support.

Initially, the co-construction team proposed tools to achieve the various objectives. The co-creation team proposed tools based on models they had already used. The objectives were then declined into 14 educational tools made available to teachers on a digital platform.

6. Build an assessment tool

An evaluation questionnaire was drawn up in line with the objectives. Its comprehensibility and clarity were tested with 177 high-school students in general and vocational second-year classes, at 3 schools, to ensure that it met the needs of the target audience. Modifications were made, including changes to vocabulary, the addition of questions and rewording. The final version of the questionnaire will measure the impact of the program on the skills and knowledge of participating high school students concerning endocrine disruptors, using a 60-point score. The questionnaire will be administered at T0 in September 2023 and at T1 in January 2024, i.e. before and after the implementation of the program. It is hoped that this score will evolve over time.

7. Implementing the program and its evaluation

The project has been supported by academic authorities, and 10 schools are currently involved in the program trial. The first intervention phase will involve 218 high school students; 493 high school students have been included in the control group Data were collected for all high school students (intervention and control) in September 2023 (T0) and after 4 months of intervention in January 2024 (T1). These questionnaires are currently being entered into the EPIDATA software for statistical analysis.

At the same time, a process evaluation will be carried out by interviewing teachers. This will provide data on the program's acceptability and the use of the tools offered on the digital platform. The interview guide will be used to investigate obstacles and facilitators to implementation, and adaptations made to the program since its launch. The RE-AIM evaluation framework (Glasgow, Vogt, & Boles, 1999) will be used to assess the program. This model was chosen because it proposes criteria that cover both the evaluation of the results obtained on knowledge and representations of endocrine disruptors and, on the other hand, the evaluation of the processes that led to these results, thus enabling them to be reproduced. Through its 5 investigative items (Recruitment, Effectiveness, Adoption, Implementation, Maintenance), it will enable us to observe potential discrepancies between the planned intervention and the intervention carried out, to take account of the effects of setting up the program, to qualify the participation of the players and the influence of the context on the progress of the program. Interviews will be conducted in person or by telephone, depending on the interviewees' preferences. Interviews will be recorded, transcribed and anonymized. Qualitative coding will be carried out using NVivo 13.

8. Conclusion

If the program is shown to be effective in terms of improving pupils' knowledge and skills in preventing exposure to endocrine disruptors, and if the qualitative study confirms the possibility of teacher autonomy based on the availability of the tools, we will be faced with the challenge of implementing this program. We have established a partnership with the Ligue Against Cancer to provide them the co-created tools and enable them to become active in this specific phase.

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