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Cytomegalovirus' knowledge in pregnancy: Education's impact on pregnant women

Conhecimento do Citomegalovírus durante a gravidez: Impacto da educação das grávidas

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Abstract

Overview and Aims: Cytomegalovirus (CMV) is the primary cause of congenital infections and the leading responsible for non-hereditary neurosensorial hearing loss. Despite its morbidity, studies show a big lack of knowledge among pregnant women (PW). This study compares PW knowledge before and after an education about CMV infection in pregnancy and determines whether there are differences in participants' retention of information when using flyers versus video presentations. It also aims to determine education's impact on preventive measures' adoption and correlate time perspective with CMV' knowledge and preventive measures' adoption.

Study design, population and methods: In this prospective cohort longitudinal study, participants were randomly assigned to receive either a flyer or a video. PW up to 21 weeks of gestational age were recruited in a secondary Portuguese hospital. This study was divided in two parts. In the first part, PW answered an in-person questionnaire and were given a flyer or video afterward. In the second part, 16 to 20 weeks after the initial assessment, participants completed a follow-up questionnaire via telephone designed to assess their knowledge retention.

Results: 139 participants were involved. 77,70% had never heard about CMV. A significant increase (p<0,001) of 52,16% in correct answers was observed when comparing the first to the follow-up questionnaires. No differences were detected between women who received flyer or video. No differences were detected on preventive measures' adoption according to participant's time perspective.

Conclusions: Educating PW about CMV increases their knowledge and promotes preventive measures' adherence. Using flyers or videos is equally effective.

Keywords: Behaviour; Congenital infection; Cytomegalovirus; Knowledge; Preventive measures.

Resumo

Introdução e Objetivos: O Citomegalovírus (CMV) é a principal causa de infeções congénitas e de surdez neurossensorial congénita não-hereditária. Apesar disto, estudos demonstram um desconhecimento deste agente infecioso entre as grávidas. Este estudo compara os conhecimentos das gestantes antes e após uma sessão de educação para a infeção por CMV durante a gravidez. Também compara se há diferenças na retenção do conteúdo utilizando panfleto ou vídeo. Ademais, pretende-se determinar o impacto da educação das gestantes e da sua perspetiva temporal na adoção das medidas preventivas e na retenção dos conteúdos apresentados.

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Desenho de Estudo, População e Métodos: Neste estudo coorte prospetivo, distribuíram-se aleatoriamente as participantes que receberam um panfleto ou vídeo. Recrutaram-se grávidas até às 21 semanas de gestação. Dividiu-se o estudo em duas partes. Na primeira, as grávidas responderam a um questionário presencial e recebem um panfleto ou um vídeo. Na segunda, entre 16 a 20 semanas após a primeira, as participantes responderam a um questionário telefónico.
Resultados: Recrutaram-se 139 grávidas. Destas, 77,70% desconheciam o CMV. Verificou-se um aumento significativo (p<0,001) de 52,16% nas respostas corretas entre o primeiro questionário presencial e o telefónico. Não foram detetadas diferenças na retenção dos conteúdos entre as participantes que receberam o vídeo e as que receberam o panfleto. Não se encontraram diferenças na adoção das medidas preventivas de acordo com a perspetiva temporal.
Conclusão: A educação das gestantes sobre o CMV aumenta os seus conhecimentos e promove a adesão às medidas preventivas da infeção. O uso de vídeo ou panfleto é igualmente eficaz.

Palavras-chave: Citomegalovírus; Comportamento; Conhecimento; Infeção congénita; Medidas preventivas.

INTRODUCTION

Cytomegalovirus (CMV), a DNA virus from the Herpesviridae family, is non-seasonal and endemic worldwide, has a seroprevalence ranging from 40% to 100%, with higher rates in low socioeconomic groups, ethnic minorities, and multiparous women[1,2].

Following primary infection, CMV establishes latency with potential for reactivation and reinfection by different strains[2]. While typically asymptomatic in immunocompetent individuals, CMV poses a significant risk in pregnancy due to transplacental transmission, making it the leading cause of congenital infection worldwide[2,3]. CMV is responsible for non-hereditary congenital sensorineural hearing loss and other severe neurodevelopmental impairments, with a higher risk of symptomatic disease when transmission occurs early in gestation[1,3]. Despite its prevalence and associated morbidity, awareness of CMV among PW remains low[5-9]. The main source of CMV infection during pregnancy is thought to be with bodily fluids and mostly by contact with pre-school children[1,2]. Transmission's risk is higher in children up to two or three years old, specially if they are in nurseries[10]. So PW with children in this age group or who work in nurseries or primary schools are at increased risk[1,2,10].

In Portugal, where this study was conducted, the estimated IgG seroprevalence is 77%, with a congenital infection prevalence of 1.05% – one of the highest rates in Europe[2,4].

As there is no effective vaccine until nowadays, primary prevention of congenital CMV infection (cCMV) relies on behavioral measures to reduce maternal infection risk, particularly in women exposed to young children[3,7-12]. It is the most effective way of reducing the risk of fetal infection and associated comorbidities[3,7-12]. Studies have shown that maternal education significantly decreases seroconversion rates, highlighting the importance of targeted interventions on PW knowledge[10-12]. PW and women who aim to get pregnant must follow preventive measures against CMV's infection as periconceptional period and first trimmest are the most critical moments to fetal formation. So, an infection in these periods is related to a higher risk of bad fetal outcomes, such as miscarriage, early pregnancy end and fetal lesions[12]. Recent studies and metanalysis have shown efficacy in secondary prevention of cCMV using HCMV hiperimmune globulin or valacyclovir. These treatments are proven to reduce mother-fetal transmission, especially if given early in pregnancy[12]. This finding suggests some benefits in tracking CMV's serologic status before and during pregnancy, as a PW with seroconversion must initiate antiviral treatment immediately. In Portugal, CMV's serologies are recommended to women in pre-conceptional concealing[15-16]. Treatment of infected newborns (NB) with valacyclovir without major malformations is correlated to better prognosis[12].

Emerging digital education strategies, such as video-based learning, may improve PW knowledge retention when compared to traditional paper flyers[17,18]. Additionally, psychological factors, including Time Perspective (TP), may influence adherence to preventive measures, with future-oriented individuals more likely to adopt healthy lifestyle measures and less risky

behaviour[19]. The Zimbardo Time Perspective Inventory (ZTPI), valid for the Portuguese population, is one of the most widely used instruments for determining an individual's time profile[19-21].

This study aims to assess the impact of educational interventions on pregnant women's knowledge of CMV and explore the relationship between TP and adherence to preventive strategies.

MATERIALS & METHODS

A prospective cohort longitudinal study was conducted in a Portuguese secondary hospital from February to August 2023. All PW up to 21 weeks of gestation were included, excluding those who had already undergone morphological ultrasound. PW were recruited during first trimester concealing, first trimester blood analysis or first trimester ultrasound, from February to May. After informed consent, participants completed a first structured questionnaire in person, which included an educational session on CMV infection during pregnancy covering prevalence, clinical presentation, transmission, risk factors and preventive measures. Sociodemographic data, pregnancy-related information, and baseline CMV knowledge were collected before the in-person session. TP was assessed using the validated Portuguese version of the ZTPI[20]. Participants were then reassessed on their CMV knowledge and asked to recall three of the five preventive measures presented at the end. After, to reinforce learning, they received by email either a video or a flyer summarizing the session, allocated randomly.

A follow-up questionnaire was administered via telephone 16 to 20 weeks later to reassess knowledge retention and adherence to preventive measures, from May to August. CMV knowledge was evaluated using a 12-item "true," "false," or "don't know" table inspired by a previous American study[18]. Two metrics were used: the hit rate per statement (HRS) and the hit rate per participant (HRP). HRS was obtained by the quotient between the number of participants who correctly classified the statement and the total number of participants who answered. HRP was obtained by dividing the number of correct items by 12.

All data was anonymized. Exel was used to organize the data. Statistical analysis was performed using SPSS v.29 and Microsoft Excel 2016, with significance set at $p<0.05$ with a 95% CI[22]. Descriptive statistics included means, standard deviations, medians, and interquartile ranges. Comparative analyses employed Mann-Whitney U, Kruskal-Wallis, and ANOVA tests for repeated measures[22-24]. A minimum sample size of 89 participants was determined, using a CI of 95% and an error margin of 10% based on a population estimate of 1174 eligible PW (number of 2022's NB).

The study received ethical approval from the Medio Ave Hospital (number 300, March 28, 2023) and the University of Minho (CEICVS 022/2023), following the Helsinki Declaration, and all participants provided written informed consent.

RESULTS

In the first phase, 139 PW were recruited. Their sociodemographic characteristics and information regarding their current pregnancy are shown in Table 1, as well as the frequency of their time profile. During follow-up, ten participants experienced miscarriage, two withdrew from the study, one did not respond to telephone contact, two did not complete the follow-up questionnaire, and 12 could not be reached. A total of 112 participants reached the second phase: 55 received the flyer and 57 the video. Of these, 43,64% who received the flyer did not review it and 45.6% who received the video did not watch it.

Most participants (77.70%, n=108) were unaware of CMV. Of the 22.30% (n=31) who claimed awareness, 93.50% (n=29) had learned about the risk of infection and associated fetal complications before pregnancy, while 54.80% (n=17) became aware during their current pregnancy. Among these, nine participants received counselling from healthcare professionals, whereas the remainder obtained information through other sources, such as social media or independent online research.

A total of 94.20% of participants were unaware of the preventive measures against CMV infection. Of the eight participants who reported knowing them, only four already applied them during the preconception period and five in their current pregnancy. There was confusion with other infectious diseases as participants

TABLE I. SOCIODEMOGRAPHIC CHARACTERISTICS, INFORMATION ON CURRENT PREGNANCY AND TIME PROFILE OF THE PARTICIPANTS.

Sociodemographic characteristics	TOTAL *n=139*
Age, years *M (±SD)*	31,73 (±5,49)
Nationality *n (%)*	
Portuguese	123 (88,50%)
Brazilian	9 (6,50%)
Angolan	3 (2,20%)
Spanish	2 (1,40%)
Indian	1 (0,70%)
Moldavian	1 (0,70%)
Educational Level *n (%)*	
Basic	24 (17,30%)
Secundary	69 (49,60%)
High Degree	46 (33,10%)
Multigravida *n (%)*	
Yes	78 (56,10%)
No	61 (43,90%)
Children, number *Mdn (IQR)*	1 (1)
Current Pregnancy	
Gestational Age *Mdn (IQR)*	10 (2)
Preconception Consultation *n (%)*	
With	78 (56,10%)
Without	61 (43,90%)
CMV's IgG *n (%)*	
Positive	64 (46,00%)
Negative	11 (7,90%)
Unknown	64 (46,00%)
Risk for CMV's infection *n (%)*	
Whit risk factors	63 (45,30%)
Whitout risk factors	76 (54,70%)
Time Perspective *n (%)*	
Past Negative	7 (5,00%)
Past Positive	74 (53,2%)
Present Hedonistic	19 (13,70%)
Present Fatalist	1 (0,10%)
Future	38 (27,30%)

M: mean; SD: Standard deviation; Mdn: median; IQR: interquartile range.

listed incorrect measures such as 'Careful washing of fruit and vegetables', 'Avoiding contact with people with active herpes' and 'Care in cleaning the cat's box'.

After the educational session, 84.20% (n=117) correctly listed three preventive measures, and 27.30% (n=38) adopted all recommended measures and the remaining 72.20% (n=101) showed an interest in adopting them.

In the telephone questionnaire, 12 PW correctly listed three preventive measures. All PW who completed the study adopted at least two of the five recommended preventive measures from the educational session, with 51.80% (n=58) implementing all of them. PW adherence to the recommended measures are presented in Figure 1. All the participants declared an interest in maintaining the measures until the end of their pregnancy.

HRS in the three stages of knowledge assessment are shown in Table 2.

The median HRP before the explanation was 0.00% (IQR=8.33%), ranging from 0.00% to 66.67%. Following the session, the mean HRP increased to 70.80% (SD=13.21%), with scores ranging from 33.33% to 100.00%. During the telephone questionnaire, the mean HRP was 60.34% (SD=15.35%), with a minimum of 16.67% and a maximum of 100.00%.

A significant improvement in knowledge was observed across the three assessment points (ANOVA for repeated measures; Wilks' lambda=0.060; F(2, 110)=859.448; p<0.001; effect size large - $\eta 2$=0.940). The mean HRP increased significantly by 62.43% (p<0.001; CI: 58.57-66.28%) before and after the educational session, during the in-person questionnaire. When comparing HRP before the educational session and during the telephone questionnaire, there was a significant mean increase of 52.16% (p<0.001; CI: 48.11-56.20%). However, a significant decrease of 10.27% (p<0.001; CI: 6.30-14.23%) in HRP between after the explanation and during the telephone questionnaire.

No significant differences in HRP were found between participants who received the flyer or the video (Mann-Whitney test; U=1534.500; p =0.845; r =0.019). The same for those who reviewed the materials provided and those who did not (Mann-Whitney test; U=1229.000; p=0.055; r =0.181).

Prior to the educational session, no significant difference (Kruskal-Wallis test; H=2.274; p=0.518) was detected in HRP according to their time profile. After the explanation, there were significant differen-ces (Kruskal-Wallis test, H=11.903; p=0.008).

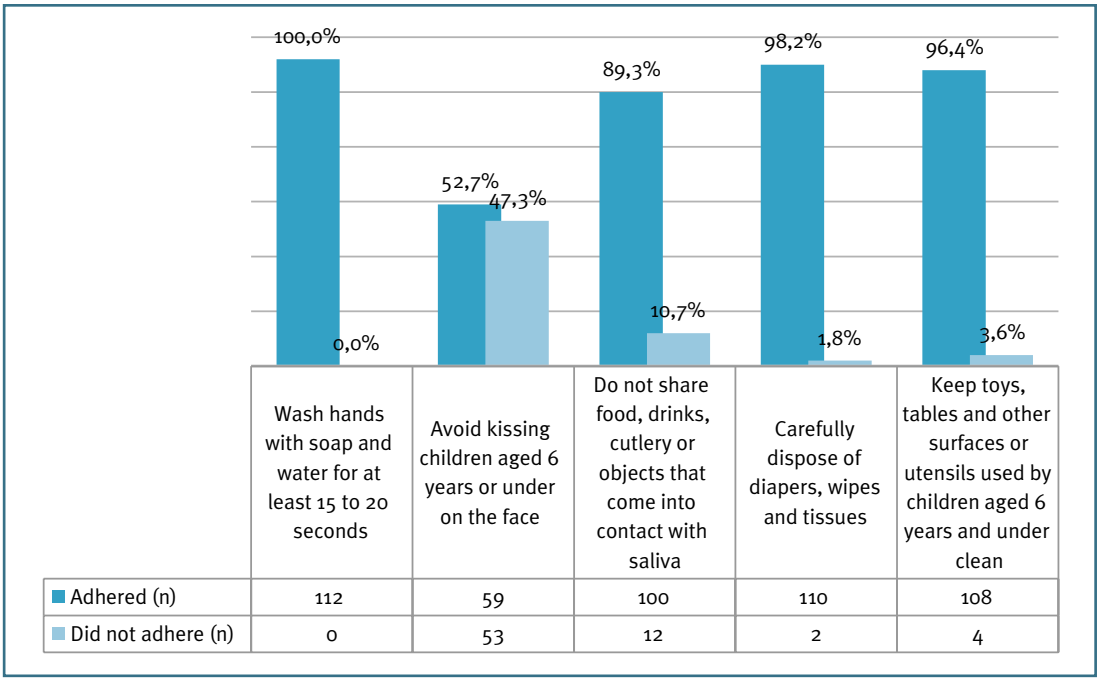

FIGURE 1. Adherence to recommended measures (n).

TABLE II. HIT RATE PER STATEMENT.

Item	Correct Answer	Hit Rate prior to the educational session	Hit Rate following the educational session	Hit rate on the telephone questionnaire
1. Most people infected with CMV will have a fever or other symptoms.	False	3,60%	39,57%	38,39%
2. CMV is transmitted through kissing.	True	6,47%	97,84%	85,71%
3. CMV is transmitted by sharing utensils (forks, toys, etc)	True	7,91%	97,84%	86,61%
4. You can get infected by CMV if you don't wash your hands after changing diapers.	True	7,91%	95,68%	80,36%
5. CMV can be transmitted from mother to child during pregnancy.	True	21,58%	97,12%	79,46%
6. There is an effective method for diagnosing recent CMV infection in adults.	False	0,72%	17,27%	23,21%
7. Most infected pregnant women pass the virus on to their baby.	False	0,00%	47,48%	39,29%
8. Most babies born infected have no symptoms.	True	1,44%	54,68%	50,89%
9. CMV can cause fetal malformations if infection occurs during pregnancy.	True	23,02%	94,96%	80,36%
10. There is no cure for CMV.	True	2,88%	86,33%	49,11%
11. Infected babies who are born without malformations or symptoms grow up healthy.	False	6,47%	43,17%	24,11%
12. Contact with young children (under the age of 6 years) is irrelevant for the transmission of CMV infection.	False	8,63%	78,42%	84,82%

TABLE III. HRP, SOCIODEMOGRAPHIC CHARACTERISTICS AND INFORMATION ABOUT THE CURRENT PREGNANCY.

Variables	Grups	Prior to the educational session			Following the educational session			On the Telephone Questionnaire		
		ST	*p*	ES	ST	*p*	ES	ST	*p*	ES
Educational level	Basic Secundary High Degree	H =11,425	0,003	NA	H =18,488	<0,001	NA	H =9,203	0,010	NA
CMVs IgG	Positive Negative Unknown	H =1,933	0,380	NA	H =1,226	0,542	NA	H =1,103	0,576	NA
Risk for CMVs infection	With Risk Factors Without Risk Factors	U= 2033,500	0,058	r= 0,161	U= 1979,500	0,074	r= 0,152	U= 1475,000	0,613	r =0,048

U: Mann-Whitey Test; H: Kruskal-Wallis Test; NA: Not applicable; ST: Statistical Test; ES: Effect size.

Future-orientated PW had a significantly higher HRP (Mdn=83.42%) (p=0.034) than PW with a 'Negative Past' time profile (Mdn=38.86%). During the telephone questionnaire, there were significant differences (Kruskal-Wallis test, H=13.715; p=0.003). PW with a 'Positive Past' time profile had a significantly higher HRP (Mdn=63.18%) compared to those with 'Negative Past' (p=0.021; Mdn=23.67%) and 'Hedonistic Present' (p=0.047; Mdn=39.44%) time profiles.

No statistically significant differences were found in the number of measures adopted according to TP (Kruskal-Wallis test, H=2.293; p=0.514).

Educational level was the only sociodemographic factor influencing HRP, with participants holding a higher degree performing better at all assessment points. A statistical analysis is found in Table 3.

Prior CMV knowledge was also associated with significantly higher HRP (Mann-Whitney test; U=643.000; p<0.001).

Despite knowledge improvements, there was no correlation between HRP and adherence to preventive measures. There were no significant differences in the adoption of recommended measures according to the participants' schooling (Kruskal-Wallis test; H=2.384; p=0.304). PW with risk factors for CMV infection (living and/or working with children under the age of six and/or immunosuppressed patients) adhered significantly less to preventive measures (Mann-Whitney test, U=834.500; p<0.001; moderate effect size- r=0.444).

DISCUSSION

This study highlights a significant lack of awareness regarding CMV infection during pregnancy and its associated comorbidities, supporting previous research[5-7]. From Table 2, our findings indicate that 78.42% of participants were unaware that CMV can be transmitted vertically during pregnancy, and 76.98% did not recognize it as a cause of fetal malformations. The lack of awareness was even higher concerning transmission routes, clinical presentation, and diagnostic methods. These results underscore the critical need for targeted education on CMV. Although education led to a notable improvement in understanding the potential for congenital infection and fetal malformations, the HRP progression suggests that participants did not fully assimilate information related to clinical presentation and diagnosis, and the long-term sequelae in asymptomatic infected newborns. This may be due to challenges such as the use of complex language by facilitators, participant characteristics, or questionnaire design factors (e.g., negative phrasing).

Interestingly, although 78 participants (56.10%) attended a preconception consultation, only nine were informed about CMV by healthcare professionals. Furthermore, the number of participants with CMV IgG serology (n=75; 54.00%) surpassed the number who were aware of CMV (n=31; 22.30%). These findings suggest that the majority of PW were either not informed or did not retain the information provided. This

highlights the need to investigate the underlying causes behind the knowledge gap. Prior studies have identified insufficient awareness among healthcare professionals regarding CMV and/or current recommendations[25], limited consultation time and human resource shortages as potential contributing factors[26].

PW's knowledge improved significantly with education. Furthermore, the higher accuracy rates among PW who were already informed before entering the study, along with the improvement across assessment points, demonstrate the importance of preconception and prenatal counselling. This highlights the essential role of repetition and knowledge reinforcement for long-term retention[27].

The progression of HRP across the study period also indicates a benefit from raising awareness. Although a significant yet expected decline was observed over time between the HRP assessed immediately after the explanation and at the telephone questionnaire, the overall increase in knowledge remains evident when compared to the HRP before the explanation[27]. In the future, developing a validated questionnaire would be essential to standardise comparisons with other studies and across more diverse populations.

Higher education was the only sociodemographic factor associated with greater knowledge of CMV infection; however, it did not influence adherence to preventive measures.

Higher HRP wasn't associated to higher number of preventive measures' adherence. This can be explained by PW focus on preventive measures and/or no interest in clinical presentation, and CMV's diagnostic methods.

Regarding TP, a future-oriented perspective was associated with improved knowledge acquisition but did not influence retention, contrary to expectations[7]. The interpretation of these findings is limited by the low representation of different temporal profiles.

The format of information delivery did not impact knowledge retention. The absence of a significant difference between participants who received a video and those who received a leaflet may be attributed to the fact that 44.64% of participants did not engage with the materials provided. This suggests that information should be delivered directly during consultations. Future research should prioritise multicentre studies with larger sample sizes or investigate the effectiveness of different formats in the initial approach.

The impact of presenting preventive measures was positive, with strong adherence to the recommended measures, underscoring the importance of preconception and prenatal counselling[11,28]. Contrary to expectations, PW with a future-oriented perspective did not demonstrate higher adherence to preventive measures compared to other participants[19].

The results suggest that PW with risk factors for infection demonstrate significantly lower adherence to preventive measures. This finding should be interpreted considering that risk factors were defined as cohabitation or workplace proximity to immunocompromised individuals and/or children aged ≤6 years. Analysis of adherence to preventive measures revealed that those with the lowest adherence were related to childcare. Future studies should investigate the underlying reasons for the observed low adherence.

The study design facilitated in situ data collection, thereby reducing the risk of recall bias. Additionally, the prior standardization of the questionnaires, the explanation provided, and the random assignment of materials helped mitigate the potential for observation bias.

Key limitations of the study include a follow-up loss of 19.42% and the monocentric design conducted at a secondary hospital, which restricts its external validity. The statistical analysis of the impact of PT on the studied variables was also constrained by the low frequency of temporal profiles.

In conclusion, this study underscores the importance of education and counselling in improving awareness and adherence to preventive measures for CMV infection during pregnancy. However, significant gaps in knowledge remain, particularly regarding clinical presentation, diagnosis, and long-term sequelae. Our findings emphasize the need for further research, including larger, multicentre studies and the development of validated tools, to better understand and address these knowledge gaps and barriers to adherence. Future interventions should consider the direct delivery of information during consultations and the exploration of various information formats to optimize patient engagement and knowledge retention.

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AUTHOR CONTRIBUTIONS

Ana Raquel Gonçalves Lopes: Design, draft and review of the work. Acquisition, analysis and interpretation of data. Sidonie Irene Monteiro: Conception design, draft and review of the work. Interpretation of data. Amélia de Almeida: Conception, draft and review of the work.

CONFLICT OF INTEREST

The authors report no conflict of interest.

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