

César Muñoz  
Brazil Senior Researcher  
Human Rights Watch

27 October 2020

**Re: Investigation into the killing of Maria del Carmen Villalba & Lilian Mariana Villalba (ages 11)**

Dear Mr Muñoz,

In response to your questions regarding the investigation into the killing of Maria del Carmen Villalba (age 11) & Lilian Mariana Villalba (age 11), the **International Rehabilitation Council for Torture Victims (IRCT)** hereby provides our expert opinion. Comprising of 158 rehabilitation centres in 74 countries, the IRCT is the world's leading centre of knowledge on the physical and psychological effects of torture and ill-treatment.

Upon your request, we have asked members and affiliates of the **Independent Forensic Expert Group (IFEG)** – *Prof Dr Onder Ozkalipci & Prof Dr Karen Kelly* – to conduct a review of the provided information. The IFEG is an international body of 42 preeminent independent forensic specialists from 23 countries, who are recognised global leaders in the medico-legal investigation of torture, ill-treatment, and unlawful killing.

In summary, first, with respect to **whether a shooting distance of 10-20 meters can be determined**, in this case, it is our expert opinion that it cannot be. While generally shooting distance may be assessed for closer range firing (approximately 1.5 meters), it is not possible for distances exceeding that.<sup>1</sup> For closer range determinations, the examination of clothing is critical. In the case of the killing of Maria del Carmen Villalba & Lilian Mariana Villalba, the destruction of their clothing represents the destruction of crucial evidence that violates the most basic and fundamental criminal investigative and forensic principles.<sup>2</sup>

Second, with respect to **whether the paraffin wax test is a reliable test of gunshot residue**, it is our expert opinion supported by the scientific literature that it is not. A

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<sup>1</sup> See e.g., *Gunshot wounds. Practical aspects of firearms, ballistics and forensic techniques*. Ed. Vincent J.M. DiMaio. Elsevier Publications, New York. 1985.

<sup>2</sup> See e.g., *The Minnesota Protocol on the Investigation of Potentially Unlawful Death* (United Nations 2016).

significant number of substances contain nitrates and can cause a positive reaction, including tobacco, tobacco ash, fertilizer, pharmaceuticals, leguminous plants, urine, rust, colored fingernail polish, residue from evaporated urine, soap and tap water.<sup>3</sup> Therefore, the probative value of a positive reaction is marginal at best. Due to its unreliability, the paraffin test is no longer used in regions such as the US and Europe and their courts have rejected this test in cases as early as 1959.<sup>4</sup>

Finally, it is our expert recommendation that **the exhumation of these two girls should be conducted in haste for collection of any remaining evidence**. While after this time, determination of the presence of gunshot residue and/or the presence of gunshot materials on the skin will most likely be lost, their exhumation should be done promptly to prevent further loss of important material and information from their bodies. The condition of their remains will be determined by the soil composition, type of weather occurring over this period of time, whether they were wrapped in cloth, plastic or similar materials and many other factors.

Further detailed analyses of the first and second issues are provided in the Annex. We remain at your disposition should you have any questions.

Yours truly,

Prof. James Lin, Esq.  
Istanbul Protocol Programme Coordinator, IRCT

Dr Onder Ozkalipci  
Forensic Physician  
Steering Committee Member, Independent Forensic Expert Group

Prof Dr Karen Kelly  
Brody School of Medicine

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<sup>3</sup> Giannelli PC. Gunshot residue tests. Criminal Law Bulletin 335 (1991) 538-544.

<sup>4</sup> Id.

## ANNEX I

### I. Determination of shooting distance

Typically, estimation of distance from a weapon is done by determining the amount of gunshot residue/materials remaining on the clothing and/or skin. In addition, the appearance of the entrance wound and its location on the body may help to determine distance. Gunshot wounds of different distances (contact, near-contact, intermediate and distant) will have identifiable characteristics and appearances that allow the forensic expert to determine approximate distance from the weapon. The gunshot entrance wound of the body must also be documented and photographed. For instance, for centerfire handguns, distant gunshot wounds begin beyond 60 cm from muzzle to target (flake powder) and up to 105 cm with ball powder.<sup>4</sup>

**Range determinations cannot be made for distant gunshot wounds,<sup>5</sup>** i.e., those exceeding approximately 105 cm. Bullets fired from 1.5, 50 or 150 meters will produce gunshot entrance wounds with identical appearances.

Aside from visual inspection, determination of distance can be determined by comparison of the appearance of the gunshot entrance wound and firing of the weapon into a test chamber. In addition, portions of the fabric surrounding the gunshot entrance wound in the clothing can be removed and analyzed chemically for gunshot residue materials.

**Thorough examination of clothing is crucial** in determining distance of firing range for gunshot wounds. In cases where the gun is within a short distance from the victim, the firing products (soot, burned and unburned, fire, smoke) from the gun barrel may leave these materials on the clothing. After the clothing is removed, there may or may not be materials on the skin to indicate the distance. Without the clothing, the distance from the gun to the victim cannot be correctly determined. It is imperative that the defects in the clothing be carefully documented and photographed with preservation of the clothing in a homicide investigation.

In this case, as the clothing was burned, the Paraguayan authorities **destroyed crucial evidence** that would assist with determination of distance estimation from the gun.

### II. Gunshot residue testing

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<sup>5</sup> Gunshot wounds. Practical aspects of firearms, ballistics and forensic techniques. Ed. Vincent J.M. DiMaio. Elsevier Publications, New York. 1985.

In general, there are significant challenges and concerns with the interpretation of gunshot residue results because of the possibilities for contamination.

a. Paraffin wax test

The test was designed to detect the presence of nitrate residues which may be deposited on the hand of a person firing a weapon due to the backblast of gases that escape during firing. These substances are residues from the smokeless powder (the propellant used in modern cartridges). The term “paraffin test” originated from the paraffin cast technique used to remove the residue from the hands. After removal, the cast is tested with a reagent (either diphenylamine or diphenylbenzidine) causing a color reaction (“dark blue spots”) indicating the presence of nitrate residues.

The **primary problem with the paraffin test** is its **nonspecificity**. A significant number of substances contain nitrates including tobacco, tobacco ash, fertilizer, pharmaceuticals, leguminous plants, urine, rust, colored fingernail polish, residue from evaporated urine, soap and tap water.<sup>5</sup> All of these substances can cause a positive reaction. “[T]he probative value of a positive reaction is marginal at best and, therefore, the paraffin test is rarely used today [in the US].”<sup>5</sup> In 1959, the first case in the US rejecting this test was reported and several courts followed suit.<sup>5</sup>

b. Modern gunshot residue testing

More modern testing for gunshot residue include swabs (aluminum stubs covered with a double-faced sticky carbon tape) of hands that are then examined under a scanning electron microscope (SEM) coupled to energy dispersive X-ray microanalysis (SEM/EDS). Besides chemical analysis, non-chemical analysis can determine the presence of gunshot residue. Short-wave-infrared images can be used to identify ammunition propellants.